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Coastal & Water Consulting

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29 March 2017

***Horton Coastal Engineering Pty Ltd ats NSW Coastal Panel* (Land and Environment Court No. 324345 of 2016), Response to 15 March 2017 Letter from Beatty Legal**

Based on a letter from Beatty Legal (solicitor for the Respondent) dated 15 March 2017, a total of 4 requests for additional information were listed. These 4 items are responded to in turn in subsequent sections.

1. ITEM 1: PEER REVIEW OF WAVE OVERTOPPING CALCULATIONS

The request for Item 1 was as follows:

> "In respect of the information provided in response to item 6[1] (which was relied upon by the Applicants' geotechnical and structural engineers), the calculations and information provided may lead to an underestimation of the hydraulic load on the structure. This may be associated with saturation of the soil mass behind the proposed structure resulting from wave run up and overtopping that may be experienced during extreme storm events. In particular the information provided is inconsistent with the extensive wave overtopping observed in less extreme storm events (in a potentially similar environment) such as occurred at Collaroy/Narrabeen during the June 2016 East Coast Low event. The Panel asks that these calculations be peer reviewed or independently verified".

The suggestion in the above item is that calculated wave overtopping rates have been underestimated for the subject Wamberal matter because extensive wave overtopping occurred at Collaroy-Narrabeen Beach in the June 2016 storm. That is, if overtopping damage occurred at Collaroy-Narrabeen in a lesser storm than the design event, then more overtopping damage would occur at Wamberal in the design event, and this should be reflected in higher calculated overtopping rates). This suggestion is disagreed with for two reasons, namely:

1. There is no means of determining if the actual rates of overtopping at Collaroy-Narrabeen Beach in the June 2016 storm were lower or higher than those calculated in Horton Coastal Engineering (2017). As far as Horton Coastal Engineering is aware, there was no measurement of wave overtopping rates at Collaroy-Narrabeen Beach in the June 2016 storm.
2. In the view of Horton Coastal Engineering, damage from wave overtopping at Collaroy-Narrabeen Beach in June 2016 was limited. Peter Horton extensively inspected properties at Collaroy-Narrabeen Beach after the June 2016 storm (inspecting every property in detail south of Devitt Street at Collaroy-Narrabeen Beach in the month after the

[1] Referring to Horton Coastal Engineering Pty Ltd (2017).

storm). The only property where any significant wave overtopping damage was observed to have potentially occurred was at 1150 Pittwater Road Collaroy, but the overtopping at this site was preceded by heavy rainfall combined with a broken stormwater pipe that caused the initiation of a sinkhole at the property. Horton Coastal Engineering demonstrated to insurers in this matter that the sinkhole was mostly caused by rainfall-runoff infiltration/percolation induced by the broken pipe, and that the available evidence would suggest that wave overtopping was much less significant in causing the damage (which was accepted by the insurers).

Notwithstanding the above issues, Haskoning Australia (a company of Royal HaskoningDHV) has peer reviewed the overtopping calculations in Horton Coastal Engineering (2017), see **Appendix A**. Haskoning Australia found that the calculations were reasonable, and reiterated that the works themselves would not expected to be significantly damaged by overtopping for the design storm over the design life, nor any of the dwellings at the subject properties.

With regard to "saturation of the soil mass" referred to in Item 1, with reference to the JK Geotechnics report in Appendix D of Horton Coastal Engineering (2017), it should be understood that such saturation is not expected. As stated on page 4 of the JK Geotechnics report (and noting that this was agreed in consultation with Horton Coastal Engineering, James Taylor & Associates, and Haskoning Australia):

> "it was considered that the overtopping waters would preferentially drain along the sloping rear yard surfaces, through the higher permeability boulder revetment and over the proposed capping beam, rather than infiltrate the near surface soils. Any infiltrating overtopping waters would take some time to reach the groundwater level and would also drain laterally as well as vertically. Consequently, it was considered that such infiltrating overtopping water would have little impact on groundwater levels compared to the natural tidal fluctuations."

That stated, JK Geotechnics has simulated an absolute 'worst case' groundwater level on the landward side of the proposed coastal protection works (at the ground surface, up to over 8.5m AHD) and also included a 0.5m depth of water as a surface surcharge. The results output from SLOPE/W for this case is provided in **Appendix B**. The Factor of Safety was found to be about 1.3, which for an ultimate design case such as this, is considered to be satisfactory. However, Paul Roberts from JK Geotechnics noted[2] that:

> "we do not consider this scenario to be realistic as the overtopped waters will drain from the site over the surface at a faster rate than they will infiltrate into the ground. We remain of the view that the adopted design groundwater levels presented in our report [Appendix D of Horton Coastal Engineering (2017)] are appropriate".

It is also illustrative to treat the piled wall as a broad crested weir and to assess the discharge over the weir for a driving head of 0.5m, representing a groundwater level of 3m AHD (as per Horton Coastal Engineering, 2017) adjacent to the capping beam at 2.5m AHD. The discharge over the capping beam for this scenario was calculated as 0.6m^3/s/m. Comparing overtopping rates up to 14L/s/m at 2077 from Horton Coastal Engineering (2017), that is 0.014m^3/s/m, the overtopping rate is over 40 times lower than the potential outflowing discharge. The ability to build up water by wave overtopping is more than counteracted by the physics of return flow. This demonstrates that the 3m AHD groundwater level assumed in Horton Coastal Engineering (2017) is conservative, and that an elevated groundwater level cannot be sustained in practice.

[2] Email from Paul Roberts to Peter Horton dated 27 March 2017.

2. ITEM 2: RISK TO PUBLIC SAFETY FROM PILED WALL

The request for Item 2 was as follows:

> "In respect of the information provided in response to item 5(c)[3], the revised proposal creates a risk to public safety associated with public use of the beach when the beach is in an eroded state. In particular, should the pile wall be exposed, members of the public will, for the entire length of the wall, be unable to retreat to safety from high water levels and breaking waves impacting the vertical face of the proposed structure. Please provide details of measures to allow for safe beach access, egress and usage at times when the pile structure is exposed."

In the view of Horton Coastal Engineering, the probability of the above scenario materialising is low. The consistency of storm wave action and elevated water levels at such times would mean that the beach was not traversable well before reaching the area seaward of the subject properties (the areas to the north and south of the subject properties would also not be traversable at these times). Furthermore, the piled wall would not restrict landward egress from the beach any more than a naturally eroding sand dune with a near-vertical erosion escarpment. For these reasons, it is not agreed that the proposed works create a risk to public safety.

The view above notwithstanding, the Applicant is willing to provide ladders (stainless steel, centrally located at each of the subject properties and extending down to -1m AHD, cast into the capping beam) to enable egress to the subject properties if sand levels were well below the capping beam.

3. ITEM 3: END EFFECTS

3.1 Request

The request for Item 3 was as follows:

(a) while the maximum additional erosion (AE) and alongshore extents (Ls) of the end effects appear to be plausible, the shape of the end effect "embayments" shown in Figures 13 and 14 do not appear to match the shape shown in McDougal et al (1987) or Carley et al (2013). Please review and/or confirm the anticipated shape of the end effect "embayments";
(b) the calculations provided indicate significant end effects on the land owned by the Corporation Sole (as well as properties to the south) which may not be capable of being satisfactorily addressed by the arrangements proposed. Please provide:
  (i) details of measures available to reduce the potential end effects including details as to potential alternative structural arrangements or alignments;
  (ii) details of measures proposed to promptly mitigate such erosion impacts; and
  (iii) details of measures to ensure that predicted ends effects do not undermine or outflank the return of the structure along the property boundary.

Item 3a was further clarified in an email from Andrew Beatty to Odette Adams (of KWM, solicitor for the Applicant) dated 24 March 2017 as follows:

[3] Referring to Horton Coastal Engineering Pty Ltd (2017).

"Although Mr Horton seems to correctly estimate the northern limit of additional erosion (and its maximum extent), the yellow line used by him for the end effect north of 25c (Figure 13 of Mr Horton's letter dated 8 March 2017) appears "peaky". Please explain why Mr Horton's yellow line north of this "peak" (ie, the maximum erosion extent) does not appear to conform with the shape shown in McDougal and Carley".

3.2 Item 3a: Shape of End Effect

It is important to note that the McDougal/Carley end effects shape is not adequately dimensioned to fully define it. As depicted in Figure 1, none of the dimensions A (alongshore cutback of end effect landward of the protection works), B (cross-shore distance to the cutback from the protection works, or C (alongshore distance to maximum erosion extent) are specified in Carley et al (2013).

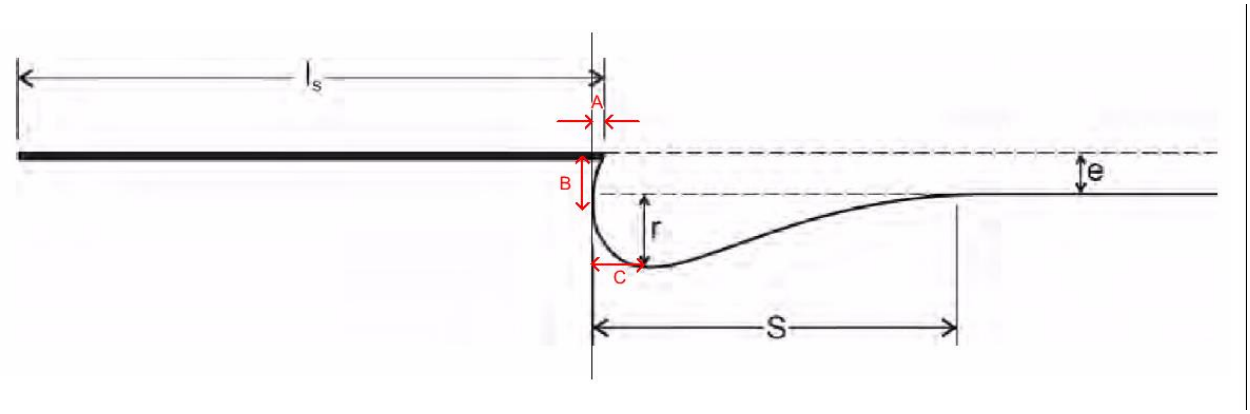


Figure 1: Unspecified dimensions (in red) from end effects shape in Carley et al (2013)

Scaling the A, B and C distances based on L_s, the resulting end effects shape is shown dashed in Figure 2 as the "theoretical scaled end effect". The end effect from Horton Coastal Engineering (2017) is shown for reference as the "end effect from previous report". Due to the effect of the protection works return (shown in Figure 2), it is considered more likely that the end effects shape will not have the cutback distance B, and will form a shape depicted as the "more likely shape due to effect of return". The approximate nature of the Carley et al (2013) method means that precise analysis is not possible.

Figure 2: Theoretical scaled end effect (yellow, dashed) north of subject properties scaling A, B and C distances based on L_s, with end effect from previous report and more likely shape due to effect of return also shown

3.3 Item 3b(i): Measures Proposed to Reduce Potential End Effects

The application does not propose measures to reduce the potential end effects of the structure. This is because:

- there is no form of protection works or design feature that can remove potential end effects for the proposed alignment;
- the proposed alignment is consistent with the existing Manyana works to the south, further landward than proposed in the 2003 EIS, and based on a holistic view of the entire Wamberal beachfront that is consistent with the expected future alignment of protection works over the entire beach;

- the works are entirely on private land, allow erosion of private land to reduce the end effect, and have less end effect than a vertical seawall constructed at the property boundary which is the option that would maximise private land retention;
- the proposed works are considered necessary to protect existing development, and do not increase the risk of undermining of any other dwellings in the 100 year ARI storm;
- in the view of Horton Coastal Engineering, end effects to the vacant blocks to the north at The Ruins can and should be dealt with by the construction of similar protection works there, as has been envisaged by the local government for almost 20 years.

As discussed in Horton Coastal Engineering (2017), the potential end effect to the south is inconsequential.

3.4 Item 3b(ii): Measures to Promptly Mitigate Erosion Impacts

The application does not propose measures to mitigate erosion impacts beyond what has been proposed in the application to date. As per Horton Coastal Engineering (2017), the current application suggests as follows (with regard to potential end effects at The Ruins):

> "If the NSW Coastal Panel can devise a reasonable consent condition that the landowners have to import a volume of suitable sand to infill demonstrated additional end effects erosion (that does not infill naturally within say 6 months of a storm), that could be considered. This is only considered to be reasonable to apply if the NSW Government states that it will be constructing protection works at The Ruins, and only over the next 5 years (say), as that should be ample time for works to be designed and constructed. If the NSW Government chooses not to protect The Ruins, it is not considered to be reasonable to apply this condition".

Six months for the infilling of sand is considered sufficient, given that any end effect on The Ruins would not be creating a threat to development. This time period is also the most efficient and environmentally conscientious, as it would allow natural processes to assist in the rebuilding process.

3.5 Item 3b(iii): Effect of End Effects on Return

The return has been designed for a scour level of -3m AHD at its seaward end and -1m AHD at its landward end, which is considered to be adequate to reduce the risk of undermining of the return. Any erosion extending landward of the return would not place the protection works or return at risk of damage.

Erosion extending landward of the return would introduce the potential for sand to slump within the 25c Ocean View Drive property (adjacent to the near-vertical erosion escarpment extending perpendicular and north of its northern property boundary). This slumping distance is about 3m for a 6m AHD dune crest with a scour level of -1m AHD, and would have the potential to cause some undermining of the northern edge of the dwelling at 25c in events in the order of the 100 year ARI storm. This could be managed by beach scraping and sand importation at the time if required.

The proposed return length is considered to be reasonable. It would be unreasonable to construct a return along the entire northern boundary at this time, given the likelihood of The Ruins being protected within the next few years. If it is decided not to protect The Ruins, then there is the option for the owner to construct a new dwelling on piled foundations, or to extend the return sometime into the future. The owner of 25c is prepared to accept the small risk of

undermining at present, and can provide an indemnification of liability for any future erosion/recession damage in relation to an approval for the proposed works if required.

4. ITEM 4: COST ESTIMATE

The request for Item 4 was as follows:

> "Please provide a cost estimate for the revised proposal."

The proposed works are estimated to cost in the order of $2.6M to construct.

5. REFERENCES

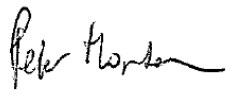
Carley, JT; Shand, TD; Mariani, A and RJ Cox (2013), "Technical Advice to Support Guidelines for Assessing and Managing the Impacts of Long-Term Coastal Protection Works", *WRL Technical Report 2010/32*, Final Draft, August, Water Research Laboratory, University of New South Wales, Manly Vale

Horton Coastal Engineering (2017), "Horton Coastal Engineering Pty Ltd ats NSW Coastal Panel (Land and Environment Court No. 324345 of 2016), Response to List of Information Required for Section 34 Conciliation Conference", 8 March

6. 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
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