BEFORE THE HUTT CITY COUNCIL

Proposed District Plan Hearings Panel – Stream 5 – Natural Hazards

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Proposed Lower Hutt District Plan

PROPOSED REMODELLING PARAMETERS FOR FLOOD HAZARD OVERLAYS – FURTHER INFORMATION

MEMORANDUM OF

Stephen Davis **Senior Policy Planner, Hutt City Council**

Alistair Osborne **Principal Stormwater Modeller, Tiaki Wai**

30 October 2026

1.0 Introduction

1.1 This memorandum responds to the panel's request for more information set out in Minute #20[1], and provides an update to the memorandum we produced with Nicola Arnesen of Wellington Regional Council of 23 September 2026[2].

1.2 We also attach a memorandum from Nicola Arnesen and Iain Dawe setting out the position of the Wellington Regional Council on the sea level rise assumptions for flood modelling for the Waiwhetū Stream.

1.3 Given the connected nature of the planning and modelling issues within the expertise of Mr Davis and Mr Osborne (respectively) this memorandum presents our joint view in section 2 and 3.

2.0 Sea level rise assumptions for the Waiwhetū Stream

Stephen Davis and Alistair Osborne

2.1 During the preparation of our joint minute, staff for the Wellington Regional Council gave their advice around the assumptions to be used for remodelling the Waiwhetū stream. They recommended that, even with the rainfall assumption being reduced to match the Tiaki Wai assumption (20%), the sea level rise should remain at 1.59m. The memo thus represents parameters agreed between ourselves and regional council staff.

2.2 Attached as Appendix 1 to this memo is another memorandum of Nicola Arnesen and Iain Dawe of the Wellington Regional Council setting out their reasons for this view.

[1] https://hccpublicdocs.azurewebsites.net/api/download/d8937615b4d04c4eabe99da68ac79ed3/_dplanreview/01ec86ad213855684ed1968987d9648e8d37
[2] https://www.huttcity.govt.nz/__data/assets/pdf_file/0023/78044/Hearing-5-Flood-Remodelling-Proposed-Criteria-for-Comment-FINAL-2026-09-23.pdf

2.3 On this basis, the regional council prefers to retain the 1.59m sea level rise figure rather than adopt the 1m sea level rise assumption. It is capable of modelling using either figure.

2.4 Ms Arnesen and Mr Dawe also set out their view that the difference in sea level assumption will make little difference to the resulting hazard classifications due to the limited protection provided by the Waiwhetū stopbanks and relatively low elevation of much of the affected area in Moera.

2.5 Obviously, we cannot know this with certainty until the model is re-run and could only know the difference if both options are run for comparison. However, we have no reason to disagree with Ms Arnesen and Mr Dawe's view.

2.6 In our view, both the 1.59m and 1m options are reasonable choices. Our preference would be to use the 1m figure for consistency with the other Tiaki Wai models, and the models used for Porirua and Wellington City.

2.7 Also, while we agree that arriving at sea levels in excess of 1 metre is inevitable, whether within the 100 year time horizon or later, the spatial accuracy and general utility of the flood modelling does decrease as we get further into the future given its other assumptions and constraints, and the uncertainty of the city's long-term response to climate change. This is particularly true for times beyond 100 years in the future.

2.8 The panel will thus need to direct use of a particular option.

2.9 For either option, the models are separate and each is individually processed into high/moderate/low bands, and then the resulting hazard layers combined. There are thus no specific technical issues with combining the eight different models into a single set of flood hazard overlays, regardless of differences in the sea level rise assumption.

3.0 30 Benmore Crescent

Stephen Davis and Alistair Osborne

3.1 Mr Gibson gives his view for Te Kārearea Ltd and Rosco Ice Cream that updated LIDAR elevation data should be used in the flood remodelling.

3.2 As Mr Osborne sets out in his earlier evidence[3] attached to the s42A report, and based on the assessment made by River Edge Consulting[4], it is likely that updated elevation data would materially change the flood modelling for the site by reducing the affected area.

3.3 However, while using more recent LIDAR would in general provide a more accurate model, it would involve re-building the model, rather than just re-running it with different parameters. This would add considerable expense to the process and lengthen the timeframe, possibly beyond the time available to the panel.

3.4 Using updated LIDAR also creates potential scope and natural justice issues, as it is probable the change would result in a mix of both decreases and increases in identified areas and their modelled severity – particularly for this area if the earthworks would have had the result in displacing flooding into the surrounding area, but also for any other changes in elevation in the model area.

3.5 These issues could potentially be avoided by using a new model solely for the site in question, using updated LIDAR elevation data. However, as a question of equity, we think it is unreasonable for the Council and/or Tiaki Wai to bear this expense at the cost of all ratepayers/customers for the benefit of a single specific site. The submitter has already commissioned independent modelling; the issue as identified by Mr Osborne in his evidence is that it has not been done in accordance with the Wellington Water Regional Stormwater Hydraulic Modelling Specifications. If the submitter is willing to conduct the modelling in accordance with the

[3] Section 42A Report, Appendix B1, paragraph 22.53.
[4] Attached to the evidence of David Gibson, 5 August 2026, from p84 onward

Specifications, then we see no obstacle to incorporating it, but in the absence of that, we recommend the re-modelling for the PDP proceed on the basis of the boundaries of the six Tiaki Wai model areas included in the PDP as notified.

3.6 To reflect the change in elevation, we think it is more reasonable to adopt the approach recommended by Mr Osborne in his evidence[5] to simply remove the flood hazard overlays from the site, with the exception of retaining the high hazard overlay reflecting the stream corridor.

4.0 Comments of Dieter Engel

Alistair Osborne

4.1 I have read the additional material submitted by Mr Engel.

4.2 Mr Engel has requested eight amendments to the remodelling process. These are addressed below.

Validation against observed flood events

4.3 Mr Engel has recommended that each model be checked against the best available significant observed events. I can confirm that each model was validated against a selection of significant events experienced within its respective catchment, using the best available information at the time of validation.

4.4 It is rare that explicitly measured values of depth, level, flow, or velocity are available for validating stormwater models as this information is rarely collected. When it has been, such as the flow measurements made in the Waiwhetū Stream and Black Creek, this has been used in the validation of the relevant models.

4.5 The limitation Mr Engel refers to in the Stokes Valley Model Build report regarding complaint information does not reflect the review of the Wellington Water complaints database to establish no

[5] Section 42A Report, Appendix B1, paragraph 22.53; Additional evidence of Alistair Osborne, 12 August 2026, para 11.1.

information was available for the two events used to validate the model. The assessment of available complaint information is a first step of the Tiaki Wai model validation process as set out in Section 7.3 of the Wellington Water (now Tiaki Wai) Regional Stormwater Hydraulic Modelling Specifications V6 – May 2023 document.

4.6 Mr Engel notes that two large events have occurred in the Stokes Valley catchment since the development and notification of the Flood Hazard Overlays in the Proposed District Plan. I am not aware of any explicitly measured data collected during these events that could be used to more accurately validate the model. Any additional work would likely still be limited to anecdotal information like that used in the original validation process, resulting in a similar conclusion that the model "validates well".

4.7 I do acknowledge there would be more anecdotal information available for validation following these events. However, I do not believe a re-validation phase would be of value relative to the time it would require and the expense it would incur, as I believe the current models are fit for purpose.

4.8 During the remodelling process, no changes are proposed to the models, rather it will be a process of simulating a different event scenario.

4.9 I also note that alongside model validation, Tiaki Wai endeavours to ensure the hydraulic models are as accurate as possible by requiring the models be developed following the detailed methodology set out in the Regional Stormwater Modelling Specifications, having the models reviewed by independent consultants, and undertaking community engagement.

Transparent observed-versus-modelled comparisons

4.10 I believe the model validation section of each of the model build reports provides this transparent comparison.

Community ground-truthing

4.11 Wellington Water (now Tiaki Wai) did undertake community ground-truthing alongside Hutt City Council (HCC) via the eleven community engagement sessions completed in 2021.

4.12 Additional community ground-truthing may provide further information to support the hydraulic models, however, there is no certainty that it would result in any meaningful improvement to model performance or understanding. Given the work already undertaken to ensure the models are fit for purpose, I do not consider the potential benefits of additional community ground-truthing to justify the time and cost that would be required.

Publication of 10-year model outputs

4.13 I do not believe this request is relevant to the Proposed District Plan flood hazard overlays. However, this is a recommendation that could be submitted to Tiaki Wai and HCC to include this information on one of their publicly available digital platforms for flood depth maps.

Separate identification of the design-event flood and freeboard

4.14 Freeboard is a representation of residual risk, which I consider to be in alignment with the Residual Flood Hazard Area set out in the GWRC Flood Hazard Planning Guidance (2023) document. The guidance document designates the Residual Flood Hazard Area as Low Hazard, alongside design-event results that are below the relevant depth and velocity thresholds. I do not think there is any benefit in distinguishing between the freeboard component of the Low Hazard category and design-event component of the Low Hazard category, as the corresponding planning rules would be identical.

4.15 Beyond the context of the PDP, this is a recommendation that could be submitted to Tiaki Wai and HCC to include this information on one of their publicly available digital platforms for flood depth maps.

Publication of the underlying hazard information

4.16 The raw model results that comprise this information are large and difficult to publish in an easily accessible format. However, they are publicly available and can be requested from Tiaki Wai.

Documentation of model changes following validation

4.17 This information is generally included in the model validation section of the model build reports.

Review against current modelling practice

4.18 The six stormwater hydraulic models built by Tiaki Wai on behalf of HCC have been developed in line with the Regional Stormwater Modelling Specifications, which constitute current modelling practice for stormwater models across the four Wellington metro councils. The modelling approach, including the freeboard approach, has been applied consistently across all the stormwater models developed by Tiaki Wai for their client councils.

STEPHEN DAVIS

ALISTAIR OSBORNE

For Hutt City Council

30 October 2026

APPENDIX 1: MEMORANDUM OF NICOLA ARNESEN AND IAIN DAWE FOR WELLINGTON REGIONAL COUNCIL

BEFORE THE HUTT CITY COUNCIL

Proposed District Plan Hearings Panel – Stream 5 – Natural Hazards

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Proposed Lower Hutt District Plan

WAIWHETŪ FLOOD MODELLING SEA LEVEL RISE PARAMETER

MEMORANDUM OF

Nicola Arnesen — **Manager – Environmental Policy, Wellington Regional Council**

Iain Dawe — **Senior Natural Hazards Analyst, Wellington Regional Council**

23 October 2026

1.0 Background

1.1 The Panel in Minute #14 sought[1] for Council to re-run the flood models used in the Flood Hazard Overlays with a climate change assumption consistent with that used in Wellington and Porirua's district plans, as recommended in the Section 42A Report[2].

1.2 The panel sought that Council staff and staff from the Wellington Regional Council meet to confirm recommended parameters for the re-modelling and to publish that for comment from other submitters[3].

1.3 The response to Minute #14 was published in the memorandum "Proposed Remodelling Parameters For Flood Hazard Overlays" signed by Stephen Davis, Alistair Osborne and Nicola Arnesen and dated 23 September 2026.

1.4 The flood modelling recommendations were set out in an Appendix to that memorandum. With regards to the Waiwhetū Stream, the parameters were to re-run the flood model using rainfall uplift consistent with the RCP4.5 scenario (ie, a 20% increase from present day instead of 35%). All other parameters used in the existing modelling were to remain the same, including sea level rise of 1.59 m, as opposed to the 1.0 m assumption used in the stormwater modelling.

1.5 In Minute #20 the Panel requested a further explanation for why the greater allowance for sea level rise (1.59 m as opposed to 1.0 m) is recommended for the Waiwhetū Stream[4] and what, if

[1] Minute 14, para 10.
[2] Section 42A Report, Natural Hazards, paras 843-849 and 927-931.
[3] Minute 14, para 11.
[4] Minute 20, para 7

any, implications adopting an inconsistent approach would have for properties in this stream catchment relative to the other catchments subject to other models.

2.0 Sea level rise and vertical land movements affecting the Lower Waiwhetū catchment

2.1 An analysis of the long term trends of local sea level from the tide gauge data in Wellington Harbour shows that since records began in 1890, sea level has been rising at a rate of 2.23 mm per annum[5]. This amounts to over 0.30 m of sea level increase over the past 136 years.

2.2 The data shows that in the middle of last century, there was an upward tick in the rate of rise, a trend that is consentient with what has been observed both internationally and regionally[6]. It is now widely accepted that there has been a measurable acceleration in the global rate of sea level rise[7]. This will have significant consequences for low lying coastal land currently subject to flood hazards.

2.3 Additionally, the whole Wellington region is tectonically subsiding. Continuous GPS records since 1995 of vertical land movements (VLM) in the region and more recent satellite altimetry data show that interactions on the Australian-Pacific plate tectonic boundary are causing regional subsidence[5]. The rates vary locally and for Lower Hutt and the Eastern Harbour

[5] Bell, R., Denys, P. & Hannah, J. (2018), Update on relative sea-level rise and vertical land motion: Wellington region. Prepared for Greater Wellington regional Council, Niwa Client Report 2019007HN, December 2018.
[6] Hague B., Jones, D., West, J. & Jacob, D., (2025), Sea level trajectories and recent records at Australian tide gauges. *Journal of Southern Hemisphere Earth Systems Science* **75**, ES24039. doi:10.1071/ES24039.
[7] WCRP Global Sea Level Budget Group: Global sea-level budget 1993–present, Earth Syst. Sci. Data, 10, 1551–1590, https://doi.org/10.5194/essd-10-1551-2018, 2018.

Shoreline range from -2.3 to -4.14 mm/yr with the rate at Seaview measured at -3.82 mm/yr[8]. This subsidence is significantly increasing the local rate of *relative* sea level rise (ie. SLR + VLM) and is effectively doubling the rate of sea level rise in the region.

2.4 The coastal inundation and sea level rise assessment prepared by NIWA for the proposed district plan and on which the coastal hazard mapping overlays have been based[8], presented a range projections for relative sea level rise out to 2130 that included vertical land movement. Forecasts presented in Table 2-4 of that report show that 1.26 m of relative sea level rise for Seaview may be expected by 2130 in the mid-range scenario (SSP2-4.5) and 1.68 m for the higher range scenario (SSP5-8.5).

3.0 Waiwhetū flood modelling parameter for sea level rise

3.1 The sea level rise scenarios all have a range from lower to higher percentiles and the 1.26 m and 1.68 m represent the forecasts at the 50th percentile. The SSP2-4.5 relative sea level rise forecasts (SLR + VLM) at 2130 for Seaview range from 0.95 m at the 17th percentile to 1.64 m at the 83rd percentile. What this means is that 1.59 m (SLR + VLM) is within the range forecast by the SSP2-4.5 scenario.

3.2 Consequently, retaining the sea level rise assumption of 1.59 m is recommended for the Waiwhetū because of the strong hydraulic connection at the river mouth estuary between the sea and the river. Coastal processes and conditions are a big driver of flood hazards in the Seaview/Moera area and strongly influence water levels and flood conveyancing in the lower catchment.

3.3 The 1.59 m sea level rise assumption also maintains consistency with the coastal flood hazard overlays in the proposed district plan.

3.4 It is important to recognise that changes in sea level happen with more inertia than changes in the atmosphere. Sea levels are rising because of melting ice caps and oceanic warming. Water expands as it heats and at least half of all the sea level rise is a function of the oceans warming as a result of absorbing heat from the atmosphere. But there is a lag between the two because water absorbs heat more slowly than the air. Even drastic cuts to greenhouse gas emissions (GHG) in the most optimistic scenarios will not prevent sea levels from continuing to rise for the next several centuries. Put more starkly, Lower Hutt is on track to reach 1.59 m sea level rise sooner or later regardless of what actions are made to curb emissions.

3.5 This is compared to rainfall, which is more sensitive to changes in atmospheric GHG composition and there is more uncertainty associated with future increases in extreme rainfall events between the different scenarios.

4.0 Waiwhetū flood modelling parameter for sea level rise

4.1 Seaview, Moera, Gracefield and the lower Waiwhetū catchment is extremely low lying, and subject to coastal, fluvial and stormwater flooding. Large parts of it are reclaimed land. The whole area sits no more than 3.0 m above the mean high water mark and a large percentage of that is less than 2.0 m elevation.

4.2 The expert opinion of GW flood protection officers is that there will be little difference in the modelled flood hazard for the lower Waiwhetū catchment between using a 1.0 m vs a 1.59 m

assumption for sea level rise. And when the relative sea level rise difference (SLR + VLM) is factored into this, the difference between the mid range SSP2-4.5 scenario of 1.26 m and 1.59 m is only 0.33 m.

4.3 A further consideration for the flood hazard in the area is that the Waiwhetū stopbanks are only capable of containing at most a 2% AEP (50 yr) flood and plans to upgrade these to a 1% AEP (100 yr) standard are some years away. It is GW flood protection officers' opinion that, even with the Waiwhetū stopbanks upgraded to a 1% AEP standard, it will be insufficient to fully cope with either a 1.0 m or 1.59 m of sea level rise and that it is unlikely that reducing the sea level rise parameter from 1.59 m to 1.0 m will alter the long term flood hazard rating from high.

4.4 By comparison, the Riverlink project will see the Te Awa Kairangi / Hutt River stopbank system upgraded to a 440 yr standard and will be capable of withstanding flood events with 1.59 m of sea level rise.

4.5 Retaining a relative sea level rise assumption for the Waiwhetū flood model of 1.59 m recognises the greater vulnerability the area faces from flood hazards both currently and in the near future.

4.6 Regardless of which scenario is selected, large areas of Lower Hutt are exposed to flooding and coastal inundation with rising sea levels. This was noted in the coastal inundation and sea level rise assessment prepared by NIWA for the proposed district plan.[8]

[8] Andrews, C (2023), Coastal inundation and sea level rise assessment for the Hutt City District. Prepared for Hutt City Council, NIWA Client Report WCC23202, June 2023, Figure 2-2; Table 2-4; Section 5, p28.



Nicola Arnesen; Iain Dawe for Wellington Regional Council

23 October 2026