Horton Coastal Engineering
Coastal & Water Consulting

HORTON COASTAL ENGINEERING PTY LTD
18 Reynolds Cres
Beacon Hill NSW 2100
+61 (0)407 012 538
peter@hortoncoastal.com.au
www.hortoncoastal.com.au
ABN 31 612 198 731
ACN 612 198 731

Jim Livingstone
C/- Ascent Geotechnical Consulting
Attention: Ben Morgan
PO Box 37
Manly NSW 1655
(sent by email only to ben@ascentgeo.com.au)

12 June 2019

Coastal Engineering Advice on 307 Whale Beach Road Palm Beach

1. INTRODUCTION AND BACKGROUND

It is proposed to construct a small detached secondary dwelling at 307 Whale Beach Road Palm Beach, for which a Development Application (DA) 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 *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 26 years of coastal engineering experience. He has postgraduate qualifications in coastal engineering, and is a Member of Engineers Australia (MIEAust) and Chartered Professional Engineer (CPEng) registered on the National Engineering Register (NER). 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 completed coastal engineering reports for numerous cliff/bluff properties in the Palm Beach area, and has inspected the area in the vicinity of the subject property on several occasions in the last few years, including a specific recent inspection of the subject property and adjacent cliff face and rock platform on 30 May 2019.

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. 24, which came into effect on 20 October 2018, was considered herein.

2. INFORMATION PROVIDED

Horton Coastal Engineering was provided with 17 drawings of the proposed development prepared by ecoshelta and Stephen Sainsbury Architect, namely G.POD000, 001, 006, 007, 100, 101, 104, 105, 130, 131, and 201-207 (all dated 12 April 2019).

3. EXISTING SITE DESCRIPTION

The subject property is located on a rocky cliff headland known as Little Head, which extends north of the sandy Whale Beach. An aerial view is provided in Figure 1, along with a section location denoted as Section A (this is a cross-section through the property, aligned to the slope)[2]. Photographs of the property are provided in Figure 2 to Figure 4.

Figure 1: Aerial view of subject property (red) on 30 August 2018, with Section A (blue) shown

[2] Note that the property boundary depicted in Figure 1 is not survey accurate, being derived from approximate NSW Government GIS cadastral data.

Figure 2: View of cliff face at subject property (approximate extent between arrows) from rock platform on 30 May 2019, looking WSW

Figure 3: View of subject property from near Whale Beach Road on 30 May 2019, looking east (proposed development area obscured by vegetation, at arrow)

Figure 4: View of subject property on 30 May 2019, looking SE to SSE, with proposed development area at arrow

Based on 2011 Airborne Laser Scanning data held by Horton Coastal Engineering, Section A is as depicted in Figure 5. It is evident that the subject property falls from a level of about 43m AHD at its landward boundary adjacent to Whale Beach Road, to about 36m AHD at the proposed development area, 32m AHD where the slope steepens about 4.6m landward of the seaward property boundary (average slope of 43° in this section down to 23m AHD), and 23m AHD at the top of the near-vertical cliff about 6.0m seaward of the seaward property boundary (average slope of 77° in this section down to 13m AHD).

Large boulders (joint blocks that have detached from the cliff in the past) are evident at the base of the cliff, in the order of 10m high, 10m to 20m long alongshore, and 5m to 10m wide cross-shore. Landward of the boulders, the slope is well vegetated (with shrubs, grasses and creepers) up to about 13m AHD, where the visible cliff steepens. Seaward of the boulders, the rock platform is at a level of 4.6m AHD over a width of about 2m, before terracing down to 2.6m AHD and then down to 0.8m AHD over a distance of 56m (average slope of 2° over this most seaward section of the rock platform).

Coffey & Partners (1987) noted that the cliff at Little Head was formed by an interbedded sequence of sandstone and interbedded siltstone/sandstone, with the interbedded siltstone/sandstone (over the lower 4m to 5m) undercutting the upper sandstone. The boulders at the base of the cliff have fallen from the cliff over the last few thousand years due to this weathering and undercutting process.

4. PROPOSED DEVELOPMENT

It is proposed to construct a small detached secondary dwelling at the location depicted in Figure 3 and Figure 4, as per the photomontage in Figure 6. Its floor level will be above 35m AHD, and it is located about 37m from the top of the near-vertical cliff section and about 26m from where the slope steepens a few metres landward of the seaward property boundary.

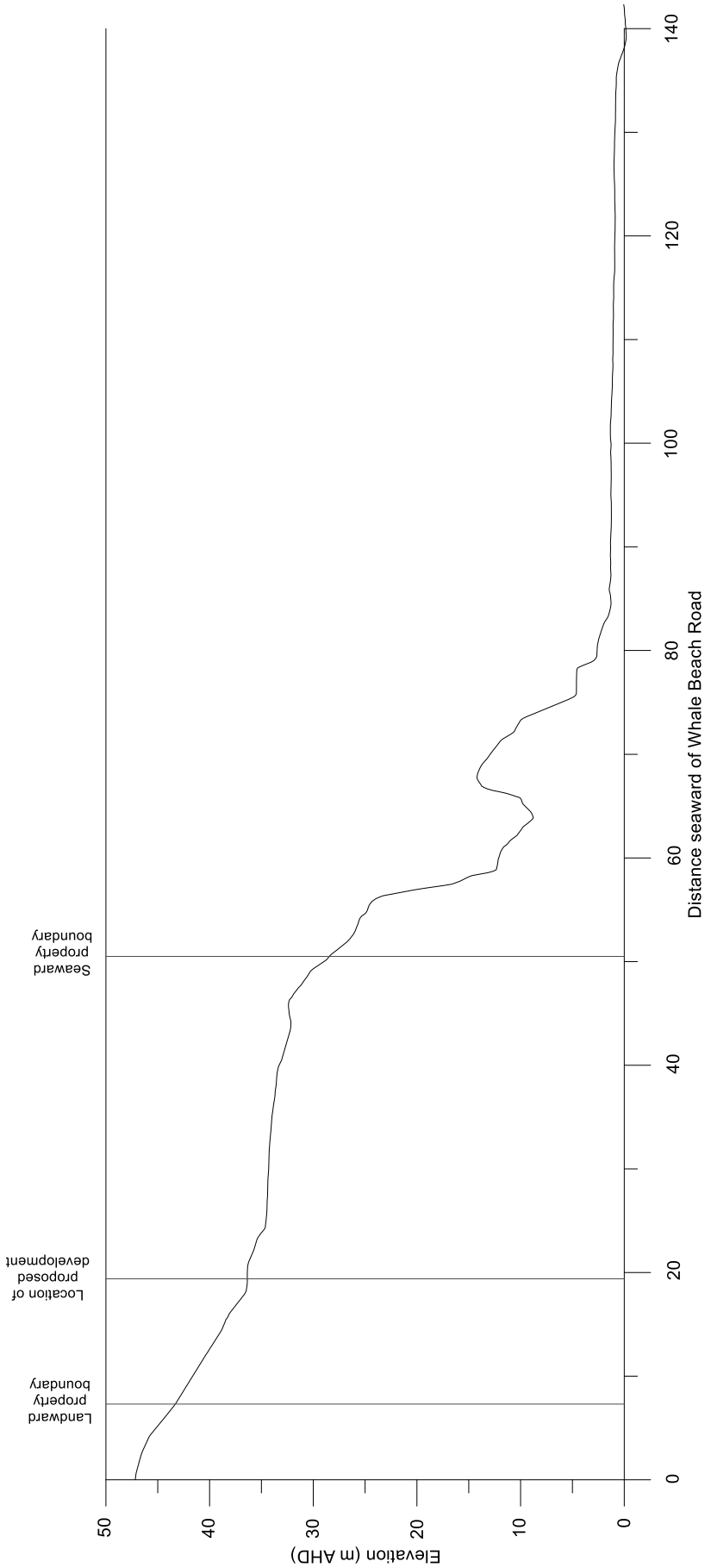


Figure 5: Section A through subject property

Figure 6: Photomontage of proposed development

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 75m of cliff recession (observed in aerial photography) seaward of the subject property over the last 6,400 years (since sea levels stabilised around their present levels) represents an average recession rate of 12mm/year, higher than these values, and the same as the maximum rates of recession for Sydney Northern Beaches coastline sandstone cliffs of 12mm/year determined by Crozier and Braybrooke (1992).

The base of the cliff at the subject property is generally protected from wave action by the large boulders, or vegetated slope where wave action can penetrate the 3m gap between the boulders seaward of the property. Therefore, chemical weathering would apply at this site, whereas mechanical weathering would not be expected over the design life of the development (in the order of 100 years or less). Therefore, a weathering rate (in the absence of waves), based on chemical weathering rates in coastal environments, of about 2mm per year is likely to be appropriate. However, to be conservative and to allow for projected sea level rise and the potential for the vegetated slope to erode, an allowance of 12mm/year of recession (consistent with historical rates) is considered to be reasonable for planning purposes.

Therefore, an allowance for recession/weathering of the cliff of 12mm/year is considered to be reasonable to apply over a design life of 100 years, and should be considered and assessed by the geotechnical engineer. The geotechnical engineer should consider this rate in conjunction with an understanding of the particular nature of the cliff materials east of the subject property, their resistance to erosion, 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 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.

6. SUBSURFACE CONDITIONS

A geotechnical investigation of the subject property has been completed by Ascent Geotechnical Consulting (2019). They considered that competent weathered bedrock would be found within about 0.9m to 2.3m from current surface levels within the site. Ascent provided various recommendations, that if adhered to they considered would result in an acceptably low risk to life and low risk to property for the proposed development.

7. COASTAL INUNDATION

With a floor level above 35m AHD, coastal inundation is not a significant risk for the proposed development over a planning period of well over 100 years.

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

8. MERIT ASSESSMENT

8.1 State Environmental Planning Policy (Coastal Management) 2018

8.1.1 Preamble

Based on *State Environmental Planning Policy (Coastal Management) 2018* (SEPP Coastal) and its associated mapping, the subject property is within a "coastal environment area" and "coastal use area".

8.1.2 Clause 13

Based on Clause 13(1) of SEPP Coastal, "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,
(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 only covering a footprint of about 6m × 6m. Ascent Geotechnical Consulting (2019) noted that the proposed development was not expected to have a significant effect on the standing water table.

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. 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, native vegetation and fauna and their habitats (of significance, which are not known to exist at the property), 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 adjacent rock platform 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.

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 seaward of the property, or north and south of the property.

With regard to (f), a search of the Office of Environment and Heritage "Aboriginal Heritage Information Management System" (AHIMS) was undertaken on 6 June 2019. This did not indicate that there were any particular Aboriginal objects or Aboriginal Places within 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 13(2) of SEPP Coastal, "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 13(1).

8.1.3 Clause 14

Based on Clause 14(1) of SEPP Coastal, "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 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), as noted in Section 8.1.2, there are no particular Aboriginal objects or Aboriginal Places within 200m of the subject property.

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 adjacent house "Orcades" at 309-311 Whale Beach Road. The proposed development is detached from this house and would therefore not be expected to impact on it.

With regard to (b), the proposed development has been designed and sited to avoid any potential adverse impacts referred to in Clause 14(1) for the matters considered herein.

Clause (c) is not a coastal engineering matter so is not considered herein.

8.1.4 Clause 15

Based on Clause 15 of SEPP Coastal, "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".

The proposed development is at an acceptably low risk of damage from projected coastal erosion/recession for a planning period of 100 years based on Ascent Geotechnical Consulting (2019), and well above and landward of projected wave runup to 2100. 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.

8.1.5 Synthesis

The proposed development satisfies the requirements of *State Environmental Planning Policy (Coastal Management) 2018* for the matters considered herein.

8.2 *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 on the base of the cliff.

Items (c), (d) and (g) are for the geotechnical engineer to assess, with consideration of the findings herein. Ascent Geotechnical Consulting (2019) found that the proposed development was at an acceptably low risk of damage over a 100 year planning period with appropriate measures incorporated in the design and construction, thus meeting (c), (d) and (g). 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.

9. FORM

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".

10. CONCLUSIONS

An allowance for erosion/weathering of 12mm/year of the cliff seaward of 307 Whale Beach Road Palm Beach should be considered and assessed by the geotechnical engineer. The geotechnical engineer should consider this estimated rate 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 spacing.

Coastal inundation is not a significant risk for the proposed development over a planning period of well over 100 years. Given this, and that the geotechnical engineer has found that the development is at an acceptably low risk of damage from coastal/geotechnical hazards over a 100 year design life, the proposed development satisfies the requirements of *State Environmental Planning Policy (Coastal Management) 2018* (Clauses 13, 14 and 15) and Clause 7.5 of *Pittwater Local Environmental Plan 2014* for the matters considered herein.

11. REFERENCES

Ascent Geotechnical Consulting (2019), *Geotechnical Assessment for Proposed New Dwelling at 307 Whale Beach Road, Palm Beach, NSW*, AG 19092, 12 June

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

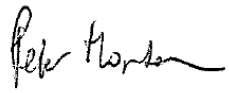
Public Works Department (1985), "Coastal Management Strategy, Warringah Shire, Report to Working Party", *PWD Report 85016*, June, prepared by AD Gordon, JG Hoffman and MT Kelly, for Warringah Shire Council

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

12. 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 +61 407 012 538.

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