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REPORT ON GEOTECHNICAL ASSESSMENT FOR APPROVED ALTERATIONS AND ADDITIONS 82 BOWER STREET, MANLY.

1. INTRODUCTION:

This report details the results of a geotechnical assessment in regard to approved alterations and additions to the existing house at No. 82 Bower Street, Manly.

The assessment and report were undertaken at the request Smith and Tzannes Architects on behalf of the owners John and Anna Lake. The assessment was undertaken to meet the requirements of Condition 5 of the Development Consent (DA2019/0126, Dated: 17th July 2019).

It is understood that the approved works involve extending the existing lower ground level of the house structure towards the south approximately 5.0m further than the existing floor plan. The works will involve an excavation of up to 2.50m depth that will extend to the common wall/boundary with No. 84 and will be located within 1.0m of the eastern side boundary with No. 80 and >10.0m from the southern street front side boundary.

The majority of the site, and the location of the approved works, is located within Landslip Risk Class 'G4' as identified within Northern Beaches (Manly) Councils – Development Control Plan 2013 – Schedule 1 Map C.

This report provides an assessment of the site conditions and the proposed development with recommendations for the design and construction to ensure geotechnical stability and good engineering practice. It also includes a risk assessment for potential instability as per the AGS March 2007 publication.

The following plans and diagrams were supplied for this assessment;

- Architectural Plans by Smith and Tzannes, Drawing No.: 15_117 DA-A-: 010, 100, 101, 102, 200, 201; Stage: DA Submission, Revision: B, Dated: 17/06/2019.

2. SITE DESCRIPTION AND GEOLOGY:

The site is located at mid-slope level, on the northern side of a south-east striking ridgeline with a natural north plunging drainage gully passing through the neighbouring properties to the west. The site contains an existing three level residential house on the northern half of the block that has a common wall with the house to the north (No. 84). The southern half of the block contains gently sloping lawns and gardens.

An aerial photograph of the site and its surrounds is provided below (Photograph 1), as sourced from NSW Government Six Map spatial data system.

Photograph 1: Aerial photo of site and surrounds

Reference to the Sydney 1: 100,000 Geological Series sheet (9130) indicates that the site is underlain by the Hawkesbury Sandstone and this geological unit was identified within the site and adjacent properties. Hawkesbury Sandstone which is of Triassic Age typically comprises medium to coarse grained quartz sandstone with minor lenses of shale and laminite. This unit weathers to produce thin sandy clay soils with geotechnical instability dominated by detachment of boulders along pre-existing defects due to natural cliff line regression or bulk excavation.

3. FIELDWORK:

Geotechnical inspection of the site and adjacent properties was undertaken by a Principal Engineering Geologist from Crozier Geotechnical Consultants on 3rd June and the 31st July 2019. Details of the fieldwork are given below together with comments relating to design and construction methods.

3.1.1. Field Observations:

At the time of inspection, the existing terrace house at No. 82 Bower Street was in a partial state of demolition and construction related to previously approved alterations and additions.

Inspection at existing lower ground floor level revealed sandstone bedrock exposed throughout the ground surface of the existing house and extending east to the boundary where the existing boundary brick walls are founded off the bedrock surface. A steep to subvertical slope of up to 2.50m in height is located at the southern end of the lower level, beyond where the existing development extended. This slope dips to the north, where there was evidence of minor rock excavation prior to the current phase of site works (i.e. related to the existing development), and also dips towards the west which appeared as a more natural slope covered in sandy fill soils down to the common wall with No. 84.

The slope exposed medium strength sandstone rock at the base which was overlain by an extremely low strength (clayey sand) unit of up to 0.40m thickness before another low to medium strength sandstone unit sits at the crest. The upper sandstone unit was detached along natural defects to the south and east resulting in large rectangular tablet of detached sandstone rock (i.e. boulder). Due to the orientation of defects and the scale of the rock this slope and detached rock are stable.

Inspection of the common wall to the residence at No. 84 was also undertaken during the initial inspection. This revealed a significant settlement crack at the southern portion that indicates downward rotation of the southern end with respect to the remainder of the wall. A trial investigation pit was subsequently undertaken and revealed that at least some portions of this part of the wall have no real footing with the base brick work founded off uncontrolled and loose sandy fill. As such this wall was recommended for remedial measures or replacement.

The neighbouring property to the east, No. 80 Bower St, contains a residential house development on the northern half with open gardens and trees located to the south including adjacent to the common boundary with the site, adjacent to the location of proposed works.

4. COMMENTS:

4.1. Geotechnical Assessment:

The inspections revealed medium strength sandstone bedrock outcropping and located below existing walls in the area of the proposed works. These outcrops extend east below the neighbouring property (No. 80) at shallow depth and are also located below the existing residence of No. 84, which is founded off this bedrock at lower ground floor level to the site residence. There were no signs of previous landslip instability within the site or adjacent properties with all structures appearing founded off medium strength sandstone bedrock.

Based on the supplied plans and the inspection results, the proposed excavation is relatively minor and will require the removal of detached boulders, weak sandy clay and fill soils along with low to medium strength sandstone bedrock.

There are no indicators that this excavation will have any adverse impact on adjacent structures or properties, with temporary and permanent batter slopes achievable within the site boundaries. The excavation would remove the detached and weak units of rock thus removing the potential for their future instability. Provided a small (≈150kg) rock hammer or rock saws and grinders are used the potential for damage to adjacent and neighbouring structures due to ground vibrations is also negligible.

Where medium strength bedrock is exposed in the excavation it will stand unsupported at near vertical slopes whilst any weathered seams/detached sections of rock can be supported by removal, underpinning or bolting, as determined on a case by case basis. It is therefore recommended that geotechnical inspection of the excavation occur directly prior to completion to allow assessment of long-term stability conditions and provision of any required support design. It is considered based on exposed conditions that any support systems will be limited in scale and will be located entirely within site boundaries with no impact to neighbouring properties.

The site inspections did not identify any signs of previous or impending landslip instability within the site or adjacent properties whilst the proposed works should not result in any instability provided the sensible excavation techniques are used and the recommendations for geotechnical inspection and support detailed in this report are followed.

4.2. Site Specific Risk Assessment:

Based on our site investigation we have identified the following credible/sensible geological/geotechnical hazards which need to be considered in relation to the existing site and the proposed works. These hazards are:

A. Landslip (rock slide/topple <2m) due to collapse of excavation perimeter due to natural defects and lack of suitable support systems;

A qualitative assessment of risk to property related to these hazards is presented in Table: 1 and 2, and is based on methods outlined in the Australian Geomechanics Society Guidelines for Landslide Risk Management 2007: Appendix C.

Hazard A was estimated to provide a **Risk to Life** of up to **1.30 x 10^{-9}** and **Risk to Property** of up to **'Very Low'** where unsuitable excavation methodologies are implemented as part of the excavation works.

The risk from instability is therefore within 'Acceptable' levels (AGS 2007), and will be reduced further where geotechnical inspection is undertaken during excavation and any support systems, if deemed necessary, are implemented in a timely manner.

4.3. Preliminary Design & Construction Recommendations:

4.3.1. New Footings:	
Site Classification as per AS2870 – 2011 for new footing design	Class 'A' for footings founded within bedrock
Type of Footing	Strip/Pad or Slab at base of excavation.
Sub-grade material and Maximum Allowable Bearing Capacity	- Weathered, LS bedrock: 1000kPa - Weathered, MS bedrock: 2000kPa*
Site sub-soil classification as per *Structural design actions AS1170.4 – 2007, Part 4: Earthquake actions in Australia*	B_e – Rock site
Remarks: All permanent structure footings should be founded off bedrock of similar strength to prevent differential settlement unless designed for by the structural engineer. All new footings must be inspected by an experienced geotechnical professional before concrete or steel are placed to verify their bearing capacity and the in-situ nature of the founding strata. This is mandatory to allow them to be 'certified' at the end of the project.	

4.3.2. Excavation:	
Depth of Excavation	Up to 2.5m depth at rear south-east corner, reduces to nil towards north and west
Distance of Excavation to Neighbouring Properties/Structures	No. 80 Bower St - Excavation 1.0m from boundary, garden at boundary, house structure >5m from excavation No. 84 Bower St – to boundary and existing common wall, however all structures founded at proposed excavation base. Bower St road reserve – excavation > 10m from boundary
Type of Material to be Excavated	Fill/Soil/ELS – to approximately 0.50m depth
	LS/MS bedrock – below soil/fill to base of excavation

Guidelines for unsurcharged batter slopes for general information are tabulated below:

Material	Safe Batter Slope (H:V)	
	Short Term/Temporary	Long Term/Permanent
Fill/Soil/ELS	1.50:1	2:1
VLS bedrock	1:1	1.50:1*
L-MS unfractured bedrock	Vertical*	Vertical*

Remarks:

* pending assessment by geotechnical engineer

Seepage through the sandy/clayey soils and at the bedrock surface can reduce the stability of batter slopes and invoke the need to implement additional support measures. Geotechnical inspection of batters will be required during site works to assess their stability, especially for permanent batters. Where safe batter slopes are not implemented the stability of the excavation cannot be guaranteed until the installation of permanent support measures. This should also be considered with respect to safe working conditions.

Equipment for Excavation	Natural soils	Excavator with Bucket
	VLS bedrock	Ripper and rock excavation equipment
	LS – MS/HS bedrock	Rock excavation equipment

ELS – extremely low strength, VLS – very low strength, LS – low strength, MS – medium strength

Recommended Vibration Limits (Maximum Peak Particle Velocity (PPV))	5mm/s for house at No. 80, 8mm/s at No. 84,
Vibration Calibration Tests Required	Only where >300kg rock hammer proposed for use
Full time vibration Monitoring Required	Dependent on vibration calibration tests
Geotechnical Inspection Requirement	Yes, recommended that these inspections be undertaken as per below mentioned sequence:

	• For assessment of batter slopes/excavation stability • Where unexpected ground conditions are identified or any other concerns are held. • Following footing excavations to confirm founding material strength
Dilapidation Surveys Requirement	Only where large (>300kg) rock hammers proposed for use
Remarks: Water ingress into exposed excavations can result in erosion and stability concerns in both sandy and clayey soils where unsupported. Drainage measures will need to be in place during excavation works to divert any surface flow away from the excavation crest and any batter slope, whilst any groundwater seepage must be controlled within the excavation and prevented from ponding or saturating slopes/batters.	

4.3.3. Retaining Structures:	
Required	New retaining structures may be required as part of the proposed development
Types	Steel reinforced concrete/concrete block walls post excavation. All walls designed in accordance with Australian Standards AS4678-2002 Earth Retaining Structures.

Parameters for calculating pressures acting on retaining walls for the materials likely to be retained:

Material	Unit Weight (kN/m3)	Long Term (Drained)	Earth Pressure Coefficients		Passive Earth Pressure Coefficient *
			Active (Ka)	At Rest (K_0)	
Fill	18	$\phi' = 29°$	0.35	0.52	N/A
ELS bedrock	22	$\phi' = 38°$	0.15	0.20	200 kPa
VLS to LS bedrock	23	$\phi' = 40°$	0.10	0.15	400 kPa

Remarks:

In suggesting these parameters, it is assumed that the retaining walls will be fully drained with suitable subsoil drains provided at the rear of the wall footings. If this is not done, then the walls should be designed to support full hydrostatic pressure in addition to pressures due to the soil backfill. It is suggested that the retaining walls should be back filled with free-draining granular material (preferably not recycled concrete) which is only lightly compacted in order to minimize horizontal stresses.

Retaining structures near site boundaries or existing structures should be designed with the use of at rest (K_0) earth pressure coefficients to reduce the risk of movement in the excavation support and resulting surface movement in adjoining areas. Backfilled retaining walls within the site, away from site boundaries or existing structures, that may deflect can utilize active earth pressure coefficients (Ka).

4.3.4. Drainage and Hydrogeology		
Groundwater Table or Seepage identified		No
Excavation likely to intersect	Water Table	No
	Seepage	Minor (<0.25L/min/m), at bedrock surface or along defects in the bedrock
Site Location and Topography		Low north side of the road, within gentle north-west dipping topography
Impact of development on local hydrogeology		Negligible
Remarks: As the excavation faces are expected to encounter seepage, an excavation trench should be installed at the base of excavation cuts to below floor slab levels to reduce the risk of resulting dampness issues. Trenches, as well as all new building gutters, down pipes and stormwater intercept trenches should be connected to a stormwater system designed by a Hydraulic Engineer.		

4.4. Conditions Relating to Design and Construction Monitoring:

To allow certification as part of construction, building and post-construction activity for this project, it will be necessary for Crozier Geotechnical Consultants to:

1. Review the structural design drawings, including the retaining structure design and construction methodology, for compliance with the recommendations of this report.
2. Conduct inspections as per Section 4.3 of this report.
3. Inspect all new footings to confirm compliance to design assumptions with respect to allowable bearing pressure and stability prior to the placement of steel or concrete.

The client and builder should make themselves familiar with the requirements spelled out in this report for inspections during the construction phase. Crozier Geotechnical Consultants cannot provide certification for the Occupation Certificate if it has not been called to site to undertake the required inspections.

5. CONCLUSION:

The site inspections revealed that the existing house within the site and No. 84 is dominantly founded off medium strength bedrock at the lower ground floor level of the existing site house. There were no signs of previous instability within the site or adjacent properties whilst eth proposed works are relatively minor and are not expected to result in any instability provided the recommendations of this report are implemented.

As such the proposed works are considered suitable for the site and the risk levels associated with the works can be maintained within 'Acceptable' levels for the design life of the development provided the recommendations of this report are implemented in full.

Prepared by:

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6. REFERENCES:

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5. Australian Standard AS 2870 – 2011, Residential Slabs and Footings
6. AS1170.4 – 2007, Part 4: Earthquake actions in Australia