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Coastal Engineering Advice on Long Reef SLSC Redevelopment

1. INTRODUCTION AND BACKGROUND

It is proposed to demolish and rebuild Long Reef SLSC. Northern Beaches Council requires that a coastal engineering assessment is prepared as part of a Development Application for the works. Horton Coastal Engineering Pty Ltd has been engaged to complete this assessment, as set out herein.

The report author, Peter Horton [BE (Hons 1) MEngSc MIEAust CPEng NER], is a professional Coastal Engineer with 27 years of coastal and water 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.

In previous employment, Peter was the main author of the *Coastal Zone Management Plan for Collaroy-Narrabeen Beach and Fishermans Beach* (CZMP) initially prepared for Warringah Council in 2014, and the *Coastal Erosion Emergency Action Subplan for Beaches in Warringah* prepared for Warringah Council in 2012. In previous employment, he also prepared a coastal engineering assessment for a DA relating to Long Reef SLSC in 2005. Peter has inspected the area in the vicinity of the subject property on many occasions in the last decade, including a specific recent inspection of the property on 16 January 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.

2. INFORMATION PROVIDED

Horton Coastal Engineering has reviewed numerous iterations of architectural drawings over the duration of the project, with Adriano Pupilli Architects Drawings DA 000 to 022 (23 drawings) dated 3 December 2019 (Revision A) considered herein. Horton Coastal Engineering was also provided with:

- 11 landscape drawings by Tyrrell Studio, Drawings LR-L001, 111, 112, 121, 122, 131-133 and 201-203 (dated 3 December 2019 and Issue 03); and

- a site survey prepared by Total Surveying Solutions and dated 14 December 2017, Plan No. 72507_A.

3. EXISTING SITE DESCRIPTION

Long Reef SLSC is located adjacent to Long Reef Beach, and about 180m north of the entrance to Dee Why Lagoon. At this location, Long Reef Beach faces approximately SSE to SE.

Based on the survey provided, and Airborne Laser Scanning data held by Horton Coastal Engineering that was captured in April 2014, ground elevations vary from about 4.5m AHD on the southern side of the main existing SLSC building, to 4.7m AHD on the northern side, increasing moving north to about 10m AHD at the northern edge of a grassed area. Moving seaward, ground elevations slightly increase to about 4.9m at the landward edge of the dune vegetation, then to at least 7.5m AHD at the dune crest, with maximum levels of about 9m AHD. At the sand/vegetation interface on the seaward side of the dune vegetation, elevations are in the order of 6.5m AHD. Levels then generally fall moving seaward to the shoreline over a typical distance of about 40m to mean sea level, with this distance reducing during and after coastal storms when beach erosion occurs.

The main existing SLSC building has a finished ground floor level of 4.5m to 4.7m AHD. A café to the west has a finished ground floor level of 4.9m AHD, with attached toilets to the north of the café having a finished ground floor level of 5.7m AHD.

A view of the existing SLSC from the dune crest is provided in Figure 1, with a view from Long Reef Beach of the dune seaward of the SLSC provided in Figure 2.

Figure 1: View of Long Reef SLSC from dune crest on 16 January 2019, looking NNE

Figure 2: View of dune seaward of Long Reef SLSC on 16 January 2019, looking north

4. PROPOSED DEVELOPMENT

It is proposed to demolish and rebuild Long Reef SLSC over a generally similar footprint to the existing SLSC. The main SLSC building, to comprise two storeys, is to have a finished ground floor level of 4.9m AHD (similar to existing). A detached amenities building is to be constructed to the NW of the main SLSC building with a finished floor level of 5.0m AHD, with a detached locker room building and café to the west of the main SLSC building with a finished floor level of 4.9m AHD. Showers are to be located south of the café and on the seaward side of the main building. The existing beach accessways seaward of the SLSC are to be retained.

The rooms along the seaward edge of the main building comprise a foyer, club store (with a lift located landward), first aid room, and SLSC storage. The seaward (southern) face of the building, moving from the most at risk SE corner to the west, comprises a solid concrete/tiled face at the public showers, then compressed fibre cement doors (at the SLSC storage, first aid room, and club store), then a glass entry to the foyer.

5. EROSION/RECESSION COASTLINE HAZARDS AND ACCEPTABLE RISK

Acceptable risk lines for erosion/recession at Long Reef SLSC are depicted in Figure 3, for a new SLSC on conventional foundations or piled foundations. These lines were derived for a conservative planning period of 100 years, as stipulated by Northern Beaches Council, and developed by the author of the report herein as documented in the report "Risk Assessment to Define Appropriate Beachfront Development Setback in Relation to Coastline Hazards for Redevelopment of Long Reef SLSC" (dated 26 May 2017). The lines were derived assuming an entirely (erodible) sandy subsurface in the active coastal erosion/recession zone above -1m AHD, which may be conservative given that subsurface clays were found in the geotechnical investigation (see Section 6).

It is evident that the proposed development is generally landward of the "acceptable risk on conventional foundations" line, meaning that it can generally be placed on conventional foundations (from a coastal engineering perspective). That is, foundation design for the proposed development can generally be undertaken with consideration of structural and geotechnical issues only, without coastal engineering input, except as noted below.

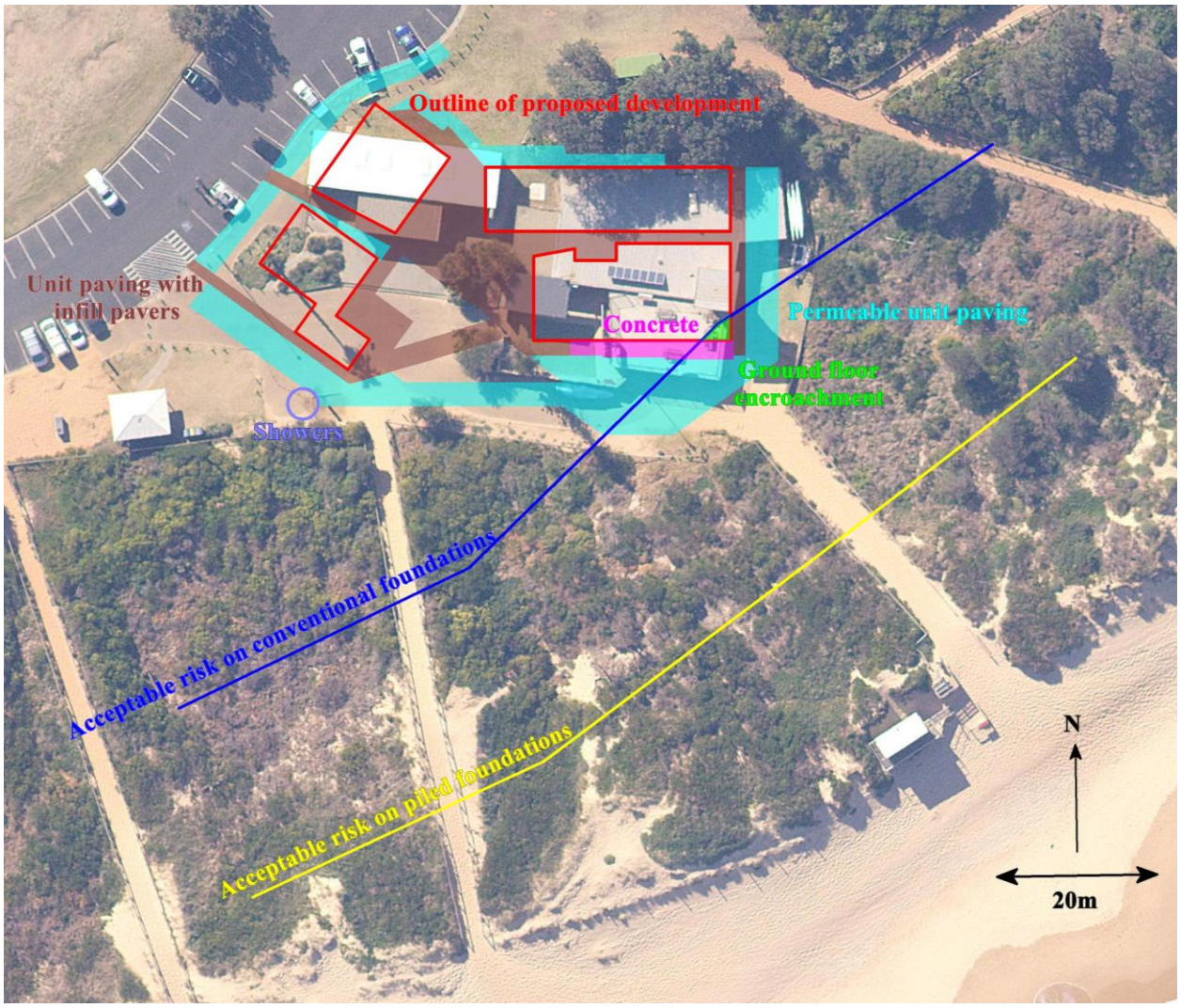


Figure 3: Acceptable risk lines for new development for a 100-year planning period at Long Reef SLSC, with outline of ground floor of proposed development and extent of ground floor encroachment seaward of the "acceptable risk on conventional foundations" line shown, and the extent of paving and concrete around the SLSC also shown (aerial photograph taken 17 August 2018)

A small area of the ground floor extends (encroaches) seaward of the "acceptable risk on conventional foundations" line, as depicted in Figure 3. Based on discussions with Adriano Pupilli Architects and the structural engineers for the development, Partridge, it is understood that it is desired to avoid piling of this ground floor encroachment area. Given that Council has stipulated a literal interpretation of the "acceptable risk on conventional foundations" line, and stipulated that a 100 year planning period was to be adopted for the coastal engineering analysis, to avoid piling it is necessary for the development to be cantilevered over the encroachment area. It is understood that the proposed stiffened raft foundations of the structure will be thickened and more heavily reinforced landward of the "acceptable risk on conventional foundations" line to enable this cantilever. If possible, it is also recommended that the concrete area to the south of the SLSC (magenta in Figure 3) is cantilevered where seaward of the "acceptable risk on conventional foundations" line, in this manner.

There is a disconnect between the design life of the proposed building (life that structural components are designed for, such as concrete) of 50 years, and the 100 year planning period adopted for the acceptable risk lines. It is considered that the coastal engineering planning period could be less than 100 years, and should be selected based on the period that Council

considers that they want the building to remain (with maintenance) before it is likely to require redevelopment, or the period that they want the building to remain before it reaches an unacceptably high risk of being undermined, or the period that they want to be remediating a deteriorating structure. It is not a requirement of *Warringah Development Control Plan 2011* that a 100 year coastal engineering planning period is adopted. That stated, a 100 year coastal engineering planning period was adopted herein, as stipulated by Council.

At the SE corner of the proposed SLSC building there is to be paving (both permeable units and units with infills) extending seaward of the "acceptable risk on conventional foundations" line. Given the long period (in the order of 100 years) before this area is likely to be impacted by coastal erosion/recession, the pavers are considered to be acceptable from a coastal engineering perspective. If this area is threatened in the future, there may be consideration of removing the pavers so that they are not undermined and end up scattered over the sandy beach area, where it would be difficult to find and recover all paving units.

6. SUBSURFACE CONDITIONS

Based on a geotechnical investigation completed by Crozier Geotechnical Consultants (2019), it is evident that the subject site in underlain by about 1m of fill and then sand, with underlying clay found as follows:

- below 0.5m AHD on the eastern side (Bore No. 1), to the limit of testing of -2.4m AHD;
- below 1.6m AHD on the western side (Bore No. 2), to the limit of testing of -1.8m AHD.

Cone Penetrometer Testing (CPT) indicated the following depths of clay:

- SW side (CPT 1): 0.6m AHD;
- SE side (CPT 2): 1.7m AHD;
- NE side (CPT 3): 0.2m AHD; and
- NW side (CPT 4): 1.2m AHD.

This indicates a variable clay level, but a consistent presence of clay in the active coastal erosion/recession zone above -1m AHD, at an average level of 1.0m AHD. If the "acceptable risk on conventional foundations" line in Figure 3 was reassessed taking these clay levels into account (supplemented by an additional geotechnical investigation to determine clay levels seaward of the proposed development and moving towards the beach), then this line may move seaward[1]. If the "acceptable risk on conventional foundations" line was reassessed to be seaward of the proposed development, then no cantilevering of the development in the SE corner would be required. If the additional construction cost of cantilevering is likely to be significant, then a reassessment of the "acceptable risk on conventional foundations" line may be considered to be warranted.

7. CATCHMENT AND OVERLAND FLOW FLOODING

Council has advised that Long Reef SLSC and its surrounds are not affected by catchment and overflow flooding for the 100 year Average Recurrence Interval event.

[1] Given that clay is less erodible than sand.

8. COASTAL INUNDATION COASTLINE HAZARDS

As noted in Section 3, the dune seaward of Long Reef SLSC has a crest elevation above 7.5m AHD. Maintenance of this elevated dune seaward of the SLSC will assist in reducing the risk of oceanic inundation of the development, although in the long term over the design 100 year planning period it must be assumed that this dune will be removed by erosion/recession. Therefore, there is the potential for inundation to impact on the SLSC.

The part of the SLSC most vulnerable to inundation is the SE corner, where a solid concrete wall is presented in the shower area, which would be expected to suitably resist inundation. The roller door on the eastern side of the building may be subject to damage from inundation, although sandbagging at times of storms would reduce this risk (roller doors cannot withstand wave forces, so have to be considered sacrificial).

It is understood that solid compressed fibre cement doors are proposed at the SLSC storage, first aid room, and club store to the west of the showers (and also below the level of the stairs moving further west). This is tolerant of getting wet and is considered to be suitable from a coastal engineering perspective, although there should be consideration of potential wave forces on these doors.

West of the stairs, full height glass is proposed at the foyer entry. It is recommended that the foyer glass at the southern entry is toughened such that it holds together when shattered, thus reducing the risk of inundation entering the foyer.

The rooms along the ground floor of the southern face of the main SLSC building should have the following measures applied to reduce the risk of inundation damage (where practical):

- floor finishes and wall materials that are able to withstand inundation, such as concrete and tiles, should be used up to 1m above the finished floor level;
- items that could be damaged by inundation, or become polluting due to inundation, should be stored at least 1m above the floor, or relocated further landward prior to a major forecast coastal storm[2]; and
- electrical fittings and outlets that could be damaged by inundation should be located at least 1m above the finished floor level, or waterproofed below this level.

Sand bags could also be deployed as required to reduce the extent of inundation into the building during coastal storms[2].

9. DUNE TOPOGRAPHY AND DUNE VEGETATION

It is important that dune topography (to provide sand volume to meet storm demand and reduce the potential for wave overtopping) and dune vegetation (to reduce windblown sand issues) is maintained seaward of the proposed development. If there is ever consideration of mechanically lowering dune topography in the future, then the acceptable risk lines would need to be reassessed.

[2] This is unlikely to be necessary for a number of decades.

10. MERIT ASSESSMENT FROM A COASTAL ENGINEERING PERSPECTIVE

10.1 *Warringah Local Environmental Plan 2011*

Clause 6.5 of *Warringah Local Environmental Plan 2011* (LEP) does not apply to the proposed development as the subject property is not shown on the Coastline Hazard Map. However, as part of Prelodgement Advice from Council (Application No PLM2019/0149), it was requested that this Clause was addressed, as set out below.

Based on Clause 6.5(3) of the 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".

With regard to 6.5(3)(a), the proposed development has been situated well landward of expected coastal processes (such as beach erosion and shoreline recession) for a sufficiently long life in the order of 100 years. It would therefore not be expected to significantly adversely affect coastal hazards over that life, nor alter coastal hazards to the detriment of the environment as per 6.5(3)(c).

For 6.5(3)(b), there is no development adjacent to the proposed development, and there is no mechanism whereby the proposed development would cause increases in coastal risks to adjacent areas, as the land at and seaward of the development is not constrained from eroding or receding.

For 6.5(3)(d), the proposed development is at an acceptably low risk of damage for a sufficiently long life. Risk to life is considered to be insignificant, noting that it is not a habitable structure and coastal storms are foreseeable. Risk to life associated with coastline hazards at the development would be managed through evacuation of the SLSC (if required) by the State Emergency Service, NSW Police and/or Council, and in accordance with the *Coastal Erosion Emergency Action Subplan for Beaches in Warringah* (that is, the SLSC would not be expected to be occupied at any time when it could be undermined).

For 6.5(3)(e), the proposed development is at an acceptably low risk of damage for a sufficiently long life, so exposure to coastal hazards has been acceptably minimised. The risk to the proposed building is less than the current building, as it encroaches a smaller distance over the "acceptable risk on conventional foundations" line, and would be supported on foundations if undermined seaward of that line.

For 6.5(3)(f), the proposed development is at an acceptably low risk of damage for a sufficiently long life, in the order of 100 years. On this basis there is no need to design the building to be relocatable. If ever at threat due to coastal hazards in the future, the structure would be expected to be well beyond its design life at that time (the life that structural components are to be designed for), making retention of such a structure unnecessary and economically unjustified.

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". As discussed in Section 5, the proposed development is generally landward of an "acceptable risk on conventional foundations" line, and can therefore generally be placed on conventional foundations (from a coastal engineering perspective). Where the development extends seaward of the "acceptable risk on conventional foundations" line, it is to be cantilevered, with thickened and more heavily reinforced foundations landward of the "acceptable risk on conventional foundations" line to enable this cantilever. Therefore, the foundations of the development have been designed to be constructed having regard to coastal risk.

The proposed development is thus consistent with Clause 6.5 of the LEP, assuming that it actually applied at the subject property.

10.2 *Warringah Development Control Plan 2011*

Part E9 of *Warringah Development Control Plan 2011*[3] (DCP) has discussion on "Coastline Hazard", but does not apply to the proposed development as the subject property is not shown on the LEP Coastline Hazard Map. However, as part of Prelodgement Advice from Council (Application No PLM2019/0149), it was requested that this Clause was addressed, as set out below.

Based on Part E9 of the DCP, requirements are as follows:

1. "The risk of damage from coastal processes is to be reduced through having appropriate setbacks and foundations, as detailed in Criteria for the Siting and Design of Foundations for Residential Development.
2. For development in the area affected by the certified Coastal Zone Management Plan for Collaroy-Narrabeen Beach and Fishermans Beach (Coastal Zone Management Plan), the applicant must demonstrate compliance with the Northern Beaches Coastal Erosion Policy, the Coastal Zone Management Plan and the Collaroy-Narrabeen Protection Works Design Specifications (as amended from time to time)".

For Item 1, the risk of damage to the proposed development from coastal processes has been reduced by generally locating the development landward of the "acceptable risk on conventional foundations" setback line, and founding the entire development landward of this line.

For Item 2, this is generally not applicable nor relevant to the proposed development, as no coastal protection works are proposed and these documents apply to Collaroy-Narrabeen Beach. Although the focus of the *Northern Beaches Coastal Erosion Policy* is mostly on the construction of coastal protection works at Collaroy-Narrabeen Beach, it can be noted that the four principles in Section 2 of that policy are as follows:

(a) "the maintenance of public beach amenity and surf quality in the future as the highest priority.
(b) property owners are primarily responsible for carrying out new development on beachfront and near beachfront land adjacent to Collaroy-Narrabeen Beach and

[3] Amendment 15 of the DCP was reviewed, which commenced on 14 September 2019.

Fishermans Beach provided that the risk of damage from coastal processes can be demonstrated to be acceptably low.

(c) the preservation of the public beachfront, beachfront assets and near beachfront assets where the risk of damage from coastal processes can be demonstrated to be acceptably low.

(d) property owners (including government) are responsible for protecting their property from the impacts of coastal processes, and are responsible for ensuring their property does not adversely impact on adjoining properties or coastal processes".

Applying the above to the proposed development, for Item (a) the development would not be expected to affect public beach amenity (from a coastal engineering perspective) nor surf quality over its design life. For Item (b), with the proposed development founded landward of the "acceptable risk on conventional foundations" setback line, it is at an acceptably low risk of damage from coastal processes, and also satisfies Item (c). For Item (d), the proposed development would not adversely impact on adjoining properties or coastal processes, as discussed in Section 10.1. Therefore, the proposed development complies with the principles of the *Northern Beaches Coastal Erosion Policy,* where geographically applied to Long Reef.

In the DCP, it is noted that "Council will take the following principles into account when it assesses development:

(i) when applications for development are lodged with Council both the Area of Wave Impact and Slope Adjustment and the Area of Reduced Foundation Capacity are to be marked on the plans submitted to Council;

(ii) in the Area of Reduced Foundation Capacity, account is made of the reduced bearing capacity of the sand adjacent to the escarpment of a potentially fully eroded Area of Wave Impact and Slope Adjustment. Structures within the Area of Reduced Foundation Capacity should be designed such that loads are transmitted to soil foundations outside it. This would generally be achieved by piling structures within the Area of Reduced Foundation Capacity into the Stable Foundation Area below it as per Criteria for the Siting and Design of Foundations for Residential Development;

(iii) for development within the Area of Reduced Foundation Capacity, geotechnical/ structural design of foundations (including specialist coastal engineering advice) may be required for the whole structure;

(iv) a suitably qualified engineer must undertake the geotechnical/structural design of the foundations in accordance with coastal engineering considerations and the Criteria for the Siting and Design of Foundations for Residential Development, and the provisions of this part; and

(v) 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."

For Items (i) to (iv), the "acceptable risk on conventional foundations" line has been delineated herein, and this considers the Zone of Wave Impact, Zone of Slope Adjustment, and Zone of Reduced Foundation Capacity. As noted in Section 5, foundation design for the proposed development can generally be undertaken with consideration of structural and geotechnical issues only, without coastal engineering input.

For Item (v), if the recommendations outlined in Section 8 are followed, the proposed development would be at an acceptably low risk of damage from coastal inundation for at least the next 50 years.

The proposed development is thus consistent with Part E9 of the DCP, assuming that it actually applied at the subject property.

10.3 *State Environmental Planning Policy (Coastal Management) 2018*

10.3.1 Preamble

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

10.3.2 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".

With regard to (a), the proposed development is in an already developed area, and would not be expected to adversely affect the biophysical, hydrological (surface and groundwater) and ecological environments[4]. As noted in Wood & Grieve Engineers (2019), the stormwater release rate is decreased post-development due to a smaller impervious area, and stormwater quality improvement targets of Council are likely to be achieved. The proposed development would not be expected as a source of pollution as long as appropriate construction environmental controls are applied.

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 located well landward of erosion/recession 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. As discussed above, Wood & Grieve Engineers (2019) noted that stormwater quality improvement targets of Council are likely to be achieved. No sensitive coastal lakes identified in Schedule 1 of SEPP Coastal are in the vicinity of the proposed development.

[4] Ecological issues are not coastal engineering matters, so Horton Coastal Engineering is unable to definitely comment on this.

With regard to (d), this is not a coastal engineering matter so is not (necessarily) comprehensively considered herein. That stated, there are no undeveloped headlands or 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 property. 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), the proposed development would not impact on public open space and access to and along the foreshore, with existing beach accessways maintained and public open space incorporated into the development.

With regard to (f), based on a search of the Office of Environment and Heritage "Aboriginal Heritage Information Management System" (AHIMS) on 28 October 2019, there are no Aboriginal sites recorded or Aboriginal Places declared within at least 200m of the development area.

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 the adverse impacts referred to in Clause 13(1).

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

With regard to (a)(ii), (a)(iii), (a)(v) and (c), these are not coastal engineering matters so are not considered herein, although for (a)(v) it can be noted that the closest heritage item listed in Schedule 5 of the LEP is over 400m from the proposed development, and the closest heritage conservation area to the proposed development is Dee Why Lagoon and Reserve, which is 180m to the south (that is, the proposed development would not expected to impact on any heritage items or heritage conservation areas listed in Schedule 5 of the LEP).

With regard to (a)(iv), there are no Aboriginal sites recorded or Aboriginal Places declared within at least 200m of the development area, as noted in Section 10.3.2.

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

10.3.4 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". As discussed in Section 10.1, 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.

10.3.5 Clause 16

Based on Clause 16 of SEPP Coastal, "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.

10.3.6 Synthesis

The proposed development satisfies the requirements of SEPP Coastal for the matters considered herein.

11. CONCLUSIONS

It is proposed to demolish and rebuild Long Reef SLSC, and Northern Beaches Council has stipulated a 100 year coastal engineering planning period for its redevelopment. The proposed Long Reef SLSC is founded landward of the "acceptable risk on conventional foundations" line for the 100 year planning period, meaning that it can generally be placed on conventional foundations (from a coastal engineering perspective). That is, foundation design for the proposed development can generally be undertaken with consideration of structural and

geotechnical issues only, without coastal engineering input. It is understood that the proposed stiffened raft foundations of the structure will be thickened and more heavily reinforced landward of the "acceptable risk on conventional foundations" line to enable a cantilever seaward of this line at the SE corner of the building. It is recommended that the concrete area to the south of the main SLSC building is also cantilevered in this manner.

Measures to reduce the risk of oceanic inundation (wave runup) damage (where practical) on the ground floor have been listed in Section 8.

It is important that dune topography (to provide sand volume to meet storm demand and reduce the potential for wave overtopping) and dune vegetation (to reduce windblown sand issues) is maintained seaward of the proposed development. If dune topography was ever considered to be mechanically lowered, then the acceptable risk lines would need to be reassessed.

The proposed development satisfies Clause 6.5 of *Warringah Local Environmental Plan 2011* and Part E9 of *Warringah Development Control Plan 2011* (with both of these planning instruments actually not applicable at the property), and satisfies the coastal engineering requirements of *State Environmental Planning Policy (Coastal Management) 2018* (Clauses 13, 14, 15 and 16) for the matters considered herein.

12. REFERENCES

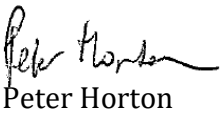
Crozier Geotechnical Consultants (2019), *Report on Geotechnical Site Investigation for Proposed Development at Long Reef Surf Life Saving Club, Collaroy*, Project No. 2017-235, 18 March, Issue 0

Wood & Grieve Engineers (2019), *Long Reef SLSC Stormwater Management Report*, 16 October, prepared by Renata Tracey, Ref: 33241, Revision A

13. 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