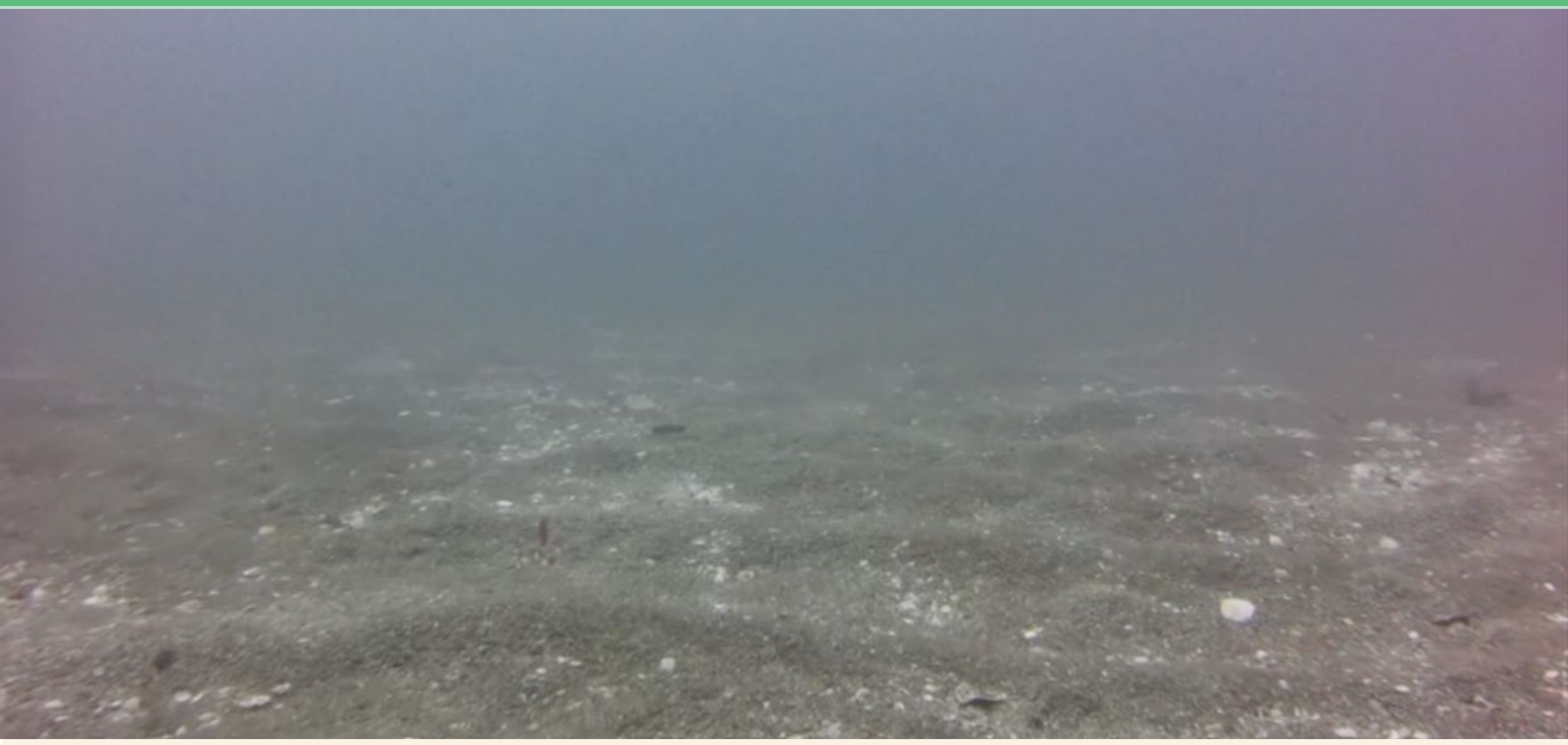

REPORT

Before the Expert Fast Track Panel
Te Ākau Bream Bay Sand Extraction Project
FTAA-2511-1150

Review of Coastal Process Evidence

Client:	Bream Bay Guardians
Reference:	PZ1136-HAS-WM-NZ-RP-A-01
Status:	Final/01
Date:	21 May 2026

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Enhancing Society Together

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Table of Contents

Acronyms

AEE	assessment of environmental effects
ASAP	Aotearoa Society of Adaptation Professionals
BMAPA	British Marine Aggregate Producers Association
CIS	coastal impact study
DoC	depth of closure
DoT	depth of transport
FTAA	Fast-Track Approvals Act
Hs	wave height
MBL	McCullum Bros. Ltd
MfE	Ministry for the Environment
mRL	metres relative level
MSL	mean sea level
NRC	Northland Regional Council
RFI	request for information
SLR	sea level rise
T&T	Tonkin & Taylor
Tp	peak wave period, in seconds (s)
UK	United Kingdom
WDC	Whangarei District Council

1 Summary

1. I am Sian John, a coastal geomorphologist with over 30 years' experience in coastal management worldwide. I was the nominated coastal process expert on the McCullum Bros. Ltd (MBL) Temporary Offshore Consent for Sand Extraction off Pākiri, Mātauranga Māori Expert Panel. The Bream Bay Guardian's asked me to undertake an independent review of the coastal process evidence submitted as part of MBL's fast-track application to mine sand from Te Ākau Bream Bay. The results are presented here.

2. In support of an application to extract 8,450,000 m^3 of sand from Te Ākau Bream Bay over a 35-year period it is reasonable to expect a high bar to be met vis-à-vis the level and detail of the investigations undertaken. Given this, I am concerned about the following:

- The very limited scale, scope and timeline of the coastal process site investigations and analysis compared, for example, with the extensive work undertaken to support extraction from other upper North Island marine sites (e.g., Pākiri).
- The absence of an adequate spatial understanding of sediment transport pathways and rates in Te Ākau Bream Bay. No meaningful modelling of sediment transport processes or sediment budgets has been undertaken. Rather than relying on theoretical parameters, we should understand what the cross-shore sediment transport rates are in the study area, including how much sediment is transported to the beaches and what the sediment deficit linked to the sand extraction could be (particularly with sea level rise (SLR)).
- The fact that the theoretical depth of closure (DoC) and depth of transport (DoT) are based on *average* significant wave heights (that exclude 10 percent of conditions), and a conservative predicted increase in extreme wave height with climate change, rather than more precautionary wave conditions. The full range of significant wave heights should have been used as the basis for these calculations, particularly as the DoC and DoT are the only parameters used in the assessment to determine whether significant adverse effects could arise, and research has identified limitations associated with the use of these methods.
- The fact that the proposed extraction area appears to be inside the DoC in places (e.g., for Profiles 2 and 4, the offshore natural indicator of the outer limit of sediment movement (larger grain sizes) is within the extraction area), and shore perpendicular sand ribbons (connected to the shore) extend into the extraction area.
- The reliance of the "limited effects" assessment on MBL adopting an approach to dredging that avoids the creation of trenches. Based on the experience of Pākiri, where deep dredged trenches were discovered by a third party, I lack this confidence.

- The very light touch taken to the assessment of cumulative effects, including longer term effects expected to be associated with predicted increases in storm intensity linked to climate change. Although the works, in theory, will cease in 35-years, because this is a relict sand resource, the impact will be decadal. Longer term effects should, therefore, be examined in far more detail.

3. In my opinion it is essential that a full and thorough understanding of the sediment supply and transport processes associated with Te Ākau Bream Bay is obtained before any extraction is consented. These processes are not sufficiently understood now and there is significant uncertainty relating to how they will evolve in the future, as our climate changes. The conclusion reached in the application that coastal process effects on beaches, dunes and surf breaks are unlikely to occur because the sand extraction is proposed seaward of the DoC, means that we need to have full confidence in the location of the DoC, which I do not have.

4. Given this, we cannot currently determine the long-term or cumulative consequences of the sand extraction activity on sediment transport or the coastal environment. Before extraction is consented, we need to have a holistic understanding of whole system effects – coastal process effects, ecological effects, and cultural effects. A precautionary approach, based on reasonable worst-case assumptions, must be adopted in the determination of this application. Particularly considering that the best sand for concrete comes from rivers, lakes or stone quarries. The reason for this being the angular shape of the grains which encourages binding and the absence of sea salt, shells and other organic material.

2 Introduction

2.1 About the author

5. My name is Sian John (she/her). I have a Master's degree in Geomorphology (with first class honours) and a Bachelor's Degree in Geography from the University of Auckland. My Master's thesis considered the implications of SLR on the shoreline of the Auckland Region over thirty years ago; and my coastal geomorphology fieldwork included shore normal surveys off Pākiri Beach with Associate Professor Mike Hilton as part of the extensive Mangawhai-Pākiri Sand Study.

6. I have worked for the Department of Conservation on Auckland's coastal resource inventory, the University of London and for Haskoning[1] on coastal management and development projects worldwide. I was the Director of Haskoning's UK Environment Division and am now the Resident Director of Haskoning NZ. My work has included numerous shoreline management and protection projects for local and central government bodies, as well as projects for the private sector (including Hutchison Ports, EDF Energy, Horizon, Tidal Lagoon Power, DP World, Peel Ports, Anglian Water, and many more). I have worked with and for several dredging and aggregate extraction companies, including Boskalis and Hanson Aggregates. This included preparing the Eastern English Channel Regional Environmental Assessment for the East Channel Association of Aggregate Extraction Contractors.

7. As Haskoning's Coastal Adaptation Specialist for the Pacific, I am currently advising on Thames Coromandel and Hauraki District Councils coastal/climate change adaptation planning projects, a Strategies to Build Better project for Auckland Council and am providing environmental and social safeguarding inputs relating to coastal development in Fiji, Niue, Samoa, Tonga and Tuvalu. I am a Member of the Environment Institute of Australia and New Zealand, the New Zealand Coastal Society, the Aotearoa Society of Adaptation Professionals (ASAP) and was the nominated coastal process expert on the MBL Temporary Offshore Consent for Sand Extraction off Pākiri, Mātauranga Māori Expert Panel.

8. Although this is not a hearing before the Environment Court, in preparing this statement, I confirm that I am familiar with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023 and complied with it. This evidence is within my area of expertise. To the best of my knowledge, I have not omitted to consider material facts known to me that might alter or detract from my opinions expressed in this brief.

[1] *Noting that Haskoning's head office is based in The Netherlands, where quarried sand is used preferentially to produce high-strength concrete.*

2.2 Report scope

9. The Bream Bay Guardian's asked me to undertake an independent review the coastal process evidence submitted as part of MBL's fast-track application to mine sand from Te Ākau Bream Bay. That is, Tonkin & Taylor's (T&T's) coastal process evidence provided in support of the *Resource Consent and Wildlife Approval Applications via the Assessment of Effects (AEE) under the Fast-track Approvals Act (FAA) 2024*.

10. My review has taken account of:

- *Te Ākau Bream Bay Sand Extraction Project – Resource Consent and Wildlife Approval Applications and Assessment of Effects under the FAA 2024* (January 2026), Chapter 11 Assessment of Effects on the Environment, Effects on Coastal Processes, Climate Change and Natural Hazards, and Cumulative Effects.
- *Te Ākau Bream Bay Sand Extraction Project – Resource* Consent and Wildlife Approval Applications and Assessment of Effects under the FAA 2024 (January 2026), Attachment 8 Te Ākau Bream Bay Sand Extraction: Coastal Process Effects Assessment (T&T).
- Other relevant information, including:
    - *Ruakaka Wastewater Long-Term Consents Project Assessment of Effects on the Environment and Resource Consent Applications*, Whangarei District Council (WDC) 2011.
    - T&T's *Crude Shipping Project Coastal Processes Assessment, 2017*, for Refining NZ.
    - L. Aragones, J.I. Pagan, I. Lopez, J.C. Serra. Depth of closure: New calculation methos based on sediment data, *International Journal of Sediment Research*. https://doi.org/10.1016/j.ijsrc.2017.12.001.
    - T&T's Northland Regional Council (NRC) *Coastal Erosion Hazard Assessment, 2020*.

11. The issues considered herein include:

- The scale and scope of the Te Ākau Bream Bay coastal process and sediment transport investigation and analysis.
- Indicators of closure depth and the location of the proposed extraction area.
- The assessment of cumulative effects, including longer term effects potentially associated with climate change and the potential implications of the extraction.

3 Context

12. The *New Zealand Coastal Policy Statement 2010* requires Councils to proactively manage coastal hazards over a 100-year timeframe. The *Climate Change Response (Zero Carbon) Amendment Act 2020* requires the Government to develop and implement policies for climate change mitigation and adaptation. For both the management of coastal hazards and adaptation at the coast, maintaining a healthy beach and a sand reserve are essential.

13. Figure 1 shows four scenarios that project the SLR New Zealand could expect out to the year 2150 from the Ministry for the Environment's (MfE's) 2022 *Interim Guidance on the use of new sea-level rise projections*. Each scenario is based on detailed assumptions regarding how effective emissions reduction policies could be, with the 8.5 H+ scenarios (the yellow lines) being the most pessimistic and 2.6 M scenarios (the green lines) being the most optimistic.

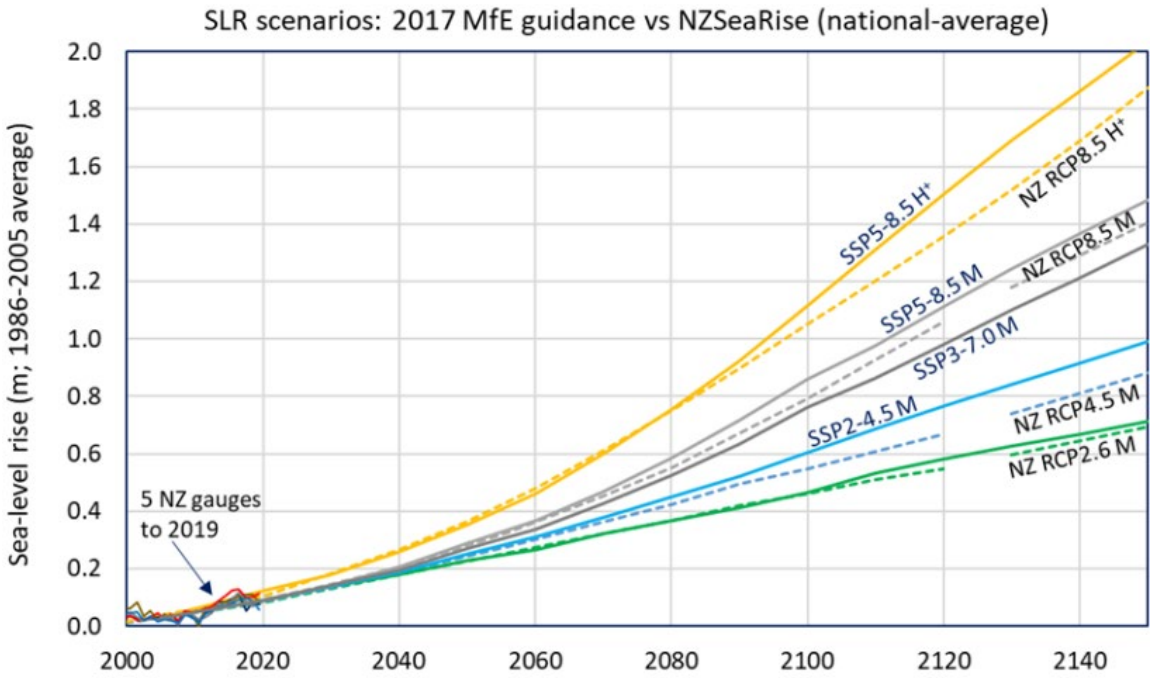

Figure 1: NZ SLR projections (MfE, 2017 and 2022) 2000 to 2150, showing increasing uncertainty.

14. While there is real uncertainty about how much sea level will rise in the future and by when, we know that sea level is rising and that between +5.5 to +14 mm/year (under a low emissions scenario) and +5.5 to +20 mm/year (under a high emissions scenario) will occur by 2050; that is, an estimated 0.2 to 0.6 m of SLR. For Bream Bay, the NZ SeaRise Programme predicts that relative SLR could be in the range of a 0.31 to 0.75 m increase by 2070, and in the range of a 0.63 to 2.01 m increase by 2130, depending on which scenario for future carbon emissions is realised.

15. Further, as warming of the atmosphere and rising seas are a key driver of the extreme water levels associated with storms and cyclones (bringing larger tides and waves), water levels and waves that used to be historically rare (e.g., a 1 in 100-year event) are likely to occur much more frequently by the middle of the 21st century.[2] This will increase risks to communities in some areas and expose new areas to risk over time.

16. This context is relevant to the important role that the sand stored in the offshore areas will have in maintaining the ocean beaches and dune systems in Te Ākau Bream Bay in the future.

(a) The sediments that MBL are proposing to remove 8,450,000 m^3 of, over a 35-year period, are fossil deposits (Hauraki Sand Facies) that were delivered to the continental shelf by the paleo Waikato River during the lower sea levels of the last glacial maximum (Schofield, 1970) and moved onshore by Holocene SLR; with subtidal terraces and beach deposits representing indicators of standstills. Without these standstills SLR largely acts as an erosional force and the historic sediment supply that formed the coastal system is no longer active (the sediment budget is functionally closed), with negligible sediment inputs to the coast or nearshore zone occurring today. That is, this sediment source will not be renewed.

(b) During storm events, wave breaking and surf zone processes operate across the upper shoreface. The lower shoreface is the seaward section of the profile and is a zone of significant wave induced sediment transport, which is connected to the upper shoreface over decadal timescales. Wave shoaling occurs on the lower shoreface during larger events, which can mobilise sediment due to wave orbital motions interacting with the seabed.

17. Consequently, these relict Holocene deposits[3] could be critical to maintaining Te Ākau Bream Bay and beach in the longer term. Working with nature must be our first line of defence and is fundamental to NZ's coastal adaptation strategy.

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[2] *MfE (2018)* Climate change projections for the Auckland region *(https://environment.govt.nz/facts-and-science/climate-change/impacts-of-climate-change-per-region/projections-auckland-region/) states that the frequency of ex-tropical cyclones is projected to either decrease or remain unchanged over the 21st century. However, an increase in storm intensity, local wind extremes and thunderstorms is predicted to occur, resulting in more damage. NIWA (2021)* Regional climate change summary tables and associated risks and opportunities for the primary sector (He Waka Eka Noa) *similarly predicts a 1 to 4% decrease in extreme winds by 2090 (with an increase in summer and a decrease in winter), but an increase in the intensity of ex-tropical cyclones. The consequence of which being that extreme water levels will occur more frequently.*

[3] *Geological formations that have been preserved in sedimentary records, indicating the extent of Holocene flooding events. They are indicative of geological processes that occurred during the Holocene and include gravel, sand and mud deposits arising from water-borne alluvial floodplain and fan processes.*

4 Sediment transport pathways in Bream Bay

18. Prior to consents being granted in the mid-2000s for sand extraction in Pākiri-Mangawhai and Kaipara Harbour, multi-phase sand studies, that included extensive field investigations and analysis, sediment mapping, numerical modelling of coastal processes and more, were undertaken for well over a decade.

19. By comparison, the studies that have been undertaken in support of the Te Ākau Bream Bay sand extraction application are extremely limited in scale and scope. Amounting to limited vibrocore samples of sediments, six bathymetric transects surveyed once, *limited* wave hindcast modelling by MetOcean Solutions Ltd linked to an assessment of potential effects on surf breaks, and calculations of the DoC. In addition, it appears that:

    (a) The wave hindcast data may not be fully calibrated with local observations and the approach adopted used representative (rather than real or extreme) wave conditions. Since extreme storm events typically control the maximum depth of sediment mobilization, any underestimation of extreme wave conditions could lead to an underestimation of the effective DoC. This could be significant given climate change, with the mean wave climate expected to become less energetic (due to more westerlies) but extremes expected to increase.

    (b) A lower significant wave height (Hs), smaller standard deviation and lower associated peak wave period (Tp) were used as part of T&T's DoC calculations for Bream Bay (0.9 ± 0.5 m and 9 s) compared to those used for Pakiri (1.04 ± 0.73 m and 12 s). A shallower outer DoC can be expected as a result (i.e., 22.2 m below MSL as compared to 25 m below MSL), particularly as an average figure was used for Bream Bay (which can be expected to be exceeded on occasion). The so-called 'buffer distance' between the proposed extraction area and the lower shoreface is only 880 m at its closest point, so a small deviation from these conditions could have large effects.

    (c) The vibrocore samples of the seabed missed the peat like material referred by T&T (page 16, Attachment 8) and apparent in sled-tow video survey data gathered by eCoast in April 2026. eCoast found bedforms across the sampling site dominated by sand ripples and mega-ripples, and small sections of permanent peat reef that were both observed (on two occasions) and sampled. If a peat layer is exposed by dredging the habitats present in Bream Bay would change significantly and, if it is dredged, the resulting turbidity would be substantial.

20. The best practice guidance replied upon by T&T, on carrying out a coastal impact study (CIS) for marine aggregate extraction (BMAPA/Crown Estate, 2013[4]), refers to the need for the CIS assessment to consider exceptionally severe wave conditions, tidal levels, and changes in tidal levels relative to the land and in waves that might be brought about by global warming and associated climate change for the duration of the extraction application. T&T's DoC assessment does not consider exceptionally severe wave conditions or changes in tidal levels, and the assessment of the potential implications of cumulative effects, including climate change, on Bream Bay is four paragraphs long.

21. Moreover, the guidance states that assessments should be undertaken of:

(a) the draw-down of beaches or sandbanks into the extraction area (leading to erosion);
(b) changes in sediment transport patterns (such as interrupting supply to coastal sandbanks or beaches); and,
(c) changes to the form and function of any nearby sandbanks.

T&T have responded to all these requirements by providing an assessment of the DoC and DoT alone. No meaningful numerical modelling of sediment transport processes, sediment budgets in Bream Bay, or changes in sediment transport patterns has been undertaken (based on observations). Consequently, there is a clear absence of an adequate spatial understanding of sediment transport pathways and rates in Bream Bay, including how much sediment is transported to the beaches and what the sediment deficit linked to the sand extraction could be.

22. This paucity of available information (lack of substantive baseline data for the proposed extraction area) is demonstrated by the application's frequent reliance on data from Mangawhai-Pākiri rather than Bream Bay itself (including on the potential presence of scallops, starfish and other biota) and the lack of explanation as to why the initially proposed location of the extraction area was moved further south, along with the location of the proposed northern control area (see Figure 2). The seabed characteristics of the proposed northern control area are not considered to be representative of the extraction area (hence the move to the south) and its proximity to the extraction area is likely to make it vulnerable to the effects of the dredging turning circle and dredged plume. Further, beds containing silt and peat (which would be disturbed by the extraction) have been identified even in the limited samples that have been taken. Local knowledge suggests that these are common in the extraction area.

[4] *It is notable that this guidance was produced some 13-years ago by the British Marine Aggregate Producers Association (BMAPA) and The Crown Estate, who extract marine sand and obtain signficant income and royalities from that process respectively.*

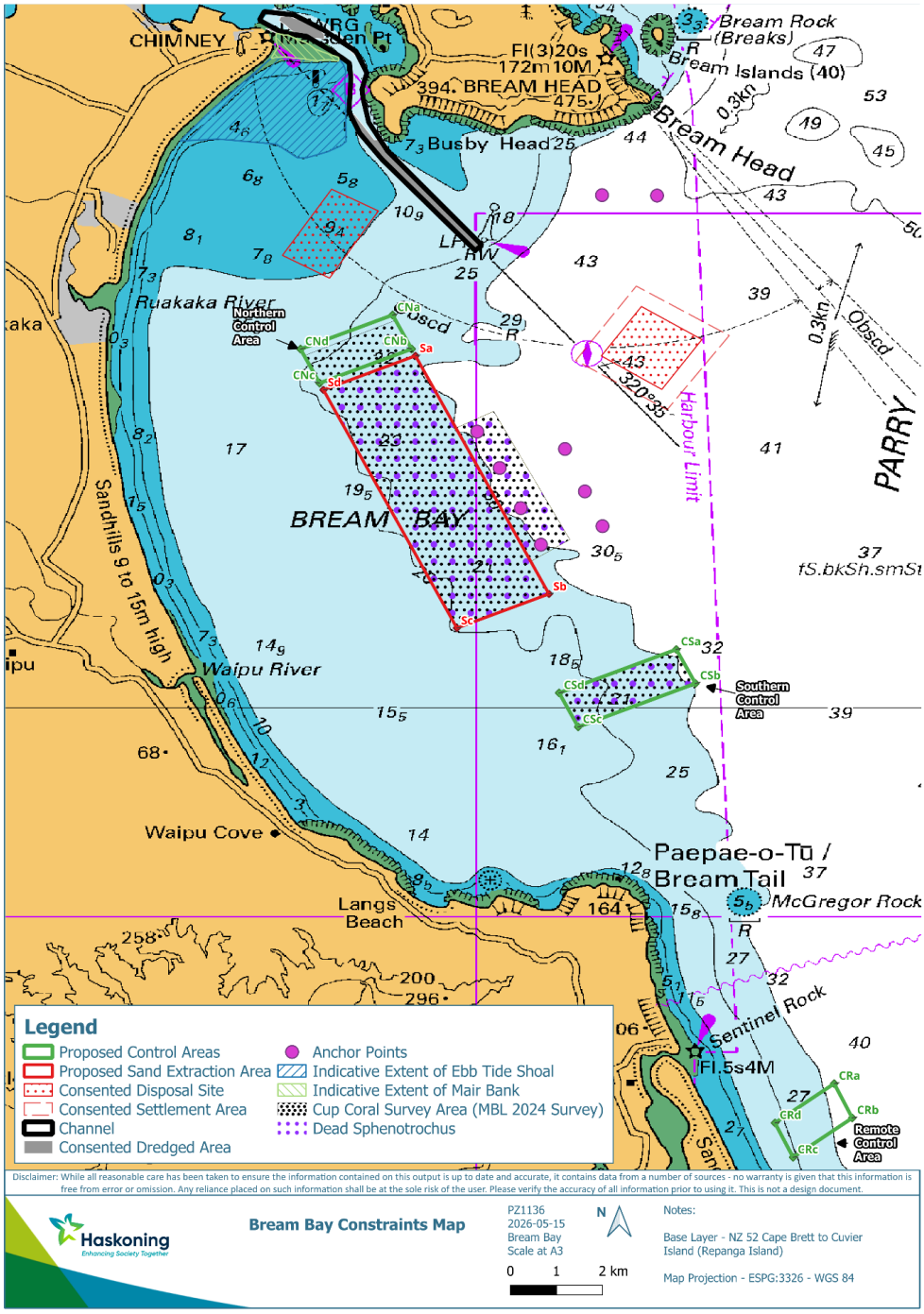

Figure 2: Te Ākau Bream Bay constraints map.

23. While the AEE purports to provide confidence by stating that – through the dredging plan – the activity is not expected to influence sediment transport processes unless (dredging) tracks create local anomalies through repetition, it is exactly such tracks that were identified in the seabed surveys undertaken in the Mangawhai-Pākiri embayment. That is, the MBL approach to dredging in Pākiri using the *William Fraser* created such local anomalies and I do not have confidence that they will be avoided in Bream Bay.

5 Indicators of closure depth

24. The conclusion of the *Te Ākau Bream Bay Sand Extraction: Coastal Process Effects Assessment* – that the overall effect of the proposed offshore sand extraction activity on physical coastal processes within Te Ākau Bream Bay will be low to negligible – is wholly reliant on the one conclusion that the proposed extraction zone is outside the DoC (i.e., within the offshore area where wave induced sediment transport does not functionally exchange with the shoreface on decadal timescales, being seaward of the 90 percentile DoT and the 45-year average outer DoC). The DoC being the seaward limit of significant cross-shore sediment transport on sandy beaches (Kraus *et al.*, 1998), but not a real sediment transport limit (Aagaard, 2014; Stive & de Vriend, 1995). Aragones *et al.* (2017) confirm that the DoC is a morphodynamic boundary instead of a transport limit since, during storms, waves of greater energy can move larger sediment outside this limit, which cannot be returned in times of calm due to the depth and weight of these particles (Guillén & Hoekstra, 1996; Niedoroda *et al.*, 1985; Putnam & Johnson, 1949).

25. T&T's assessment acknowledges that the modern, favoured DoT method (based on the physics of wave induced sediment transport using shear stress and representing the boundary of the lower shoreface zone of frequent sediment transport) suggests that the lower shoreface extends an average of 2 km from shore (i.e. to -17.5 mRL) but could extend to 3.2 km from shore (i.e. to -20.5 mRL). Recent research has identified limitations in the analytical outer DoC method, identifying it as less suitable for embayed beaches where results do not match by geomorphic observation (Valiente, *et al.*, 2019). However, T&T's assessment concludes that it is still considered to be a useful parameter, and it is used to indicate the lower shoreface boundary of infrequent or possible sediment transport. For Te Ākau Bream Bay, the 45-year average outer DoC extends 2.9 km offshore (i.e. to -19.1 mRL) but could extend to 4.6 km offshore (i.e. to -22 mRL) at locations that have finer sediments and larger average waves.

26. Given that the DoC is the single parameter being used to determine whether significant adverse effects could arise, it is of concern that:

(a) research has identified limitations associated with the use of the method;
(b) the method is based on a scientifically derived empirical rule, which typically collates data and fits a curve through scatter, i.e., it is uncertain and provides a median at best;
(c) 90 percentile and 45-year hindcast average wave conditions have been adopted (which do not reflect conditions 10% of the time nor effects beyond a 0-year timeframe);
(d) beyond the outer DoC, wave induced functional sediment exchange could occur over longer timescales (see Section 5 below); and,
(e) Figure 3 illustrates that significant, contiguous 'shoreface-connected ridges' (Hamon-Kerivel, et al., 2020), with depths shallower than -22 mRL, extend well into the extraction area.

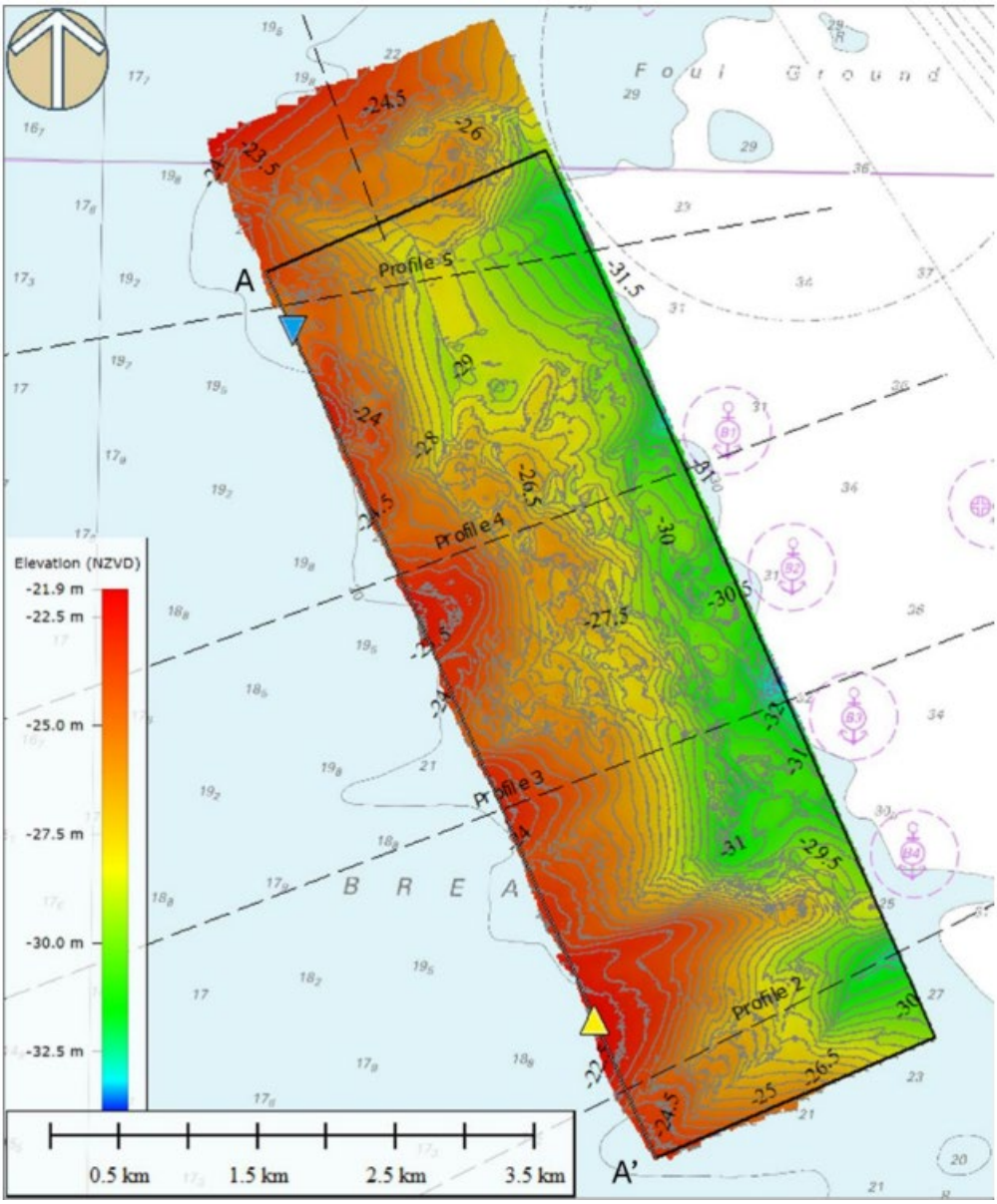

Figure 3: Proposed extraction area bathymetry (AEE Appendix 8, Figure 3.6).

27. T&T use the combination of an analytical and profile-based method to calculate the outer DoC (i.e., wave parameters and the resulting closure depth values for each year in the hindcast were calculated for each profile). Aragones *et al*. (2017) argue that the methods based on profile surveys experience greater variation in their results or cannot yield a value for the DoC, since cross-shore profiles are morphologically diverse. This is evident in Bream Bay where it can be seen (in Figure 3) that:

(a) Profile 2 – where the outer DoC has been calculated as -18.9m – is in a swale;
(b) Profile 3 – with a calculated outer DoC of -19.3m – is on a moderate ridge;

(c) Profile 4 – with a calculated outer DoC of -22.2m – is on a ridge; and,

(d) Profile 5 – with a calculated outer DoC of -21.3m – is also on a ridge.

28. I expect that the outer DoC for the large ridge between Profiles 2 and 3 would represent the worst case (a deeper DoC than that represented by Profile 4), if a profile was available for this location. Further, the dates of the annual outer DoC locations should be presented to determine whether there is a time pattern (i.e., are the deeper depths more recent?) or a storm occurrence correlation. Profiles 3, 4, and 5 in Figure 4 show clearly that outer DoC's within the extraction area do occur relatively frequently, and likely would occur more frequently if the uncertainties in both wave modelling and the Hallermeier rule were accounted for.

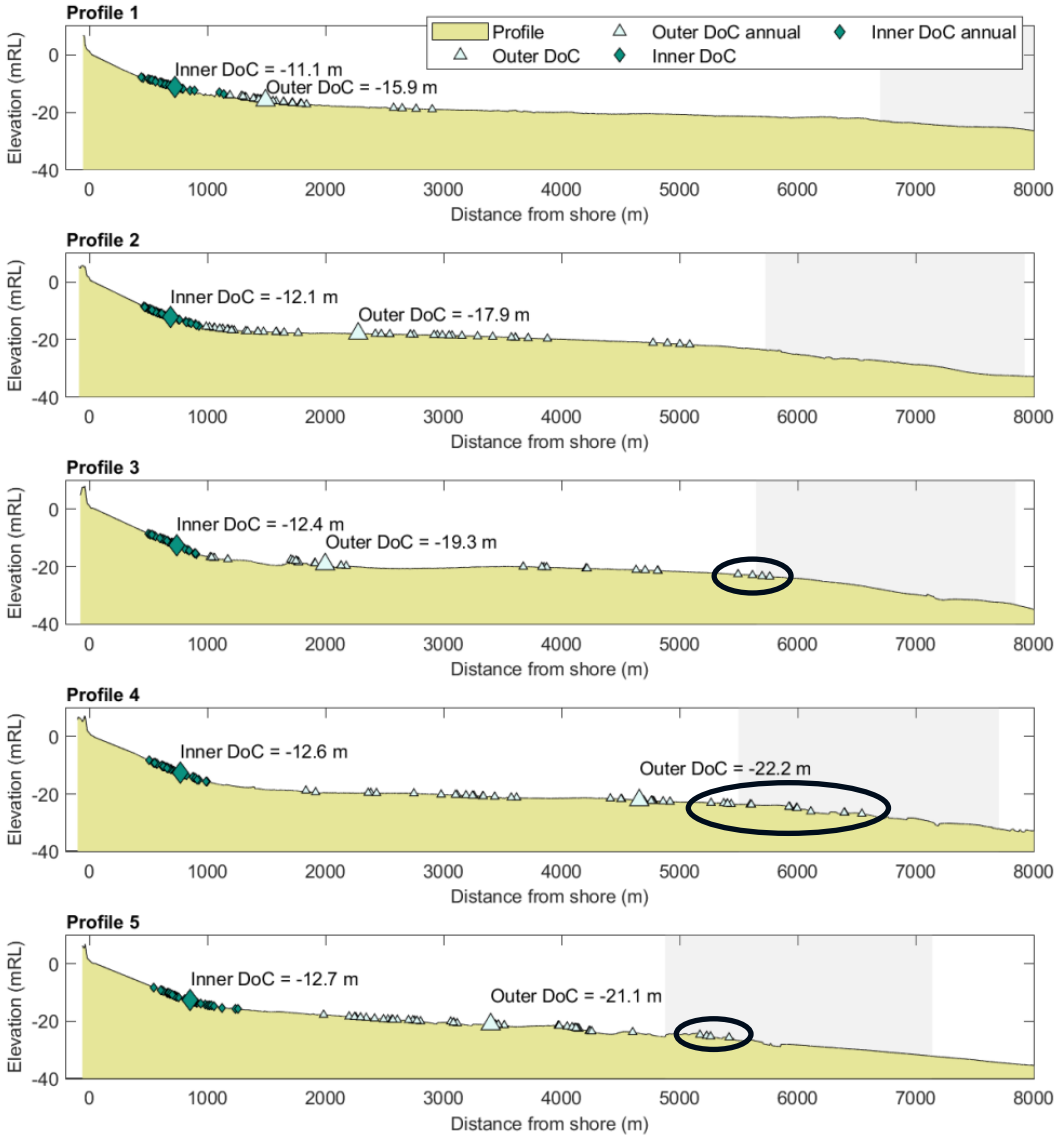

Figure 4: Annual range of the inner and outer DoC for each profile, as calculated for each year in the 45-year wave hindcast. Small symbols indicate the annual value and larger symbols the 45-year mean. Grey shading represents the proposed sand extraction area (or control area) on each profile (AEE 8, Figure 4.2). The black circles indicate those instances where the yearly outer DoC is in or close to the extraction area.

29. As set out above, Aragones *et al.* (2017) postulate that the most powerful waves and currents can move sediment with larger grainsizes offshore but cannot move them back towards the shore. Hence, increases in grainsize offshore are the system's natural indicator of the outer limit of sediment movement, i.e. the inshore DoC and the offshore DoC. The wave height H* used in Hallermeier's equation is only for wave heights exceeded 12 hours per year, making it likely that closure depth will change yearly, whereas the location of the offshore accumulation of larger sediment represents the overall cumulative effects of wave/current energy on sediments for decades or more, not simply the 12 hours per year in Hallermeier[5]. Figure 5 indicates that, for Profiles 2 and 4, the offshore natural indicator of the outer limit of sediment movement (larger grainsizes) is within the extraction area (as do the outer DoC annual results for Profile 4).

30. It is also notable that research at Pākiri by Hilton, *et al.* (1996), on which the T&T assessment relies, identified the seaward limit of the lower shoreface at 25 m below Chart Datum. In fact, in their response to Minute 4 RFI 1 (para 51), T&T quote Hilton, *et al.'s* (1996) finding that the maximum limit of the modern beach system and hence the nearshore system was around the 25 m depth contour and that shoreward transport under wave action was negligible beyond the 30 m water depth. T&T then go on to say that the findings of their assessment, including their DoT calculations, support this view. Notably, a third of the proposed extraction area at Bream Bay is largely inside the 25 m depth contour, and the Ruakaka Wastewater Long-Term Consents Project AEE (WDC, 2011) found that observed currents in Bream Bay at the proposed location of the Ruakaka ocean outfall (some 3 km offshore) are sufficient at times to disturb the seabed and mobilise fine sands.

31. The conclusion reached in the application that any coastal process effects are unlikely to occur because the sand extraction is proposed seaward of the DoC, means that we need to have full confidence in the location of the DoC, which I do not have.

[5] *In Appendix 8 (Part 2) T+T state that, in this case,* "The average wave height and period were calculated using all hourly data in the 45-year wave hindcast. Average conditions are appropriately resolved in the wave modelled and therefore do not need scaling up as the 12 h exceeded wave height was for the inner DoC."

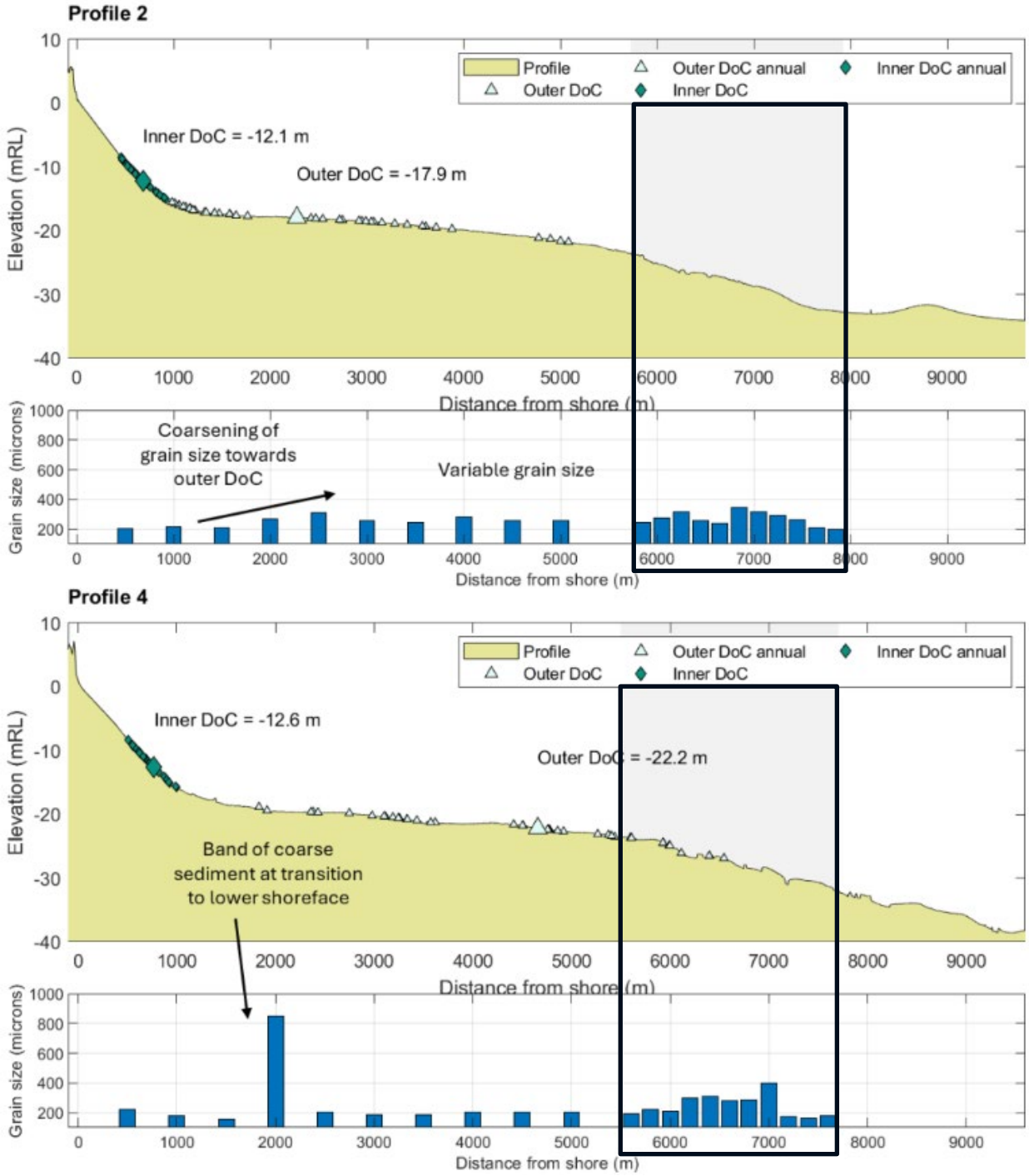

Figure 5: Interpretation of profile geometry, sediment grain size and DoC calculations (AEE Appendix 8, Figure 4.3)

6 Assessment of cumulative effects, including climate change

32. The Application documentation asks if the project "will support adaptation, resilience, and recovery from natural hazards", and the response given is "yes". MBL suggest that the sand extraction will be neutral in relation to natural hazards (not exacerbating their effects) and that the sand extracted will be integral to the construction of infrastructure and development projects to enable adaptation and resilience to and recovery from natural hazards. Aside from this indicating a complete lack of understanding as to what the core principles behind adaptation and resilience are, it is misleading to state that sand extraction will be neutral in relation to natural hazards in the mid- to long-term. This is not something we can know. What we do know is that the project will remove 8,450,000 m^3 of non-renewable sand from the Bream Bay sediment system over a 35-year period, and wave induced functional sediment exchange could occur over longer timescales. That is, as stated above, these relict Holocene deposits could be critical to maintaining the beaches and ecology that characterise Bream Bay in the future.

33. T&T's assessment of the potential implications of cumulative effects and climate change[6] on Bream Bay is four paragraphs long and limited to the duration of the consent, SLR of 0.35 m and a conservative predicted increase in extreme wave height of 5%. The proposition being that the higher rates of SLR associated with SSP5-RCP8.5 typically used in hazard assessments would be non-conservative here, as higher sea levels push the lower shoreface boundary landward, but increased extreme wave heights push the DoC seawards. For a project proposing to extract 8,450,000 m^3, this is not considered to be sufficient. For example, T&T acknowledge that predicted changes in wave climate are uncertain, yet insufficient account has been taken of the predicted increase in storm intensity, including larger wave heights, and the effect this could have on the DoC. Although the works, in theory, will cease in 35-years, because this is a relict resource[7], the impact will be felt well beyond this 35-year period[8]. This is the coasts' sediment source for the future. Hence, if it is depleted, the impact will occur in the future.

34. T&T postulate that:

[6] *Climate change being taken as the only assumed cumulative effect.*

[7] *The application states that there are limited quantities of new sediment entering the bay from the catchment and coastal erosion processes of the adjacent cliffs. The primary sediment source for Bream Bay and the nearshore coastal sediment system was delivered to the continental shelf by the Waikato River via the Firth of Thames when sea levels were lower than they are now.*

[8] *It is also for this reason that the applicants' proposed monitoring period is completely inadequate.*

(a) the impacts of climate change due to SLR will cause the DoC to move up and landward (and therefore the risk of extraction causing drawdown would not increase with climate change); and,

(b) the combined effect of rising sea level and increasing mean wave height is a predicted increase in depth of the outer DoC by up to 0.9 m. MetOcean Solutions Ltd (2024) has predicted that wave processes on the upper shoreface could be altered by a few cm if the full extraction is achieved, i.e., climate change will have an unknown impact on the mean wave climate but will likely result in a larger extreme wave climate (T&T, 2024).

35. It is concerning that a more detailed examination – taking a precautionary approach (i.e., based on reasonable worst-case assumptions[9], in line with best practice) – of the impact of a larger extreme wave climate and predicted rates of SLR over the next 100-years (in line with the *New Zealand Coastal Policy Statement 2010*) has not been undertaken. The conclusion reached that there is sufficient buffer distance (880 m at the closest point) between the proposed extraction area and the lower shoreface to allow for uncertainty in future wave climate changes and to keep the DoT and DoC boundaries landward of the proposed extraction area, is based on a potential conservative increase in extreme wave height of 5% rather than 15% (which could also occur). Even the BMAPA/Crown Estate 2014 guidance states that a CIS assessment needs to consider exceptionally severe wave conditions. Further, given that an empirical rule (with embedded uncertainty) has been used to determine the DoC, alongside climate change and wave climate uncertainties, arguably 880 m is not a lot. A qualitative description of how sediment movement is expected to change in extreme conditions would be more useful. Presenting a theoretical DoC does not address potential longer-term or cumulative effects.

36. With regard to cumulative effects, it is notable that T&T's assessment of cumulative effects on coastal process only considers climate change, particularly as their 2017 *Crude Shipping Project Coastal Processes Assessment* (which focused on Refining NZ's proposed channel dredging) recognised that the highly valued Mair Bank and the coastline extending southward from Marsden Point were already experiencing change and some net loss of sand. They predicted that the dredging (alone) could result in increased erosion pressure on Mair Bank, as well as ongoing

[9] *T&T acknowledge the uncertainty relating to the future wave climate of Te Ākau Bream Bay, with the available evidence indicating that the extreme wave height may reduce or stay the same or potentially increase by up to 5% with some very low likelihood of extreme waves increasing by up to 15%. However, the assessment considered the effect of climate change causing a 5% increase in the mean and annual extreme wave height (not 15%). The outer DoC calculated using the Hallermeier wave base equation was found to be sensitive to a 5% increase in wave height, resulting in an outer DoC that shifts the depth seaward by up to 0.9 m when considering the balance of higher sea level moving the point landward and larger waves moving the point seaward (page 67, para 1).*

shoreline erosion, due to increased wave heights reaching the shoreline because of the lower seabed levels on the ebb tide shoal. That is, the proposed and subsequently consented channel dredging could add to the net loss of sand from the ebb tide shoal.

37. The recommended measure to address this was the placement of suitable dredged sediment within the ebb tide shoal that could migrate landward, as a practical means of maintaining the volume of the ebb tide shoal and enhancing a supply of sand to both the shoal and the adjacent shoreline. However, Refining NZ sought operational flexibility regarding the volume of material to be disposed at specific locations, which led T&T to recommend that pre- and post-dredging surveys should be undertaken and information on the volumes and locations of deposition of both the capital and maintenance dredging recorded. MBL's extraction proposals should be considered in conjunction with this assessment, particularly as sediment transport occurs in a northerly direction in Bream Bay towards Mair Bank. It is not clear how the bank could be affected by the proposed sand extraction in conjunction with the channel dredging consent, which is still active. Furthermore, it is not clear how the shipping channel itself could be affected by the sand extraction. Channel Infrastructure NZ report some 4 m of sand accumulation around Jetty 1 in 4-years, despite this not being predicted in T&T's modelling for the capital dredging consent.

7 Monitoring proposals

38. Given that the potential effects of the extraction could be decadal, the proposed monitoring period is woefully inadequate. Beyond the initial monitoring period proposed, monitoring of the seabed and the connection between the seabed in the extraction area and the coastline (including the beach) should occur at least every 2 years and for as long as the extraction continues. The proviso that the works would cease should noticeable effects occur, should also remain in place. However, what is meant by noticeable effects, first, needs to be carefully defined.