

BEFORE AN INDEPENDENT HEARINGS PANEL

THE PROPOSED WAIKATO DISTRICT PLAN (STAGE 2)

UNDER the Resource Management Act 1991 (the Act)

IN THE MATTER OF Hearing 27D: Coastal Hazards (Proposed Waikato District Plan) submissions
and further submissions

**STATEMENT OF REBUTTAL EVIDENCE FOR BRONWEN BETH GIBBERD FOR THE WAIKATO
DISTRICT COUNCIL**

DATED 3 MAY 2021

1. Introduction

- 1.1. My name is Bronwen Beth Gibberd. I am a Coastal Scientist and Director of 4D Environmental Ltd and have held that role since 2007. I have been working in the coastal science and coastal management field since 2000. I am a member of the New Zealand Coastal Society (technical subgroup of IPENZ).
- 1.2. I have the following qualifications and experience:
 - (a) MSc (Hons) Marine Sciences from the University of Waikato (2000).
 - (b) 20 years involvement in applied coastal processes, focussed particularly on the assessment and management of coastal hazards, and coastal monitoring. My background and work experience includes: i) Coastal Earth Scientist for the Waikato Regional Council (previously Environment Waikato), ii) Coastal Geomorphologist for Royal Haskoning (U.K) and iii) Owner and director of my own coastal science and management consultancy – 4D Environmental Ltd since 2007.
 - (c) Completion of numerous coastal hazard assessments and provision of coastal management advice at numerous sites in New Zealand and in the United Kingdom, including coastal hazard assessments for District Plan reviews at several Districts in the Waikato and Wellington Regions. I am also co-author of the National Guidance Manual for coastal hazard assessment.
- 1.3. I confirm that I am familiar with the Code of Conduct for Expert Witnesses as set out in the Environment Court Practice Note 2014. I have read and agree to comply with the Code. Except where I state that I am relying upon the specified evidence or advice of another person, my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.
- 1.4. This statement of evidence is given in support of the Waikato District Council, in relation to the proposed Waikato District Plan (Stage 2 – Natural Hazards). In particular, this evidence relates to the definition and mapping of the High Risk Coastal Hazard Areas (Inundation and Erosion), and Coastal Sensitivity Areas (Inundation, Erosion and Open Coast).
- 1.5. I was co-author of the Waikato Coastal Hazard Assessment relevant to this Waikato District Plan review. My co-author, Mr Jim Dahm has over 30 years of experience in the field of coastal hazard management and has completed hundreds of coastal hazard assessments

throughout the country. The recommendations provided in our reports and in this evidence reflect the views of Mr Dahm as well as my own.

2. Scope of Evidence

2.1. This statement of evidence provides a response to issues raised in the following statements of evidence provided by the submitters:

- (a) Statement of evidence of Mr Kenneth Read, CMW Consultants, on behalf of Rangitahi Limited
- (b) Statement of evidence of Mr Mark Mitchell on behalf of Ruth Walden
- (c) Statement of evidence of Dr Brett Beamsley
- (d) Statement of evidence of Mr Tyler Barry
- (e) Statement of evidence of the Horongarara Community Group
- (f) Statement of evidence of Mr Michael Carter on behalf of the Horongarara Community Group
- (g) Statement of evidence of Mr Andrew Wilson
- (h) Statement of evidence of Ms Trish Waugh

3. Response to Statement of Evidence of Mr Kenneth Read, on behalf of Rangitahi Limited.

3.1. Mr Read provides background to the geotechnical research undertaken by CMW for Precincts A, B and D of the Rangitahi Development, and states that:

- (a) Coastal erosion was considered in the preparation of geotechnical assessment reports prepared by CMW for Precincts A, B and D of the Rangitahi development. The geotechnical assessment by CMW (Precincts A and B) considered climate change with respect to changes in water infiltration and ground water levels, but there was no explicit climate change assessment relating to changes in coastal erosion processes that may be associated with sea level rise.
- (b) Special Design Zones “Slope” and “Cliff” areas identified in Precinct A and B adequately provide for management of coastal hazards.
- (c) Building setbacks/building line restrictions proposed in Precinct D closely follow the Coastal Sensitivity Area (Erosion) in the proposed District Plan and can adequately provide for management of coastal erosion hazard.

3.2. Issue: Mr Read’s evidence indicates that coastal erosion processes were included in the assessment of design slope areas and coastal cliff areas in Precinct A and B.

- 3.3. Response: Mr Read has provided some additional information to allow me to further consider whether the special design zones and proposed building setbacks adequately identify areas of coastal margin that may be susceptible to coastal erosion hazard. While the detail of how this information was incorporated into the recommended design slope areas is not available, the CMW reports, and Mr Read's evidence illustrate that a considerable amount of information was collected along the coastline of the Rangitahi development.
- 3.4. Issue: Mr Read argues that the Special Design Zones "Slope" and "Cliff" areas identified in Precinct A and B adequately provide for management of coastal hazards.
- 3.5. Response: In Precinct A, the Specific Design Zone (Slope) covers almost all of the areas within residential properties identified as High Risk Coastal Hazard Area (Erosion) and Coastal Sensitivity Area (Erosion), as well as many areas further inland that are susceptible to land-based instability and are not vulnerable to coastal processes.
- 3.6. There are small areas within the Coastal Sensitivity Area (Erosion) not covered by the Specific Design Zone (Slope) in Precinct A. In these areas, the Coastal Sensitivity Area (Erosion) is particularly wide due to the elevated, steeply sloping topography, rather than a concern about rapid coastal erosion at the toe of the slope. Given the assessment by CMW represents a more detailed site-specific investigation of potential slope instability than our coastal hazard assessment, I am comfortable that the potential hazard has been provided for.
- 3.7. In precinct B, the Specific Design Zone (Coastal Cliff), while based on a different methodology, covers the areas within private property that are identified by the Coastal Sensitivity Area (Erosion).
- 3.8. The preliminary map in Mr Read's evidence provides an indication of the likely restriction/building setback areas to be applied in Precinct D. These areas align closely with the proposed High Risk Coastal Hazard Area (Erosion) and Coastal Sensitivity Area (Erosion) on Lots 231-235.
- 3.9. Based on the information provided, the Specific Design Zones (Slope) in Precinct A, Specific Design Zones (Coastal Cliff) in Precinct B and the proposed building setbacks/building line restrictions (Precinct D) cover the areas that we consider to be potentially vulnerable to coastal erosion. While CMW did not specifically consider the effect of sea level rise on coastal erosion in Precincts A and B, it appears that the defined special design zones do

cover almost all the areas we identified as potentially vulnerable with 1.0 m of sea level rise.

- 3.10. I understand that the current consent notices applied in the specific design zones (Precinct A & B) require that a geotechnical assessment be obtained prior to development to ensure matters of slope stability are provided for. However, I am not aware that there is any requirement to ensure that this assessment also includes specific consideration of coastal hazards, including the impact of sea level rise. Therefore, while the spatial coverage of the specific design zones and building restriction areas are adequate, it is my understanding that development can still occur within these areas without due consideration of coastal hazards. The Coastal Sensitivity Area (Erosion) overlay serves this purpose.

4. Response to Statement of Evidence of Mr Mark Mitchell

4.1. Mr Mitchell raises the following issues:

- (a) A site-specific amendment should be made to the High Risk Coastal Hazard Area (Erosion) to reflect extensive engineering works that have been undertaken on the property at 39 Bay View Road.
- (b) A 1V:2H slope is too conservative for defining the High Risk Coastal Hazard Area (Erosion) on cliff coastlines in Raglan Harbour.
- (c) The High Risk Coastal Hazard Area (Erosion) could be renamed to “Coastal Hazard (Erosion) Area”.

4.2. Issue: This evidence relates directly to a submission by Ruth Walden, which requests a site-specific amendment to the High Risk Coastal Hazard Area (Erosion) to reflect extensive engineering works on the property at 39 Bay View Road (designed and overseen by Mr Mitchell). Mr Mitchell raises the concern that the proposed District Plan does not provide for development on the basis of engineered works on site.

4.3. Response: Our coastal hazard assessment recommends that site specific data can be used to demonstrate that hazards can be avoided or managed at a proposed location within the identified hazard overlays. It is important that these investigations do consider the long-term potential for coastal hazards to affect the proposed development, including the impacts of sea level rise.

4.4. Issue: Mr Mitchell argues that adopting a slope of 1V:2H in defining the High Risk Coastal Hazard Area (Erosion) is too conservative. Mr Mitchell argues against the statement that

existing slopes are 1V:1H-1V:1.5 and notes the very steep cliff faces in the sandstone material in Cox Bay are steeper than 1V:1H.

- 4.5. Response: I agree with Mr Mitchell that scarps formed in sandstone material in Cox Bay are typically very steep, in the order of 1V:1H or steeper. However, substrates higher in the profile form more gradual slopes (1V:1.5H to 1V:2H). For the purposes of defining coastal hazard areas, we have implemented a single slope factor to provide for the average slope of the entire cliff. Where failures have occurred locally, our observations and data analyses indicate that the average slope is typically close to 1V:1.5H.
- 4.6. I agree with Mr Mitchell that hazard areas could be better defined with detailed investigations that characterise the geological strata at a property-scale. We have clearly stated in our coastal hazard assessment that site-specific investigations may confirm that development can occur safely within the identified hazard and sensitivity areas. Property-specific field data collection was beyond the scope of our local scale assessment.
- 4.7. In response to submissions on the proposed Plan and based on further field measurements, we have suggested adjusting the High Risk Coastal Hazard Area (Erosion) to reflect a steeper slope of 1V:1.5H. This has significantly reduced the width of the High Risk Coastal Hazard Area (Erosion) on the property at 39 Bay View Road and may go some way to addressing Mr Mitchell's concerns.
- 4.8. Issue: Mr Mitchell suggests that the High Risk Coastal Hazard Area (Erosion) be renamed to "Coastal Hazard (Erosion) Area" to alleviate the technical problems that are likely to arise with the term "High Risk".
- 4.9. Response: We have identified the High Risk Coastal Hazard Area (Erosion) as the area where there is significant risk from coastal erosion with existing sea level, within the lifespan of the District Plan. On a cliff coastline such as Cox Bay, erosion hazard is associated with occasional (and potentially dramatic) slope failure associated with very slow erosion at the toe of the cliff. As discussed in our hazard assessment, many factors influence the potential for significant failure at a property scale, and the actual level of risk within the identified zone will vary.
- 4.10. I can understand Mr Mitchell's perspective regarding the desire to remove the "high risk" classification from properties. I personally (from a scientific perspective) acknowledge the difficulties in quantifying risk at a local scale assessment with limited data, and I have no technical objection to the proposed name change, provided that management of the area

continues to reflect the coastal hazard. My understanding is that there may be planning implications of such a change are outside my area of expertise.

5. Response to Statement of Evidence of Dr Brett Beamsley

5.1. Dr Beamsley raises the following issues:

- (a) His residence at 41 Rose Street is affected by the High Risk Coastal Hazard Area (Inundation) overlays, which imposes restrictions on future development on the property.
- (b) The approach we have taken neglects to consider Raglan tide data and the most recent Kawhia tide data.
- (c) The levels we have applied to map the High Risk Coastal Hazard Area (Inundation) and Coastal Sensitivity Area (Inundation) are unnecessarily conservative.
- (d) A more appropriate approach would be to directly apply a 1% AEP level based on analysis of Kawhia and Raglan tide data.

5.2. Issue: Dr Beamsley is concerned that the High Risk Coastal Hazard Area (Inundation) restricts the future development of coastal property that is disproportionate to the actual risk.

5.3. Response: The property at 41 Rose Street is not within the High Risk Coastal Hazard Area (Inundation), but a small portion is affected by the Coastal Sensitivity Area (Inundation). Dr Beamsley may have misinterpreted the coastal overlay maps, as he has also referred to the High Risk Coastal Hazard Area (Inundation) while discussing figures and levels that relate to the Coastal Sensitivity Area (Inundation). I have assumed for the purposes of my responses here that Dr Beamsley is referring to the effect that the Coastal Sensitivity Area (Inundation) has on his property. Notwithstanding this, discussion of the choice of storm tide elevations is relevant to both the High Risk Coastal Hazard Area (Inundation) and Coastal Sensitivity Area (Inundation).

5.4. Issue: Dr Beamsley feels we have been negligent in relying on a 2015 analysis of Kawhia tide gauge data, and not completing an updated analysis of Kawhia and Raglan water level data.

5.5. Response: Our coastal hazard assessment considered the available information to define coastal inundation hazard areas. A detailed re-analysis of the tide data was not within the scope of our services. The best information available at the time was the tide data analysis completed by NIWA for the Waikato Regional Council (Stephens et al. 2015), which

provides detailed observations of storm tide characteristics and components, and extreme level and joint probability analysis of the then six-year water level record at Kawhia tide gauge (Kawhia Wharf).

- 5.6. The Raglan Wharf tide data was not included in the report by Stephens et al, (2015) as record was short and highly fragmented, with only three years of (broken) data record available at the time. Major disruption in data collection at Raglan mean that less than eight years of water level data has been collected between 2008 and 2020.
- 5.7. The High Risk Coastal Hazard Area (Inundation) has been defined as land with elevation below 3.0 m MVD-53. While this level was chosen based largely on the analysis of Kawhia tide gauge data by Stephens et al. (2015), we also sought observations, photographs and knowledge of Regional Council staff, and of local residents during the three rounds of community consultation.
- 5.8. We considered the additional tide record at Kawhia and Raglan, including discussion with Regional Council staff in this regard. We concluded that that additional data did not include any extreme events that were likely to significantly influence the analysis and that a data record of 10 years (at the time of our reporting in 2019) is still insufficient to confidently predict a 1% AEP storm tide level.
- 5.9. I therefore firmly disagree that we have been negligent and have ignored important data. While additional data is available at Kawhia and Raglan, existing datasets are still too short in opinion to confidently predict 1% AEP storm tide levels, regardless of the statistical approach applied.
- 5.10. Issue: Dr Beamsley argues that we have used an unreasonably conservative approach to defining the High Risk Coastal Hazard Area (Inundation) as we have used maximum values from Kawhia tide gauge data rather than directly applying a 1% AEP level from joint probability analysis. Dr Beamsley argues that we have applied a “worst-case” event and that application of “maximum” values in our choice of storm tide levels represents a 0.0001% AEP (1:10,000 year) event (i.e. $0.01 \times 0.01 \times 0.01$) and that it is unreasonable to apply this event in a planning sense.
- 5.11. Response: Stephens et al. (2015) completed an extreme level and joint probability analysis and estimated a 1% AEP storm tide level of approximately 2.7 m (MVD-53), with an upper 95% confidence interval of 2.8 m (MVD-53). However, the study also acknowledged the

considerable uncertainty associated with this level, due to the short tide record and the characteristics of storm tide composition on the West Coast.

- 5.12. Given this uncertainty, Stephens et al. (2015) also provided extreme storm tide value (3.16 m MVD-53 at Raglan) to reflect the possibility that a high spring tide may coincide with a significant storm surge (as this had not happened in the short record). This value was calculated using maximum observed values from the short dataset. While a probability cannot be assigned for this event, Stephens et al. (2015) acknowledged that it is likely to be less than 0.5% AEP (1:200 year event).
- 5.13. After careful consideration the above calculations, and of other unpublished data, we have applied a level of 3.0 m (MVD-53) to define the High Risk Coastal Hazard Area (Inundation). It is not possible to quantify the return period of such an event as it is not the product of a joint probability analysis. However, it is not as extreme as the 3.16 m MVD-53 level defined by NIWA as likely to be less than 0.5% AEP.
- 5.14. Dr Beamsley has suggested that we are applying a level equivalent to a 1:10,000-year event. This is a misrepresentation of our methodology. The components used do not have an AEP of 0.01 (or “smaller” as implied by Dr Beamsley). We have considered the maximum storm surge measured over just a six-year record. It is reasonable to assume that this could be a relatively “common” event.
- 5.15. We have been open about the potential for some conservatism in the 3.0 m MVD-53 level. In applying this level directly to spatially mapping the High Risk Coastal Hazard Area (Inundation), we have not added any provision to account for potential error in the elevation dataset (+/-0.15 m). We have also not added any allowance for wave run-up, either from wind-generated waves, or long period infragravity waves (which are widely recognised in Raglan Harbour as a contributor to coastal flooding). In my opinion, both factors may need to be explicitly provided for if a lower underlying storm surge level was applied to define the coastal hazard overlays.
- 5.16. The exact level of risk varies within the coastal hazard overlays depending on ground elevation, the physical location of the property and the nature of development. Projected sea level rise is expected to increase the extent and severity of inundation hazard over time, and areas that face only occasional or very minor flooding will become increasingly affected. These factors make it difficult to quantify coastal inundation risk at the scale of a District or even local assessment. The High Risk Coastal Hazard Area (Inundation) identifies

areas of land that are vulnerable to inundation, but risk can be managed through minimum floor levels and resilient design. Property-specific circumstances and measures may minimise risk if the hazard is identified and provided for at the time of development.

- 5.17. Issue: Dr Beamsley has completed his own analysis of the available Raglan and Kawhia tide data, including an additional six years of record at Kawhia, and suggests that the results of this analysis could be applied to the definition of the coastal inundation overlays in the Waikato District Plan. Dr Beamsley seeks “a change to the value stated above (2.61 m above MVD-53 + 1 m Sea Level Rise) for defining High Risk Coastal Hazard (inundation) Area”.
- 5.18. Response: As the High Risk Coastal Hazard Area (Inundation) does not include any allowance for sea level rise, I have assumed here that Dr Beamsley is referring to the level used to define the Coastal Sensitivity Area (Inundation), which is currently defined as 3.00 m + 1.00 m sea level rise (4.00 m MVD-53). The Coastal Sensitivity Area (Inundation) would be defined by 3.61 m (MVD-53) and Dr Beamsley’s residence at 41 Rose Street would not be affected by the overlay.
- 5.19. While I have not seen a detailed report describing Dr Beamsley’s methods, I do not dispute the outcomes of his analysis of the Raglan and Kawhia water level data, which has produced results that are very close to the 1% AEP value calculated by Stephens et al. (2015). His analysis recommends the same storm tide level for both Raglan and Kawhia which provides useful indication that storm tide levels at Raglan are relatively well represented by analysis of Kawhia data.
- 5.20. I understand Dr Beamsley’s concern that the 3.0 m MVD-53 level does not directly represent a 1% AEP event. However, it is my opinion that simply applying the statistically calculated 1% AEP level would not reflect the limitations of the relatively short available data record, potential errors in the elevation dataset or wave run-up effects.
- 5.21. The presence of coastal hazard overlays should not prevent appropriate ongoing use and development in these areas, but it is critical to recognise that coastal inundation hazard is expected to increase over time and decisions made today will have significant impacts in future decades. Investigations and adaptive management at a property scale can be used to support development (e.g. floor levels, building design etc).

6. Response to Statement of Evidence of Mr Tyler Barry, Whale Bay.

6.1. Mr Barry raises the following issues:

(a) The definition of the High Risk Coastal Hazard Area (Erosion) and Coastal Sensitivity Area (Open Coast) is unnecessarily conservative at 9 Tohora Close, Whale Bay.

6.2. Issue: Mr Barry highlights that the Whale Bay area is founded on erosion-resistant volcanic rock and is not vulnerable to coastal erosion.

6.3. Response: Tohora Close is fronted by boulder beach and the surrounding area is dominated by hard volcanic materials. The Whale Bay settlement is however located on an area of terrace deposits (river and stream alluvium and swamp deposits), and there is evidence of fill in some areas where the bank is exposed. Field observations indicate there is slow ongoing erosion of these overlying materials, forming a steep bank fronting the reserve seaward of the residential properties. We do not have detailed information about the depth or characteristics of the terrace materials, so we have to assume that they are potentially subject to slow erosion.

6.4. Issue: Mr Barry does not accept that long term coastal erosion could affect the property at 9 Tohora Close, which is elevated well above sea level.

6.5. Response: Mr Barry is correct that the property is elevated above the level potentially vulnerable to coastal inundation. The seaward portion of the property is potentially vulnerable to coastal erosion in the longer term with sea level rise associated erosion and subsequent slope instability.

6.6. The High Risk Coastal Hazard Area (Erosion) provides for just 2 m of erosion of the bank, and a relatively steep stable slope of 1V:1.5H. The High Risk Coastal Hazard Area (Erosion) only affects the reserve seaward of the residential properties.

6.7. In defining the Coastal Sensitivity Area (Open Coast), we have provided for a simple landward and upward translation of the boulder beach along the current beach slope (1V:10H) in response to 1 m of sea level rise and have provided for failure of the bank materials to a more conservative 1V:2H stable slope. The Coastal Sensitivity Area (Erosion) extends into the property at 9 Tohora Close due to the slope component on the relatively elevated section.

6.8. The Coastal Sensitivity Areas do not reflect a confirmed hazard. They are simply areas where the potential long-term impact of coastal hazards should be considered when undertaking

new development or intensifying use. Further detailed field investigations of the underlying materials may indicate that development of some locations within the Coastal Sensitivity Area is appropriate. We simply do not have property-specific field data to make that judgement.

7. Response to Statements of Evidence of Horongarara Community, Te Akau South.

- 7.1. Revised coastal hazard mapping was undertaken at Horongarara Peninsula (Ryan Road subdivision) in response to submissions from the local community. This has resulted in several properties being affected by the High Risk Coastal Hazard Area (Erosion).
- 7.2. Evidence has been received from the Horongararara Community Group (representing 2B & 2D Ryan Road), Ms Trish Waugh (2C Ryan Road), Andrew Wilson (2E Ryan Road). These parties raise the following issues:
 - (a) The community has commissioned an expert to collect site specific data to refine the High Risk Coastal Hazard Area (Erosion) at Ryan Road (2B, 2C, 2D & 2E), and request that the Council grant time to produce this information.
 - (b) There are errors in the contour data used in the coastal hazard assessment.
- 7.3. Issue: The community group has commissioned an expert (Mr Michael Carter) to collect site specific data that can be used to further refine the High Risk Coastal Hazard Area (Erosion) at 2B-2E Ryan Road, and request that the Council grant time to produce this information. Mr Carter (Engineering Geologist) believes that the High Risk Coastal Hazard Area (Erosion) can be further refined based on drilling, subsurface characterisation and quantitative analysis, and has provided a letter of support.
- 7.4. Response: The local scale assessment at Te Akau South identified a High Risk Coastal Hazard Area (Erosion) and Coastal Sensitivity Area (Erosion), based on very low rates of erosion and the application of stable slopes. This approach is consistent with the broad approach taken elsewhere on the developed cliff shoreline of Raglan Harbour. Property-specific field data collection was beyond the scope of our investigation.
- 7.5. As noted by the submitters, our coastal hazard assessment is limited to analysis of the exposed geology on the shoreline, the available topographic data, and any information provided by residents. We have not had the resources to collect and analyse field data at a property scale throughout the District.

- 7.6. I have no objection to the outcomes of further detailed field investigations being utilised to further refine the High Risk Coastal Hazard Area (Erosion) and Coastal Sensitivity Area (Erosion), provided that the information addresses coastal processes, both with current sea level and (with regard to the Coastal Sensitivity Area (Erosion)), the long term impact of projected sea level rise. I would recommend that Mr Carter works closely with the Council to ensure that the investigation is targeted to provide the information required.
- 7.7. Issue: The submissions suggest that there is an error in the contour mapping used in our report.
- 7.8. Response: There is no information provided about the location or nature of this error, so I am unable to comment further.
- 7.9. Dr Tom Shand (Tonkin & Taylor) is currently undertaking a peer review of the Te Akau South coastal hazard assessment. While the review report is not yet finalised at the time of preparing this evidence, preliminary comments from Dr Shand are that the assessment is a “robust local scale assessment”, likely to have applied appropriate values for erosion and appropriate stable slopes based on the arguments presented. Preliminary comments highlight the following matters that are relevant to the concerns of the submitters:
- (a) Dr Shand feels that the hazard assessment is better described as “local scale” than “site-specific”.
 - (b) The minimum width of 20 m and 30 m applied to the high risk and sensitivity areas may be conservative, but do not appear to be applied widely.
 - (c) The application of two different slopes in Section 3 (eastern shoreline) is slightly confusing and it may be appropriate to slightly modify the approach to apply a consistent stable slope of 1V:1.5H while providing for the presence of historical landslides.
- 7.10. Dr Shand’s preliminary review comments are constructive. Based on these preliminary comments, I expect we will adopt most, if not all of Dr Shand’s suggestions:
- (a) I agree with Dr Shand’s suggestion to refer to our Te Akau South coastal hazard assessment as “local scale” rather than “site specific”.
 - (b) The minimum 20 m and 30 m widths applied to the coastal hazard overlays were included to limit the impact of small-scale changes in topography (e.g. stream mouths)

on the width of the overlays. These minimum widths were applied along short stretches of the eastern shoreline and do not affect the coastal hazard overlays on any residential properties.

- (c) Our decision to apply two different slopes on the eastern shoreline reflects changes in the topography and exposed geology at the coast. The more conservative slope of 1V:2H was applied in the area where there has clearly been active instability and slip material has created more gradual sloping coastal margin. Dr Shand has suggested we apply a consistent 1V:1.5H slope, with an adjustment in the landslip area to apply this slope from the rock toe that is presumably buried under slip material. I agree that this could be a valid approach, and while it is unlikely to alter the coastal hazard overlays dramatically, it may provide for some refinement in the area around 2E and 10D Ryan Road.



Bronwen Gibberd

3 May 2021