

James and Anna Markham
C/- Cadence & Co Design
Attention: Natasha Grice
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11 September 2022

Coastal Engineering Advice on 287 Whale Beach Road Whale Beach

1. INTRODUCTION AND BACKGROUND

It is proposed to demolish the existing dwelling and to construct a new dwelling at 287 Whale Beach Road Whale Beach, for which a Development Application is to be submitted to Northern Beaches Council.

The property is located within a “Bluff/Cliff Instability” area designated on the *Coastal Risk Planning Map* (Sheet CHZ_015) that is referenced in *Pittwater Local Environmental Plan 2014*. Therefore, the property is subject to Chapter B3.4 of the *Pittwater 21 Development Control Plan* (DCP)¹, 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 30 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 along Whale Beach Road. He undertook a specific inspection of the subject property and adjacent cliff face on 25 June 2022.

Note that all levels given herein are to Australian Height Datum (AHD). Zero metres AHD is approximately equal to mean sea level at present. Completed Form No. 1 as given in the *Geotechnical Risk Management Policy for Pittwater* is attached at the end of the document herein.

¹ The Pittwater 21 DCP up to Amendment No. 27, which came into effect on 18 January 2021, was considered herein.

2. INFORMATION PROVIDED

Horton Coastal Engineering was provided with a total of 9 Cadence & Co Design architectural drawings (Drawing Numbers DD01 and 03 to 10), all Revision A and dated 24 February 2022. A site survey by Adam Clerke Surveyors was also provided, Reference 25492F and dated 10 March 2022.

3. EXISTING SITE DESCRIPTION

The subject property is located along the southern face of Little Head, immediately NE of the sandy Whale Beach. Vertical and oblique aerial views are provided in Figure 1 and Figure 2 respectively, with a section location denoted as Section A depicted in Figure 1². Coffey & Partners (1987) noted that the cliff profiles from Little Head to south Palm Beach had been formed by an interbedded sequence of sandstone and interbedded siltstone/sandstone.



Figure 1: Aerial view of subject property (red outline), with location of Section A shown in blue (aerial photograph taken 5 April 2022)

² Note that the property boundary depicted in Figure 1 is only approximate.



Figure 2: Oblique aerial view of subject property (at arrow) on 5 April 2022, facing NW

Photographs of the cliff seaward of the property, and the seaward portion of the property, are provided in Figure 3 and Figure 4 respectively. Based on Airborne Laser Scanning (ALS) data held by Horton Coastal Engineering that was collected in 2020, elevations along Section A (from Figure 1) perpendicular to the cliff face are depicted in Figure 5.

Ground elevations along Section A approximately vary from about 42m AHD at Whale Beach Road, 19m AHD at the seaward property boundary, and 14.9m and 2.5m AHD at the top and bottom respectively of the near-vertical (average slope of 83°) cliff portion seaward of the property (with the portion above the top of the near-vertical portion to Whale Beach Road having an average slope of 17°).



Figure 3: View of cliff face south of subject property (approximately between arrow) on 25 June 2022, facing north



Figure 4: View of seaward portion of subject property on 25 June 2022, facing NNW

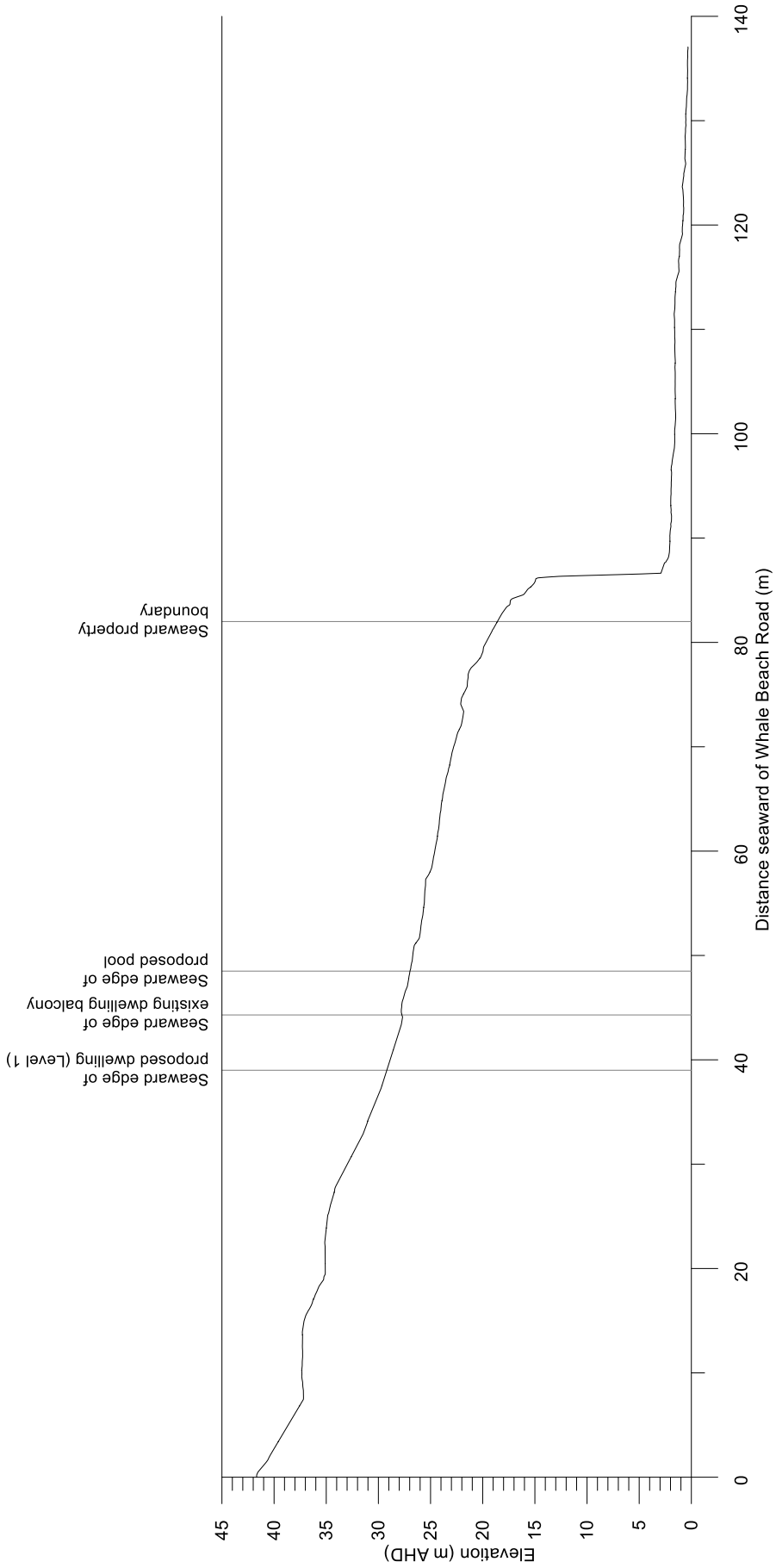


Figure 5: Section A through subject property and cliff to south

4. PROPOSED DEVELOPMENT

It is proposed to demolish the existing dwelling and to construct a new dwelling and swimming pool. The minimum habitable floor level of the development is 27.6m AHD, with the pool coping at 26.4m 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. 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.

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 also consistent with average rates of recession for Sydney Northern Beaches coastline sandstone cliffs of 4mm per year determined by Crozier and Braybrooke (1992). An apparent approximate 50m of cliff recession (observed in aerial photography as the distance of the cliff from the seaward edge of the rock platform at present) seaward of the subject property 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 8mm/year, generally consistent but higher than these values. Note that maximum rates of recession for Sydney Northern Beaches coastline sandstone cliffs of 12mm/year were determined by Crozier and Braybrooke (1992).

The base of the cliff seaward of the subject property, at a level of about 2m AHD, would be semi-regularly impacted by shallow-depth wave runup at high tide, and occasionally impacted by more severe wave runup during coastal storms with large waves and elevated water levels (particularly when coinciding with high tide). This wave runup could extend up to levels of about 8m AHD at present in a 100-year Average Recurrence Interval (ARI) storm, increasing to around 9m AHD in 100 years if near upper-limit projections of sea level rise are realised.

Given this, it should be assumed that both chemical and mechanical weathering would apply at this site. An erosion/weathering rate of 8mm per year is considered to be appropriate, with sensitivity testing for a rate of 12mm/year. 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. To be conservative, the rates can be applied over the entire exposed cliff face, although in reality it would be expected that runoff would generally be below 9m AHD in a severe coastal storm over the 100-year design life. Therefore, an allowance for recession/weathering of the cliff face of about 8mm to 12mm per year should be considered and assessed by the geotechnical engineer.

The geotechnical engineer should consider these estimated rates in conjunction with an understanding of the particular nature of the cliff materials seaward of the subject property, their resistance to erosion, and potential failure planes related to geotechnical issues such as the joint spacing³.

This should be confirmed by the geotechnical engineer, but it is expected that the erosion/weathering described above would lead to undercutting and collapse of blocks on the cliff face over the long term, with failure planes at the joints. That stated, any potential future failure of the upper slope landward of the cliff 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 minimum floor levels above 27m AHD, coastal inundation is not a significant risk to the existing and proposed development over a planning period of well over 100 years.

7. MERIT ASSESSMENT

7.1 Preamble

The merit assessment herein has been undertaken assuming that the geotechnical engineer will find that the proposed development is at an acceptably low risk of damage from coastal erosion/recession of the cliff seaward of the property for a design life of at least 100 years.

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)⁴ and its associated mapping, the subject property is partly within the “Coastal Environment” area (see Section 7.2.2), and within the “Coastal Use” area (see Section 7.2.3).

7.2.2 *Clause 2.10*

Based on Clause 2.10(1) of SEPP Resilience, “development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:

³ Coffey & Partners (1987) noted that the controlling feature of interbedded sandstone/siltstone cliffs (as at the subject property) was the bedding spacing and relative proportion of sandstone/siltstone.

⁴ Formerly *State Environmental Planning Policy (Coastal Management) 2018*.

- (a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,
- (b) coastal environmental values and natural coastal processes,
- (c) the water quality of the marine estate (within the meaning of the *Marine Estate Management Act 2014*), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,
- (d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,
- (e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
- (f) Aboriginal cultural heritage, practices and places,
- (g) the use of the surf zone”.

This is not a coastal engineering matter, but it can be noted that with regard to (a), the proposed development would not be expected to adversely affect the biophysical, hydrological (surface and groundwater) and ecological environments, being in an existing developed area and with stormwater drainage arrangements understood to be similar to the existing arrangements.

With regard to (b), the proposed development would not be expected to adversely affect coastal environmental values or natural coastal processes over an acceptably long design life, as it would be founded on a cliff well above wave action for an acceptably rare storm.

With regard to (c), the proposed development would not be expected to adversely impact on water quality, with the residential land use, as long as appropriate construction environmental controls are applied. No sensitive coastal lakes are located in the vicinity of the proposed development.

With regard to (d), the proposed development would not impact marine vegetation, undeveloped headlands and rock platforms, with none of these items in proximity to the development (being on an already developed headland, and being well above and landward of the rock platform at the northern end of Whale Beach for an acceptably rare storm and acceptably long life). No significant impacts on marine fauna and flora would be expected as a result of the proposed development, as the development would not interact with subaqueous areas for an acceptably rare storm and acceptably long life. Assuming that there are no species of native vegetation and fauna and their habitats of significance that would be impacted at the property, (d) is satisfied.

With regard to (e), it can be noted that the proposed development is entirely within the subject property boundary and will not alter existing public access arrangements outside of the property.

With regard to (f), a search of the Heritage NSW “Aboriginal Heritage Information Management System” (AHIMS) was undertaken on 11 September 2022. This resulted in no Aboriginal sites nor Aboriginal places being recorded or declared within at least 50m of the subject property.

With regard to (g), the proposed development would not interact with the surf zone for an acceptably rare storm occurring over an acceptably long life, so would not impact on use of the surf zone.

Based on Clause 2.10(2) of SEPP Resilience, “development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

- (a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1), or
- (b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or
- (c) if that impact cannot be minimised—the development will be managed to mitigate that impact”.

The proposed development has been designed and sited to avoid any potential adverse impacts referred to in Clause 2.10(1).

7.2.3 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), no Aboriginal sites nor Aboriginal places have been recorded or declared within at least 50m of the subject property, as noted in Section 7.2.2.

With regard to (a)(v), the nearest environmental heritage item to the subject property listed in Schedule 5 of *Pittwater Local Environmental Plan 2014* is the house “Orcades” at 309–311 Whale Beach Road Palm Beach. This heritage item is located about 130m from the subject property. The proposed development would not be expected to impact on this heritage item.

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.

7.2.4 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.

7.2.5 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 subject property.

7.2.6 Synthesis

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

7.3 Clause 7.5 of *Pittwater Local Environmental Plan 2014*

Clause 7.5 of *Pittwater Local Environmental Plan 2014* (LEP 2014) applies at the subject property, as the property is identified as “Bluff/Cliff Instability” on the Coastal Risk Planning Map Sheet CHZ_015. 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 base 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) would be 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.

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 8mm to 12mm/year of the cliff seaward of 287 Whale Beach Road Whale Beach should be considered and assessed by the geotechnical engineer. The geotechnical engineer should consider these estimated rates in conjunction with an understanding of the particular nature of the cliff materials south of the subject property, their resistance to erosion, and potential failure planes related to geotechnical issues such as the joint spacing. That stated, any potential future failure of the upper slope landward of the cliff may be unrelated to coastal processes at the base of the cliff, so other failure mechanisms should 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 2.10 to 2.13), and Clause 7.5 of *Pittwater Local Environmental Plan 2014* 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

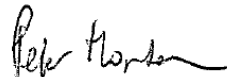
Sunamura, Tsuguo (1983), "Processes of Sea Cliff and Platform Erosion", Chapter 12 in *CRC Handbook of Coastal Processes and Erosion*, editor Paul D Komar, CRC Press Inc, Boca Raton, Florida, ISBN 0-8493-0208-0

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 James and Anna Markham (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 <u>James and Anna Markham</u> Name of Applicant
Address of site <u>287 Whale Beach Road Whale Beach</u>

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 11 September 2022 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

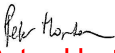
Geotechnical Report Details:

Report Title: <u>Coastal Engineering Advice on 287 Whale Beach Road Whale Beach</u>
Report Date: <u>11 September 2022</u>
Author: <u>Peter Horton</u>
Author's Company/Organisation: <u>Horton Coastal Engineering Pty Ltd</u>

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

<u>See Section 2 and Section 10 of coastal report</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  **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