

IN THE MATTER **of the Resource Management
Act 1991**

AND **an application by Gisborne
District Council**

FOR **Proposed Coastal Protection
Works at Wainui Beach**

STATEMENT OF EVIDENCE (COASTAL IMPACTS)

Willem Pieter de Lange

For Consent Authority

1 February 2018

1 INTRODUCTION

1. My full name is Willem Pieter de Lange, and I am a Senior Lecturer in the School of Science, University of Waikato, where I am the co-convenor for the Earth Sciences Programme. I hold the following qualifications from the University of Waikato:
 - BSc (1981) in Computer Science and Earth Sciences;
 - MSc (Hons) (1983) with first class honours in Computer Science and Earth Sciences;
 - DPhil (1989) with a thesis on wave-induced sediment transport
2. My training was in Earth and Ocean Sciences, particularly in sedimentology and coastal processes, and Computer Science, particularly numerical modelling, data analysis and visualisation. My MSc thesis examined tsunami hazard in the Bay of Plenty, and involved numerical modelling of tsunami generation, propagation and impacts along the coastline and within Tauranga Harbour. My DPhil thesis dealt specifically with the behaviour of dredge spoil used to renourish Pilot Bay Beach, Mt Maunganui, but also compared the performance of the two numerical models (2DD and DHI System 21). My DPhil also assessed the contribution of wave-induced sediment transport, particularly over the flood tidal delta (Centre Bank) and intertidal flats, to the total sediment transport within the Harbour.
3. I am a member of the Coasts, Oceans, Ports and Rivers Institute (COPRI) of the American Society of Civil Engineers (ASCE), the Coastal Education and Research Foundation (CERF), The Oceanographic Society (TOS), and the NZ Coastal Society and NZ Society for Earthquake Engineering technical groups of Engineering New Zealand.
4. Since 1984, mostly at the University of Waikato, I have undertaken research into fundamental coastal processes and management pertaining to New Zealand estuaries and the coast. My research has concentrated on the characterization and mitigation of coastal hazards, including tsunamis, storm surges, meteo-tsunamis, extreme waves, waterspouts, sea level variations,

climate fluctuations, and coastal erosion. I have also participated in and reviewed various lifelines vulnerability assessments for major urban areas around New Zealand.

5. I have published more than 200 peer-reviewed scholarly publications including 104 journal papers and book chapters, and 107 conference papers. I have also supervised more than 130 graduate and postgraduate student theses to completion including 25 PhD projects. My teaching has been focused on coastal geomorphology, processes, engineering and management. Until the recent establishment of a BE Civil degree at the University of Waikato, the engineering component has not included the design of structures; instead dealing with constraining design parameters and impact assessment.
6. I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and have complied with that practice note in preparation of this evidence. I agree to comply with it in presenting evidence at this hearing. The evidence that I give is within my area of expertise, except where I have stated my reliance on other identified evidence. I have considered all material facts that are known to me that might alter or detract from the opinions that I express in this evidence.

2 SCOPE OF EVIDENCE

7. I was asked to review the initial proposal for Wainui Beach Protection Works and the submissions made to the Gisborne District Council concerning the proposal. My review report was issued in September 2017. I subsequently undertook a site visit to examine the state of structures along Wainui Beach and assess the materials forming the slopes requiring protection. I prepared a supplementary report based on this site visit and discussions with Gisborne District Council staff, which was issued alongside the Section 42A report in January 2018.

8. With the development of a revised proposal for consideration, I was asked to review the new proposal. The two issues that appear to need to be addressed is the type of structure proposed, and the design life of the structure, which is linked to several assumptions made by the engineers.

9.

3 TYPE OF STRUCTURE

10. It is unclear from the original proposal and the final version why a rock revetment is the only design considered, although the evidence of Dr Shand does evaluate minor variations of a rock revetment.

11. It was evident from my site visit that there are a large variety of different approaches used along the length of Wainui Beach. Many are damaged and have been “improved” by the addition of rock riprap on the slopes. This was the case at 21 Wairere Road, where the proposal is to remove the riprap. While the proposal notes that the riprap placement was haphazard, used poorly graded material and did not include a geotextile liner, it did not report that the rocks used are degrading.

12. The riprap used locally sourced rocks that include clays that are susceptible to swelling and shrinkage in response to wetting and drying, which is likely to occur in the supra-littoral environment where they are utilised (Figure 1). It was evident that rocks emplaced in August 2016 at 21 Wairere Road were already breaking apart as a consequence of this process. In discussions with Gisborne District Council staff, it may be difficult to obtain suitable local rocks that are not susceptible to wetting and drying.

13. In my opinion there should be consideration in the design process of the durability of the rocks used, given that the design is based on assumptions of the median mass of the boulders in the revetment face. If there are logistic or economic constraints on the availability of suitable material then an alternative design such as a bulkhead may be a better approach.

14. The durability of the rocks used will also impact on the design-life, which is discussed below.



Figure 1- Rock revetment on Wainui Beach comprised of locally sourced boulders, which are degrading due to wetting and drying in a supra-littoral environment.

4 DESIGN LIFE

15. As I pointed out in my report on the initial report, reconstruction of the protection works at Tuahine Crescent was desirable due to the likelihood of increased erosion of the flanking structures if it failed (often referred to as an end-effect). This argument also applies if the proposed revetment is sufficiently more resilient to erosion than the flanking structures. In this case, it is possible that the revetment will result in increased erosion on the flanks if the flanking structures fail.

16. There is also a clear desire from the overall Wainui Beach community to have an alternative to the existing structures replaced within 25 years, as expressed in submissions and the Wainui Beach Erosion Management

Strategy released in 2014. This is consistent with the New Zealand Coastal Policy Statement (2010).

17. Therefore, in my opinion, the replacement structure should be considered a temporary structure to meet the desires of the community, and avoid enhancing the hazard for adjoining properties as their structures fail. This means that the situation is not an “industry standard” and using a “standard” 50-year design life may not be warranted. As noted by Dr Shand, a temporary structure may be designed to a lower standard based on higher frequency but smaller magnitude events.
18. As is clear from Dr Shand’s evidence the design of the structure scales with the duration of the design-life. In other words, a 50-year design life assumes larger waves, higher extreme water levels and more sea level rise than a 25-year design life. This results in a higher and wider structure, with a greater minimum mass requirement for the boulders in the revetment face.
19. One aspect of the design life of the structure that I cannot evaluate with the information provided in the proposal, is the durability of the rocks used in the revetments. As discussed briefly above, I am concerned that at least a proportion of the boulders available locally will degrade fairly rapidly due to the presence of swelling clays. If this is the case, it will impact on the design life of a revetment structure.

4.1 Sea level assumptions

20. A significant design parameter that is affected by the duration of the design-life is the assumed sea level rise. It is also suggested that sea level rise will contribute to the failure of other protection structures along Wainui Beach. In paragraph 4.4 of his evidence, Dr Shand summarised the assumptions of sea level, which includes Ministry for the Environment guidance released after the initial proposal. Unlike the other design parameters no probability is associated with the assumed sea level ranges, which are based on CMIP5 modelling of 4 scenarios. The worst-case scenario (RCP8.5) was originally

- assessed as extremely unlikely, and currently appears to be less likely than that.
21. However, my concern is the statement that Gisborne is stable to slightly subsiding ($\sim 1 \text{ mm.y}^{-1}$) used to justify using the upper end of the ranges of sea level for the design at Wainui Beach. This based on a report by Bevan and Litchfield (2012), which indicates that the trend for 10 years of continuous GPS data obtained at $38.6353^{\circ}\text{S } 177.8860^{\circ}\text{E}$ is $-1.1 \pm 0.6 \text{ mm.y}^{-1}$. The site is located near Patutahi inland from Gisborne, and not on the coast (Figure 2).
 22. Bevan and Litchfield note that the trend at the site is the opposite and $1\text{-}1.5 \text{ mm.y}^{-1}$ faster than that determined by modelling of tectonic stresses and from geologic evidence (ie subsidence instead of uplift). They suggest this is due to locking on the subduction interface between Gisborne and the Marlborough Sounds. The effects of more recently identified slow-slip earthquakes have not been incorporated into the analysis, although they were recognised in the limited data.
 23. Geological evidence indicates Poverty Bay has been tilting during the Holocene (Brown, 1995), with northern area of Poverty Bay uplifting and southern area subsiding about a central pivot region (Figure 2). The continuous GPS record analysed by Bevan and Litchfield was obtained on the southern subsiding side of the inferred pivotal zone. Wainui Beach occurs at the northern end of the uplifting zone and is associated with the highest rates of uplift. The rates of uplift are discussed in my site visit report, but range from $1\text{-}3.2 \text{ mm.y}^{-1}$ during the Holocene. The properties in Tuahine Crescent are located on estuarine sediment similar to the exposures at Sponge Bay, and suggest $>10 \text{ m}$ of uplift over the last 8,000 years.
 24. Given the evidence for uplift, in my opinion it is not reasonable to assume the upper limits of global sea level rise for the potential relative sea level change at Wainui Beach. Although instrumental sea level data are available for Gisborne, the measurements at the Port are affected by river discharge, which will reduce their reliability. Therefore, it is difficult to derive a historical sea level trend for Gisborne. Hence, in my opinion, the lowest MfE values are probably the best indicator of future sea level, and preferable to the highest values. However, given the uncertainties in the CIMP5 projections,

they shouldn't be used to estimate future sea level for Wainui Beach too far into the future (ie, better for 25 years than 50 years).

25. The consequence of a reduction in the assumed future sea levels is a lower design height to address overtopping, which will also reduce the width of the structure.

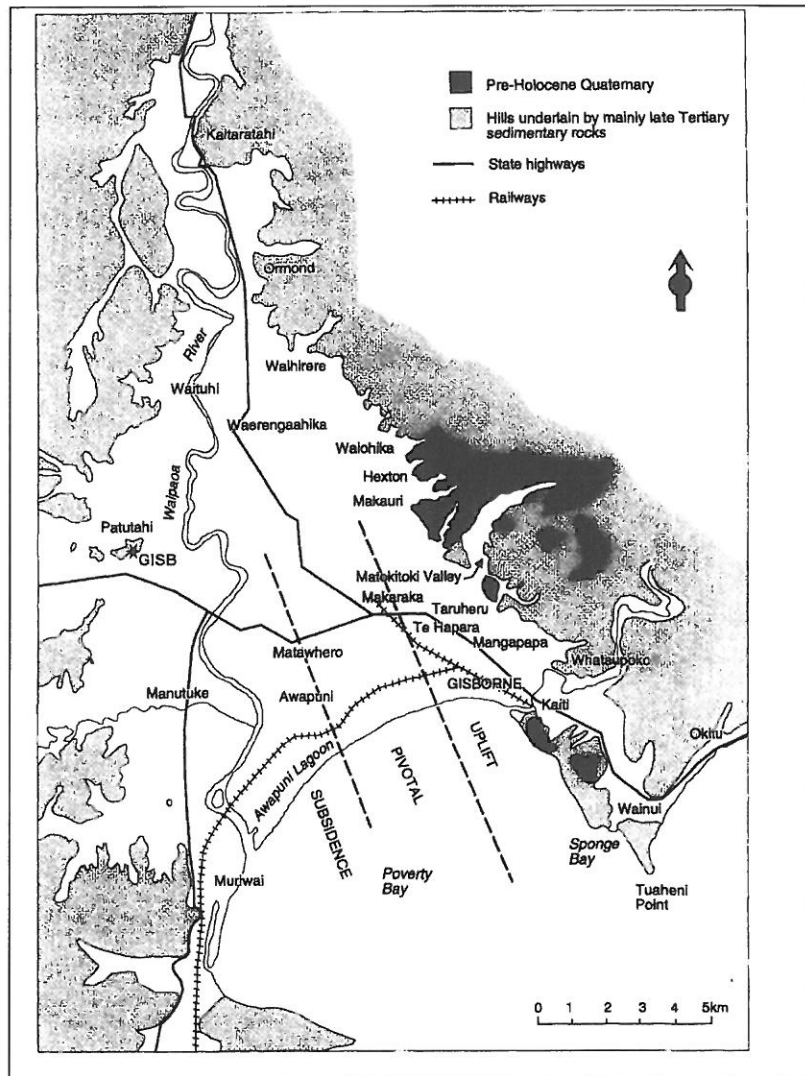


Figure 2 – Holocene tectonic sub-regions within Poverty Bay (Fig 2 – Brown, 1995), and the location of the GISB continuous GPS record at Patutahi.

5 SUMMARY

26. As indicated in my previous reports, I do not consider that the removal of the rock riprap at Wairere Road will result in any adverse effects on physical processes at Wainui Beach.
27. I confirm that I cannot identify any adverse effects on physical processes at Wainui Beach associated directly with the replacement of the existing

structures at Tuahine Crescent. However, I consider that the design criteria for the proposed rock revetment will result in a structure that is more resistant to erosion than the flanking structures. This can lead to enhanced erosion on the flanks of the proposed revetment if the remaining structures fail, which represents an increased hazard for properties adjacent to the structure.

28. In my opinion the key determinant is whether the proposed structure is intended to be permanent with a minimum 50-year design life, or a temporary structure to maintain the integrity of the existing coastal protection structures at the eastern end of Wainui Beach until such time as an alternative approach to managing coastal erosion is agreed upon and implemented. My impression is that a temporary structure is the community's preference, and in my opinion, the construction of a permanent structure at this time will constrain alternatives considered in the future.

Brown, L.J. 1995. Holocene shoreline depositional processes at Poverty Bay, a tectonically active area, northeastern North Island, New Zealand. *Quaternary International*, 26: 21-33



Dr Willem de Lange
1 February 2018

