**Ref:** AG 23793
26 November 2024

# Geotechnical Assessment

**Project:** Alterations & Additions
77 Bungan Head Road, Newport NSW

**Prepared for:**
Claudio Minns

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## WHAT TO DO WITH THIS REPORT

While your geotechnical assessment report may be a statutory requirement from council in support of your application, it also contains information important to the structural design and construction methodology of your project. Therefore, it is critical that all relevant parties are provided with a copy of this report.

**We suggest you give a copy of your geotechnical assessment report to:**

- **Your Architect/Building Designer**
- **Your Certifier**
- **Your Excavation Contractor**
- **Your Structural/Stormwater/Civil Engineer**
- **Your Project Manager**
- **Your Builder**

## NEXT CRITICAL STAGES

Keep in mind that you will need AscentGeo again at different stages of your project. This may include:

- **Review or endorsement of structural plans/architectural plans for a Construction Certificate**
- **Foundation/Footing inspection**
- **Excavation hold point inspection**
- **Final site inspection and certification for an Occupation Certificate**

## GENERAL ADVICE

**If after reading this report you have any questions, are unsure what to do next or when you need get in touch, please reach out to us.**

Given AscentGeo can't be on site the whole time, we recommend that you or/and your builder take a lot of progress photos, especially during excavation. Many of the potential problems that may pop up can be resolved if we have clear photos of the work that's been done.

A lot can change on site during a construction project: some of these changes are normal and innocuous, while others can be symptoms of larger or more serious issues. For this reason, it's important to contact us to discuss any changes you notice on site that you aren't sure about. This could include but not be limited to changes to ground or surface water, movement of structures, and settlement of paths or landscaping elements.

We're here to help.

**The AscentGeo Team**

**ASCENTGEO**

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# Geotechnical Assessment

For **Alterations & Additions** at

## 77 Bungan Head Road, Newport NSW

| Document Status | | | Approved for Issue | |
|---|---|---|---|---|
| **Version** | **Author** | | **Reviewer** | **Date** |
| 1 | Cameron Young<br>BEnvSci Geol MAIG | | Ben Morgan<br>BScGeol MAIG RPGeo | 26.11.2024 |
| **Document Distribution** | | | | |
| **Version** | **Copies** | **Format** | **To** | **Date** |
| 1 | 1 | PDF | Claudio Minns | 26.11.2024 |

### Limitations

This report has been prepared for Claudio Minns,  in accordance with AscentGeo's fee proposal dated 24 November 2023.

The report is provided for the exclusive use of the property owner and their nominated agents for the specific development and purpose as described in the report. This report must not be used for purposes other than those outlined in the report or applied to any other projects.

The information contained within this report is considered accurate at the time of issue with regard to the current conditions on site as identified by AscentGeo and the documentation provided by others.

The report should be read in its entirety and should not be separated from its attachments or supporting notes. It should not have sections removed or included in other documents without the express approval of AscentGeo.

## Contents

# 1 Overview

## 1.1 Backgroundf

This report presents the findings of a geotechnical assessment carried out at 77 Bungan Head Road, Newport NSW (the 'Site'), by AscentGeo. This geotechnical assessment has been prepared to meet Northern Beaches Council lodgement requirements for a Development Application (DA), as well as informing detailed structural design and construction methodology.

## 1.2 Proposed Development

The proposed development will take place on Lot 371 in DP 531048, being 77 Bungan Head Road, Newport NSW as per plan by Kiprovich & Associates Pty Ltd, plan no. 07_166DETAIL, dated 19 October 2007.

Details of the proposed development are outlined in a series of architectural drawings prepared by Space Design Architecture, project number 017-026, drawing numbers DA000-002, 100-102, 200, 201, 300, 400, 401, 500, 501, issue 11 dated 20/11/24.

The works comprise the following:

- Partial demolition of the existing dwelling, demolition of the concrete crib wall at the rear of the dwelling and preparation of new footings
- Construction of a refurbished two storey dwelling, with internal lift, double garage and with extension to the northern side of the retained structure.
- Construction of a new sandstone block retaining wall across the rear of the dwelling.
- Various soft and hard landscaping detail.

## 1.3 Relevant Instruments

This geotechnical assessment has been prepared in accordance with the following relevant guidelines and standards:

- Northern Beaches Council – Pittwater Local Environment Plan (LEP) 2014 and Pittwater Development Control Plan (DCP) 2014
- Appendix 5 (to Pittwater P21) Geotechnical Risk Management Policy for Pittwater – 2009
- Australian Geomechanics Society's 'Landslide Risk Management Guidelines' (AGS 2007)
- Australian Standard 1726–2017 Geotechnical Site Investigations
- Australian Standard 2870–2011 Residential Slabs and Footings
- Australian Standard 1289.6.3.2–1997 Methods of Testing Soils for Engineering Purposes
- Australian Standard 3798–2007 Guidelines on Earthworks for Commercial and Residential Developments.

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## 2 Site Description

### 2.1 Summary

A summary of site conditions identified at the time of our assessment is provided in Table 1.

**Table 1.** Summary of site conditions

| Parameter | Description |
|---|---|
| Site visit | Cameron Young, Engineering Geologist – 30 November 2023 |
| Site address | 77 Bungan Head Road, Newport NSW – Lot 371 in DP 531048 |
| Site area $m^2$ (approx.) | 1331$m^2$ (by SIXMaps calc.) |
| Existing development | One and part two storey brick house with garage. Concrete paved areas. Paver driveway and parking areas. |
| Slope Aspect | East |
| Average gradient | ~10 degrees |
| Vegetation | Lawn areas at front and rear. Small shrubs. Large paperbark trees towards western boundary. |
| Retaining structures | Concrete crib walls around the rear of the house and along northern boundary are in reasonable condition for their age. Recently constructed sandstone block wall and rendered concrete block walls along southern and eastern boundaries are in good condition. |
| Neighbouring environment | Residentially developed to the north, south and west. Escarpment and Pacific Ocean to the east. |

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**Figure 1.** Site location – 77 Bungan Head Road, Newport NSW (© SIX Maps NSW Gov)

### 2.2 Site Description

The subject site has a rectangular shape and is accessed via a private driveway from the end of the cul-de-sac of Lovering Place. A gentle slope, with easterly aspect, falls across the property at average gradient of 10 degrees. A vertical escarpment beyond the eastern boundary falls a rock shelf at sea level and the Pacific Ocean. Areas to the northeast of the house and the lawn area towards the eastern boundary have been filled to level and are supported by concrete crib walls and rendered concrete block walls that are in good condition. A concrete crib wall along the rear of the house (southern side) is in reasonable condition for its age and will be demolished and replaced as part of the proposed works.

The existing dwelling is a one and part two storey brick house with garage and is in reasonable condition for its age. The structures on the adjoining properties to the north, south and west are more recent constructions and appear to be in good condition based on cursory inspection from within the subject site. Bedrock was not outcropping on the subject site, however, is visible in the escarpment beyond the eastern boundary.

A site plan is included in Appendix A. The six photos presented in Appendix B show the general conditions of the site on the day of the site visit conducted by AscentGeo.

### 2.3 Geology and Geological Interpretation

The Sydney 1:100,000 Geological Sheet 9130 (NSW Dept. Mineral Resources, 1983) indicates the site is located near the stratigraphic boundary between the Middle Triassic Hawkesbury Sandstone (Rh) and Newport Formation of the Narrabeen Group (Rnn). The Hawkesbury Sandstone rocks are comprised of medium to course grained quartz sandstone, minor shale and laminite lenses. The Newport Formation bedrock is typically comprised of interbedded laminite, shale and quartz to lithic quartz sandstones.

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The Hawkesbury Sandstone forms capping units in this area, with the Newport Formation Geology being found at lower stratigraphic locations. Based on visual assessment of the site and neighbouring properties, it is likely that this site is underlain predominately by upper Newport Formation geology.

The soil profile consists of shallow uncontrolled silty fill and silty topsoil (O & A Horizons), silty clay (B Horizon) and weathered, low strength bedrock (C Horizon). Based on our observations and the results of testing on site, we would expect weathered low strength weathered bedrock to be found between 1.3 to 2.3 metres below current surface levels across the area of the proposed works and deeper where fill has been introduced to create the level lawn at the northern and eastern side of the house.

**Note:** The local geology is comprised of highly variable interbedded clay, shale and sandstone, with the possibility of sandstone boulders present in the soil profile. Subsequently ground conditions on site may alter significantly across short distances. This variability should be anticipated and accounted for in the design and construction of any new foundations.

### 2.3 Fieldwork

A site visit and investigation was undertaken on 30 November 2023, which included a geotechnically focused visual assessment of the property and its surrounds; geotechnical mapping; photographic documenting; and a limited subsurface investigation including hand auger borehole and dynamic cone penetrometer (DCP) testing.

**Hand Auger Borehole Testing**

Two hand auger boreholes (BH01 & BH02) tests were drilled at the approximate locations shown on the site plan (Appendix A) to visually identify the subsurface material. Engineering logs of the hand auger boreholes are presented in Appendix C.

**Dynamic Cone Penetrometer (DCP) Testing**

Three (3) DCP tests were carried out to assess the in situ relative density of the shallow soils and the depth to weathered rock. These tests were carried out in accordance with the Australian Standard for ground testing: AS 1289.6.3.2–1997 'Methods of testing soils for engineering purposes.' Test locations were constrained by existing structures, hard surfaces and the presence of utilities.

The location of these tests is shown on the site plan provided in Appendix A and a summary of the test results is presented below in Table 2, with the full details presented in the engineering logs in Appendix C.

**Table 2.** Summary of DCP test results

| Test | DCP 1 | DCP 2 | DCP 3 |
|---|---|---|---|
| **Summary** | Practical Refusal @ 1.3m Dull thudding on inferred bedrock. White clay on dry tip. | Practical Refusal @ 2.1m Dull thudding on inferred bedrock. Orange and brown clay on dry tip. | Practical Refusal @ 2.5m Dull thudding on inferred bedrock. Orange and brown clay on dry tip. |

**Note:** The equipment chosen to undertake ground investigations provides the most cost-effective method for understanding the subsurface conditions given site access constraints. Our interpretation

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of the subsurface conditions is limited to the results of testing undertaken and the known geology in the area. While every care is taken to accurately identify the subsurface conditions on site, variation between the interpreted model presented herein and the actual conditions on site may occur. Should actual ground conditions vary from those anticipated, we recommend that the geotechnical engineer at AscentGeo is informed as soon as possible to advise if modifications to our recommendations are required.

# 3 Geotechnical Assessment

## 3.1 Geological Model

Based on the results of our site assessment, ground testing, geological mapping and our experience in the area, the subsurface conditions encountered on site may be summarised as follows in Table 3.

**Table 3.** Interpreted geological model

| Unit | Material | Comments |
|---|---|---|
| **1** | **Topsoil / Fill** | Silty topsoil and fill material. Unit 1 is inferred to be uncontrolled and poorly compacted. |
| **2** | **Silty Clay** | Low-medium plasticity silty clay of generally firm consistency. |
| **3** | **Shale** | Generally, highly weathered, very low to low strength (Class V–IV*) interbedded shale and sandstone. |

* Pells, Mostyn & Walker, 1998.

## 3.2 Site Classification

Due to the presence of fill material and the proximity of the site to the escarpment in the east, the Site is classified as **"P"** in accordance with AS 2870–2011. A classification of "A" may be adopted for footings taken to confirmed bedrock.

**Table 4**. Site classification table for residential slabs and footings (AS2870-2011)

| Site Classification | Soil description | Expected range of movement |
|---|---|---|
| A | Most sand and rock sites with little or no ground movement from moisture changes. | |
| S | Slight reactive clay sites, which may experience only slight ground movement from moisture changes. | 0–20mm |
| M | Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes. | 20–40mm |

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| Site Classification | Soil description | Expected range of movement |
|---|---|---|
| H1 | Highly reactive clay sites, which may experience high ground movement from moisture changes. | 40–60mm |
| H2 | Highly reactive clay sites, which may experience very high ground movement from moisture changes. | 60–75mm |
| E | Extremely reactive sites, which may experience extreme ground movement from moisture changes. | >75mm |
| P | May consist of any of the above soil types, but in combination with site conditions produce undesirable foundations. P sites may also include fill, soft soils, mine subsidence, collapsing soils, prior or potential landslip, soils subject to erosion, reactive sites subject to abnormal moisture conditions, or sites which cannot be classified otherwise. | |

### 3.3 Groundwater

No groundwater was encountered during testing. Normal groundwater seepage is expected to move downslope through the soil profile along the interface with underling bedrock or any impervious horizons in the profile such as clays.

Due to the position of the Site relative to the slope and the underlying geology, no significant standing water table is expected to influence the site.

Groundwater seepage during and after periods of inclement weather should be anticipated through more permeable soil layers, close to the interface with weathered rock and from joints and discontinuities deeper in the weathered rock.

### 3.4 Surface Water

Overland or surface flows entering the site from the adjoining areas were not identified at the time of our inspection; however, normal overland runoff could enter the site from adjacent areas during heavy or extended rainfall.

### 3.5 Slope Instability

A landslide hazard assessment of the existing slope has been undertaken in general accordance with Australian Geomechanics Society's 'Practice Note Guidelines for Landslide Risk Management', published in March 2007.

- No evidence of significant soil creep, tension cracks or landslip instability were identified across the site or on adjacent properties as viewed from the subject site at the time of our inspection.
- Various retaining structures across the site are all in reasonable to good condition.
- Based on reference to the plan entitled "Geotechnical Hazard Mapping" (Ref. P21DCP-BC-MDCP2002, dated 2007) prepared by GHD LONGMAC on behalf of Northern Beaches Council (Pittwater), the site is mapped in a **Geotechnical Hazard H1** zone.

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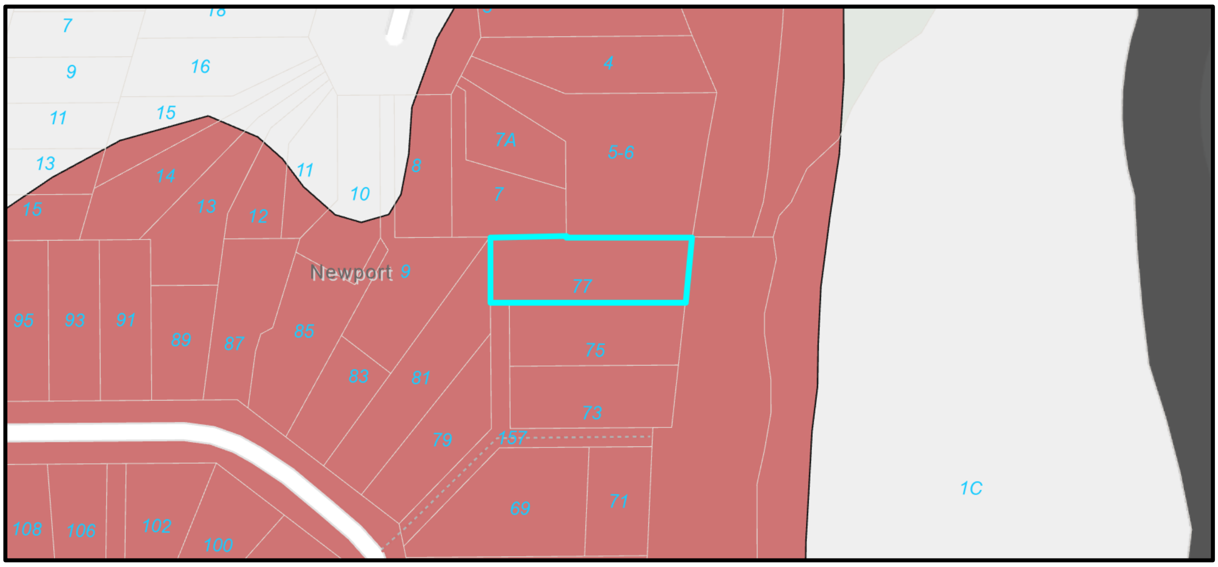


**Image 2.** PLEP Geotechnical Hazard Map
– 77 Bungan Head Road, Newport NSW **© NBC Maps**

LEGEND
**Pittwater Geotechnical Hazard Map**
- Geotechnical Hazard H1
- Geotechnical Hazard H2

### 3.6 Coastal Processes

The cliff recession rate of 1.3m to 2.0m over 100 years from Horton Coastal Engineering (Report #IrJ0720, dated 18 November 2024) has been considered, along with the typical joint spacing of the cliff face, and potential instability in the soil layer above the rock if a block failure occurred, to estimate the landward extent of cliff instability over the design life. This extent is not within the zone of influence of exisiting or proposed structures over the design life of the structures. Therefore, the proposed development is at an acceptably low risk of damage from coastal erosion/recession of the cliff seaward of the site for a design life of at least 100 years.

Considering the potential geotechnical failure mechanisms at the site, the proposed development is at an acceptably low risk of damage from geotechnical processes for a design life of at least 100 years. The proposed development is unlikely to increase the level of risk for any people, assets and infrastructure in the vicinity due to geotechnical processes.

### 3.7 Geotechnical Hazards and Risk Analysis

No significant geotechnical hazards were identified beside or above the subject site, including but not limited to the immediately adjoining residential properties, and the road reserve.

Removal of the concrete crib wall at its southeastern end will be within the zone of influence of the southern boundary. The potential failure of the unsupported slope before the new retaining structure is installed is a potential hazard.

Whilst the proposed works are not considered to significantly impact the stability of the escarpment to the east of the site, the potential failure weathered rock from the escarpment does pose a potential hazard to the site over uncertain timeframes. Due to the gradual nature of erosional processes, the timing of such an event is not possible to accurately predict.

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Based on observation made during our site assessment the following geological/geotechnical hazards have been identified in relation to the proposed works:

- **Hazard One:** Failure of the batter following removal of the concrete crib wall and before the new retaining structure is in place.
- **Hazards Two:** Failure of weathered rock from the escarpment to the east impacting on the subject site.

**Table 5.** Risk analysis summary

| HAZARDS | HAZARD ONE | HAZARD TWO |
|---|---|---|
| **TYPE** | Failure of the batter following removal of the concrete crib wall and before the new retaining structure is in place. | Failure of weathered rock from the escarpment to the east impacting on the subject site. |
| **LIKELIHOOD** | 'Possible' ($10^{-3}$) | 'Rare' ($10^{-5}$) |
| **CONSEQUENCES TO PROPERTY** | 'Medium' (15%) | 'Minor' (5%) |
| **RISK TO PROPERTY** | 'Moderate' ($2 \times 10^{-3}$) | 'Low' ($2 \times 10^{-4}$) |
| **RISK TO LIFE** | $5.5 \times 10^{-4}$/annum | $3.2 \times 10^{-7}$/annum |
| **COMMENTS** | Following implementation of the recommendations outlined in Section 3.7, the above risk levels would reduce to '**Acceptable**' levels within the site. | This level of risk to life and property is **'ACCEPTABLE'.** |

### 3.8 Conclusion and Recommendations

The proposed development is considered to be suitable for the site. The existing conditions and proposed development are considered to constitute an '**ACCEPTABLE**' risk to life and a '**LOW**' risk to property ***provided that the recommendations outlined in Table 6 are adhered to during design and construction*.**

**Table 6.** Geotechnical recommendations

| Recommendation | Description |
|---|---|
| **General** | It is strongly recommended that a builder and excavation contractor with demonstrable experience be engaged to undertake the proposed crib wall demolition and rebuilding works.<br><br>We would recommend that a site meeting be scheduled prior to commencement of these works, between the principal contractor, the |

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| Recommendation | Description |
|---|---|
| | excavator operator, and the geotechnical engineer to discuss excavation and construction methodology, shoring systems, and necessary inspections and contingency plans. |
| **Soil Excavation** | Soil excavation will be required to establish new footings across the site. It is anticipated that these excavations will encounter shallow uncontrolled fill and silty topsoil, silty clay, and weathered bedrock. The excavation of soil, clay and extremely weathered rock should be possible with the use of bucket excavators and rippers, or for piered footings, traditional auger attachments.<br><br>For shallow excavations (<1.0m), provided the residual soil is battered back to a minimum of 45 degrees and covered, they should remain stable without support for a short period until permanent support is in place.<br><br>Permanent batters are not considered appropriate for this site. |
| **Rock Excavation** | All excavation recommendations as outlined below should be read in conjunction with Safe Work Australia's *Code of Practice: Excavation Work*, published in October 2018.<br><br>It is essential that any excavation through rock that cannot be readily achieved with a bucket excavator or ripper should be carried out initially using a rock saw to minimise the vibration impact and disturbance on the adjoining properties, existing structures and any previously installed supporting systems. Any rock breaking must be carried out only after the rock has been sawed, and in short bursts (2–5 seconds), to prevent the vibration amplifying. The break in the rock from the saw must be between the rock to be broken and the closest adjoining structure.<br><br>All excavated material is to be removed from the site in accordance with current Office of Environment and Heritage (OEH) regulations. |
| **Vibrations** | The Australian Standard AS2670.1–2001 'Evaluation of human exposure to whole-body vibration General requirements. Part 1: General requirements, suggests a daytime limit of 5mm/s component PPV for human comfort is acceptable. In general, vibration criteria for human disturbance are more stringent than vibration criteria for effects on building contents and building structural damage. Hence, compliance with the more stringent limits dictated for human exposure, would ensure that compliance is also achieved for the other two categories. Furthermore, it is noted that this approach satisfies the requirements of Appendix J of AS2187.2–2006 'Explosives – storage and use', which also limits PPV to 5mm/s for residential settings. |

<table>
<tr><th>Recommendation</th><th>Description</th></tr>
<tr><td></td><td>
As such, we would suggest that the recommendations for method and/or equipment presented in the table below be adopted to maintain an allowable vibration limit of 5mm/s PPV.
<table>
<tr><th></th><th colspan="2">Maximum Peak Particle Velocity 5mm/sec</th></tr>
<tr><th>Distance from adjoining structure (m)</th><th>Equipment</th><th>Operating Limit (% of Maximum Capacity)</th></tr>
<tr><td>1.5 – 2.5</td><td>Hand operated jackhammer only</td><td>100</td></tr>
<tr><td>2.5 – 5.0</td><td>300kg rock hammer</td><td>50</td></tr>
<tr><td>5.0 – 10.0</td><td>300kg rock hammer<br>or 600kg rock hammer</td><td>100 (300kg)<br>or 50 (600kg)</td></tr>
</table>
It may be necessary to move to smaller rock hammers or to rotary grinders or rock saws if vibrations limits cannot be met. (Manufactures of the plant should be contacted for information regarding peak vibration output.)
The propagation of vibrations can be mitigated by pulsing the use of rock hammers, i.e., short bursts, utilising line sawing along boundaries.
It is essential that at all times excavation equipment must be operated by experienced personnel, according to the manufacturer’s instructions and in a manner consistent with minimising vibration effects.
</td></tr>
<tr><td>Excavation Support</td><td>
Due to the length of the concrete crib wall and the unknown depth of the transversal header elements and footing, we recommended that the wall be demolished and rebuilt in stages to mitigate the potential for collapse. The south-eastern most extent of the wall to be demolished will be within the zone of influence of the southern boundary and will require temporary support in the time between demolition and construction of the replacement structure. The demolition of the south-eastern most extent of the wall should be undertaken last, to allow for an understanding of the header elements and footing and the likely batter materials to be encountered.
Careful inspection of batter faces by AscentGeo, at regular hold points should be carried out to ensure no significant geological defects are present in the batter which may compromise the stability of the batter faces and proposed retention system.
</td></tr>
<tr><td>Retaining Structures</td><td>
Retention systems should be designed by a qualified structural engineer in accordance with Australian Standard AS 4678 using the following geotechnical parameters:
</td></tr>
</table>

| Recommendation | Description |
|---|---|

| | | | Earth Pressure Coefficients | | |
|---|---|---|---|---|---|
| **(Unit) Material** | **Bulk Unit Weight ($kN/m^3$)** | **Friction Angle (°)** | **Active $K_a$** | **At Rest $K_0$** | **Passive $K_p$** |
| (Unit 1) Fill / Topsoil | 18 | 29 | 0.38 | 0.60 | 2.00 |
| (Unit 2) Natural Clay | 19 | 28 | 0.33 | 0.55 | 2.50 |
| (Unit 3) Shale Class IV | 22 | 26 | 0.30 | 0.45 | 3.00 |

Retention systems should be designed to prevent hydrostatic pressure from developing behind the wall. As such, retaining walls to be constructed as part of the site works are to incorporate back wall subsoil drainage pipes, and are to be backfilled with suitable free-draining materials wrapped in a non-woven geotextile fabric (i.e. Bidim A34 or similar) to prevent the clogging of the drainage with fine-grained sediment.

Design of appropriate retention systems should consider potential surcharges from sloping land above the wall, soil creep, adjacent structures and footings, and construction related activities such as compaction of fill and construction plant.

**Footings**

All pad, strip or piered footings should be founded on and socketed a minimum of 500mm into the in situ underlying weathered bedrock. For fully cleaned footings in at least low strength bedrock, the allowable bearing pressure is **400kPa**. Higher allowable bearing capacities may be achievable subject to inspection and certification of excavated footings by AscentGeo.

Pier footings should be of sufficient diameter to enable effective base cleaning to be carried out during construction. Small diameter piers that cannot be cleaned should be designed for shaft friction, resulting in a longer rock socket.

To mitigate the risk of differential settlement, it is essential that all footings are founded on competent bedrock of similar consistency. This may require excavation through sandstone floaters or the relocation of planned footings.

**It is essential that the foundation materials of all footing excavations be inspected and approved by AscentGeo before steel reinforcement and concrete is placed. This inspection should be scheduled while excavation plant and operators are still on site, and before steel reinforcement has been fixed or the concrete booked.**

**Fills**

Any fill that may be required is to comprise local sand, clay, and weathered rock. Existing organic topsoil is to be cleared in preparation for the introduction of fill.

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| Recommendation | Description |
|---|---|
| | Any new fill material is to be placed in layers not more than 250mm thick and compacted to not less than 98% of Standard Optimum Dry Density at plus or minus 2% of Standard Optimum Moisture Content.<br>All new fill placement is to be carried out in accordance with AS 3798–2007 'Guidelines on earthworks for commercial and residential developments.'<br>Fill should not be placed on the site outside of the lateral extent of new engineered retaining walls. The retaining walls should be in place prior to the placement of new fill, with suitable permanent and effective drainage of backfill. |
| **Sediment and Erosion Control** | Appropriate design and construction methods shall be required during site works to minimise erosion and provide sediment control. In particular, siltation fencing and barriers will be required and are to be designed by others. |
| **Stormwater Disposal** | The effective management of ground and surface water on site may be the most important factor in the long-term performance of built structures, and the stability of the block more generally.<br>It is essential that gutters, downpipes, drains, pipes and connections are appropriately sized, functioning effectively, and discharging appropriately via non-erosive discharge.<br>All stormwater collected from hard surfaces is to be collected and piped directly to the council stormwater network through any storage tanks or on-site detention that may be required by the regulating authorities, and in accordance with all relevant Australian Standards and the detailed stormwater management plan by others.<br>Saturation of soils is one of the key triggers for many landslide events and a significant factor in destabilisation of structures over time. As such, the review and design of stormwater systems must consider climate change and the increased potential for periods of concentrated heavy rainfall. |
| **Inspections** | It is essential that the foundation materials of all footing excavations be visually assessed and approved by AscentGeo before steel reinforcement and concrete is placed. **Failure to engage AscentGeo for the required hold point/excavation/foundation material inspections will negate our ability to provide final geotechnical sign off or certification.** |
| **Conditions Relating to Design and Construction Monitoring** | To comply with Northern Beaches Council conditions and enable the completion of Forms 2B and 3, as required by Council's Geotechnical Risk Management Policy, it may be necessary at the following stages for Ascent to: |

| Recommendation | Description |
|---|---|
| | • Review the geotechnical content of all structural engineer designs prior to the issue of Construction Certificate – **Form 2B**<br>• Complete the abovementioned excavation hold point and foundation material inspections during construction to ensure compliance to design with respect to stability and geotechnical design parameters<br>• By Occupation Certificate stage (project completion), AscentGeo must have inspected and certified excavation/foundation materials. A final site inspection will be required at this stage before the issue of the **Form 3**. |

Should you have any queries regarding this report, please do not hesitate to contact the author of this report, undersigned.

For and on behalf of **AscentGeo,**

**Ben Morgan** BScGeol MAIG RPGeo
Managing Director | Engineering Geologist

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## 4 References

Australian Geomechanics Society Landslide Taskforce, Landslide Practice Note Working Group 2007 (Mar). 'Practice Note Guidelines for Landslide Risk Management 2007'. *Australian Geomechanics Journal,* vol. 42, no. 1, pp. 63–114.

GHD Geotechnics 2007, *Geotechnical Hazard Mapping of the Pittwater LGA 2007*, Pittwater Council's Geotechnical Risk Management Map P21CDP-BC-MDCP083, GHD Longmac.

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Safe Work Australia, 2018 (Oct), *Code of Practice: Excavation Work*, Safe Work Australia.

Standards Australia 1997, *Methods of Testing Soils for Engineering Purposes*, AS1289.6.3.2:1997, Standards Australia, NSW.

Standards Australia 2001, *Evaluation of human exposure to whole-body vibration. Part 1: General requirements,* AS2670.1:2001, Standards Australia, NSW.

Standards Australia 2002, *Earth-retaining structures,* AS4678:2002, Standards Australia, NSW.

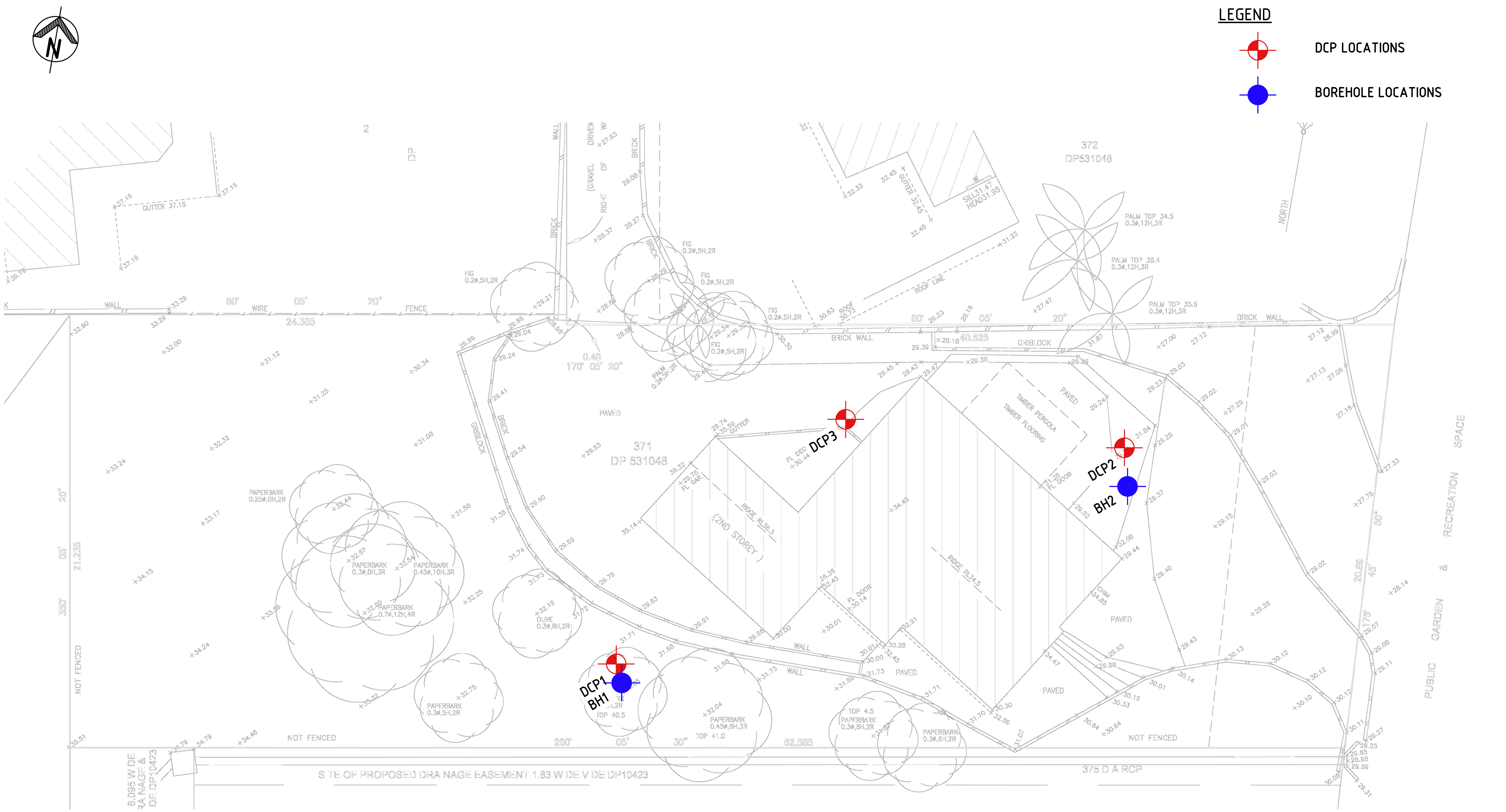
Standards Australia 2007, *Guidelines for Earthworks for Commercial and Residential Developments.* AS3798:2007, Standards Australia, NSW.

Standards Australia 2011, *Residential Slabs and Footings*, AS2870:2011, Standards Australia, NSW.

Standards Australia 2017, *Geotechnical Site Investigations*, AS1726:2017, Standards Australia, NSW.

# Appendix A

Site plans




SITE PLAN/GROUND TEST LOCATIONS

SCALE NTS

| REV | DATE | REVISION DESCRIPTION | REV BY | CHCKD |
|---|---|---|---|---|
| A | 26.11.24 | PRELIMINARY ISSUE | VT | BM |

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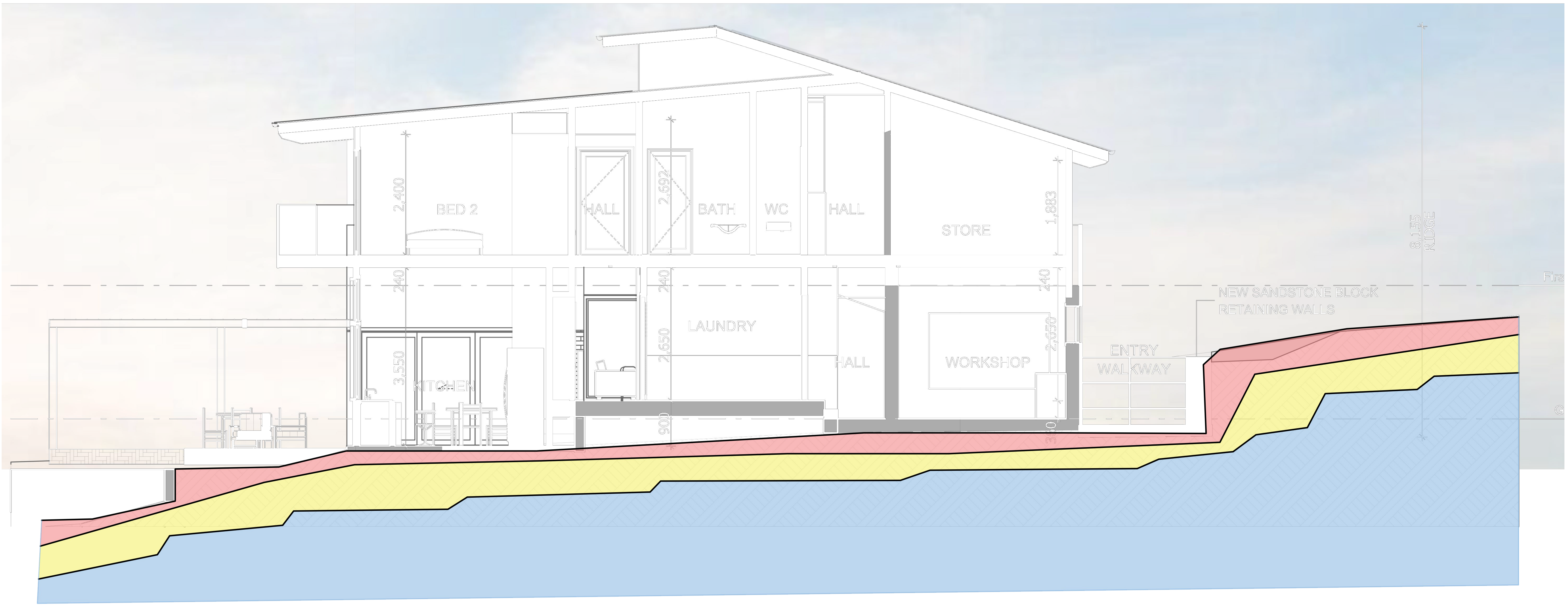
CLIENT:
CLAUDIO MINNS



SITE PLAN/GROUND TEST LOCATIONS
AT 77 BUNGAN HEAD ROAD
NEWPORT NSW

DATE: 26/11/2024
SCALE: AS SHOWN @ A3
DRAWING TITLE: SITE PLAN
DRAWING NO: AG 23793- S1

INTERPRETED SUBSURFACE SECTION ONLY.
ACTUAL GROUND CONDITIONS MAY VARY.




LEGEND

- UNCONTROLLED FILL / SILTY TOPSOIL
- SILTY CLAY
- NEWPORT FORMATION BEDROCK

## INFERRED GEOLOGICAL SECTION

SCALE NTS

| REV | DATE | REVISION DESCRIPTION | REV BY | CHCKD |
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| A | 26.11.24 | PRELIMINARY ISSUE | VT | BM |


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INFERRED GEOLOGICAL SECTION
AT 77 BUNGAN HEAD ROAD
NEWPORT NSW

DATE: 26/11/2024
SCALE: AS SHOWN @ A3
DRAWING TITLE: SECTION
DRAWING NO: AG 23793- S2

# Appendix B

Site photos

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# Appendix C

Bore Logs | DCP Test Results

# GEOTECHNICAL LOG - BORE HOLE

ASCENTGEO GEOTECHNICAL CONSULTING

| | | | |
|---|---|---|---|
| **Client:** Claudio Minns | **Job No:** AG 23793 | **BOREHOLE NO.: BH01** |
| **Project:** Alterations & Additions | **Date:** 30.11.23 | |
| **Location:** 77 Bungan Head Road, Newport | **Operator:** CY | Sheet 1 of 1 |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations) | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | 0.0 | *TOPSOIL*. **SILTY SAND**. Dark brown/grey. Fine to medium grained. Rootlets | SM | L | D |
| | | 0.3 | **SILTY CLAY.** Orange/ Light brown. Fine grained. Low to moderate plasticity. Minor sand. | CL | F<br>St | M |
| | | 0.8 | **Borehole terminated @ 0.8m in stiff clay. No water encountered.** | | | |

NOTE: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: N/A
Equipment: Hand Auger
Hole width (mm):
Angle from Vertical (°):

# GEOTECHNICAL LOG - BORE HOLE

ASCENTGEO GEOTECHNICAL CONSULTING

| | | | |
|---|---|---|---|
| **Client:** Claudio Minns | **Job No:** AG 23793 | | **BOREHOLE NO.: BH02** |
| **Project:** Alterations & Additions | **Date:** 30.11.23 | | |
| **Location:** 77 Bungan Head Road, Newport | **Operator:** CY | | Sheet 1 of 1 |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations) | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | 0.0 | *TOPSOIL*. **SILTY SAND**. Dark brown/grey. Fine to medium grained. Rootlets | SM | L | D |
| | | 0.2 | **SILTY CLAY.** Pale orange/ Light brown with maroon mottles. Fine grained. Low to moderate plasticity. Stiffness incrceasing with depth. | CL | F<br>ST | M |
| | | 0.7 | **Borehole terminated @ 0.7m in stiff clay. No water encountered.** | | | |
| | | 2.0 | | | | |

NOTE: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: N/A
Equipment: Hand Auger
Hole width (mm):
Angle from Vertical (°):

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# Dynamic Cone Penetration Test Report

| | | | |
|---|---|---|---|
| **Client:** | Claudio Minns | **Job No:** | AG 23793 |
| **Project:** | Alterations & Additions | **Date:** | 30.11.23 |
| **Location:** | 77 Bungan Head Road, Newport | **Operator:** | CY |
| **Test Procedure:** | AS 1289.6.3.2 – 1997 | | |

**Test Data**

| Test No: DCP 1 | | Test No: DCP 2 | | Test No: DCP 3 | | Test No: | | Test No: | |
|---|---|---|---|---|---|---|---|---|---|
| Test Location: Refer to Site Plan | | Test Location: Refer to Site Plan | | Test Location: Refer to Site Plan | | Test Location: | | Test Location: | |
| RL: | | RL: | | RL: | | RL: | | RL: | |
| Soil Classification: P | | Soil Classification: P | | Soil Classification: P | | Soil Classification: | | Soil Classification: | |
| Depth (m) | Blows | Depth (m) | Blows | Depth (m) | Blows | Depth (m) | Blows | Depth (m) | Blows |
| 0.0 – 0.3 | 1 – D | 0.0 – 0.3 | 3 | 0.0 – 0.3 | 3 | | | | |
| 0.3 – 0.6 | 7 | 0.3 – 0.6 | 7 | 0.3 – 0.6 | 4 | | | | |
| 0.6 – 0.9 | 10 | 0.6 – 0.9 | 13 | 0.6 – 0.9 | 6 | | | | |
| 0.9 – 1.2 | 22 | 0.9 – 1.2 | 16 | 0.9 – 1.2 | 15 | | | | |
| 1.2 – 1.5 | 25 Pr | 1.2 – 1.5 | 21 | 1.2 – 1.5 | 19 | | | | |
| 1.5 – 1.8 | | 1.5 – 1.8 | 25 | 1.5 – 1.8 | 17 | | | | |
| 1.8 – 2.1 | | 1.8 – 2.1 | 28 | 1.8 – 2.1 | 22 | | | | |
| 2.1 – 2.4 | | 2.1 – 2.4 | 25 Pr | 2.1 – 2.4 | 27 | | | | |
| 2.4 – 2.7 | | 2.4 – 2.7 | | 2.4 – 2.7 | 45 Pr | | | | |
| 2.7 – 3.0 | | 2.7 – 3.0 | | 2.7 – 3.0 | | | | | |
| 3.0 – 3.3 | | 3.0 – 3.3 | | 3.0 – 3.3 | | | | | |
| 3.3 – 3.6 | | 3.3 – 3.6 | | 3.3 – 3.6 | | | | | |
| 3.6 – 3.9 | | 3.6 – 3.9 | | 3.6 – 3.9 | | | | | |
| 3.9 – 4.2 | | 3.9 – 4.2 | | 3.9 – 4.2 | | | | | |
| 4.2 – 4.5 | | 4.2 – 4.5 | | 4.2 – 4.5 | | | | | |
| 4.5 – 4.8 | | 4.5 – 4.8 | | 4.5 – 4.8 | | | | | |
| DCP 1: Practical Refusal @ 1.3m Dull thudding on inferred bedrock. White clay on dry tip. | | DCP 2: Practical Refusal @ 2.1m Dull thudding on inferred bedrock. Orange and brown clay on dry tip. | | DCP 3: Practical Refusal @ 2.5m Dull thudding on inferred bedrock. Orange and brown clay on dry tip. | | | | | |

| | | |
|---|---|---|
| Remarks: Available test locations limited by large trees, existing hard surfaces and possible buried services . No groundwater encountered. | Weight: | 9 kg |
| | Drop: | 510 mm |
| | Rod Diameter | 16 mm |

Pr = Practical Refusal. Rods progressingly slowly through weathered bedrock.

# Appendix D

Information Sheets

# General Notes About This Report

**INTRODUCTION**

These notes have been prepared by Ascent Geotechnical Consulting Pty Ltd (Ascent) to help our Clients interpret and understand the limitations of this report. Not all sections below are necessarily relevant to all reports.

**SCOPE OF SERVICES**

This report has been prepared in accordance with the scope of services set out in Ascent's proposal under Ascent's Terms and Conditions, or as otherwise agreed with the Client. The scope of work may have been limited by a range of factors including time, budget, access and/or site constraints.

**RELIANCE ON INFORMATION PROVIDED**

In preparing the report, Ascent has necessarily relied upon information provided by the Client and/or their Agents. Such data may include surveys, analyses, designs, maps and design plans. Ascent has not verified the accuracy or completeness of the data except as stated in this report.

**GEOTECHNICAL AND ENVIRONMENTAL REPORTING**

Geotechnical and environmental reporting relies on the interpretation of factual information, based on judgment and opinion, and is far less exact than other engineering or design disciplines.

Geotechnical and environmental reports are prepared for a specific purpose, development, and site, as described in the report, and may not contain sufficient information for other purposes, developments, or sites (including adjacent sites), other than that described in the report.

**SUBSURFACE CONDITIONS**

Subsurface conditions can change with time and can vary between test locations. For example, the actual interface between the materials may be far more gradual or abrupt than indicated.

Therefore, actual conditions in areas not sampled may differ from those predicted, since no subsurface investigation, no matter how comprehensive, can reveal all subsurface details and anomalies.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations can also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. Ascent should be kept informed of any such events, and should be retained to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

**GROUNDWATER**

Groundwater levels indicated on borehole and test pit logs are recorded at specific times. Depending on ground permeability, measured levels may or may not reflect actual levels if measured over a longer time period. Also, groundwater levels and seepage inflows may fluctuate with seasonal and environmental variations and construction activities.

**INTERPRETATION OF DATA**

Data obtained from nominated discrete locations, subsequent laboratory testing and empirical or external sources are interpreted by trained professionals in order to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions in accordance with any relevant industry standards, guidelines or procedures.

**SOIL AND ROCK DESCRIPTIONS**

Soil and rock descriptions are based on AS 1726 – 1993, using visual and tactile assessment, except at discrete locations where field and / or laboratory tests have been carried out. Refer to the accompanying soil and rock terms sheet for further information.

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**FURTHER ADVICE**

Ascent would be pleased to further discuss how any of the above issues could affect a specific project. We would also be pleased to provide further advice or assistance including:

- Assessment of suitability of designs and construction techniques;
- Contract documentation and specification;
- Construction advice (foundation assessments, excavation support).

# Abbreviations, Notes & Symbols

## SUBSURFACE INVESTIGATION

**METHOD**

**Borehole Logs**

| | |
|---|---|
| AS# | Auger screwing (#-bit) |
| AD# | Auger drilling (#-bit) |
| B | Blank bit |
| V | V-bit |
| T | TC-bit |
| HA | Hand auger |
| R | Roller/tricone |
| W | Washbore |
| AH | Air hammer |
| AT | Air track |
| LB | Light bore push tube |
| MC | Macro core push tube |
| DT | Dual core push tube |

**Excavation Logs**

| | |
|---|---|
| BH | Backhoe/excavator bucket |
| NE | Natural exposure |
| HE | Hand excavation |
| X | Existing excavation |

**Cored Borehole Logs**

| | |
|---|---|
| NMLC | NMLC core drilling |
| NQ/HQ | Wireline core drilling |

**SUPPORT**

**Borehole Logs**

| | |
|---|---|
| C | Casing |
| M | Mud |

**Excavation Logs**

| | |
|---|---|
| S | Shoring |
| B | Benched |

**SAMPLING**

| | |
|---|---|
| B | Bulk sample |
| D | Disturbed sample |
| U# | Thin-walled tube sample (#mm diameter) |
| ES | Environmental sample |
| EW | Environmental water sample |

**FIELD TESTING**

| | |
|---|---|
| PP | Pocket penetrometer (kPa) |
| DCP | Dynamic cone penetrometer |
| PSP | Perth sand penetrometer |
| SPT | Standard penetration test |
| PBT | Plate bearing test |
| $s_u$ | Vane shear strength peak/residual (kPa) and vane size (mm) |
| N* | SPT (blows per 300mm) |
| Nc | SPT with solid cone |
| R | Refusal |

**denotes sample taken*

**BOUNDARIES**

| | |
|---|---|
| _______ | Known |
| _ _ _ _ _ | Probable |
| --------- | Possible |

## SOIL

**MOISTURE CONDITION**

| | |
|---|---|
| D | Dry |
| M | Moist |
| W | Wet |
| Wp | Plastic Limit |
| Wl | Liquid Limit |
| MC | Moisture Content |

**CONSISTENCY**

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

**DENSITY INDEX**

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

**USCS SYMBOLS**

| | |
|---|---|
| GW | Well graded gravels and gravel-sand mixtures, little or no fines |
| GP | Poorly graded gravels and gravel-sand mixtures, little or no fines |
| GM | Silty gravels, gravel-sand-silt mixtures |
| GC | Clayey gravels, gravel-sand-clay mixtures |
| SW | Well graded sands and gravelly sands, little or no fines |
| SP | Poorly graded sands and gravelly sands, little or no fines |
| SM | Silty sand, sand-silt mixtures |
| SC | Clayey sand, sand-clay mixtures |
| ML | Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands |
| CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays |
| OL | Organic silts and organic silty clays of low plasticity |
| MH | Inorganic silts of high plasticity |
| CH | Inorganic clays of high plasticity |
| OH | Organic clays of medium to high plasticity |
| PT | Peat muck and other highly organic soils |

## ROCK

**WEATHERING**

| | |
|---|---|
| RS | Residual Soil |
| XW | Extremely Weathered |
| HW | Highly Weathered |
| MW | Moderately Weathered |
| DW* | Distinctly Weathered |
| SW | Slightly Weathered |
| FR | Fresh |

**covers both HW & MW*

**STRENGTH**

| | |
|---|---|
| EL | Extremely Low |
| VL | Very Low |
| L | Low |
| M | Medium |
| H | High |
| VH | Very High |
| EH | Extremely High |

**ROCK QUALITY DESIGNATION (%)**

$$= \frac{\text{sum of intact core pieces > 100mm}}{\text{total length of section being evaluated}} \times 100$$

**CORE RECOVERY (%)**

$$= \frac{\text{core recovered}}{\text{core lift}} \times 100$$

**NATURAL FRACTURES**

**Type**

| | |
|---|---|
| JT | Joint |
| BP | Bedding plane |
| SM | Seam |
| FZ | Fractured zone |
| SZ | Shear zone |
| VN | Vein |

**Infill or Coating**

| | |
|---|---|
| Cn | Clean |
| St | Stained |
| Vn | Veneer |
| Co | Coating |
| Cl | Clay |
| Ca | Calcite |
| Fe | Iron oxide |
| Mi | Micaceous |
| Qz | Quartz |

**Shape**

| | |
|---|---|
| pl | Planar |
| cu | Curved |
| un | Undulose |
| st | Stepped |
| ir | Irregular |

**Roughness**

| | |
|---|---|
| pol | Polished |
| slk | Slickensided |
| smo | Smooth |
| rou | Rough |

# Soil & Rock Terms

## SOIL

**MOISTURE CONDITION**

| Term | Description |
|---|---|
| Dry | Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through the hand. |
| Moist | Feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere. |
| Wet | As for moist, but with free water forming on hands when handled. |

For cohesive soils, moisture content may also be described in relation to plastic limit ($W_P$) or liquid limit ($W_L$). [>> much greater than, > greater than, < less than, << much less than].

**CONSISTENCY**

| Term | $c_u$ (kPa) | Term | $c_u$ (kPa) |
|---|---|---|---|
| Very Soft | < 12 | Very Stiff | 100 - 200 |
| Soft | 12 - 25 | Hard | > 200 |
| Firm | 25 - 50 | Friable | - |
| Stiff | 50 - 100 | | |

**DENSITY INDEX**

| Term | $I_D$ (%) | Term | $I_D$ (%) |
|---|---|---|---|
| Very Loose | < 15 | Dense | 65 – 85 |
| Loose | 15 – 35 | Very Dense | > 85 |
| Medium Dense | 35 – 65 | | |

**PARTICLE SIZE**

| Name | Subdivision | Size (mm) |
|---|---|---|
| Boulders | | > 200 |
| Cobbles | | 63 - 200 |
| Gravel | coarse | 20 - 63 |
| | medium | 6 - 20 |
| | fine | 2.36 - 6 |
| Sand | coarse | 0.6 -2.36 |
| | medium | 0.2 - 0.6 |
| | fine | 0.075 - 0.2 |
| Silt & Clay | | < 0.075 |

**MINOR COMPONENTS**

| Term | Proportion by Mass coarse grained | fine grained |
|---|---|---|
| Trace | ≤ 5% | ≤ 15% |
| Some | 5 - 2% | 15 - 30% |

**SOIL ZONING**

| | |
|---|---|
| Layers | Continuous exposures |
| Lenses | Discontinuous layers of lenticular shape |
| Pockets | Irregular inclusions of different material |

**SOIL CEMENTING**

| | |
|---|---|
| Weakly | Easily broken up by hand |
| Moderately | Effort is required to break up the soil by hand |

**SOIL STRUCTURE**

| | |
|---|---|
| Massive | Coherent, with any partings both vertically and horizontally spaced at greater than 100mm |
| Weak | Peds indistinct and barely observable on pit face. When disturbed approx. 30% consist of peds smaller than 100mm |
| Strong | Peds are quite distinct in undisturbed soil. When disturbed >60% consists of peds smaller than 100mm |

## ROCK

**SEDIMENTARY ROCK TYPE DEFINITIONS**

| Rock Type | **Definition** (more than 50% of rock consists of….) |
|---|---|
| Conglomerate | … gravel sized (> 2mm) fragments |
| Sandstone | … sand sized (0.06 to 2mm) grains |
| Siltstone | … silt sized (<0.06mm) particles, rock is not laminated |
| Claystone | … clay, rock is not laminated |
| Shale | … silt or clay sized particles, rock is laminated |

**STRENGTH**

| Term | Is50 (MPa) | Term | Is50 (MPa) |
|---|---|---|---|
| Extremely Low | < 0.03 | High | 1 – 3 |
| Very Low | 0.03 – 0.1 | Very High | 3 – 10 |
| Low | 0.1 – 0.3 | Extremely High | > 10 |
| Medium | 0.3 – 1 | | |

**WEATHERING**

| Term | Description |
|---|---|
| Residual Soil | Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident |
| Extremely Weathered | Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water. Fabric of original rock is still visible |
| Highly Weathered | Rock strength usually highly changed by weathering; rock may be highly discoloured |
| Moderately Weathered | Rock strength usually moderately changed by weathering; rock may be moderately discoloured |
| Distinctly Weathered | See 'Highly Weathered' or 'Moderately Weathered' |
| Slightly Weathered | Rock is slightly discoloured but shows little or no change of strength from fresh rock |
| Fresh | Rock shows no signs of decomposition or staining |

**NATURAL FRACTURES**

| Type | Description |
|---|---|
| Joint | A discontinuity or crack across which the rock has little or no tensile strength. May be open or closed |
| Bedding plane | Arrangement in layers of mineral grains of similar sizes or composition |
| Seam | Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed) |
| Shear zone | Zone with roughly parallel planar boundaries, of rock material intersected by closely spaced (generally < 50mm) joints and /or microscopic fracture (cleavage) planes |
| Vein | Intrusion of any shape dissimilar to the adjoining rock mass. Usually igneous |

| Shape | Description |
|---|---|
| Planar | Consistent orientation |
| Curved | Gradual change in orientation |
| Undulose | Wavy surface |
| Stepped | One or more well defined steps |
| Irregular | Many sharp changes in orientation |

| Infill or Coating | Description |
|---|---|
| Clean | No visible coating or discolouring |
| Stained | No visible coating but surfaces are discoloured |
| Veneer | A visible coating of soil or mineral, too thin to measure; may be patchy |
| Coating | Visible coating ≤ 1mm thick. Ticker soil material described as seam |

| Roughness | Description |
|---|---|
| Polished | Shiny smooth surface |
| Slickensided | Grooved or striated surface, usually polished |
| Smooth | Smooth to touch. Few or no surface irregularities |
| Rough | Many small surface irregularities (amplitude generally < 1mm). Feels like fine to coarse sandpaper |

Note: soil and rock descriptions are generally in accordance with AS1726-1993 Geotechnical Site Investigations

# Graphic Symbols Index

**Soil**

- Fill
- Peat, Topsoil
- Clay
- Silty Clay
- Gravelly Clay
- Sandy Clay
- Silt
- Sandy Silt
- Clayey Silt
- Gravelly Silt
- Gravel
- Sandy Gravel
- Clayey Gravel
- Silty Gravel
- Sand
- Gravelly Sand
- Silty Sand
- Clayey Sand

**Rock**

- Sandstone
- Shale
- Clayey Shale
- Siltstone
- Conglomerate
- Claystone
- Dolerite, Basalt
- Granite
- Limestone
- Tuff
- Coarse grained Metamorphic
- Medium grained Metamorphic
- Fine grained Metamorphic
- Coal

**Other**

- Asphalt
- Concrete
- Brick

**Water Measurements**

- Level at time of drilling
- Level after drilling
- Inflow
- Outflow

# Foundation Maintenance and Footing Performance: A Homeowner's Guide

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

## Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

## Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

**GENERAL DEFINITIONS OF SITE CLASSES**

| Class | Foundation |
|---|---|
| A | Most sand and rock sites with little or no ground movement from moisture changes |
| S | Slightly reactive clay sites with only slight ground movement from moisture changes |
| M | Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes |
| H | Highly reactive clay sites, which can experience high ground movement from moisture changes |
| E | Extremely reactive sites, which can experience extreme ground movement from moisture changes |
| A to P | Filled sites |
| P | Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise |

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

## Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

## Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

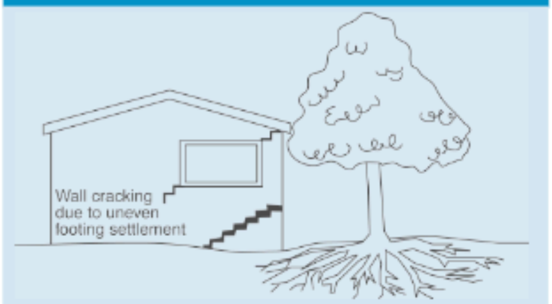
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

**Trees can cause shrinkage and damage**




As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

## Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

## Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

## Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

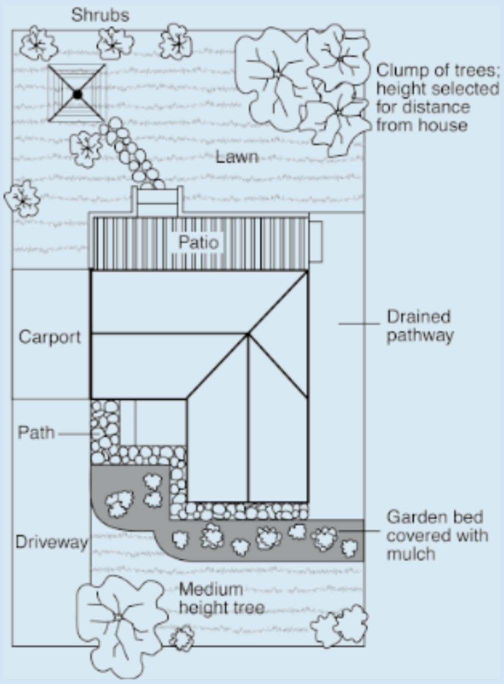
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

**CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS**

| Description of typical damage and required repair | Approximate crack width limit (see Note 3) | Damage category |
|---|---|---|
| Hairline cracks | <0.1 mm | 0 |
| Fine cracks which do not need repair | <1 mm | 1 |
| Cracks noticeable but easily filled. Doors and windows stick slightly | <5 mm | 2 |
| Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired | 5–15 mm (or a number of cracks 3 mm or more in one group) | 3 |
| Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted | 15–25 mm but also depend on number of cracks | 4 |

**Gardens for a reactive site**




should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation
In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

*Warning:* Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden
The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees
Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs
State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation
Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

## Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

**This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.**



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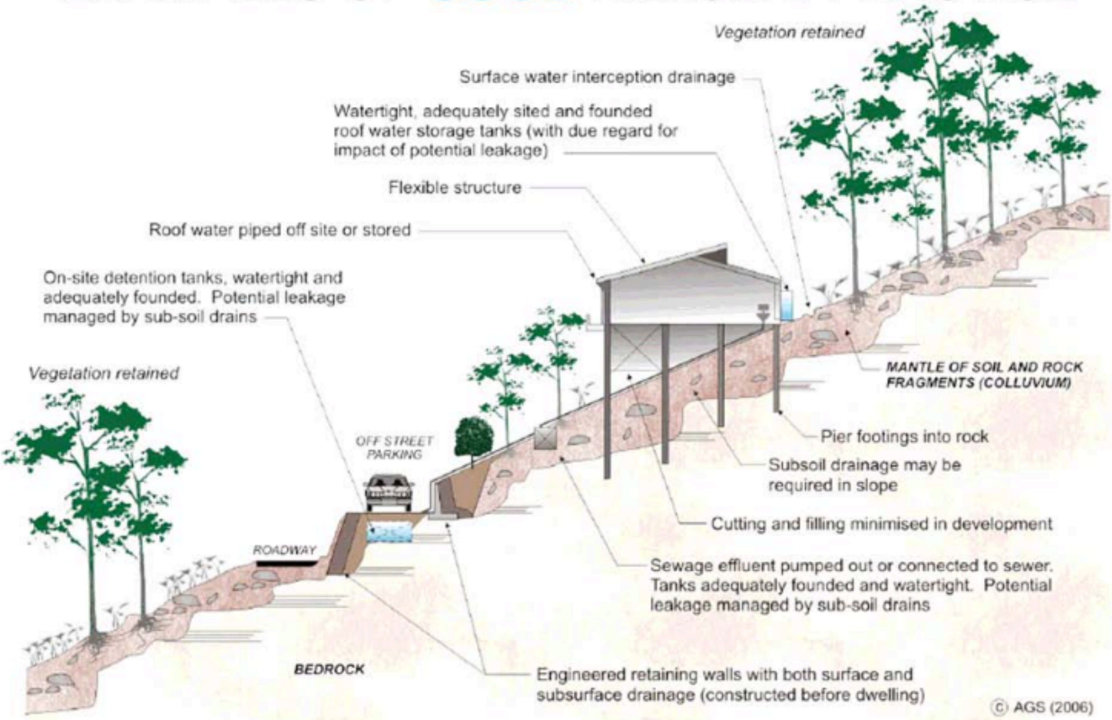
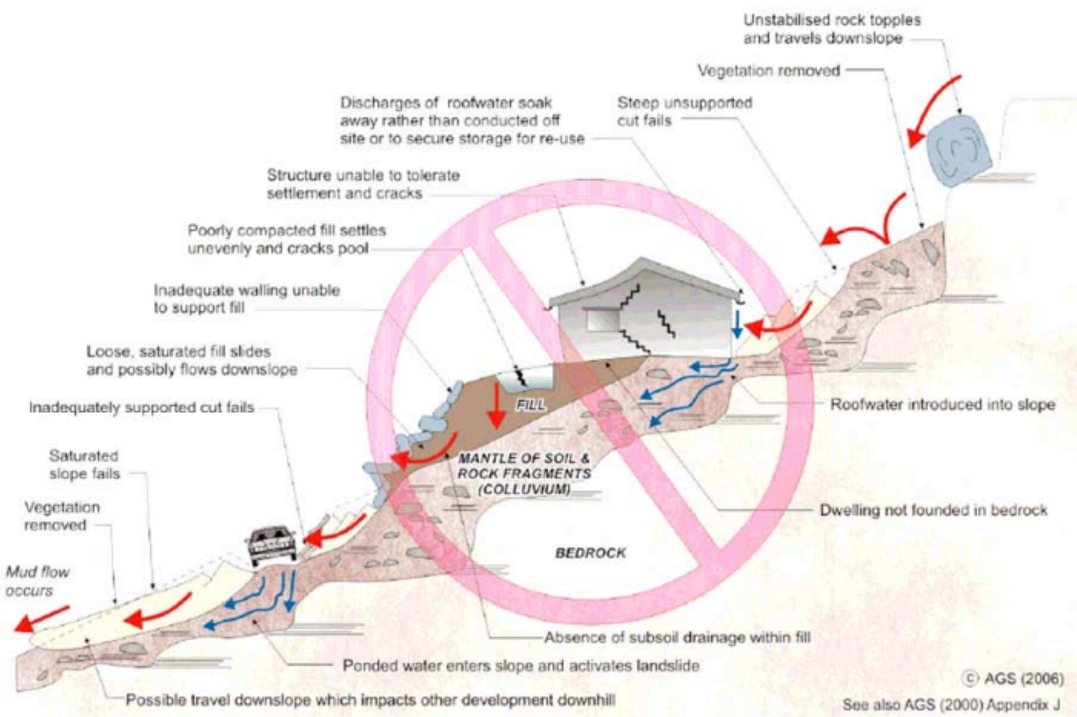
# EXAMPLES OF **GOOD** HILLSIDE PRACTICE




# EXAMPLES OF **POOR** HILLSIDE PRACTICE



# APPENDIX C: LANDSLIDE RISK ASSESSMENT

## QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

### *QUALITATIVE MEASURES OF LIKELIHOOD*

| Approximate Annual Probability | | Implied Indicative Landslide Recurrence Interval | | Description | Descriptor | Level |
|---|---|---|---|---|---|---|
| **Indicative Value** | **Notional Boundary** | | | | | |
| $10^{-1}$ | $5 \times 10^{-2}$ | 10 years | 20 years | The event is expected to occur over the design life. | ALMOST CERTAIN | A |
| $10^{-2}$ | $5 \times 10^{-3}$ | 100 years | 200 years | The event will probably occur under adverse conditions over the design life. | LIKELY | B |
| $10^{-3}$ | $5 \times 10^{-4}$ | 1000 years | 2000 years | The event could occur under adverse conditions over the design life. | POSSIBLE | C |
| $10^{-4}$ | $5 \times 10^{-5}$ | 10,000 years | 20,000 years | The event might occur under very adverse circumstances over the design life. | UNLIKELY | D |
| $10^{-5}$ | $5 \times 10^{-6}$ | 100,000 years | 200,000 years | The event is conceivable but only under exceptional circumstances over the design life. | RARE | E |
| $10^{-6}$ | | 1,000,000 years | | The event is inconceivable or fanciful over the design life. | BARELY CREDIBLE | F |

**Note:** (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

### *QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY*

| Approximate Cost of Damage | | Description | Descriptor | Level |
|---|---|---|---|---|
| **Indicative Value** | **Notional Boundary** | | | |
| 200% | 100% | Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage. | CATASTROPHIC | 1 |
| 60% | 40% | Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage. | MAJOR | 2 |
| 20% | 10% | Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage. | MEDIUM | 3 |
| 5% | 1% | Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works. | MINOR | 4 |
| 0.5% | | Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.) | INSIGNIFICANT | 5 |

**Notes:** (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

# PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

## APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

### *QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY*

| LIKELIHOOD | | CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage) | | | | |
|---|---|---|---|---|---|---|
| | **Indicative Value of Approximate Annual Probability** | **1: CATASTROPHIC 200%** | **2: MAJOR 60%** | **3: MEDIUM 20%** | **4: MINOR 5%** | **5: INSIGNIFICANT 0.5%** |
| **A – ALMOST CERTAIN** | $10^{-1}$ | VH | VH | VH | H | M or **L** (5) |
| **B - LIKELY** | $10^{-2}$ | VH | VH | H | M | **L** |
| **C - POSSIBLE** | $10^{-3}$ | VH | H | M | M | **VL** |
| **D - UNLIKELY** | $10^{-4}$ | H | M | **L** | **L** | **VL** |
| **E - RARE** | $10^{-5}$ | M | **L** | **L** | **VL** | **VL** |
| **F - BARELY CREDIBLE** | $10^{-6}$ | **L** | **VL** | **VL** | **VL** | **VL** |

**Notes:** (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

### *RISK LEVEL IMPLICATIONS*

| Risk Level | | Example Implications (7) |
|---|---|---|
| VH | VERY HIGH RISK | Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property. |
| H | HIGH RISK | Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property. |
| M | MODERATE RISK | May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable. |
| **L** | LOW RISK | Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required. |
| **VL** | VERY LOW RISK | Acceptable. Manage by normal slope maintenance procedures. |

**Note:** (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

# Appendix E

Coastal Engineering Report

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18 November 2024

**Coastal Engineering Advice on 77 Bungan Head Road Newport**

## 1. INTRODUCTION AND BACKGROUND

It is proposed to undertake alterations and additions at 77 Bungan Head Road Newport (also known as 6a Lovering Place Newport), hereafter denoted as the 'site', for which a Development Application is to be submitted to Northern Beaches Council.

The site is located within a "Bluff/Cliff Instability" area designated on the *Coastal Risk Planning Map* (Sheet CHZ_017) that is referenced in *Pittwater Local Environmental Plan 2014*. Therefore, the site is subject to Chapter B3.4 of the *Pittwater 21 Development Control Plan* (DCP), and the *Geotechnical Risk Management Policy for Development in Pittwater*. Based on Chapter 6.5(i) of this policy, "a coastal engineer's report on the impact of coastal processes on the site and the coastal forces prevailing on the bluff must be incorporated into the geotechnical assessment as an appendix and the Coastal Engineer's assessment must be addressed through the Geotechnical Report and structural specification". Accordingly, this coastal engineering report is set out herein.

The report author, Peter Horton [BE (Hons 1) MEngSc MIEAust CPEng NER], is a professional Coastal Engineer with 33 years of coastal engineering experience. He has postgraduate qualifications in coastal engineering, and is a Member of Engineers Australia and Chartered Professional Engineer (CPEng) registered on the National Engineering Register. He is also a member of the National Committee on Coastal and Ocean Engineering (NCCOE) and NSW Coastal, Ocean and Port Engineering Panel (COPEP) of Engineers Australia. Peter has prepared coastal engineering reports for numerous cliff/bluff properties in the former Pittwater Local Government Area in recent years, including at Newport. He undertook a specific inspection of the site on 8 December 2023, and a specific inspection of its adjacent cliff face and rock platform on 4 January 2024.

All levels given herein are to Australian Height Datum (AHD). Zero metres AHD is approximately equal to mean sea level in the ocean adjacent to the NSW mainland at present. Completed Form No. 1 as given in the *Geotechnical Risk Management Policy for Pittwater* is attached at the end of the report herein.

  

## 2. INFORMATION PROVIDED

Horton Coastal Engineering was provided with a total of 18 drawings prepared by Space Design Architecture Pty Ltd (namely Drawings DA 000 to 003, 100 to 102, 201, 300, 400, 401, 500, 501, 600 and 700 to 703) various Issues up to 11 and all dated 7 November 2024.

A site survey by Kiprovich & Associates was also provided, namely Plan No 07_166DETAIL dated 19 October 2007. Another survey by Byrne & Associates (namely Plan No A3 – 10965ID2, dated 1 March 2023 and Issue B) of a retaining wall constructed near part of the seaward and northern boundary of the site in 2022 was also provided.

## 3. EXISTING SITE DESCRIPTION

The site is located landward of a rock platform and rocky cliff. This cliff, Bungan Head, extends between the sandy Bungan Beach in the south and sandy Newport Beach in the north. A vertical aerial view of the site is provided in Figure 1, with a section location (Section A) also depicted in Figure 1.

An oblique aerial view of the site and adjacent cliff and rock platform is provided in Figure 2, with a photograph of the cliff seaward of the site (taken from the adjacent rock platform) provided in Figure 3.

Based on NSW Government LiDAR and reflectance data that was collected in 2018 and 2020, supplemented by the surveys noted in Section 2, elevations versus distance along Section A (from Figure 1) perpendicular to the cliff face are depicted in Figure 4.

Coffey & Partners (1987) noted that the top section of the cliff at the site was predominantly sandstone (highly weathered) and close to vertical (with overhangs due to undercutting), with the central section comprising interbedded siltstone and sandstone at a slope of about 65° to 75° to the horizontal. This interbedding was noted to lead to undercutting in highly weathered siltstone and toppling of sandstone slabs defined by joint sets and bedding planes. The lower section of cliff was noted to be red siltstone of the Bald Hill Claystone with a slope of about 35° to the horizontal.

Based on the LiDAR and reflectance data depicted in Figure 4, key elevations and slopes along Section A are as follows:

- area in vicinity of proposed development at about 30m AHD;
- top of cliff at 25.9m AHD, located about 18.7m seaward of proposed development;
- average slope of about 74° from the top of cliff down to a ledge at 12.5m AHD;
- average slope of about 40° from the bottom of the ledge at 12.2m AHD down to 8.5m AHD; and
- average slope of about 78° from 8.5m AHD down to 4.2m AHD.

A relatively flat rock platform is located at the base of the cliff, and is about 80m wide at low tide.

Little Reef extends offshore of the rock platform to the NE of the site. Waves tend to converge in its lee, due to diffraction processes.

  


**Figure 1: Aerial view of site (approximate red outline), with Section A shown in blue and aerial photograph taken 22 July 2024**

**Figure 2: Oblique aerial view of site (at arrow) on 7 April 2024, facing west**

**Figure 3: View of cliff face and rock platform seaward of site (approximately between arrows) on 4 January 2024, facing west**

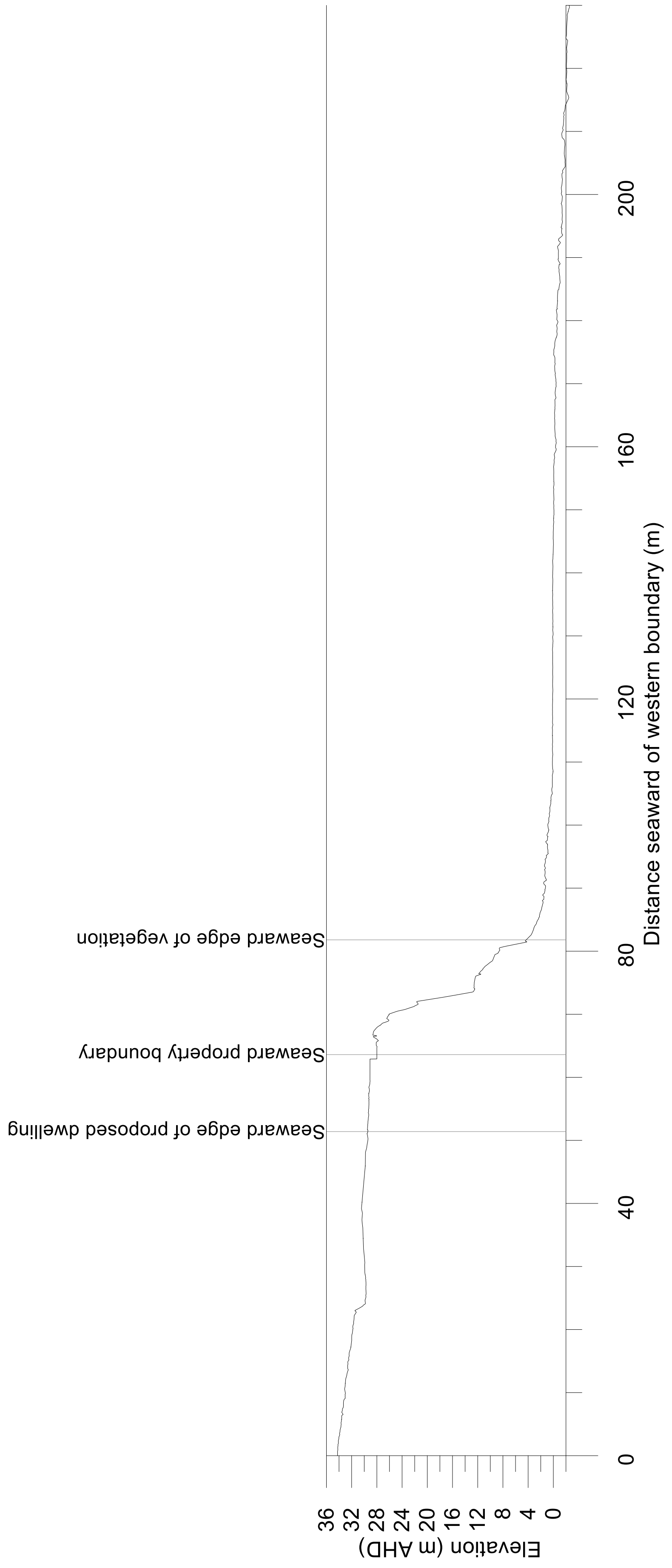


**Figure 4: Section A through site and adjacent cliff and down to rock platform and offshore**

# 4. PROPOSED DEVELOPMENT

It is proposed to undertake alterations and additions to the dwelling at the site over two levels, retaining existing ground floor levels of around 30m AHD.

# 5. MECHANISMS FOR CLIFF EROSION

## 5.1 Preamble

Erosion of sheer cliffs can occur in two forms (Public Works Department, 1985), either:

- a slow, relatively gradual attrition of cliff material due to the effects of weathering; or
- relatively infrequent but sudden collapse of large portions of cliff face, due to undercutting, wave impact forces, changed groundwater conditions, rock shattering or increased loadings related to construction, and other processes.

Weathering may induce undercutting and toppling failure of overhanging blocks if the rate of weathering is highest near the base of the cliff or at other levels below the top of the cliff. Overhangs are currently evident in the cliff face, as visible in Figure 3. Erosion of steep slopes tends to occur suddenly in association with heavy rainfall or changes to drainage patterns, slope undercutting, and increases in load on the slope.

## 5.2 Weathering and Erosion

Both chemical and mechanical weathering can reduce the strength of cliff material (Sunamura, 1983). Chemical weathering includes hydration and solution, caused by the interaction between cliff material and sea water. Mechanical weathering comprises:

- the wetting and drying process in the intertidal zone;
- generation of repeated stresses in cliff material by periodic wave action (particularly waves that break on the cliff); and
- frost effects in cold latitudes.

Mechanical weathering can also be caused by wind.

Historical rates of recession for softer beds of Sydney coastline sandstone cliffs, which include chemical and mechanical weathering, have been determined to be 2mm to 5mm per year by Dragovich (2000). This is consistent with average rates of recession for Sydney Northern Beaches coastline sandstone cliffs of 4mm per year determined by Crozier and Braybrooke (1992).

The width of the rock platform from the toe of the cliff is about 80m, as observed in aerial photography. This apparent approximate 80m of cliff recession seaward of the site over the last 6,400 years (since sea levels stabilised around their present levels, and assuming that the cliff was at the seaward edge of the rock platform at that time) represents an average recession rate of 13mm/year, consistent with maximum rates of recession for Sydney Northern Beaches coastline sandstone cliffs of 12mm/year as determined by Crozier and Braybrooke (1992).

The lower portion of the cliff below about 8m AHD (increasing to around 9m AHD in 100 years if projected sea level rise is realised) is subject to occasional wave action (runup), especially during coastal storms with large waves and elevated water levels.

Given this, it should be assumed that both chemical and mechanical weathering would apply over the lower portion of the cliff. A recession/weathering rate of 13mm per year is considered to be appropriate over the lower portion, with sensitivity testing for a rate of 20mm/year as a conservative 1.5 multiple rate increase to account for future sea level rise[1]. These rates should be considered and assessed by the geotechnical engineer. The rates are considered to be reasonable to apply over a design life of 100 years, including allowance for projected sea level rise[2].

It is recognised that the upper cliff at the site is not subject to wave action and may be subject to a lower recession rate than 13 to 20mm/year, but to be conservative these rates can be applied over the entire cliff face. The geotechnical engineer should consider these rates in conjunction with an understanding of the particular nature of the cliff materials at the site, their resistance to erosion/recession, and potential failure planes related to geotechnical issues such as the joint spacing[3]. With the cliff toe located about 15m seaward of the top of the cliff east of the site, coastal processes are unlikely to have any influence on the recession of the upper cliff over a 100 year design life.

This should be confirmed by the geotechnical engineer, but it is expected that the recession/weathering described above would lead to undercutting and collapse of blocks on the central and upper cliff face over the long term, with failure planes at the joints. That stated, any future failure of the upper slope of the cliff and in the vicinity of the proposed development may be unrelated to coastal processes at the base of the cliff, so other failure mechanisms should be considered by the geotechnical engineer.

## 6. COASTAL INUNDATION

With the top of the cliff at 25.9m AHD, coastal inundation is not a significant risk for the proposed development over a planning period of well over 100 years, including consideration of projected sea level rise.

## 7. MERIT ASSESSMENT

### 7.1 Preamble

The merit assessment herein has been undertaken assuming that the geotechnical engineer finds that the proposed development is at an acceptably low risk of damage from coastal erosion/recession of the cliff seaward of the site, and other processes, for a design life of at least 100 years[4]. The assessment set out below is reliant on this being the case, so this assumption must be confirmed by the geotechnical engineer.

[1] There are no established methods to estimate increased recession rates of cliff lines due to sea level rise, but a 1.5 factor on historical rates is considered to be particularly conservative. In the 2011 *Wyong Coastal Zone Management Plan* (CZMP) and 2017 draft Wyong CZMP, a factor of 1.2 was used to 2100.
[2] Note that this does not mean that the cliff toe is predicted to recede at a steady rate of 13 to 20mm/year. In reality, there are likely to be slower rates of weathering over decades or centuries until a significant undercut occurs that detaches a block above, which leads to a sudden loss of an extent of cliff face much larger than the order of 10 to 20mm. However, averaging this slower weathering and block failures over the long term, an average rate of 13mm to 20mm/year (which can also be stated as 1.3m to 2.0m per 100 years) at the cliff toe is expected.
[3] Coffey & Partners (1987) noted that the controlling feature of interbedded sandstone/siltstone cliffs was the bedding spacing and relative proportion of sandstone/siltstone.
[4] At a location with underlying bedrock such as the site, it is the responsibility of the geotechnical engineer, not the coastal engineer, to determine the risk to the development.

  

## 7.2 *State Environmental Planning Policy (Resilience and Hazards) 2021*

### *7.2.1 Preamble*

Based on *State Environmental Planning Policy (Resilience and Hazards) 2021* (SEPP Resilience)[5] and its associated mapping, the site is within a "Coastal Use" area (see Section 7.2.2).

### *7.2.2 Clause 2.11*

Based on Clause 2.11(1) of SEPP Resilience, "development consent must not be granted to development on land that is within the coastal use area unless the consent authority:

(a) has considered whether the proposed development is likely to cause an adverse impact on the following:
  (i) existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
  (ii) overshadowing, wind funnelling and the loss of views from public places to foreshores,
  (iii) the visual amenity and scenic qualities of the coast, including coastal headlands,
  (iv) Aboriginal cultural heritage, practices and places,
  (v) cultural and built environment heritage, and
(b) is satisfied that:
  (i) the development is designed, sited and will be managed to avoid an adverse impact referred to in paragraph (a), or
  (ii) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or
  (iii) if that impact cannot be minimised—the development will be managed to mitigate that impact, and
(c) has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development".

With regard to Clause (a)(i), the proposed development is entirely on private property and will not affect public foreshore, beach, headland or rock platform access.

Clauses (a)(ii) and a(iii) are not coastal engineering matters so are not considered herein.

With regard to (a)(iv), a search of the Heritage NSW "Aboriginal Heritage Information Management System" (AHIMS) was undertaken on 4 December 2023. This resulted in no Aboriginal sites nor Aboriginal places being recorded or declared within at least 50m of the site.

With regard to (a)(v), the nearest environmental heritage items to the site listed in Schedule 5 of *Pittwater Local Environmental Plan 2014* are the 'Fink' house at 153 Queens Parade East Newport (located about 130m north of the site) and 'Bungania' house at 77 Myola Road Newport (located about 170m SW of the site). The proposed development would not be expected to impact on these or more distant heritage items.

With regard to (b), the proposed development has been designed and sited to avoid any potential adverse impacts referred to in Clause 2.11(1) for the matters considered herein. Clause (c) is not a coastal engineering matter so is not considered herein.

[5] Formerly *State Environmental Planning Policy (Coastal Management) 2018*.

  

#### *7.2.3 Clause 2.12*

Based on Clause 2.12 of SEPP Resilience, "development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land".

Assuming that the geotechnical engineer will find that the proposed development is at an acceptably low risk of damage from erosion/recession over a 100 year design life, and given that the proposed development is well above and landward of projected wave runup over 100 years, the proposed development would not even be expected to interact with coastal processes over its design life, let alone affect any other land. That is, the proposed development is unlikely to cause increased risk of coastal hazards on that land or other land over its design life.

#### *7.2.4 Clause 2.13*

Based on Clause 2.13 of SEPP Resilience, "development consent must not be granted to development on land within the coastal zone unless the consent authority has taken into consideration the relevant provisions of any certified coastal management program that applies to the land".

No certified coastal management program applies at the site.

#### *7.2.5 Synthesis*

The proposed development satisfies the requirements of *State Environmental Planning Policy (Resilience and Hazards) 2021* for the matters considered herein.

### 7.3 *Coastal Management Act 2016*

The management objectives for the "coastal use" coastal management area are described in Section 9 of the *Coastal Management Act 2016*. By addressing Clause 2.11 of SEPP Resilience in Section 7.2.2 herein, these management objectives have essentially been addressed. There are no other matters relevant to the subject DA that need to be considered in the *Coastal Management Act 2016*.

### 7.4 *Pittwater Local Environmental Plan 2014*

#### *7.4.1 Clause 7.5*

Clause 7.5 of *Pittwater Local Environmental Plan 2014* (LEP 2014) applies at the site, as the site is identified as "Bluff/Cliff Instability" on the Coastal Risk Planning Map Sheet CHZ_017. Based on Clause 7.5(3) of LEP 2014, "development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:

(a) is not likely to cause detrimental increases in coastal risks to other development or properties, and
(b) is not likely to alter coastal processes and the impacts of coastal hazards to the detriment of the environment, and
(c) incorporates appropriate measures to manage risk to life from coastal risks, and

(d) is likely to avoid or minimise adverse effects from the impact of coastal processes and the exposure to coastal hazards, particularly if the development is located seaward of the immediate hazard line, and
(e) provides for the relocation, modification or removal of the development to adapt to the impact of coastal processes and coastal hazards, and
(f) has regard to the impacts of sea level rise, and
(g) will have an acceptable level of risk to both property and life, in relation to all identifiable coastline hazards".

With regard to (a) and (b), the proposed development would not increase coastal risks nor alter coastal processes and the impacts of coastal hazards, as it would not affect the wave impact process at the toe of the cliff.

Items (c), (d) and (g) are for the geotechnical engineer to assess, with consideration of the findings herein. Assuming that they find that the proposed development is at an acceptably low risk of damage over a 100 year planning period with appropriate measures incorporated in design and construction, (c), (d) and (g) have been met. On this basis, (e) should not be necessary, noting that this would be more applicable in a sandy beach environment. With regard to (f), sea level rise has been considered herein.

#### *7.4.2 Clause 7.8*

Clause 7.8 of LEP 2014 is not applicable to the proposed development, as the proposed works are landward of the Foreshore Building Line (landward of the Foreshore Area) at the site.

### 7.5 *Pittwater 21 DCP*

Based on Chapter B3.4 of the DCP, "development must not adversely affect or be adversely affected by geotechnical and coastal processes nor must it increase the level of risk for any people, assets and infrastructure in the vicinity due to geotechnical and coastal processes".

As noted in Section 7.2.3, the proposed development is not expected to increase the level of risk for any people, assets and infrastructure in the vicinity due to coastal processes. This item is satisfied if the geotechnical engineer confirms that the proposed development is at an acceptably low risk if being affected by geotechnical and coastal processes, and unlikely to increase the level of risk for any people, assets and infrastructure in the vicinity due to geotechnical processes.

## 8. FORM

A completed *Geotechnical Risk Management Policy for Pittwater* Form No. 1 is attached at the end of the document herein. Note that the declaration on Form No. 1 is not appropriate for a coastal report, with the revised declaration below:

> "I am aware that the above Coastal Report, prepared for the abovementioned site is to be submitted to assist with a geotechnical investigation for a Development Application for this site, with that geotechnical investigation relied on by Northern Beaches Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed. No declaration can be made on the geotechnical investigation as this has not been prepared nor reviewed by me, and nor do I have geotechnical engineering expertise".

## 9. CONCLUSIONS

An allowance for erosion/weathering of 13mm/year of the lower portion of the cliff seaward of 77 Bungan Head Road Newport (also known as 6a Lovering Place Newport), with sensitivity testing up to 20mm/year, should be considered and assessed by the geotechnical engineer. To be conservative, these rates can be applied over the entire cliff face. The geotechnical engineer should consider these rates in conjunction with an understanding of the particular nature of the cliff materials at the site, their resistance to erosion/recession, and potential failure planes related to geotechnical issues such as the joint spacing. With the cliff toe located about 15m seaward of the top of the cliff east of the site, coastal processes are unlikely to have any influence on the recession of the upper cliff over a 100 year design life.

This should be confirmed by the geotechnical engineer, but it is expected that the recession/weathering described above would lead to undercutting and collapse of blocks on the central and upper cliff face over the long term, with failure planes at the joints. Other failure mechanisms should also be considered by the geotechnical engineer.

Coastal inundation is not a significant risk for the proposed development over a planning period of well over 100 years. Given this, and assuming that the geotechnical engineer will find that the development is at an acceptably low risk of damage from erosion/recession over a 100 year design life, the proposed development satisfies the requirements of *State Environmental Planning Policy (Resilience and Hazards) 2021* (Clauses 2.11 to 2.13), the *Coastal Management Act 2016*, Clause 7.5 of *Pittwater Local Environmental Plan 2014*, and Chapter B.4 of the *Pittwater 21 DCP* for the matters considered herein.

## 10. REFERENCES

Coffey & Partners (1987), "Coastal Management Study, Assessment of Bluff Areas", *Report No. S8002/1-AA*, March, for Warringah Shire Council

Crozier, PJ and JC Braybrooke (1992), "The morphology of Northern Sydney's rocky headlands, their rates and styles of regression and implications for coastal development", *26th Newcastle Symposium on Advances in the Study of the Sydney Basin*, University of Newcastle

Dragovich, Deirdre (2000), "Weathering Mechanisms and Rates of Decay of Sydney Dimension Sandstone", pp. 74-82 in *Sandstone City, Sydney's Dimension Stone and Other Sandstone Geomaterials*, edited by GH McNally and BJ Franklin, Environmental, Engineering and Hydrogeology Specialist Group (EEHSG), Geological Society of Australia, Monograph No. 5

Public Works Department (1985), "Coastal Management Strategy, Warringah Shire, Report to Working Party", *PWD Report 85016*, June, prepared by AD Gordon, JG Hoffman and MT Kelly, for Warringah Shire Council

Sunamura, Tsuguo (1983), "Processes of Sea Cliff and Platform Erosion", Chapter 12 in *CRC Handbook of Coastal Processes and Erosion*, editor Paul D Komar, CRC Press Inc, Boca Raton, Florida, ISBN 0-8493-0208-0

## 11. SALUTATION

If you have any further queries, please do not hesitate to contact Peter Horton via email at peter@hortoncoastal.com.au or via mobile on 0407 012 538.

  

Yours faithfully
HORTON COASTAL ENGINEERING PTY LTD

Peter Horton
Director and Principal Coastal Engineer

This report has been prepared by Horton Coastal Engineering on behalf of and for the exclusive use of Life Property Group (the client) and is subject to and issued in accordance with an agreement between the client and Horton Coastal Engineering. Horton Coastal Engineering accepts no liability or responsibility whatsoever for the report in respect of any use of or reliance upon it by any third party. Copying this report without the permission of the client or Horton Coastal Engineering is not permitted.

*Geotechnical Risk Management Policy for Pittwater Form No. 1 is attached overleaf*

## GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER

### FORM NO. 1 – To be submitted with Development Application

**Development Application for** Life Property Group
Name of Applicant
**Address of site** 77 Bungan Head Road Newport

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

*I,* Peter Horton *on behalf of* Horton Coastal Engineering Pty Ltd
(Insert Name) (Trading or Company Name)

on this the 18 November 2024 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 $2million.

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

Coastal ~~**Geotechnical**~~ **Report Details:**

| | |
|---|---|
| Report Title: | Coastal Engineering Advice on 77 Bungan Head Road Newport |
| Report Date: | 18 November 2024 |
| Author: | Peter Horton |
| Author's Company/Organisation: | Horton Coastal Engineering Pty Ltd |

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

| |
|---|
| See Section 2 and Section 10 of coastal report |
| |
| |

~~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 [signature] ………………… See revised declaration in Section 8 of report

Name Peter Horton

Chartered Professional Status MIEAust CPEng NER

Membership No. 452980

Company Horton Coastal Engineering Pty Ltd

# Appendix F

Geotechnical Forms 1 & 1A
Northern Beaches Council – Pittwater LEP

# GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER

## FORM NO. 1 – To be submitted with Development Application

**Development Application for** ______________________________
Name of Applicant

**Address of site** 77 Bungan Head, Road, Newport NSW

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

I, Ben Morgan *on behalf of* AscentGeo Geotechnical Consulting
(insert name) (Trading or Company Name)

on this the 26.11.2024 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 $2 million.

**Please mark appropriate box**

- ☐ 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
- ☒ I 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 paragraph 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy from 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 am of the opinion that the Development Application only involves Minor Development/Alterations that do not require a Detailed Geotechnical Risk Assessment and hence my report is in accordance with the Geotechnical Risk Management Policy for Pittwater – 2009 requirements for Minor Development/Alterations.
- ☐ Have examined the site and the proposed development/alteration is separate form and 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
- ☐ Provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

**Geotechnical Report Details:**

Report Title: Geotechnical Assessment Report for alterations and additions at 77 Bungan Head Road, Newport (AG 23793)

Report Date: 26 November 2024

Author: Cameron Young

Author's Company/Organisation: AscentGeo Geotechnical Consulting

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

Architectural design plans prepared by Space Design Architecture, project number 017-026, drawing numbers DA000-002, 100-102, 200, 201, 300, 400, 401, 500, 501, issue 11 dated 20/11/24.

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 Northern Beaches 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 Ben Morgan

Chartered Professional Status MAIG RPGeo (Geotechnical & Engineering)

Membership No. 10269

Company AscentGeo Geotechnical Consulting

## 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 77 Bungan Head Road, Newport NSW |

*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: Geotechnical Assessment Report for alterations and additions at 77 Bungan Head Road, Newport (AG23793) |
| Report Date: 26 November 2024 |
| Author: Cameron Young |
| Author's Company/Organisation: AscentGeo Geotechnical Consulting |

**Please mark appropriate box**

☒ Comprehensive site mapping conducted 30.11.23
(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 30.11.23

☒ 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 | Ben Morgan |
| Chartered Professional Status | MAIG RPGeo (Geotechnical & Engineering) |
| Membership No. | 10269 |
| Company | AscentGeo Geotechnical Consulting |

REGISTERED PROFESSIONAL GEOSCIENTIST
AUSTRALIAN INSTITUTE OF GEOSCIENTISTS
BENJAMIN J. MORGAN
RPGeo No: 10269