Draft evidence on Planning report for Natural Hazards s42a report, Te Tai o Poutini Plan

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1. My full name is Sharon Maria Hornblow, I work as a Natural Hazards Analyst at West Coast Regional Council, based in Paroa, Greymouth.
2. I have prepared this statement of evidence on behalf of West Coast Regional Council in respect of technical related matters arising from the submissions and further submissions on the Natural Hazards Chapter of the proposed Te Tai o Poutini Plan

Qualifications and Experience

3. I hold a Doctor of Philosophy in Geology from Canterbury University. I have over 10 years' experience working in both academic and local government settings on the study of active tectonics, geomorphology, and the mapping of geological, flood and coastal hazards. The focus of my job is the use of environmental data and hazard mapping to build community resilience and decrease risk from natural hazards and climate change.
4. In my current role, which I started in November 2022, I advise various teams through the West Coast Regional Council, along with Territorial Authorities, of natural hazard exposure, oversee the collection of data and investigations to better define the hazards, and assist Council Planning and Engineering functions with their respective applications of natural hazard information to risk reduction. This is achieved through my in-depth understanding of geological and hazard mapping datasets, and my ability to research and communicate relevant information to affected parties.

Code of Conduct

5. I confirm that I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023 and that I have complied with it when preparing this statement of evidence. Other than when I state that I am relying on the advice of another person, this 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 that I express.

Conflict of Interest

6. To the best of my knowledge, I have no real or perceived conflict of interest.

Scope of Evidence:

7. The scope of this evidence is limited to my summary of the natural hazard overlays proposed to be included in Te Tai o Poutini Plan, brief description of the scientific basis and source data used to inform them, and comments on my understanding of the robustness of methods used to inform the mapping of areas at risk from natural hazards in the West Coast region.

Natural Hazards in Te Tai Poutini:

8. The West Coast region, Te Tai Poutini, is vulnerable to a range of natural hazards. Some are posed by the local geological processes responsible for the striking, mountainous

landscape, for example high frequency of major fault rupture events. The geographical setting of the West Coast also ensures the highest rainfall totals in New Zealand, resulting in land instability and damaging river flooding, and frequent storms bringing both damaging storm surge inundation and erosion to the long coastline. Hazards such as slips, floods and coastal erosion are familiar to communities, as is the process of cleaning up and repairing damage. Less familiar is the long-term outlook over decades to 100 years, where the cumulative impacts of coastal hazards and repeat flooding necessitate a planning-based approach to mitigate the risk inherent in the landscape. This is where the careful mapping of exposure to natural hazards, and the application of these spatial data to hazard overlays, will assist in mitigating natural hazard risk to communities, infrastructure and individuals on the West Coast.

River flood hazard overlays:

9. A set of overlays has been used to define different levels of severity, and spatially accurate mapping, of flood hazard on the West Coast. Understanding the risk, especially to the main town centres of each District, is important due to the concentration of risk in each of the low-lying river adjacent parts of Hokitika, Greymouth and Westport. Hazard overlays for severe and susceptibility have considered flood protection infrastructure where present and future flood protection projects (Westport Hazard overlay).
10. The primary mechanism for mapping flood hazard severe and susceptibility is by hydrodynamic modelling of the current 1% Annual Exceedance Probability (AEP) river flows, based on hydrological records for the catchment held by WCRC. Surveyed river cross sections and ground elevation data of the wider landscape (Light Detection and Ranging or LiDAR) are used to understand how the flood flows would behave. Land River Sea Consulting ran modelling for the Buller, Grey and Hokitika Rivers and presented WCRC with the outputs of depth and speed[1][2][3]. A combination of these which is designed to describe risk from a human perspective and ranked as 'hazard category' and taken from Australian Rainfall and Runoff Guidelines, according to Land River Sea consulting.

Flood hazard severe:

11. The 'severe' ranking likely comes from the H5 and H6 ranking of water moving at more than 2 m per second, and/or over 2 m deep. The Guidelines suggest that in these areas buildings are likely to experience structural damage or failure, and lives are at risk. The models assume no breach in the flood protection infrastructure (i.e. they do not consider residual risk) and use current climate 1% AEP runs. For Franz Josef I understand the research into flood hazards for the Future Franz Josef Project for the Westland District Council, like the area in the operative WDC District Plan, was used to draw the flood hazard severe polygon, as the latest Waiho River hydrodynamic modelling from Land River Sea was not received in time for the draft TTPP.

[1] Land River Sea Ltd. (2020); Hokitika River: Hydraulic Modelling and Flood Hazard Mapping. Report prepared by Matthew Gardner for West Coast Regional Council, June 2020.
[2] Land River Sea Ltd. (2023); Grey River Flood Modelling. Report prepared by Matthew Gardner for West Coast Regional Council, May 2023. N.B. Flood modelling shapefile outputs received by WCRC 2021.
[3] Land River Sea Ltd. (2022); Buller River: Flood Model Upgrade. Report prepared by Matthew Gardner for West Coast Regional Council, February 2022.

Flood hazard susceptible:

12. The rationale behind having a second, wider flood overlay for less severe flooding is that not all flooding is life-threatening but repeated exposure to even small flood depths puts pressure on infrastructure and still may present risk to life. There are also areas where not enough data exist to accurately map areas where depths and speeds of river flooding are likely to pose a significant threat.
13. For Westport, Greymouth and Hokitika, excluding the area of the Hokitika and Westport overlays, the areas where 1% AEP modelled flood depth is less than 2 m, but still within the inundation extent, are mapped as 'susceptible' to flooding. These areas include lower Hazard thresholds, for example H4 (over 1.2 m depth) where there is still danger to life or safe evacuation but not to structures. For areas outside the main centres, for example Haast, Karamea and Franz Josef, the mapping is based on past WCRC and Civil Defence staff records and understanding of flood extents, from previous events or those recorded in documentation of historic flooding.

Climate Change:

14. Although model runs for 1% and 2% AEP flows for current and various future climate change projections (higher rainfall based on national climate change modelling, and various sea level rise increments) were completed by the consultant only the current climate model runs were used to inform the flood hazard severe and susceptible overlays. I am unsure what the rationale for this was, as the mapping and draft plan took place before I started working at WCRC, but my understanding is that the decision to not use the future climate runs rested with the Te Tai o Poutini Plan committee of the time.

Peer Review:

15. I have requested details of external peer review from Matthew Gardner of Land River Sea consulting, and he provided me details of River Edge Consulting's review of the Buller flood model[4]. I understand that the other rivers' modelling used for the Te Tai o Poutini Plan was not independently reviewed, though the same consultant carried out the work using the same kinds of input data, and modelling process. However, as each river system is unique, and assumptions made about boundary conditions differ for each site it would be standard practice to independently peer review each report and model.

Flood plain overlay:

16. This overlay is a very approximate mapping of areas that may constitute flood plains, where little data is held by the Council. I understand the source to be from a mix of civil defence records of past flooding, geological maps, rating district information on protection works. I have not been able to find any other source data or records of how this was mapped. The extent of the polygons appears to have been completed in haste with little regard for the extent covering the edges of hills and significant topography in places, and many of the 'plains' mapped are abandoned fluvial outwash terraces from the last glacial period. More time would need to be spent with the flood records and photographs WCRC hold, along with the more useful recently released LiDAR mapping

[4] River Edge Consulting (2022); Buller Hydraulic Model Review. Report prepared by River Edge Consulting to Matt Gardner, Land River Sea, March 2022.

which would allow a much more accurate, if still approximate, representation of valley areas at possible risk of river flooding to be mapped.

New LiDAR data update:

17. In 2023, all mapping was updated with WCRC's high accuracy Light Detection and Ranging (LiDAR) data, as per best-practice for coastal hazard modelling. Ground elevation above mean sea level is important for considering the rate of potential erosion, along with making mapped inundation areas more accurate. These areas have been used to develop the coastal hazards Variation - this will be the subject of more detailed evidence in the future hearing on that Variation.

Hokitika coastal overlay:

18. In mapping the potential inundation at Hokitika using the hydrodynamic model for 1% AEP storm surge with 1 m SLR, it was found that the height of the flood walls and coastal protection surrounding the township were insufficient to stop inundation in the town centre. This area is mapped approximately as the Hokitika overlay. An increased level of service was already being planned for Hokitika coastal and river protection works, but when the Hokitika overlay was developed there was uncertainty (similar to the Westport hazard overlay), as to what future upgrade to protection works would look like, due primarily to lack of certainty over central government and other funding sources.
19. The lack of 'coastal hazard severe' on the Hokitika beachfront recognises the cyclic nature of the erosion (lack of clearly defined trend one way or another) which has been observed in past decades[5] and indicates the expectation that the existing seawall and future improvements will be maintained to hold the current line of coastal defence. To address the current potential for inundation, while recognising that the future risk profile would change, an overlay with rules requiring specific minimum floor levels was chosen.

Climate change and coastal overlays:

20. I understand that although climate impacts were considered in mapping the coastal hazard overlays, these extend only to effects on the coastline and sea level. The impact on river flood flows combined with future higher sea level and storm surge was not used, although these combined impacts were modelled by Land River Sea consulting in 2020[6]. The Hokitika Coastal overlay is considering only additional elevation in water coming up the river from the coast, not the potential for much higher river flows also putting pressure on the coastal town infrastructure (through higher rainfall projections with climate change).

Westport Hazard Overlay:

21. As per the above discussion on Hokitika, the proposed Westport flood protection scheme did not have funding and final design decided upon when the coastal and river hazard overlays were being created, so consideration of a combination of 'coastal hazard alert' inundation heights and modelled flood heights from a current 1% AEP event are used to advise on finished floor heights for areas inside this overlay. Most of

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[5] NIWA (2016); Rivermouth-related shore erosion at Hokitika and Neils Beach, Westland. Report prepared by D. M. Hicks for West Coast Regional Council.

[6] Land River Sea Ltd. (2020); Hokitika River: Hydraulic Modelling and Flood Hazard Mapping. Report prepared by Matthew Gardner for West Coast Regional Council, June 2020.

the area within the overlay would be covered by at least one of the coastal or river overlays, if not for the Westport overlay, and presumably the future protection meaning these areas are protected at these levels. I cannot comment on decisions to be made on whether Snodgrass Road and other areas outside of the currently proposed flood protection works will revert to 'coastal hazard alert' 'flood severe' or 'susceptible' or something else.

22. The application of rules in the Westport Hazard Overlays have caused some confusion for District Council staff to date, in part due to the non-intuitive requirement for minimum floor level calculation. In relation to the height of a modelled 1% AEP coastal event it specifies in the rule that it must include 1m sea level rise, but in relation to river flooding it just refers to a 1% AEP event with no recognition of higher flows and deeper flooding which has been modelled in future climate runs on the Buller River.[7]

Earthquake hazard overlay

23. When a ground surface rupture occurs on a major fault line, such as the class 1 active faults along the Alpine fault corridor on the West Coast, significant damage can occur with the lateral and vertical movement (up to 9 m in a single event expected on parts of the Fault) and the displacement is not limited to a single trace but can be spread out over tens to hundreds of metres. To recognize the potential for damage when fault rupture occurs, and without more accurate fault surface rupture distribution science available at the time, buffer zones in 50 m increments were mapped around mapped Alpine Fault traces as part of the draft TTPP. This reflects the best risk-based approach, which is to identify the fault trace as best as possible and avoid building habitable structures in areas where ground deformation may occur, as few structures will survive a major rupture event.
24. GNS Science were commissioned by WCRC to re-evaluate the location and nature of the ground surface rupture hazard along the length of the Fault, and this was received after the draft Plan maps were made[8]. The detailed mapping reflects where the fault is most likely to rupture in a narrow trace (disturbing tens of metres of the surface) and where distributed displacement (hundreds of metres wide) is more likely, or the location is uncertain. These distinctions are important and if the more accurate mapping can be adopted in conjunction with New Zealand's active faults guidelines, the effective overlay can be narrowed down and the hazard better defined in more areas.

Land instability overlay

25. I understand the land instability overlay as having been developed using existing landslide, erosion, and rockfall susceptibility mapping and information held by the WCRC or provided by District Councils. For example, Erosion Prone areas identified in the WCRC Land and Water Plan, the existing Buller District Council Little Wanganui overlay, and Punakaiki rockfall runout mapping from the early 2000s. Some areas where active or past slips, and rockfall protection structures along State Highways 6 and 73

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[7] Land River Sea Ltd. (2022); Buller River: Flood Model Upgrade. Report prepared by Matthew Gardner for West Coast Regional Council, February 2022.

[8] Langridge, R. M., Morgenstern, R., Coffey, G. L., Clarke, L. B. 2022. Updated Alpine Fault mapping and fault avoidance zones for priority areas in the West Coast region. GNS Science consultancy report 2022/08.

look to have also been included. I have not found any documentation listing each area the overlay covers and its rationale.

26. I note the mapping is not accurate to a property scale in most cases, as it is primarily transferring approximate, large scale-mapped extents of areas where instability has been noted in the past. The mapping also does constitute a full, regional overlay which considers all areas equally regardless of current development. For example, many areas along state highways are prone to rockfall or have experienced significant landslides in the past (e.g., areas along the state highway around Harihari and Franz Josef). It also does not differentiate between land instability and runout of landslides or rockfall, with both source hazards being included in the mapping. Landslide runout mapping is currently being undertaken by GNS Science, and coverage of susceptibility to this hazard is likely to be extensive, based on rainfall, seismic risk and topography of the West Coast.
27. I see the main rationale of having the mapping in its current form is the provision of a precautionary approach where there is a need to check if a land instability hazard may exist, and where further information would be prudent before further development is allowed. At Punakaiki the overlay is mapped over the full extent identified by a scientist in 2000 as the maximum rockfall runout. Since then, 2003 mapping used by Cooper (2000). A 2003 report[9] revised the hazard area back toward the road, based on low frequency of release of the originally mapped large boulders that reached the coast.

Coastal tsunami overlay:

28. West Coast Regional Council had probabilistic tsunami modelling done for the coastline, by GNS Science in 2020[10]. This focused on the coastline around the three main centres and suggested red orange and yellow zones were part of the deliverables. For example, the yellow zone uses an ensemble of models including severe, low-likelihood events, such as a Puysegur trench magnitude 9 earthquake, to determine where significant wave depth would reach well inland in the main centres on the West Coast. The red zone (beach and marine threat) is not based on the probabilistic model of different likelihoods of extreme wave run-up for low-recurrence tsunami events, but simply maps the area within 2 m of MHWS, the standard approach for this evacuation zone at the time, based on the national Guidelines for tsunami evacuation at the time. It is questionable that this overlay will capture any areas not already within the 'coastal hazard alert' overlay as that also uses a simple elevation approach to identify areas connected to the sea and below the elevation of a 1% AEP storm surge plus 1 m sea level rise, which is higher than 2 m above MHWS.

Lake tsunami overlay:

29. The purpose of this overlay appears to be to identify areas near lake shores on the West Coast where tsunami, triggered by mass movement into or beneath the lake, or lake seiche during seismic shaking could cause waves to run up and cause damage and life risk. I note that a 5 m buffer around lakes was chosen without any rationale stated for this choice. The mapping was completed on aerial imagery, with no consideration given

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[9] Howard, M., McMorran, T. (2003) Punakaiki rockfall study for Buller District Council. Report prepared by URS for Buller District Council, September 2003.

[10] Gusman AR, Wang X, Burbidge DR, Lukovic B, Roger J, Power WL. (2020) Tsunami evacuation zones for West Coast Regional Council. Lower Hutt (NZ): GNS Science. 75 p. Consultancy Report 2020/82.

to current or average lake levels, or whether highest seasonal lake levels should be used.

30. Probabilistic modelling would be the ideal way of determining risk levels from lake tsunami on the west coast (e.g., life risk calculations based on different event sizes and likelihood). However, mapping accurate wave run-up onshore resulting from the various kinds of geological triggers of lake tsunami or seiche events would require in-depth analysis of the potential trigger events, themselves quite rare events, and follow-up modelling of likely wave height and runup impacting communities. Although science has made some progress in this area recently (e.g., 2024 publication from Victoria University on mapping of subaqueous mass movement in lakes Brunner and Mapourika[11]) there is a lot of further work required before a reasonably accurate picture of risk, and therefore Planning recommendations, can be formed with confidence.

[11] K.E. Hughes, S.J. Fitzsimons and J.D. Howarth. (2024) Lacustrine mass movements in active tectonic settings: Lake tsunami sources in New Zealand's South Island, Geomorphology