



GEOTECHNIQUE[®] PTY LTD



Job No: 13801/2
Our Ref: 13801/2-AB
31 October 2016

ABN 64 002 841 063

Woolwich Pty Ltd
C/- Craig & Rhodes Pty Ltd
Suite 400, Level 4, 16-18 Cambridge Street
EPPING NSW 2132
Email: amorelli@crhodes.com.au

Attention: Mr A Morelli

Dear Sir

re: **Proposed Residential Subdivision
Lot 32 Section C in DP5464 – 41 Warriewood Road, Warriewood
Geotechnical Risk Assessment Report**

This report provides geotechnical risk assessment for the proposed residential subdivision at the above site. The work was approved by Mr B S Ibrahim on behalf of Woolwich Pty Ltd in a signed confirmation of engagement dated 28 October 2016, and was carried out in accordance with our email quote sent on 17 October 2016.

Proposed Development

From the information received, it is understood that the site is proposed to be subdivided into a number of lots with two internal roads totalling about 240m. Proposed Lorikeet Grove Road runs parallel to the existing Warriewood Road and connected by Road No 1 which runs through the middle of the site. Most of the residential lots are located north of the proposed Lorikeet Grove Road. Densely vegetated southern part of the site (south of Lorikeet Grove Road) is proposed for a number of community lots to be used for asset protection zone, riparian corridor, bio-retention basin and creek rehabilitation work. A geotechnical inspection was required to assess risk associated with the proposed development.

Background Information

Geotechnique Pty Ltd conducted a geotechnical investigation for the proposed residential development at the above site. A total of thirteen (13) test pits were excavated (in the accessible northern half of the site) to a depth of 2.5m to investigate subsurface conditions across the site. Based on the investigation, a geotechnical report was issued focusing on pavement design and bio-retention basin design (Our Ref: 13801/1-AA-R3 dated 19 October 2016).

Based on our previous investigation, the sub-surface profile is anticipated to comprise a sequence of topsoil / fill (200mm to 400mm thick), underlain by natural alluvial soils. Sandy soil was found at relatively shallow depths, whereas clayey soil was encountered deeper. Bedrock was not encountered to the termination depths of the test pits.

Groundwater/seepage was not observed in any of the test pits. It should be noted that the levels of groundwater/seepage might vary due to rainfall, temperature, and other factors not evident during test pit excavation.

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Lot 32 Section C in DP5464 – 41 Warriewood Road, Warriewood

Regional Geology

Based on the Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, Edition 1, 1983), published by the Department of Minerals Resources, Geological Survey of New South Wales, the subsurface materials across the site are anticipated to be stream alluvium and/or estuarine sand, comprising silty to peaty quartz sand, silt and clay, ferruginous and humic at places, with shell layers.

Reference to the Soil Landscape Map of Sydney (Soil Landscape Series Sheet 9130, Scale 1:100,000, Edition 2, 2002), prepared by the Department of Land and Water Conservation of NSW, indicates that the landscape at the site belongs to the Warriewood Group, which is characterised by level to gently undulating swales, depressions and in filled lagoons on Quaternary sand, with local relief of less than 10m, ground slopes of less than 3%, depth to water table of less than 2.0m. Soils in this group comprise sandy humus, sand and peat, with thickness exceeding 1.5m. This landscape has a high water table, and is subjected to flooding.

Site Conditions

The site is bound by Warriewood Road to the north, Narrabeen Creek to the south, and semi-rural properties to the east and west. Densely spaced residential houses can be found on the other side of the Warriewood Road. The site consisted of a brick house with tiled roof, a number of storage shades and a driveway. The northern half of the property is fenced into small areas for cattle farming, and the southern half is densely vegetated. The topography of the site generally slopes toward the creek at 4 to 5 degrees.

Field Inspection

Field inspection for the assessment was carried out on 25 October 2016 by a geotechnical engineer from this company and consisted of walkover survey along the creek. The proposed bio-retention basin and creek rehabilitation work was reviewed before the inspection.

Discussion and Recommendations

From the information received, we understand that the proposed bio-retention basin and asset protection zone (located south of Lorikeet Grove Road) requires removal of existing trees and bushes. The creek rehabilitation work includes cut and fill along the Narrabeen Creek. The riparian corridor is proposed with a design slope gradient varying between 1V:4H and 1V:8H towards the creek. The existing ground condition near the creek was found wet and soft.

Slope Stability Assessment

Site factors such as slope angles, thickness of insitu soils, strength of sub-surface materials, and concentrations of water generally govern the stability of a site. "Practice Note Guidelines for Landslide Risk Management" prepared by Australian Geomechanics Society (Reference 1) recommend that the landslide risk of a site is assessed on the basis of the likelihood of a landslide event and the consequences of that event. Applying the Australian Geomechanics Society guidelines, the site for the proposed development is assessed as follows:

- **Qualitative Measures of Likelihood** – For the existing site conditions, it is our assessment that an event of a slope failure (including soil, boulder and debris slide or flow) is "Rare", which means a slope failure might occur under exceptional circumstances over the design life, with an indicative annual probability of $\approx 10^{-5}$. The Geotechnical Risk Management Policy for Pittwater – 2009, also indicates that the site is located within Geotechnical Hazard Zone "H3" meaning that the likelihood of instability is "Rare" and might occur under exceptional circumstances over the design life.

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- **Qualitative Measures of Consequences to Property** – It is our assessment that the consequences of slope failure in the site to the property would be "Minor", resulting in limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.

Based on the above Qualitative Measures, the site for the proposed development work is assessed to have a "Very Low Risk" to the property. The definitions of the risk levels are provided in Reference 1 and an abstract is presented below.

Risk Level		Implication
VH	Very High Risk	Extensive detailed investigation and research, planning and implementation of treatment options, essential to reduce risk to acceptable levels; might be too expensive and not practical.
H	High Risk	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels.
M	Moderate Risk	Tolerable, provided treatment plan is implemented to maintain or reduce risks. Might be accepted. Might require investigation and planning of treatment options.
L	Low Risk	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	Very Low Risk	Acceptable. Manage by normal slope maintenance procedures.

The following is recommended to maintain the risk to "Very Low":

- Cut and fill slopes are minimised and all cut and fill slopes are battered appropriately or retained by engineered retaining walls founded in stable ground.
- Provide proper surface and sub-surface drainage to drain water away from the slope.
- All exposed slopes should be protected against erosion.

General

The assessment and recommendations presented in this report are based on site inspection and previous geotechnical investigation at the site. Considering both guidelines from Australian Geomechanics Society and Pittwater Council, we assess the site for the proposed development has a "Very Low Risk" to the property and acceptable during and after construction of the proposed development.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD



MD ARIFUL ISLAM
Senior Geotechnical Engineer

Reviewed By



INDRA JWORCHAN
Principal Geotechnical Engineer

Attached Forms 1A and 1B, Geotechnical Risk Management Policy for Pittwater

Reference

1. Australian Geomechanics Society Landslide Taskforce, Landslide Practice Note Working Group - "Practice Note Guidelines for Landslide Risk Management", March 2007.

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

Development Application for WOOLWICH PTY LTD
Name of Applicant
Address of site 41 WARRIEWOOD ROAD, WARRIEWOOD

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: 13801/2-AB: GEOTECHNICAL RISK ASSESSMENT
Report Date: 31 OCTOBER 2016
Author: DR MD ARIFUL ISLAM & INDRA JWORCHAN
Author's Company/Organisation: GEOTECHNIQUE PTY LTD

Please mark appropriate box

- Comprehensive site mapping conducted 25 OCTOBER 2016 (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 4 AUGUST 2016
- 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 [Handwritten Signature]
Name INDRA JWORCHAN
Chartered Professional Status CPENG
Membership No. 806995
Company GEOTECHNIQUE PTY LTD

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

Development Application for <u>WOOLWICH PTY LTD</u>	Name of Applicant
Address of site <u>41 WARRIEWOOD ROAD, WARRIEWOOD</u>	

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

I, INDRA JWORCHAN on behalf of GEOTECHNIQUE PTY LTD
 (Insert Name) (Trading or Company Name)

on this the 28 OCTOBER 2016 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

Geotechnical Report Details:

Report Title: <u>13801/2-AB: GEOTECHNICAL RISK ASSESSMENT</u>
Report Date: <u>31 OCTOBER 2016</u>
Author: <u>DR MD ARIFUL ISLAM & INDRA JWORCHAN</u>
Author's Company/Organisation: <u>GEOTECHNIQUE PTY LTD</u>

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

<u>AUSTRALIAN GEOMECHANICS SOCIETY GUIDELINE</u>
<u>PITTWATER COUNCIL GEOTECHNICAL RISK MANAGEMENT POLICY</u>
<u>DRAWING NO 063-ICC-DA-001 to 042 & 063-ICC-DA-101 to 113</u>

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]
 Name INDRA JWORCHAN
 Chartered Professional Status CPENG
 Membership No. 806995
 Company GEOTECHNIQUE PTY LTD