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5 March 2025

Coastal Engineering Advice on 153a Ocean Street Narrabeen

1. INTRODUCTION AND BACKGROUND

It is proposed to undertake alterations and additions at 153a Ocean Street Narrabeen (hereafter denoted as the 'site'), for which a Development Application is to be submitted to Northern Beaches Council. Given the proximity of the site to Collaroy-Narrabeen Beach, a coastal engineering assessment is required by Council, as set out herein.

The report author, Peter Horton [BE (Hons 1) MEngSc MIEAust CPEng NER], is a professional Coastal Engineer with 33 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. 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.

In previous employment, Peter was the main author of the *Coastal Zone Management Plan for Collaroy-Narrabeen Beach and Fishermans Beach* (CZMP) prepared for Warringah Council in 2014, and the *Coastal Erosion Emergency Action Subplan for Beaches in Warringah* prepared for Warringah Council in 2012. He has also prepared DA coastal engineering reports at numerous locations along Collaroy-Narrabeen Beach over his career. Peter has inspected the area in the vicinity of the site on many occasions in the last few decades, including specific recent inspections of the site on 17 September 2020 and 12 January 2025.

All levels given herein are to Australian Height Datum (AHD). Zero metres AHD is approximately equal to mean sea level at present in the ocean immediately adjacent to the NSW mainland.

2. INFORMATION PROVIDED

Horton Coastal Engineering was provided with 22 architectural drawings (Drawing Numbers A000 to 008, 100 to 103, 200, 300, 400, 500, 501, 700, 800 and 900; and LA00) of the proposed development prepared by McNally Architects, all dated 31 January 2025. A site survey completed by Bee & Lethbridge (Ref No 23343, dated 9 October 2024) was also provided.

3. EXISTING SITE DESCRIPTION

Collaroy-Narrabeen Beach is about 3.5km long, extending between Narrabeen Head and the Narrabeen Lagoon entrance in the north, to a cliff at Collaroy Rock Baths in the south. The site is located between Octavia Street and Loftus Street at Narrabeen, towards the northern end of the beach.

At this location, the beach faces approximately ESE, and is exposed to the dominant south to south-easterly storm wave climate offshore of Sydney, as well as waves from the east and north of east. An oblique aerial view of the site is provided in Figure 1, and site photographs are given in Figure 2 and Figure 3.

Based on the survey provided, ground levels at the site vary from about 9.5m AHD at the seaward boundary, 9.7m AHD on the seaward side of the dwelling (which has a floor level of 9.91m AHD, and a garage at 9.51m AHD), and 9.5m AHD on the landward side of the dwelling.

Seaward of the site, there is a currently a vegetated dune that is about 25m wide. The beach and dune seaward of the site has a typical width to the shoreline at mean sea level (based on the NSW Beach Profile Database) of about 60m to 100m, with a median of 72m, varying with erosion and accretion cycles.

Figure 1: Oblique aerial view of site (at arrow) on 22 July 2024, facing west

Figure 2: View of site (at arrow) from near seaward boundary on 12 January 2025, facing NW

Figure 3: View of site (at arrow) from Narrabeen Beach on 12 January 2025, facing WNW

4. PROPOSED DEVELOPMENT

It is proposed to demolish the seaward portion of the existing dwelling and to construct an outdoor terrace extending about 5.3m east from the seaward face of the straight portion of the existing dwelling (or extending about 2.3m east of the most eastern point on the curved portion of the seaward face of the existing dwelling). This outdoor terrace is to have a finished floor level of 9.81m AHD, with the adjacent ground floor level of the dwelling at 9.91m AHD, the same as existing. A first floor balcony is proposed to extend over the entire width of the dwelling, which currently does not include the central portion.

A new roof is proposed over the altered areas, and various internal alterations are also proposed.

5. SUBSURFACE CONDITIONS

A geotechnical investigation of the site has not been completed as part of the subject DA. Based on experience, it is considered likely that the site is generally underlain by sand to below -1m AHD.

6. EROSION/RECESSION COASTAL HAZARDS

6.1 Generic Explanation of Hazard Zones

Nielsen et al (1992) has delineated various coastal hazard zones, as discussed below and shown in Figure 4, assuming an entirely sandy (erodible) subsurface, which is expected as discussed in Section 5.

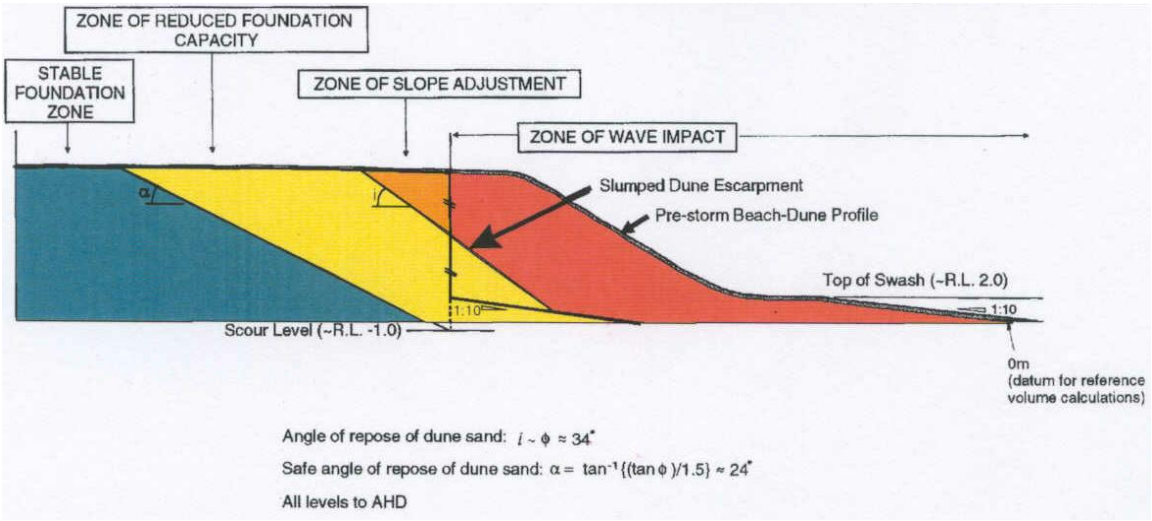


Figure 4: Schematic representation of coastal hazard zones (after Nielsen et al, 1992)

The Zone of Wave Impact (ZWI) delineates an area where any structure or its foundations would suffer direct wave attack during a severe coastal storm. It is that part of the beach which is seaward of the beach erosion escarpment.

A Zone of Slope Adjustment (ZSA) is delineated to encompass that portion of the seaward face of the beach that would slump to the natural angle of repose of the beach sand following removal by wave erosion of the design storm demand. It represents the steepest stable beach profile under the conditions specified.

A Zone of Reduced Foundation Capacity (ZRFC) for building foundations is delineated to take account of the reduced bearing capacity of the sand adjacent to the storm erosion escarpment. Nielsen et al (1992) recommended that structural loads should only be transmitted to soil foundations outside of the ZRFC (ie landward or below), as the factor of safety within the ZRFC is less than 1.5 during extreme scour conditions at the face of the escarpment. In general (without the protection of a terminal structure such as a seawall or revetment), dwellings/structures not piled and located within the ZRFC would be considered to have an inadequate factor of safety.

6.2 Existing Council Hazard Lines

In Figure 5, various coastal hazard lines are depicted at the site, with an outline of the seaward portion of the proposed development also shown in yellow.

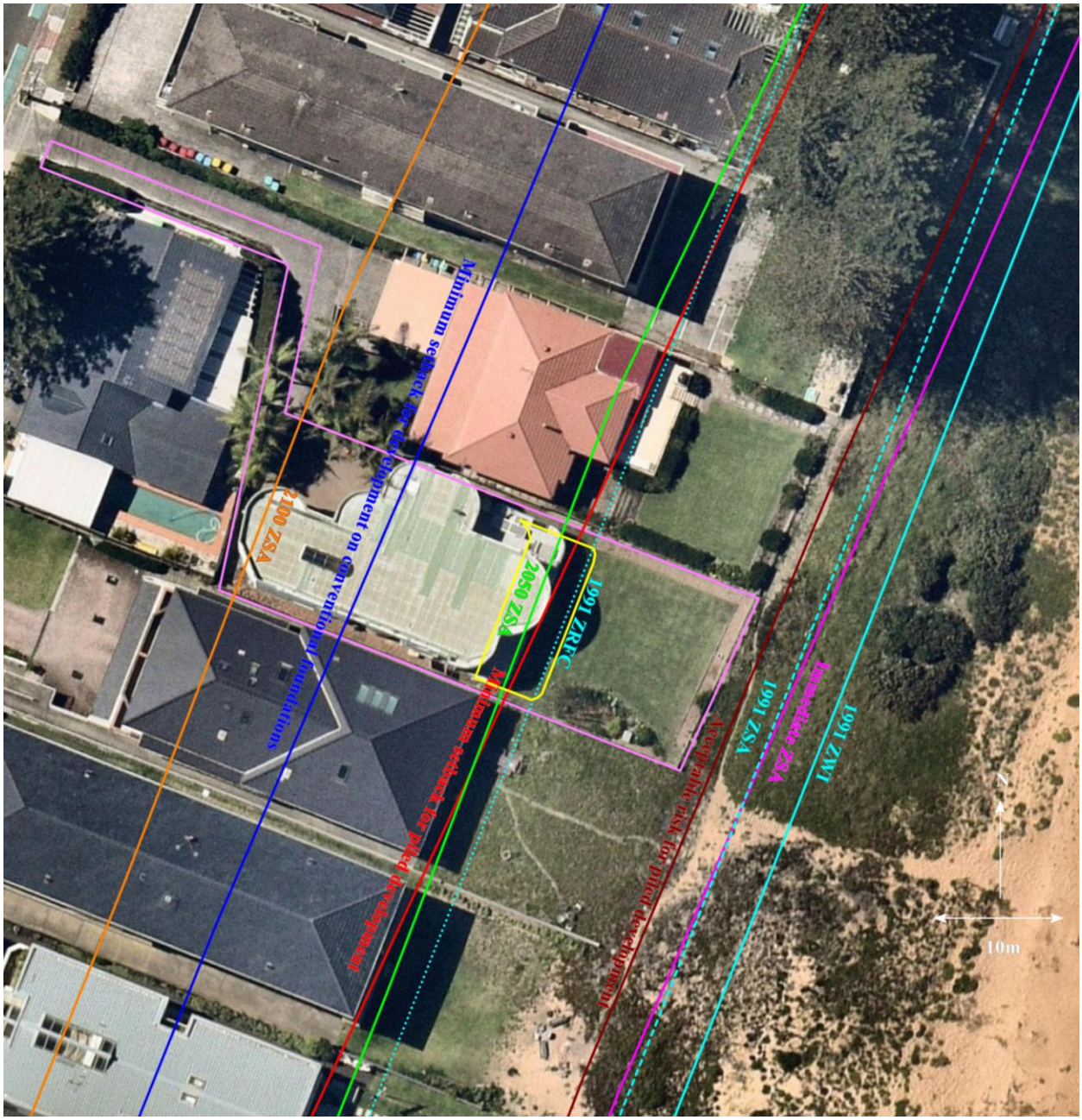


Figure 5: Coastal hazard lines and CZMP setbacks at site, with seaward portion of proposed dwelling in yellow, approximate boundary in pink, and aerial photograph taken on 23 November 2024

Geomarine (1991) devised former adopted Council hazard lines at Collaroy-Narrabeen Beach, with these lines (1991 ZWI, 1991 ZSA and 1991 ZRFC), all defined for an immediate planning period, depicted in Figure 5. Even though they are superseded, the *Warringah Local Environmental Plan 2011* Coastline Hazard Map still depicts these lines. The seaward edge of the proposed development is approximately coincident with the 1991 ZRFC.

As part of the CZMP, revised (compared to 1991) coastal hazard lines were delineated at Collaroy-Narrabeen Beach for immediate, 2050 and 2100 planning periods. These CZMP hazard lines (Immediate ZSA, 2050 ZSA and 2100 ZSA) are depicted in Figure 5, with all 3 lines at the landward edge of the ZSA. The proposed development extends about 3m seaward of the 2050 ZSA.

In the CZMP, two lines defining the required minimum setback for new beachfront development at the site were delineated, including consideration of development on conventional foundations and piled foundations[1]. These lines are depicted in Figure 5 as the 'minimum setback for development on piled foundations' and 'minimum setback for development on conventional foundations' respectively. These setback lines were developed based on a 60 year design life, which was justified in the CZMP as being appropriate based on consideration of Australian Standards, tax legislation and community expectations.

It is evident in Figure 5 that the proposed development is well seaward of the minimum setback for development on conventional foundations, meaning that piling of the proposed development is required, as outlined in Section 6.3.

As evident in Figure 5, the proposed works also extend 1.8m to 2.5m seaward of the minimum setback for piled development. This setback is located 15m landward of the seaward property boundary. As the main author of the CZMP, it is emphasised that the minimum setback for new piled beachfront development at this location was not delineated on the basis of coastal engineering risk considerations. Rather, it was delineated based on the following factors:

- maintaining existing established building lines;
- equity (for example, view loss for neighbours due to existing building lines); and
- beach amenity (for example, visual impact of structures near the public beach).

The works extending seaward of the minimum setback for piled development are acceptable from a coastal engineering perspective if these works are founded as outlined in Section 6.3. The works are acceptable overall if they provide a satisfactory outcome in terms of view loss and amenity impacts on adjacent development and the public beach, which are not coastal engineering considerations and hence not addressed herein, being addressed in the Statement of Environmental Effects submitted with the DA.

6.3 Foundation Design Requirements

The significantly altered portions of the proposed development, namely the seaward edge of the dwelling and seaward terrace, shall be founded on deep piles. It is required that a minimum depth of piling is adopted based on the distance seaward of the minimum setback for development on conventional foundations (with this distance denoted as X herein). That is, pile depths would need to be devised based on ignoring the upper Z metres of soil, where Z is equal to $X\tan(33)$, based on an angle of repose (Φ) for sand of 33°.

[1] Conventional foundations include slab-on-ground, strip footings and shallow piers, and can be distinguished from deep piled foundations.

Therefore, for example, the upper 7.1m of soil (that is, soil above 2.6m AHD[2]) should be ignored in defining the depth of piles at the piles at the landward edge of the terrace (which is located about 10.9m seaward of the minimum setback for development on conventional foundations), and the upper 10.6m of soil (soil above -0.9m AHD[3]) should be ignored in defining the depth of piles at the seaward edge of the terrace (which is located about 16.3m seaward of the minimum setback for development on conventional foundations). Note that the *Z* value does not need to extend below -1m AHD.

As part of detailed design, the structural engineer should allow for sand slumping forces in the seaward direction and wave forces in the landward direction on the piles, as advised by a coastal engineer.

As part of detailed design, it will also be necessary for the geotechnical and structural engineers to consider the potential for differential settlement between the new piled portions and existing portions of the development. It may be decided to found all new piles at the same level to minimise the risk of differential settlement. This is acceptable as long as the above requirements are followed at a minimum.

There are no particular foundation requirements from a coastal engineering perspective for any portions of the proposed development landward of the minimum setback for development on conventional foundations, where foundation design can be undertaken based on conventional structural and geotechnical engineering considerations.

Note that 1991 structural engineering drawings of the existing development depict 14 concrete piles (600mm diameter, 3m long, 25MPa) and reference to the ZRFC covering the seaward portion of the development. That is, the seaward portion of the existing dwelling is likely to have some piling already, but not sufficient to meet the requirements outlined above.

It would not be possible to retrofit deep piles to the existing portions of the development being retained, with the 'proposed development' as defined herein limited to the seaward edge of the dwelling and seaward terrace.

7. COASTAL INUNDATION COASTAL HAZARDS

In Geomarine (1991) and the CZMP, a present day wave runup level of 8m AHD was adopted at Collaroy-Narrabeen Beach in the vicinity of the site (which can be taken as a 100 year ARI[4] wave runup level exceeded by 2% of waves), assuming a foreshore at the runup level or higher. This runup level could increase further with sea level rise, conservatively to around 9m AHD if upper limit sea level rise projections are realised over the next 80 or so years.

With the site at an elevation of around 9.5m AHD, and a ground floor level of 9.91m AHD, wave runup and coastal inundation are not expected to be significant risks at the site over the 60 year design life, and there are thus no coastal engineering requirements for the proposed development in relation to runup and inundation.

[2] That is, the piles would need to extend some distance below 2.6m AHD at this location, developing their capacity to resist the applied loads entirely below 2.6m AHD (the level above which soil is assumed not to provide any resistance at this location).
[3] That is, the piles would need to extend some distance below -0.9m AHD at this location.
[4] Average recurrence interval.

8. CONSENT MATTERS

8.1 *Warringah Local Environmental Plan 2011*

Based on Clause 6.5(3) of the *Warringah Local Environmental Plan 2011* (LEP), 'development consent must not be granted unless the consent authority is satisfied that the development:

(a) will not significantly adversely affect coastal hazards, and
(b) will not result in significant detrimental increases in coastal risks to other development or properties, and
(c) will not significantly alter coastal hazards to the detriment of the environment, and
(d) incorporates appropriate measures to manage risk to life from coastal risks, and
(e) avoids or minimises exposure to coastal hazards, and
(f) makes provision for relocation, modification or removal of the development to adapt to coastal hazards and NSW sea level rise planning benchmarks'.

Based on Clause 6.5(4), 'development consent must not be granted unless the consent authority is satisfied that the foundations of the development have been designed to be constructed having regard to coastal risk'.

With regard to Clauses 6.5(3)(a), (b) and (c), the proposed development is unlikely to have a significant impact on coastal hazards or increase the risk of coastal hazards in relation to any other land (or the environment), as it is to be founded with structural integrity on piles (assuming that the requirements in Section 6.3 are followed) above the level of wave action for an acceptably rare storm and acceptably long design life. In fact, the requirements in Section 6.3 would mean that the proposed development has a lower risk of being damaged by erosion/recession than the existing development.

The proposed development would have an acceptably low risk of being affected by coastal hazards if the foundation design requirements provided in Section 6.3 are followed, and Clauses 6.5(3)(d) and (e) and 6.5(4) would therefore be satisfied.

With regard to Clause 6.5(3)(f), the proposed development has been designed to not be damaged by coastal hazards for an acceptably rare storm and acceptably long design life, rather than relocated or removed. This is consistent with the CZMP.

8.2 *Warringah Development Control Plan 2011*

Part E9 of the *Warringah Development Control Plan 2011* (DCP)[5] has discussion on 'Coastline Hazard'. Based on the DCP, the risk of damage from coastal processes is to be reduced through having appropriate setbacks and foundations. If foundation design is carried out consistent with Section 6.3, the proposed development would be appropriately founded. The proposed beach setback of the development is acceptable from a coastal engineering perspective, with the Statement of Environmental Effects submitted with the DA discussing planning issues related to this setback.

Furthermore, based on Part E9 of the DCP, the applicant must demonstrate compliance with the *Northern Beaches Coastal Erosion Policy*, the CZMP and the *Collaroy-Narrabeen Protection Works Design Specifications*. As no coastal protection works (seawalls) are proposed, neither

[5] Amendment 22 of the DCP was reviewed, which commenced on 1 June 2022.

the *Northern Beaches Coastal Erosion Policy* (except as noted below) nor *Collaroy-Narrabeen Protection Works Design Specifications* are generally applicable for the subject DA.

With regard to the *Northern Beaches Coastal Erosion Policy*, as noted above this is mostly focussed on the construction of coastal protection works. However, it can be noted that:

- as per 2(b), the risk of damage to the proposed development from coastal processes is acceptably low; and
- as per 2(d), the proposed development would not adversely impact on adjoining properties or coastal processes.

Therefore, the proposed development complies with the *Northern Beaches Coastal Erosion Policy,* where relevant.

Also, based on the DCP, development must be constructed with a suitable floor level or in a manner that minimises the risk of coastal inundation for severe coastal storms occurring over the next 50 years. This is the case for the proposed development, as discussed in Section 7.

8.3 *State Environmental Planning Policy (Resilience And Hazards) 2021*

8.3.1 Preamble

Based on *State Environmental Planning Policy (Resilience and Hazards) 2021*[6] (SEPP Resilience) and its associated mapping, the site is the site is within a 'coastal environment area' (see Section 8.3.2) and 'coastal use area' (see Section 8.3.3).

8.3.2 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,
(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'.

With regard to (a), the proposed works are in a developed residential area, and would not be expected to adversely affect the biophysical and hydrological (surface and groundwater) environments. Based on review of stormwater drainage drawings prepared by Harrison & Morris Consultancy, conventional stormwater management measures are proposed including

[6] Encompassing the former *State Environmental Planning Policy (Coastal Management) 2018*.

Atlantis Flo-Cell drainage cells, and piped drainage to an existing absorption system seaward of the dwelling. The proposed development would not be a source of pollution as long as appropriate construction environmental controls are applied.

Assuming that there is no native vegetation or fauna and their habitats at the site that would be impacted by the works (and there is no reason to assume otherwise), the proposed works would not be expected to adversely affect the ecological environment.

With regard to (b), the proposed development would not be expected to adversely affect coastal environmental values or natural coastal processes over its design life, as it is at an acceptably low risk of damage from erosion/recession and inundation for an acceptably rare storm and over an acceptably long design life.

With regard to (c), the proposed development would not adversely impact on water quality as long as appropriate construction environmental controls are applied.

With regard to (d), this is not a coastal engineering matter so is not necessarily definitively considered herein. That stated, there are no undeveloped headlands nor rock platforms in proximity to the proposed development, no marine vegetation in the area to be developed, and no known native vegetation of significance at the site. No significant impacts on marine fauna and flora would be expected as a result of the proposed development, as the development would not be expected to interact with subaqueous areas over the design life.

With regard to (e), the proposed development would not impact on public open space and access to and along the foreshore, being entirely within private property.

With regard to (f), a search of the Heritage NSW 'Aboriginal Heritage Information Management System' (AHIMS) was undertaken on 5 March 2025. This resulted in no Aboriginal sites nor Aboriginal places being recorded or declared within at least 50m of the site.

With regard to (g), the proposed development is entirely on private property and would thus not interact with the public surf zone over its design life, and only interact with the surf zone within the site in an extreme storm when surfing would not generally be carried out due to the dangerous conditions. Therefore, the proposed development 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 the adverse impacts referred to in Clause 2.10(1).

8.3.3 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 (a)(i), the proposed development would not impact on foreshore or beach access, as discussed previously.

With regard to (a)(ii), (a)(iii) and (c), these are not coastal engineering matters so are not considered herein.

With regard to (a)(iv), there are no particular Aboriginal sites nor Aboriginal places within 50m of the proposed development, as noted in Section 8.3.2.

With regard to (a)(v), the nearest environmental heritage items to the proposed development listed in Schedule 5 of the LEP are the shops and residences at 65 and 67 Waterloo Street Narrabeen, around 500m from the site. The proposed development would not be expected to impact on this or more distant heritage items.

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).

8.3.4 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'. As noted in Section 8.1, the proposed development would not be expected to give rise to any increased coastal hazard on that land or adjacent land, and actually reduces the risk of coastal hazards.

8.3.5 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'. The CZMP operated as a certified coastal management program until 31 December 2023, but has now lapsed. However, the CZMP is still a relevant consideration. The foundation requirements devised herein are consistent with the CZMP requirements.

8.3.6 Synthesis

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

9. CONCLUSIONS

It is proposed to undertake alterations and additions at 153a Ocean Street Narrabeen. The foundations of the proposed development (seaward edge of the dwelling and seaward terrace) must satisfy the requirements described in Section 6.3.

If the requirements outlined in Section 6.3 are implemented, the proposed development would be consistent with the coastal engineering requirements listed in Clause 6.5 of *Warringah Local Environmental Plan 2011,* Part E9 of the *Warringah Development Control Plan*, *State Environmental Planning Policy (Resilience and Hazards) 2021*, the CZMP, and the *Northern Beaches Coastal Erosion Policy*.

10. REFERENCES

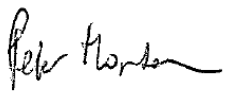
Geomarine (1991), "Narrabeen-Collaroy Fishermans Beach, Criteria for the Siting and Design of Foundations for Residential Development", *Geomarine Report No. 69021R02*, in association with Coffey Partners International, for Warringah Shire Council, February

Nielsen, AF; Lord, DB and HG Poulos (1992), "Dune Stability Considerations for Building Foundations", *Australian Civil Engineering Transactions*, Institution of Engineers Australia, Volume CE34, No. 2, June, pp. 167-173

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



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