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Our Reference: 19/10758

Rohani Investments
c/- Macphail & Sproul Architects
Studio 4.1/105 Kippax St.
Surry Hills NSW 2010

Attention: **John Macphail**

Dear Sirs

Geotechnical & Landslip Assessment - Revised
242 Warringah Road, Beacon Hill
Lot 10 in DP 6854

1) Introduction

This report presents a geotechnical and landslip assessment of the conditions that are likely to be encountered during the construction of a proposed new building at No. 242 Warringah Road, Beacon Hill.

No detailed subsurface investigation has been undertaken. The following comments are based on observations made both on-site and in the local vicinity as well as our experience with similar geotechnical environments. This current assessment has been prepared on the understanding that the proposed excavation works will need to be inspected by an experienced geotechnical engineer.

Approval for preparation of this assessment was given by Mr. John Macphail of Macphail & Sproul Architects, who are the architects for the project. This report has been revised to account for the correct location of the proposed sub-basement.

2) Topographical Conditions & Present Development

The site presently comprises a single occupancy residential property at No. 242 Warringah Road, Beacon Hill.

It is located part way up the western slopes above Dee Why. The property is on the northern down hill side of Warringah Road, at the north eastern corner of the intersection with Ellis Road. It is situated some 2 km west of Dee Why Beach and 2.5 km north of Manly Dam.

The existing development comprises a two storey residence situated close to the centre of the property. The building is of timber and brick construction with sandstone block foundations. No obvious significant distress was observed in the external walls of this building during our inspection.

There is a separate small dwelling/granny flat at the south eastern corner of the house. The remaining areas are gardens or paved with some occasional trees.

Adjacent development includes a two weatherboard house on the lot to the east and a two storey brick home to the north. These structures extend to within some 1.5 m of the northern and eastern boundaries.

The lot is approximately rectangular shaped with plan dimensions of about 13 m x 57 m. The block slopes gently down to the north. There is an overall fall of less than 7 m, with an average slope of under 8^{o}.

2) Proposed Works

We understand that it is proposed to build a new multi occupancy residence on this property. The works will entail three stories that include a sub-basement with car parking, laundry and garden room. This will extend under the vast majority of the new building.

The proposed works will require excavation to a maximum depth of less than 4 m.

At its closest point the deepest part of the excavation will be some 4.3 m from the nearest building, on the adjacent property (to the east, No. 240 Warringah Road).

A number of retaining walls will be required as part of the new works.

4) Geotechnical Conditions

Reference to the Sydney geological series sheet, at a scale of 1:100,000, indicates that the site is underlain by the Triassic Age Hawkesbury Sandstone contained within the Wianamatta Group. Rocks within this formation comprise fine to medium grained quartz sandstone. The landform in this area is typical of that found in the Hawkesbury sandstone environment, with rock at shallow depth, some steep cliff faces and rock exposed in numerous locations.

All available evidence suggests that the site is underlain by Hawkesbury Sandstone at shallow depth. There is competent rock (Hawkesbury Sandstone) exposed in the existing shallow excavation along the western boundary. Also there are significant insitu rock outcrops exposed on the other side of Warringah Road. We consider that sandstone is likely to be encountered at similar depths over a lot of the new construction area.

It is likely that that the existing building is founded on rock. There is rock exposed in various places in the local vicinity. The houses on the adjacent lots may be founded on rock.

We have observed natural cliff faces and man made cuts in the general vicinity of significant height that have stood nearly vertical with no apparent signs of instability. In some places there has been minor undercutting of the face along relatively soft shaley layers, in other locations occasional individual blocks have become dislodged along the bedding and subvertical joint planes.

The rock exposures in the area are inferred to be insitu undisturbed Hawkesbury Sandstone.

In summary, the evidence indicates that the existing house on No. 242 and possibly the adjacent buildings appears to bear on this insitu Hawkesbury Sandstone.

5) Comments on the Geotechnical Aspects of the Proposed Development

The following comments are based on the assumption that the geotechnical conditions typically found in this part of Beacon Hill are representative of the subsurface conditions at this site. It is important to note that at this time no boreholes have been drilled though insitu rock was observed at a number of locations. When making an assessment of the subsurface conditions across a site from limited information it should be recognized that unforeseen variations may occur. The data derived from our observations and experience in the area have been extrapolated across the site to form a geotechnical model and then an engineering opinion is provided about overall subsurface conditions and their likely behaviour with the proposed development. The actual conditions may differ from those inferred herein, especially below an existing building where there has been previous excavation work. No observation, experience or even a very detailed subsurface exploration program, no mater how comprehensive, can reveal all the subsurface details and anomalies.

5.1) Landslip Assessment

This landslip assessment has been prepared in accordance with the Northern Beaches Council 2011 LEP Planning Rules, Section E-10 Landslip Risk.

The property is partly in Risk Class Zone A (slopes < 5^0) and partly in Zone B (slopes 5^0 to 25^0). The average slope on this site is 8^0.

Using the Council flow chart check list (Section E-10) we note:

History of Landslip	- No/Unknown
Proposed Excavation > 2m	- Yes
Proposed Fill > 2m	- No
Site Developed	- Yes
Existing Fill > 1 m	- No
Existing Excavation > 2m	- No
Natural Cliff > 3 m	- No

There are no obvious signs of slope instability in the immediate vicinity of the site. The slopes on, immediately above and below the site are gentle. It is considered that a detailed Landslip Risk Assessment is not required and that it is unlikely that the reported proposed new works will increase the risk of instability for this site assuming the recommendations made in this report are followed.

5.2) *Excavation*

It is expected that the excavation will encounter medium strong sandstone at shallow depth, typically at less than 1 m though in some places immediately below the topsoil or existing pavements.

Typically the Hawkesbury Sandstone's are horizontally bedded with subvertical joints. This type of profile can be observed in many places in Sydney where Hawkesbury Sandstone is exposed.

Removal of the majority of the rock would normally require the use of rock excavation equipment such as rock breakers. Based on our experience it is unlikely that small excavators alone without assistance will be able to remove any significant amount of the rock. Hydraulic breakers mounted on an excavator or hand operated jack hammers are often required to break up the majority of the rock before it can be removed using an excavator.

Care will be required to ensure that both the adjacent roadways and the immediately adjacent structures are not damaged when excavating the rock. Particular care will need to be taken when excavating along the northern and eastern boundaries so as not to cause any uncontrolled local instability. As previously mentioned the adjacent houses are likely to be founded on rock. Buildings bearing on rock can be highly susceptible to damage from vibrations when rock excavations are made in the immediate vicinity.

It is extremely difficult to definitively predict the effect of the above type of excavation on adjacent buildings and structures. There are various relations available that have been used to carry out such predictions, but these do not easily take account of the natural variability of rock such as Hawkesbury Sandstone. There have been many cases in Sydney where predictions based on experience or the above relationships have been proved inaccurate, and adjacent structures have been damaged. For these reasons the following comments should only be taken as a guide, particular care must be exercised when removing the rock. It is worth noting that excavation contractors often claim that they can safely excavate very close to buildings in Sydney.

Excavation methods should be adopted which limit ground vibrations at the adjoining developments to not more than 10 mm/sec. Vibration monitoring will be required to verify that this is achieved. However, if the contractor adopts methods and/or equipment in accordance with the recommendations in Table 1 for a ground vibration (Peak Particle Velocity) limit of 5 mm/sec, vibration monitoring may not be required.

The limits of 5 mm/sec and 10 mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in Table 1:

TABLE 1

RECOMMENDATIONS FOR ROCK BREAKING EQUIPMENT

Distance from adjoining structure (m)	Maximum Peak Particle Velocity 5 mm/sec		Maximum Peak Particle Velocity 10 mm/sec*	
	Equipment	Operating Limit (% of Maximum Capacity)	Equipment	Operating Limit (% of Maximum Capacity)
1.5 to 2.5	Hand operated jackhammer only	100	300 kg rock hammer	50
2.5 to 5.0	300 kg rock hammer	50	300 kg rock hammer or 600 kg rock hammer	100 50

NOTE: * Vibration monitoring is recommended for 10 mm/sec vibration limit.

At all times, the excavation equipment must be operated by experienced personnel, according to the manufacturer's instructions and in a manner consistent with minimising vibration effects.

Use of other techniques (such as rock sawing), although less productive, will reduce or possibly eliminate risks of damage to property through vibration effects transmitted via the ground.

If rock sawing is carried out around excavation boundaries for the full depth of the excavation, in not less than say 1 metre deep lifts, a small rock hammer could be used at up to 50% maximum operating capacity with an assessed peak particle velocity not exceeding 5 m/sec. Importantly this is subject to observation and confirmation by a vibration specialist or geotechnical engineer at the commencement of excavation.

We recommend for this project that saw cutting is carried out, at a very minimum around the perimeter of the excavation before any rock breaking is commenced even when using small rock breakers. As already mentioned care will be required when removing any detached blocks if encountered, so as not to dislodge either the block behind or above, or undermine the more competent rock in the area.

It should be noted that vibrations that are below threshold levels for building damage may be experienced at adjoining developments.

5.2) *Excavation Support*

Based on our experience and the condition of the present rock exposures in the immediate area it is likely that a large proportion of the excavation in rock should remain stable unsupported, at least in the short term. Until the new excavation is commenced and the actual conditions are exposed it is not practical to be more definitive. There is the possibility that a low height retaining wall could need to be constructed at the top of the excavation to support any shallow soil strength materials above the underlying rock.

It is important that the adjacent roadways and houses to the side are supported both during the excavation process and in the long term. The proposed excavation must not be allowed to remove

support for the faces. This is especially true for the development to the east which will be close to the shallow end of the excavation.

It is recommended that an experienced geotechnical engineer or engineering geologist observes the excavation as it progresses. At that time he will be able to recommend any support that is required for either temporary or permanent conditions and help to finalise the design of the final cut slopes and any retaining walls/support that may be required.

As noted above experience has demonstrated that near vertical cuts in the sandstone found in this area will normally remain stable for long lengths of time. An allowance should be made for the installation of some passive grouted dowels in conjunction with possibly shotcrete. Without any other information it may be appropriate to assume that up to say 20% of the face will need support. If it is necessary to provide dowels or anchors for support, depending on their location these could extend below the neighboring properties if they are required along the sides of the property. Also if shaley seams are encountered they will need to be protected from long term undercutting using shotcrete and pins or infill concrete cut into the face. An allowance for the equivalent of say two seams, each possibly 200 mm thick, extending around say the perimeter of the new excavation may be appropriate. Even with the above support there is always the chance that some small blocks which are not identified during excavation will become dislodged later with time. If the exposed conditions warrant it then an alternative may be to use the proposed new structure in front of the new face to provide permanent support.

Retaining walls supporting any significant depth of soil can be designed assuming an earth pressure coefficient of 0.4 in the soil strength materials and a nominal pressure 10 kPa in rock of medium strength or greater. If stiff retaining walls are used which can not move they should be designed for an At Rest earth pressure of 0.55 in soil strength materials. A soil density of 20 kN/m^3 is recommended. Adequate allowance must also be made for water pressures if appropriate drainage is not included, and also for the loading affects from adjacent buildings or sloping ground. All new retaining walls should be designed by an engineer and must found on rock.

5.3) *Hydrology/Groundwater*

If groundwater is encountered in the excavation it is likely to be observed at close to the soil/rock interface, at this site along the top of the rock. It is considered unlikely that the proposed works will have any obvious affect on the local hydrogeological conditions. The adjacent buildings are likely to bear on the underlying sandstone and thus any unlikely short term minor change in ground water level should have little observable affect on these structures. There was no obvious seepage observed in the shallow rock face on the western boundary at this site in June 2018 or October 2019.

If significant water inflows are observed during excavation then advice should be sought from an experienced geotechnical engineer.

It will be necessary to install drainage in the sub-basement area that flows to the local stormwater system. If this is not practical then some form of sump and pump may be necessary.

5.4) *Foundations*

The site has been classified in accordance with the guidelines set out in the "Residential Slabs and Footings", AS2870-1996. Based on the expected subsurface conditions the site is classified as Stable Non Reactive (A) provided the foundations bear on the insitu sandstone.

All new foundations should be founded on rock.

Strip or pad footings bearing on the insitu sandstone can be proportioned assuming a maximum allowable bearing pressure of 1 MPa. This again should be verified by an engineer once the actual conditions are exposed.

FINAL COMMENT

It is concluded that a detailed slope stability/slip assessment is not required for this site.

As already noted above this geotechnical assessment has been provided on the basis that the excavation will be inspected during the works to ensure that appropriate measures are taken as the actual subsurface conditions become apparent. To date no detailed subsurface investigations have been undertaken.

Given the above comments it is considered that:

a. The insitu Hawkesbury sandstone at this site is capable of withstanding the proposed loading from the new works

b. The insitu rock is capable of withstanding the proposed excavation, though some support may be necessary depending on the final conditions exposed

c. If the recommendations made in this report are followed then adequate protection and support will be provided for adjacent properties

d. As noted above it may be necessary to install drainage inside the new store room to control potential long term seepage

e. There are no obvious signs of instability/landslip on the site.

The attached *Notes Relating To Geotechnical Report* are an intrinsic part of this report.

We do note that we have assumed in our costing for this investigation that you, the client, will contact us by phone on a number of occasions to discuss the proposed works, especially in regards to the findings presented in this report.

Please do not hesitate to contact the writer if you would like to discuss this report.

Yours Sincerely

Michael A Adler BSc, BE, MSc, DIC, MIEAust, CPEng

NOTES RELATING TO GEOTECHNICAL REPORTS
Michael Adler & Associates

Introduction

These notes outline some of the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

When copies of reports are made, they should be reproduced in full.

Geotechnical Reports

Geotechnical reports are prepared by qualified personnel using information supplied or obtained. They are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work often supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (e.g.. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (e.g.. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by Michael Adler & Associates in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for all situations such as:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.
- Interpretation by others of this report.

If these occur, Michael Adler & Associates would be pleased to resolve the matter through further investigation, analysis or advice.

Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, Michael Adler & Associates should be notified immediately. Early identification of site anomalies generally results in most problems being more readily resolved, and allows reinterpretation and assessment of the implications for future work.

Subsurface Information

Logs of a borehole, rock core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacing and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of the available subsurface information and application to design/ construction should take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements not based on specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures such as rock coring or penetration testing mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Supply of Geotechnical Information For Tendering Purposes

It is recommended that tenderers are provided with as much geological and geotechnical information as there is available. It is best practice to provide copies of all geotechnical related reports, opinions and data.

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