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Coastal & Water Consulting

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23 February 2023

Coastal Engineering Advice on 18 Hillcrest Avenue Mona Vale

1. INTRODUCTION AND BACKGROUND

It is proposed to construct a secondary dwelling at 18 Hillcrest Avenue Mona Vale, 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_018) that is referenced in *Pittwater Local Environmental Plan 2014*.

Therefore, the property is subject to Chapter B3.4 of the 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 Hillcrest Avenue. He undertook a specific inspection of the subject property (including its cliff face and adjacent rock platform) on 26 January and 2 February 2023.

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.

2. INFORMATION PROVIDED

Horton Coastal Engineering was provided with seven Gartner Trovato Architects drawings (Drawings A.00 to A.06), all dated 1 December 2022 and Issue A. A site survey by Mepstead & Associates was also provided, reference 5810, Revision D, and dated 30 September 2022.

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

3. EXISTING SITE DESCRIPTION

The subject property is located at the northern end of Mona Vale Headland, and adjacent to a rock platform and cliff at the southern end of Bungan Beach. A vertical aerial view of the property is provided in Figure 1, with a section location denoted as Section A also depicted in Figure 1[2].

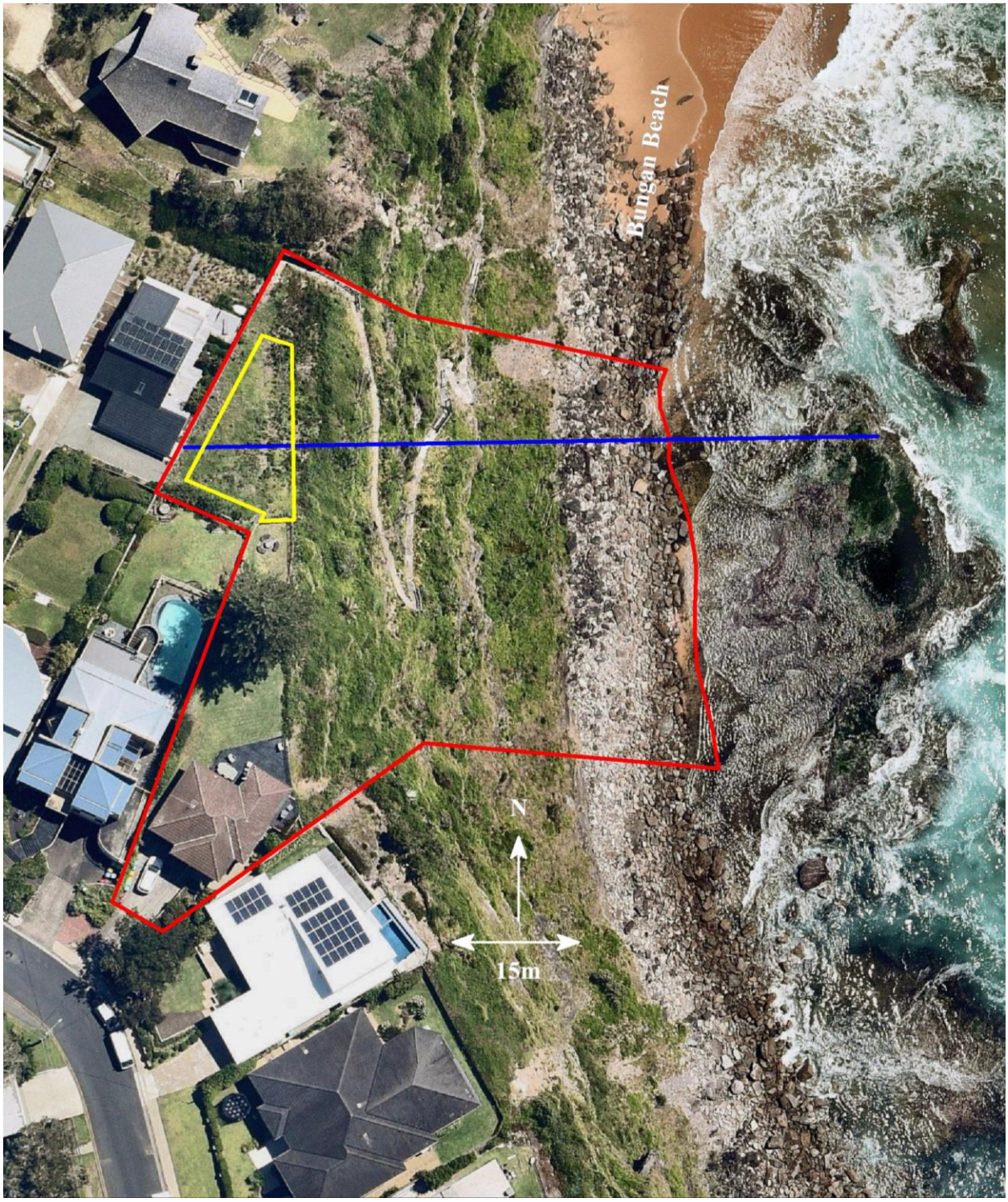


Figure 1: Aerial view of subject property (red outline), with location of Section A shown in blue and outline of proposed development in yellow (aerial photograph taken 23 November 2022)

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

Coffey & Partners (1987) noted that the cliff/bluff at the northern end of Mona Vale Headland had a stepped profile. This was noted to be primarily due to the rock type, bedding spacing and degree of weathering, with near vertical faces developed in sandstone layers, and slopes of about 45° in units composed predominantly of shale/siltstone.

An oblique aerial view of the property and adjacent rock platform is provided in Figure 2, with a photograph of the cliff at the property (taken from the adjacent rock platform) provided in Figure 3, and a photograph of the proposed development area provided in Figure 4.

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 50m AHD in the development area, 48m AHD at the top of cliff, and 0.6m AHD at the seaward property boundary. The upper section of the cliff (down to about 13.6m AHD) has an average slope of 1:0.5 (vertical:horizontal, V:H) or 61°. The lower section of cliff to the seaward edge of vegetation (which can be considered as the cliff toe) at about 4.0m AHD is flatter at an average slope of about 1V:1.1H or 42°. Below this, where boulders are exposed, the average slope is flatter again at about 1V:3.5H or 16° down to the rock platform at about 0.6m AHD.

Figure 2: Oblique aerial view of subject property (existing dwelling at yellow arrow, and proposed location of secondary dwelling at red arrow) on 5 April 2022, facing NW

Figure 3: View of cliff face at subject property (development area extent approximately between arrows) on 2 February 2023, facing WSW

Figure 4: View of area proposed to be developed (at arrow) on 17 February 2022, facing NNE

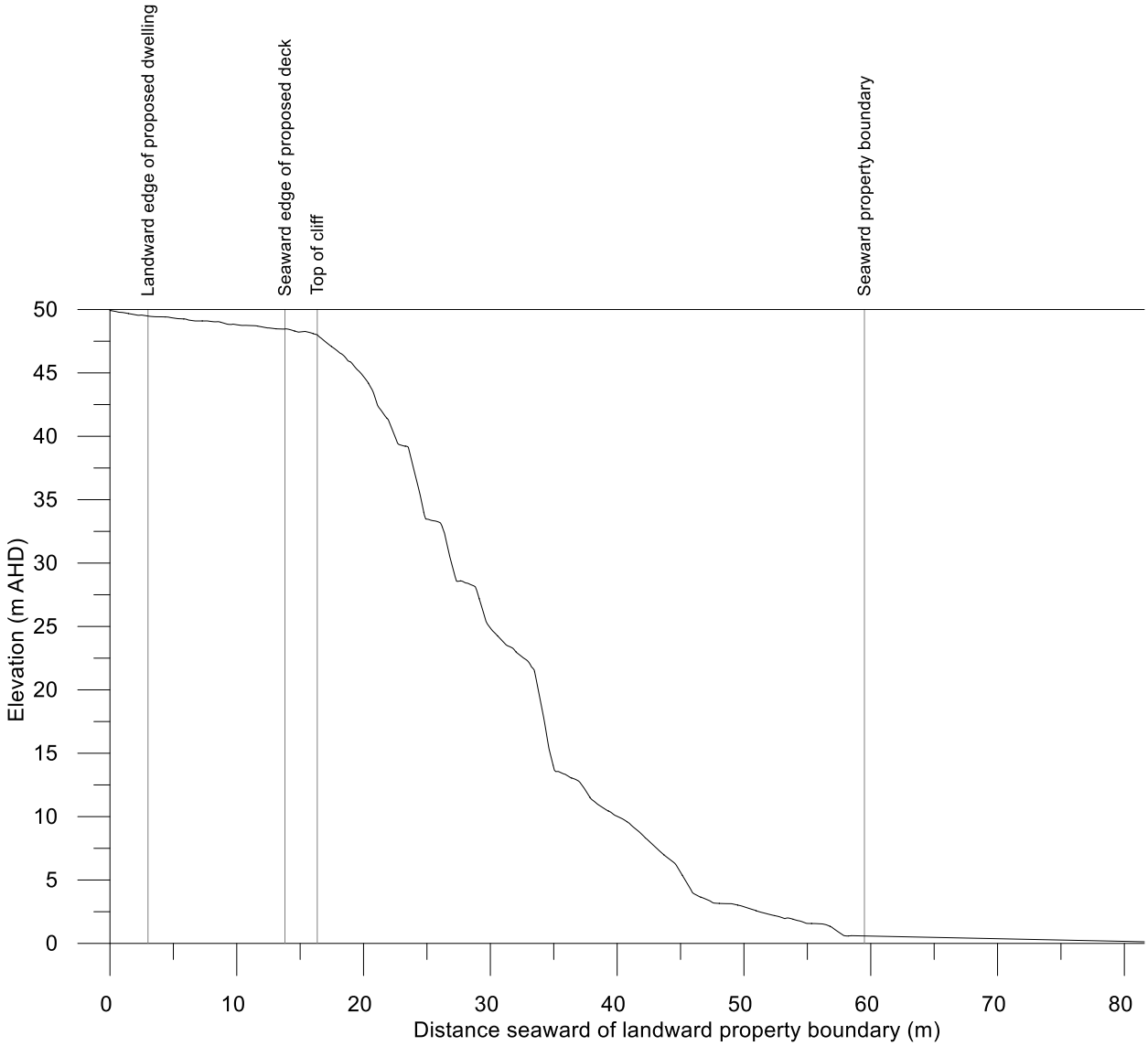


Figure 5: Section A through subject property including cliff face and rock platform

4. PROPOSED DEVELOPMENT

It is proposed to construct a single split-level secondary dwelling at the subject property, with the finished floor level at 50m to 51m AHD. The position of the proposed dwelling (including its surrounding deck) is outlined on Figure 1. A storage and water tank area is proposed under the northern portion of the deck, with a floor level of about 47.3m 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 varies along the cliff profile. 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.

Mechanical weathering can also be caused by wind.

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 40m of cliff recession (observed in aerial photography as the distance of the toe of the cliff from the seaward edge of the rock platform at present) at and seaward of the subject property over the last 6,400 years (since sea levels stabilised around their present levels, and assuming that the cliff toe was at the seaward edge of the rock platform at that time) represents an average recession rate of 6mm/year, consistent with 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 exposed cliff (vegetated portion above the rock boulders) at the subject property is above the intertidal zone (above 1m AHD) but would be impacted by wave runup at times, particularly during coastal storms with large waves and elevated water levels. 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 projected sea level rise is realised.

Given this, it should be assumed that both chemical and wave-induced mechanical weathering would apply at this site. A recession/weathering rate of 6mm per year of the cliff face is considered to be appropriate, with sensitivity testing for a rate of 12mm/year. Therefore, an allowance for recession/weathering of the cliff of about 6mm to 12mm per year 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.

The rates can be applied over the entire cliff face. Although runup would generally be below 9m AHD in a severe coastal storm over the 100 year design life, so wave-induced mechanical weathering would be limited to the lower portion of the cliff face, the upper cliff face is exposed to mechanical weathering through wind action.

The geotechnical engineer should consider these estimated rates in conjunction with an understanding of the particular nature of the cliff materials at the subject property, their resistance to erosion/recession, and potential failure planes related to geotechnical issues such as the joint spacing[3].

This should be confirmed by the geotechnical engineer, but it is expected that the recession/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[4]. That stated, any future failure of the upper slope of the cliff in the vicinity of the proposed development 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 the habitable development above 50m AHD, coastal inundation is not a significant risk to the proposed development over a planning period of well over 100 years, including consideration of projected sea level rise.

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 at the property, and other processes, 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)[5] and its associated mapping, the subject property is within a "Coastal Environment" area (see Section 7.2.2) and "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:

(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,

[3] Coffey & Partners (1987) noted that the controlling feature of interbedded sandstone/siltstone cliffs was the bedding spacing and relative proportion of sandstone/siltstone.
[4] Overhangs are currently evident in the cliff face, as visible in Figure 3.
[5] Formerly *State Environmental Planning Policy (Coastal Management) 2018*.

(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 conventional stormwater management features such as rainwater tanks and a dispersion system over the cliff face.

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 and seaward of the property 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 23 February 2023. This resulted in no Aboriginal sites nor Aboriginal places being recorded or declared within at least 200m 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 200m 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 at 26 Grandview Parade Mona Vale. This heritage item is located at least 120m 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_018. 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 6mm/year of the cliff at 18 Hillcrest Avenue Mona Vale, with sensitivity testing up to 12mm/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 at the subject property, their resistance to erosion, and potential failure planes related to geotechnical issues such as the joint spacing. That stated, any future failure of the upper slope of the cliff and in the property 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 to 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

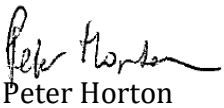
Public Works Department (1985), "Coastal Management Strategy, Warringah Shire, Report to Working Party", *PWD Report 85016*, June, prepared by AD Gordon, JG Hoffman and MT Kelly, for Warringah Shire Council

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

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 Neil Burnard
Name of Applicant
Address of site 18 Hillcrest Avenue Mona Vale

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 23 February 2023 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: Coastal Engineering Advice on 18 Hillcrest Avenue Mona Vale
Report Date: 23 February 2023
:
Author: Peter Horton
Author's Company/Organisation: Horton Coastal Engineering Pty Ltd

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

See Section 2 and Section 10 of coastal report

~~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