CROZIER GEOTECHNICAL CONSULTANTS

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REPORT ON GEOTECHNICAL SITE INVESTIGATION

for

PROPOSED GANGWAY TO BOAT MOORING PENS

at

THE NEWPORT, 1 KALINYA STREET, NEWPORT

Prepared For

Michael Jarvin

Project No.: 2015-240.1

July, 2016

Document Revision Record

Issue No	Date	Details of Revisions
0	29th July, 2016	Original issue

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

Development Application for_____
Name of Applicant

Address of site The Newport, 1 Kalinya Street, Newport

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

I, ***Troy Crozier*** *on behalf of* ***Crozier Geotechnical Consultants***

on this the 29th July 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:

☐ 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: Geotechnical Report for Proposed Gangway to Boat Mooring Pens

Report Date: 29th July 2016 **Project No.:** 2015-240.1

Author: T Crozier

Author's Company/Organisation: Crozier Geotechnical Consultants

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

- Statement of Environmental Effects by AW Planning, Job No.: 16011, Dated: 12th July 2016.
- Arrangement Plans by Superior Jetties, Drawing No.: OPP-7835-D03, D04, Revision: A, Dated: 13/05/2016.
- Design Plans by Superior Jetties, Drawing No.: OPP-7835-TG-1 and CA-1, Revision: , Dated: 27/06/2016

I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature .....

Name ...**Troy Crozier**.....

Chartered Professional Status...**RPGeo (AIG)**.....

Membership No. ....**10197**.....

Company... **Crozier Geotechnical Consultants**

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 ___ The Newport, 1 Kalinya Street, Newport _____

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 Report for Proposed Gangway to Boat Mooring Pens
Report Date: 29th July 2016 **Project No.:** 2015-240.1
Author: T Crozier
Author's Company/Organisation: Crozier Geotechnical Consultants

Please mark appropriate box

- ■ Comprehensive site mapping conducted _____ (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 .....bedrock exposed in area of proposed works.....
  - ☐ Yes Date conducted .....
- ☐ 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 .....50 years..... 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.

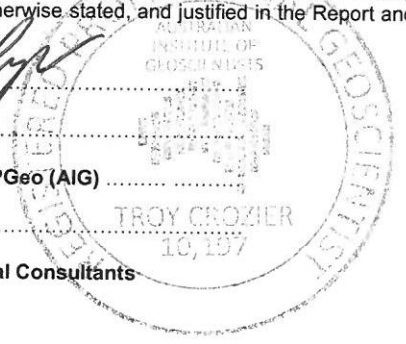
Signature .....

Name ...**Troy Crozier**.....

Chartered Professional Status...**RPGeo (AIG)** .....

Membership No. ...**10197**.....

Company... **Crozier Geotechnical Consultants**



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GEOTECHNICAL REPORT FOR PROPOSED GANGWAY TO BOAT MOORING PENS THE NEWPORT ON PITTWATER, 1 KALINYA STREET, NEWPORT, NSW.

1. INTRODUCTION:

This report details the results of a geotechnical inspection carried out as part of a Development Application for Boat Mooring Pens at The Newport on Pittwater, 1 Kalinya Street, Newport, NSW. The inspection and assessment were undertaken by Crozier Geotechnical Consultants (CGC) at the request of Michael Jarvin.

The Newport consists of a large rectangular block of land located on the low west side of Kalinya Street, Newport and contains the existing hotel/entertainment venue with associated structures. On the western side of the block a natural hill slope extends down to the foreshore of the Pittwater waterway.

It is understood that the proposed works involve construction of a series of new floating boat mooring pens within the waterway which will be connected via a suspended gangway to an access pathway adjacent to the rear of the existing developments within the site. The gangway will require a new concrete beam to support its eastern end within the hill slope. It is proposed to construct this beam with a series of reinforced concrete piers drilled into the hill slope.

This assessment was made for the Development Application related to the gangway and its footing only, which is the landward portion of the proposed development.

A review of Pittwater Councilôs Geotechnical Risk Management Policy 2009 mapping identified that the site has been classified as being within the H1 landslip hazard zone therefore the site and proposed works require a geotechnical assessment and reporting as part of the Development Application. Reference to the Pittwater Council ï LEP 2014, Acid Sulfate Soils Mapping, the site is located within Class 5 ï Acid Sulfate Soils Hazard Zone.

The investigation comprised:

a) A detailed geotechnical inspection and mapping of the site and adjacent properties by a Principal Engineering Geologist.

The following plans were supplied by for the work;

- Statement of Environmental Effects by AW Planning, Job No.: 16011, Dated: 12th July 2016.
- Arrangement Plans by Superior Jetties, Drawing No.: OPP-7835-D03, D04, Revision: A, Dated: 13/05/2016.
- Design Plans by Superior Jetties, Drawing No.: OPP-7835-TG-1 and CA-1, Revision: , Dated: 27/06/2016

2. SITE FEATURES:

2.1. Description:

The Newport entertainment venue consists of a large rectangular shaped block of land located on the low western side of Kalinya Street at the intersection with Beaconsfield Street with Queens Parade extending down the northern boundary. It is situated within gently sloping topography that extends to the eastern foreshore of the Pittwater waterway. The majority of the site has been modified from its natural condition however a narrow strip along the western boundary, at the foreshore, appears natural. This portion of the site consists of a steep vegetated slope down to a foreshore rock shelf.

2.2. Geology:

Reference to the Sydney 1: 100,000 Geological Series sheet (9130) indicates that the site is underlain by the Newport Formation (Rnn) of the Upper Narrabeen Group. The Newport Formation is of middle Triassic Age and typically comprises interbedded laminite, shale, quartz to lithic quartz sandstones and pink clay pellet sandstones.

3. FIELD WORK:

3.1. Methods:

The field investigation comprised a walk over inspection and mapping of the site and adjacent properties on the 28th July 2016 by a Principal Engineering Geologist which included a photographic record of site conditions as well as geological/geomorphological mapping of the site and adjacent land. Explanatory notes are included in Appendix: 1. Mapping information is shown on Figure: 1.

3.2. Field Observations:

The majority of The Newport site is gently west sloping and modified from its natural condition with extensive built structures which have been recently modernised. On the western side of the property a raised concrete open entertainment area exists above a parking and loading area. The parking area appears excavated into the hill slope up to approximately 2.0m depth with a vegetated steep (25°) slope extending up from the carpark pavements gutter to a low ridge line which extends along the western boundary, see Photo: 1.

Photo: 1 - Carpark and gutter along west side of down The Newport site

Photo: 2 - Steep natural vegetated slope extending towards foreshore

The western side of the ridge is formed as a steep (average 22°) vegetated slope (Photo: 2) which extends down to the foreshore. For the northern half of the site, adjacent to the western end of Queens Parade, the base of the slope is formed as a low (<4.0m) cliff line down to a foreshore rock platform. The cliff is formed at very steep (40°) to vertical slopes which have resulted from erosion of the claystone/laminite bedrock exposed along the foreshore. At the base of the cliff is an iron rich shale/siltstone horizon up to 1.0m in height with a sandstone rock platform extending from its base towards the west, see Photo: 3.

At the northern end of the site Queens Parade extends down below the foreshore line and is formed as a gently sloping bitumen car parking area which is surrounded by a low (<1.0m) dry stacked rock sea wall. Approximately 10m south of the rock walls the eroded cliff ends reduces in height, see Photo: 4.

Photo: 3 ï Cliff line at foreshore showing exposed weathered bedrock and erosion along informal pedestrian pathways

Photo: 4 ï Area of reduced coastal erosion away from road extension and sea wall at the western end of Queens Parade.

The cliff contains extensive outcrops of extremely low to very low strength claystone/siltstone which are exposed due to erosion with clayey soils and a thin topsoil formed above. In parts the erosion has created small scale overhangs and areas of potential small scale landslip instability within the weak rock and thin soil profile formed above. The slopes along the western side of the site show signs of pedestrian activity which has resulted in concentration of surface stormwater and subsequent shallow gully erosion.

4. COMMENTS:

4.1. Geotechnical Assessment:

The geotechnical inspection did not identify any signs of previous or impending large scale or deep seated landslip instability within the site or the location of the proposed works. The cliff line on the western boundary, at the foreshore contains some small scale potential earth slides with this appearing to be the result of weak bedrock and the interaction of erosion adjacent to the rock wall at the end of Queens Parade and pedestrian activity creating gullying.

The proposed works involve the placement of an elevated gangway to provide access to a floating mooring berth structure with the adjacent waterway. The gangway will involve a concrete beam at its upper western end for stability. The beam will be supported by the construction of two reinforced concrete piles which

will be bored into the natural slope. There are no other earthworks proposed within the site as part of the mooring berths.

The installation of pile footings to support the moorings is outside the scope of this assessment.

The site is within an area designed as Acid Sulfate Soils - Class 5 however the works will involve the drilling of two bored piles through residual soils and weathered bedrock above the water table therefore acid sulfate soils will not be intersected or excavated as part of the drilling process. The piles will be concrete in-filled post excavation and therefore there will be no impact to local hydrogeology as a result of the proposed works. As such the works will not impact acid sulfate soils and no further assessment is considered necessary.

The recommendations and conclusions in this report are based on an assessment utilizing only surface observations. However Based on the exposed site geological and topographical conditions, along with existing structures and proposed works, it is considered that only one small scale landslip hazard exists, being earth slides (<2m³) due to over-steepened slopes from erosion at the foreshore.

Due to the small scale of the hazard, the low level of occupancy of the area along with a lack of structures potentially impacted the risk associated to this hazard is considered to be within the óAcceptableô risk management criteria (see Table A and B) of the Pittwater Council Risk Management Policy and will remain so for the design life of the proposed development, taken as 50 years. Form 1 and 1a of Pittwater Councils Policy are attached.

Prepared by:

Troy Crozier
Principal Engineering Geologist
MAIG, RPGeo. No.: 10197

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Appendix 1

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

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

Description and classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. Sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12 - 25
Firm	25 – 50
Stiff	50 – 100
Very stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300mm)	CPT Cone Value (Qc – MPa)
Very loose	less than 5	less than 2
Loose	5 – 10	2 – 5
Medium dense	10 – 30	5 -15
Dense	30 – 50	15 – 25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling to allow information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the company and some comments on their use and application.

Test Pits – these are excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descent into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) – the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling – the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers – the hole is advanced using 90 – 115mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling – similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. From SPT).

Continuous Core Drilling – a continuous core sample is obtained using a diamond-tipped core barrel, usually 50mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedures is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150mm of say 4, 6 and 7
  as 4, 6, 7
  N = 13
- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm
  as 15, 30/40mm.

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50mm diameter thin wall sample tubes in clay. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone – abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australia Standard 1289, Test 6.4.1.

In tests, a 35mm diameter rod with a cone-tipped end is pushed continually into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separte 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected buy electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) their information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: -

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0 – 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0 – 50 MPa) is less sensitive and is shown as a full line. The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios 1% - 2% are commonly encountered in sands and very soft clays rising to 4% - 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range: -

Qc (MPa) = (0.4 to 0.6) N blows (blows per 300mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range: -

Qc = (12 to 18) Cu

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculations of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer – a 16mm diameter flattened rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test 6.3.2). The test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2). The test was developed initially for pavement sub-grade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

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

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

Ground Water

Where ground water levels are measured in boreholes there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made. More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. A three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. To a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

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

- unexpected variations in ground conditions – the potential for this will depend partly on bore spacing and sampling frequency,
- changes in policy or interpretation of policy by statutory authorities,
- the actions of contractors responding to commercial pressures,

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

Site Anomalies

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

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a special ally edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

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

TABLE : A

Landslide risk assessment for Risk to life

HAZARD	Description	Impacting	Likelihood	Spatial Impact	Occupancy	Evacuation	Vulnerability	Risk to Life
A	Landslip (earth slide <2m³) from natural slope due to erosion		Weak rock and some existgin erosion creating over-steepening in localised areas, potential for ongoing erosion to remove hazards before the occur	a) will impact small sections of foreshore/slopes at rear edge of site	a) Persons walking along foreshore and slopes, 0.5hr/day	a) Possible to not evacuate	a) Person in open space possible buried	
		a) foreshore and slopes above	Possible 0.001	0.1	0.0210	0.5	0.8	**8.40E-07**

* hazards considered in current condition and/or without suitable remedial/stabilisation measures
* likelihood of occurrence for design life of house (considered 100years)
* considered for person most at risk
* evacuation scale from Almost Certain to not evacuate (1.0), Likely (0.75), Possible (0.5), Unlikely (0.25), Rare to not evacuate (0.01)
* vulnerability assessed using Appendix F - AGS Practice Note Guidelines for Landslide Risk Management 2007

TABLE : B

Landslide risk assessment for Risk to Property

HAZARD	Description	Impacting	Likelihood		Consequences		Risk to Property
A	Landslip (earth slide <2m³) from natural slope due to erosion	a) foreshore and slopes above	Possible	The event could occur under adverse conditions over the design life.	Insignificant	Little Damage, no significant stabilising required or no impact to neighbouring properties.	Very Low

* hazards considered in current condition, without remedial/stabilisation measures and during construction works.
* qualitative expression of likelihood incorporates both frequency analysis estimate and spatial impact probability estimate as per AGS guidelines.
* qualitative measures of consequences to property assessed per Appendix C in AGS Guidelines for Landslide Risk Management.
* Indicative cost of damage expressed as cost of site development with respect to consequence values: Catastrophic : 200%, Major: 60%, Medium: 20%, Minor: 5%, Insignificant: 0.5%.