BEFORE THE HEARING PANEL

IN THE MATTER OF	the Resource Management Act 1991 (the Act)
AND	
IN THE MATTER OF	submissions on Proposed Plan Change 1 to the Natural Resources Plan for the Wellington Region under Part 4 of Schedule 1 of the Act
AND	
IN THE MATTER OF	The reports on the topic of *Rural Land Use,* pursuant to Section 42A of the Act on behalf of Wellington Regional Council for Proposed Plan Change 1 to the Natural Resources Plan Hearing Stream 3

STATEMENT OF EVIDENCE OF DR LESLIE ROBERT BASHER ON BEHALF OF WAIRARAPA FEDERATED FARMERS

TECHNICAL EVIDENCE – EROSION AND SEDIMENT MANAGEMENT

HEARING STREAM 3 – RURAL LAND USE ACTIVITIES, FORESTRY INCLUDING VEGETATION CLEARANCE AND EARTHWORKS

5 May 2025

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INTRODUCTION

1. Greater Wellington Regional Council (GWRC) Plan Change 1 (PC1) proposes changes to the region-wide Natural Resource Plan (NRP) provisions for two whaitua (Te Whanganui–a–Tara and Te Awarua–Porirua). Some of the proposed changes introduce rules around erosion and sediment management.
2. Wairarapa Federated Farmers (WFF) lodged a submission on PC1 arguing that the sediment-related rules are a significant over-reach and are not well supported by the data and models relied on.
3. I have prepared this evidence on behalf of WFF to address their concerns regarding aspects of the erosion and sediment management changes proposed by PC1.
4. WNZ requested expert advice regarding:
   - Sediment models used to underpin PC1,
   - Erosion risk maps prepared for PC1,
   - Natural state objectives and associated sediment-related rules.
5. This statement of evidence primarily relates to the relevant matters on the above topics in the Section 42A Report for Hearing Stream 3– Rural Land Use of Mr Willis[1], the recommendations made with respect to the erosion management provisions proposed to manage erosion risk in the two whaitua, and I also comment on supporting evidence referred to by Mr Willis.

QUALIFICATIONS AND EXPERIENCE

6. My full name is Leslie Robert Basher.
7. I have a BSc (geology, University of Canterbury), Dip.Agr.Sci. (soil science, Lincoln College) and PhD (soil science, Lincoln College).
8. I am a member of the New Zealand Geosciences Society, New Zealand Soil Science Society and New Zealand Association of Resource Management.

[1] Willis G 2025. Section 42A Hearing Report Hearing Stream 3, Topic - Rural Land Use, prepared for Greater Wellington Regional Council for Plan Change 1 to the Natural Resources Plan for the Wellington region.

9. I am currently self-employed (since October 2020) as a consultant on erosion and sediment issues. Prior to this I worked for Manaaki Whenua – Landcare Research (and its predecessor organisations) for 43 years as a scientist and research programme leader. During this time I was involved in many science research programmes and completed numerous contracts on erosion for all the major land uses in New Zealand (forestry, pastoral farming, horticulture, urban) and for most geographic regions of New Zealand. My career focused on measurement and modelling of erosion processes, along with their mitigation. I remain a Research Associate of MWLR.
10. My previous work experience relevant to my assessment of the erosion management provisions in this plan change relates to erosion process measurement and modelling; erosion and sediment modelling at hillslope, catchment and national scale; identification of erosion prone land, and landslide and debris flow susceptibility; and erosion mitigation. This work has given me a good understanding of erosion processes, their modelling and mitigation.
11. I led work that resulted in the development of the SedNetNZ model[2], now widely used to assess long-term average annual sediment loads, erosion process contribution to sediment load, and to model the effectiveness of a range of mitigations in reducing sediment load and achieving desired water quality outcomes.
12. I have authored multiple reports and papers on erosion-related risks (landslides, debris flows, surface erosion processes) associated with both pastoral farming and plantation forestry. I led work that developed the Erosion Susceptibility Classification (ESC) for the National Environmental Standard for Plantation Forestry[3].

[2] Dymond JR, Herzig A, Basher L, Betts HD, Marden M, Phillips CJ, Ausseil A-G, Palmer DJ, Clark M, Roygard J 2016. Development of a New Zealand SedNet model for assessment of catchment-wide soil-conservation works. Geomorphology 257: 85–93 doi:10.1016/j.geomorph.2015.12.022

[3] Basher L, Barringer J 2017. Erosion Susceptibility Classification for the NES for Plantation Forestry. Landcare Research Contract Report LC2744 for the Ministry for Primary Industries; Basher L, Lynn I, Page M 2015. Update of the Erosion Susceptibility Classification (ESC) for the proposed National Environmental Standard for Plantation Forestry - revision of the ESC. MPI Technical Paper No. 2015/13. Prepared by Landcare Research for the Ministry for Primary Industries (Landcare Research Contract Report LC2196)

CODE OF CONDUCT

13. I have read the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note 2023 (Part 9). I have complied with the Code of Conduct in preparing this evidence. My experience and qualifications are set out above. Except where I state I rely on the evidence of another person, I confirm that the issues addressed in this evidence are within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

SCOPE OF EVIDENCE

14. My evidence covers:

    - Sediment models: the appropriateness of the sediment models relied on, and the extent to which improvements in data/models could assist better understanding of sources and smarter targeting of sediment control measures
    - Erosion risk maps: the appropriateness of the erosion risk methodology relied on to direct rules requiring retirement and revegetation of grazed pasture land[4]
    - Natural state objectives: the appropriateness of objectives intended to achieve "natural' state or close to natural state by 2040
    - Sediment-related rules: the appropriateness of proposed rules to achieve "natural state" by 2040

15. In preparing this statement of evidence I mostly comment on the S42A report of Mr Willis and the recommendations made in that report with respect to the erosion management provisions proposed to manage erosion risk in the two whaitua.

16. I have read relevant parts of the following documents as referred to by Mr Willis in his report:

[4] Many of the same restrictions apply to forestry land

a. The erosion risk mapping by Collaborations[5] as described in Mr Nations evidence[6],
b. Other hearing reports pursuant to section 42A of the Act mentioned above including Forestry and Vegetation Clearance[7],
c. Proposed Plan Change 1 to the Natural Resources Plan ('NRP PC1') for the Wellington Region,
d. Wairarapa Federated Farmers ('WFF) Submission on NRP PC1.

BACKGROUND

17. PC1 lists a series of objectives, policies and rules that relate to erosion risk management.
18. WFF lodged a submission in December 2023 on PC1. They argued that the sediment-related rules are a significant over-reach and are not well supported by the data and models used by GWRC. Key points were
    - The timeframe for long-term aspirations to reduce sediment to "more natural levels" should be longer (2100 not 2040),
    - Policies/rules which direct compulsory retirement/revegetation should be deleted,
    - Policies/rules which direct stock exclusion on small streams (<1m) should be deleted,
    - Rules which would significantly tighten up existing regional/national controls on rural earthworks/forestry/stock exclusion should be deleted, instead relying on existing NRP rules and existing national regulations (e.g. the NES for Commercial Forestry).
19. The Section 42A reports for Hearing Stream Three (Rural Land Use Activities, Forestry and Vegetation Clearance, and Earthworks; Forestry and Vegetation Clearance) provide an analysis of all the submissions received by GWRC in relation to the proposed erosion

[5] Collaborations, 2023. Erosion Risk Mapping for Te-Awarua-o-Porirua and Te-Whanganui-a-Tara Rev2. Prepared for Greater Wellington Regional Council. 11 September 2023
[6] Nation TE 2025 Statement of evidence of Thomas Edward Nation on behalf of GWRC – Erosion Risk Mapping Technical Evidence.
[7] Watson S 2025. Section 42A Hearing Report Hearing Stream 3, Topic – Forestry and Vegetation clearance, prepared for Greater Wellington Regional Council for Plan Change 1 to the Natural Resources Plan for the Wellington region

risk management in PC1 and make recommendations for responding to those submissions.

20. Section 3.9 of Mr Willis report Section 42A report covers the issue of Managing Erosion Risk. He notes that this issue is covered by plan provisions under Policies WH.P23 and P.P22, Schedule 36, Maps 90 and 93 and the associated definitions. These provisions "require landowners, via their Farm Environment Plan (FEP), to plant and maintain mapped Highest Erosion Risk land in woody vegetation and undertake appropriate erosion control on mapped High Erosion Risk land". He makes a number of comments in relation to the catchment sediment load modelling, mapping erosion risk and the necessity of the erosion management provisions.
21. He recommends that Policies WH.P23 and P.P22 Schedule 36, Maps 90 and 93 are amended, and makes specific recommendations around the catchment sediment load modelling, mapping of erosion risk and the necessity of the erosion management provisions.
22. As part of his recommended changes it is proposed to delete reference to high and highest erosion risk land and replace it with the term "potential erosion risk land" which refers to only the highest (10%) risk land under pasture, woody vegetation, or forest cover. In addition he proposes the term "Priority erosion treatment land" for land identified through field inspection as part of the FEP preparation process in accordance with Schedule 36, and retains reference in Policy WH.P21 P.P20 (Managing diffuse discharges of sediment,….) to requiring treatment of priority erosion treatment land.
23. Similarly, section 3.15 of Mr Watson's evidence notes a number of objections to the erosion risk mapping and recommends deletion of any link between the forestry rules and policies in PC1 and the highest erosion risk land (plantation forestry) definition and mapping. He also recommends the maps of erosion risk in PC1 for woody vegetation and plantation forestry be modified as described in clause 22.

24. Mr Watson also comments on the natural state objective (clauses 140, 261, 262) and notes that "requiring activities that generate sediment ……. to achieve the same sediment levels as those expected if the land was in its natural state is unrealistic".
25. He recommends deletion of Schedule 33 and its reference to natural state.

CHARACTERISTICS OF THE TWO WHAITUA

26. Erosion risk in New Zealand is related to both natural factors (especially geology, climate, slope) as well as management factors (land use and land management)[8].
27. New Zealand has high rates of erosion and sediment transport largely as a result of the natural driving factors, especially in the hill country and mountain lands. Spatial variation in sediment generation within New Zealand is highly variable and largely controlled by these natural factors[9].
28. Any policies and practices that aim to regulate land use to have an impact on sediment generation and loads delivered to the river network need to recognise the physical setting for those controls.
29. The two whaitua are dominated by moderately steep to very steep slopes underlain by greywacke rock (74% of the area). There is a small area of hill country developed on loess also. Primarily it is this hill country that has a potential erosion risk. Most of the land is mapped as Land Use Capability Classes 6 (30%) and 7 (35%), with a significant area of class 8 (18%). In the ESC most of the land is mapped as High (45%) or Moderate (20%).
30. Analysis of the relative susceptibility of different types of rocks to erosion was one of the bases of the Erosion Susceptibility Classification (ESC) developed for the NES for Plantation Forestry[10] (see Table 1). There is a wide range of rock strength across New

[8] See Basher LR 2013. Erosion processes and their control in New Zealand. Pp. 363–374 in Dymond, J (Ed), Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln.
[9] See Hicks DM, Shankar U, McKerchar AI, Basher L, Jessen M, Lynn I, Page M 2011. Suspended sediment yields from New Zealand rivers. Journal of Hydrology (NZ) 50: 81–142
[10] Basher L, Lynn I, Page M 2015. Update of the Erosion Susceptibility Classification (ESC) for the proposed National Environmental Standard for Plantation Forestry - revision of the ESC. MPI Technical Paper No. 2015/13. Prepared by Landcare Research for the Ministry for Primary Industries (Landcare Research Contract Report LC2196).

Zealand with greywacke (Gw in Table 1) classed as very strong (i.e. one of the least erodible rock types in New Zealand).

Table 1 Relative rock strength of different unweathered rock types (Table 7 from Basher et al. 2015)

Rock strength	Rock type[11]
Extremely weak	Ng, Rm, Ta, Sc, Lp, Kt, Tp, Ft*, Vu*, Pt, Wb, Us*, Uf*
Very weak	Mo, Ft*, La*, Vu*, Af, Gr*, Us*, Uf*
Weak	Mf, Me, Lo, Mx, Ac
Strong	Tb, Vb, Cl, Gl, Mm, Mb, Sm, Sb, Cw, Li*
Very strong	Vo, Ar, Si, Cg, **Gw**, Li*, Sx, Sy
Extremely strong	In, Gn, Um, Gs, Ma

31. This lower susceptibility of greywacke slopes to landslides is illustrated in Fig. 1. This figure shows a comparison between the probability of landsliding versus slope angle for slopes underlain by greywacke, sandstone and mudstone. It quite clearly shows that greywacke slopes produce far fewer rainfall-induced landslides than Tertiary soft rock hillslopes. This process (rainfall-induced landslides) is likely to be the dominant sediment-producing process both in the long-term and during infrequent high-intensity storms and greywacke, and is the process typically targeted for erosion mitigation in the hill country of these two whaitua.

[11] Symbols follow Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF 2009. Land Use Capability Survey Handbook – a New Zealand handbook for the classification of land, 3rd ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science.

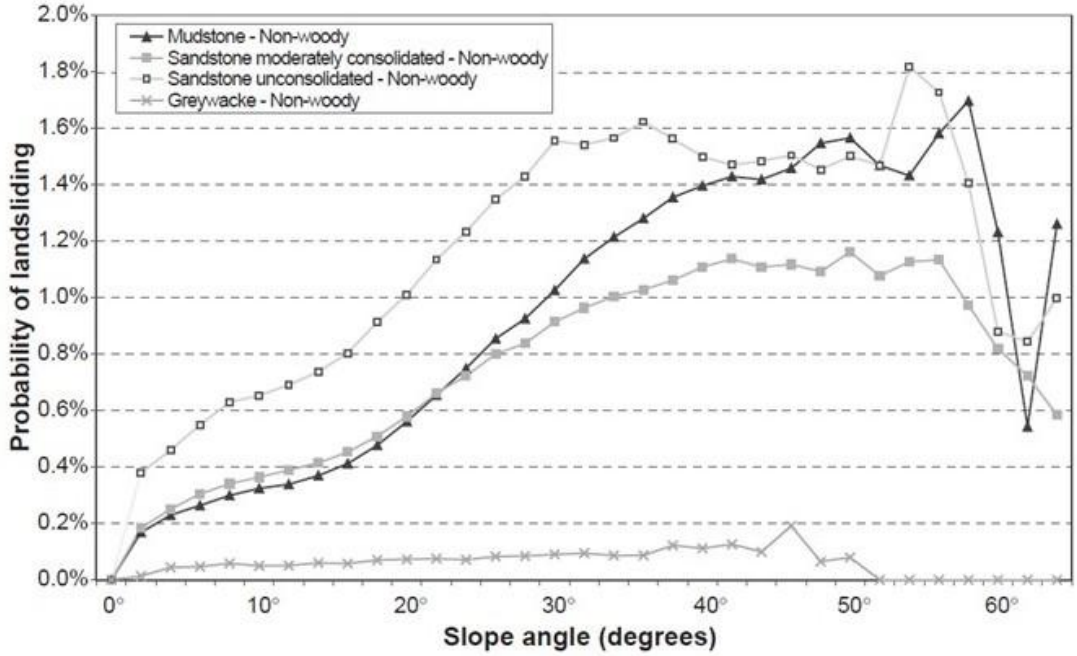


Figure 1 Graph of landslide probability (under non-woody vegetation) versus slope angle for the four main rock types in Manawatu–Wanganui hill country[12] (from Dymond et al. 2006).

EROSION RISK MAPPING, MODELLING AND IDENTIFICATION OF TARGET LAND

32. The erosion risk mapping is described in the evidence of Mr Nation[13]. He outlines the erosion risk layers developed to support PC1[14] and recent changes made to the mapping approach. Mr Nation also notes that the approach differs from that used in RPS Change 1[15].
33. Erosion risk would normally be evaluated as a function of susceptibility of the land to erosion, frequency of erosion-causing events and consequences of those events. The Easton et al. (2023) approach really only assesses susceptibility even though the word "risk" is used.

[12] Dymond JR, Ausseil A-G, Shepherd JD, Buettner L 2006. Validation of a region-wide model of landslide susceptibility in the Manawatu–Wanganui region of New Zealand. Geomorphology 74: 70–79.
[13] Nation TE 2025 Statement of evidence of Thomas Edward Nation on behalf of GWRC – Erosion Risk Mapping Technical Evidence
[14] Detailed in Easton S, Nation T, Blyth J 2023 Erosion Risk Mapping for Te-Awarua-o-Porirua and Te-Whanganui-a-Tara Prepared by Collaborations for Greater Wellington Regional Council
15 Highly erodible land in RPS Change 1 is based on the Erosion Susceptibility Classification in the National Environmental Standards for Plantation Forestry 2017

34. To briefly summarise the erosion risk mapping approach in the notified version of PC1:

    a. It models hillslope (surface and landslide erosion) and streambank erosion, with different approaches for the three sediment sources;

    b. It uses methodologies and parameters partly derived from the daily time-step sediment model (dSedNet);

    c. Surficial erosion risk is determined based on a spatially distributed implementation of the Revised Universal Soil Loss Equation (RUSLE) which numerically models soil loss rates as a function of 5 factors (rainfall erosivity, soil erodibility, slope length and steepness, a cover factor, and a conservation practice factor). The results were then aggregated into "nominal risk categories" based on area-quantiles calculated from the modelled soil loss rates;

    d. Land at risk of shallow landslide erosion was simply defined as "steep land (>26°) without woody vegetation cover";

    e. Hillslope erosion risk was then determined as the intersection of surficial and landslide erosion risk to produce classes of:

        highest risk pasture (most erodible 10%), very high risk pasture (most erodible 20%), high risk pasture (most erodible 30%);

        highest risk forestry (most erodible 10%)

    The maps included in PC1 were titled "Erosion risk" and showed the three classes of pasture land and the Highest class of plantation forestry land;

35. Subsequently two revisions have been made:

    a. Streambank erosion risk was added using an approach outlined in Smith et al. (2019)[16]. Relative susceptibility of stream reaches was grouped into five

[16] Smith HG, Spiekermann R, Dymond J, Basher L 2019. Predicting spatial patterns in riverbank erosion for catchment sediment budgets. New Zealand Journal of Marine and Freshwater Management 53: 338–362

classes (low to highest) based on the erosion susceptibility index[17] of individual stream reaches[18];

b. A revision was requested by GWRC to remove the 'high risk' category and leave only the 'highest' risk category (highest 10%). In addition the classes of potential erosion risk land have been renamed as vegetation classes (pasture, plantation forestry, and woody vegetation).

The basis of the mapping remains the same as the original mapping.

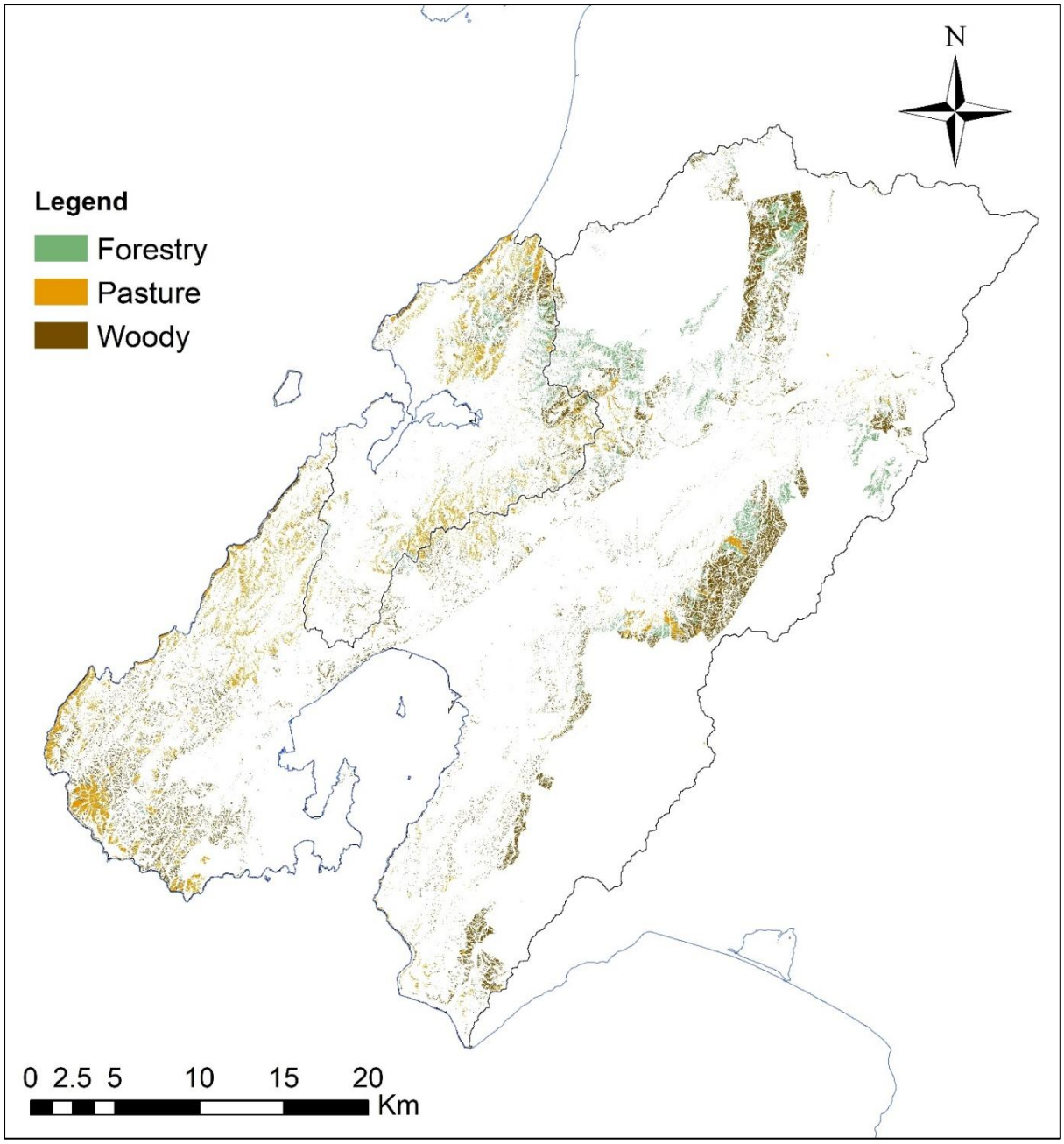
36. It is also important to note that the erosion risk classes are relative not absolute. They are based on the results of the risk assessment in these two whaitua only, rather than being evaluated on an absolute basis that would allow comparison across the region (for example, on different rock types), or nationally.

37. The resulting revised maps for both whaitua are shown in Map 1[19]. The outcome of the revised mapping is to include a smaller area as having potential erosion risk than the original mapping. However, it appears that the mapping of just the highest risk land still results in very large areas being identified as requiring erosion management (Map 1). According to Tables 1 and 2 in Easton et al. (2023) about 8% of the land currently in pasture or plantation forestry is considered to have a potential erosion risk. The mapping approach used has mapped large areas of land that by other classifications are generally considered not to have serious erosion management issues (i.e. significant areas of LUC class 6 land, and large areas mapped in the ESC as Moderate or High.

[17] Based on stream power, channel sinuosity, soil erodibility, valley confinement, and extent of riparian vegetation

[18] From River Environment Classification version 2.5

[19] Data supplied by GWRC



Map 1 Potential erosion risk land in Te Awarua-o-Porirua and Te Whanganui–a-Tara whaitua

38. While the analysis has utilised data, and produced outputs, at fine spatial resolution I consider the basis of the erosion risk mapping deeply flawed.
39. In my opinion combining landslide and surface erosion into a single risk layer is inappropriate. Easton et al. (2023) argue it was done to “to provide a single risk layer that is easier to understand and disseminate than two separate layers” and “provides flexibility of mitigation options for potential treatment”. Because the two processes

require completely different mitigation approaches (acknowledged by Easton et al. 2023) they need to be assessed separately so that the appropriate mitigation(s) are selected. In addition, because the hillslope erosion component is the intersection of both landslide and surface erosion risk it is impossible to tell where the extent of potential erosion is a function of landslide risk and where it reflects surface erosion risk.

40. The most problematic issue with the erosion in my opinion is the use of a slope threshold to determine susceptibility[20] to landslide erosion. There are several problems with this:

    a. The choice of a threshold slope angle of 26° based on the data presented in DeRose (2013) and Dymond et al. (2016)[21] is inappropriate. The data presented in those two papers was largely based on analysis of Tertiary soft rock hill country rather than the greywacke that underlies the hill country in these two whaitua (see Fig. 1). This terrain is far more susceptible to landslide erosion than greywacke (see clause 31) and therefore the choice of this threshold slope angle for greywacke slopes is completely inappropriate.

    b. The use of a threshold slope angle by Easton et al. (2023) to characterise susceptibility to landsliding is crude and simplistic. Figure 1 shows that landslides occur over a wide range of slope angle. There are far better ways to now characterise landslide susceptibility. Mr Nation suggests that SedNetNZ uses 26° as a landsliding slope threshold. However this is incorrect – the model calculates landslide erosion as a function of slope angle[22] and a similar approach could have been used for PC1. Advanced quantitative methods of characterising landslide susceptibility are now

[20] Note my use of susceptibility. I consider the erosion risk maps to show susceptibility to landslides, rather then the risk from landslides

[21] De Rose, RC (2013). Slope control on the frequency distribution of shallow landslides and associated soil properties, North Island, New Zealand. Earth Surface Processes and Landforms 38: 356-371; Dymond JR, Herzig A., Basher L, Betts HD, Marden M, Phillips CJ, Roygard J (2016). Development of a New Zealand SedNet model for assessment of catchment-wide soil conservation works. Geomorphology 257: 85-93

[22] See Betts HD, Basher L, Dymond JR, Herzig A, Marden M, Phillips CJ 2017. Development of a landslide component for a sediment budget model. Environmental Modelling and Software 92: 28–39

available in New Zealand[23] and would provide a far better basis for determining the susceptibility to landslides, in an absolute rather than relative sense.

c. A further limitation of the landslide risk assessment is that it does not consider connectivity. Not all landslides will deliver sediment to stream channels and connectivity analysis assesses the probability of landslides delivering sediment to stream channels. In modelling applications this is typically incorporated as a Sediment Delivery Ratio[24]. In my view it should be assessed as part of defining the land at risk of landslide erosion as the overall objective is to impact sediment levels in streams and rivers. The available DEM could have been used to assess connectivity.

d. Easton et al. (2023) acknowledge the erosion risk maps do not account for sediment delivery or connectivity but do not offer any comment on why.

41. In my opinion the use of the Revised Universal Soil Loss Equation (RUSLE) on steep pasture and forested slopes is problematical, considering that the model has never been well calibrated for these conditions. Easton et al. (2023) note that RUSLE predicts high erosion rates even with extensive native woody vegetation cover, and it is slope angle and rainfall that have the dominant effects on modelled erosion rates. Similarly, Mr Nation's evidence notes high surficial erosion risk and shallow-landslide risk are typically spatially correlated on pastoral land.

42. The map of RUSLE-modelled surface erosion is in my view largely a slope map and the predictions of sediment yield (t ha^{-1} yr^{-1}) are likely to be highly unreliable, have high uncertainty and provide a poor basis for estimating the risk of surface erosion on pastoral grassland.

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[23] See for example: Smith HG, Spiekermann R, Betts H, Neverman AJ 2021. Comparing methods of landslide data acquisition and susceptibility modelling: examples from New Zealand. Geomorphology 381, 107660; Spiekermann RI, van Zadelhoff F, Schindler J, Smith HG, Phillips C, Schwarz M 2023. Comparing physical and statistical landslide susceptibility models at the scale of individual trees. Geomorphology 440: 108870

[24] In SedNetNZ this is set at 0.5 for hill country (i.e. only 50% of the sediment generated from landslides will reach stream channels) and 0.1 for mountainlands

43. Mr Willis comments (clause 104) that "surficial erosion risk …….. can be a very significant source of sediment in PC1 catchments". He cites no evidence to support this statement, and in my opinion surface erosion is likely to be a minor source of sediment in the two whaitua which are dominated by greywacke hill country. In this terrain landslides are generally considered to be the dominant erosion process and contribute most to sediment delivered to streams[25]. While surface erosion does occur in pastoral hill country, its significance has not been well quantified. It is often very localised, poorly connected to streams and a small contributor to overall sediment load[26]. In my opinion the definition of hillslope erosion risk should focus on landslide erosion.

44. Two other existing approaches with available data could have been used to characterise landslide risk:

- The Erosion Susceptibility Classification in the National Environmental Standards for Plantation Forestry as used in RPS Plan Change 1. Mr Willis argues this is inappropriate because it does not include consideration of surface erosion. As argued above this is not a major limitation, however the scale and resolution of this mapping is a limitation and precludes use at farm scale. It does in my opinion provide a better overall picture of susceptibility on this terrain, on an absolute basis (i.e. it's based on a national classification). It shows that much of the two whaitua that are identified as Potential Erosion Risk Land are mapped as Moderate (20%) or High (25%) in the ESC.
- The Highly Erodible Land Model[27] identifies land at risk to the main forms of mass-movement soil erosion in New Zealand (landslide, earthflow, and gully) if it does not have protective woody vegetation (Dymond et al, 2006). The model uses a digital elevation model (DEM) to identify slopes, incorporates different erosion terrains with

[25] See Basher LR 2013. Erosion processes and their control in New Zealand. Pp. 363–374 in Dymond, J (Ed), Ecosystem services in New Zealand – conditions and trends. Manaaki Whenua Press, Lincoln

[26] For example, in their study of the Manawatu River Dymond et al. (2016) estimated landslide erosion provided 59% of the long-term river sediment load while surface erosion only contributed 16%

27 Dymond JR, Ausseil A-GE, Shepherd JD, Buettner L 2006. Validation of a region- wide model of landslide susceptibility in the Manawatu–Wanganui region of New Zealand. Geomorphology 74: 70–79

erosion (slope) thresholds based on these terrains, and land cover. This is the model that was used to identify target land for erosion mitigation as part of Horizons SLUI programme which seeks similar outcomes to PC1 with respect to erosion management. The DEM and land cover mapping provide high spatial resolution for this mapping.

Both these approaches assess landslide risk using a nationally consistent basis.

45. Mr Willis notes the majority of submissions on PC1 oppose the erosion risk mapping approach or seek amendment to it. Submitters argued:

    a. The methodology was not fit-for-purpose,
    b. The maps were considered inaccurate at farm scale
    c. Assessing erosion risk on a relative rather than absolute scale was inappropriate
    d. Submitters opposing the erosion risk assessment approach and resulting maps either seek substantial revision or deletion with many seeking that they be replaced or complemented by farm-scale assessment

Many of these comments align with my own analysis of the erosion risk mapping above.

46. Mr Willis acknowledges the limitations of the mapping but recommends the following changes:

    a. The erosion risk maps be deleted
    b. The mapping is simplified (as outlined in clause 24b) and the maps are titled Potential Erosion Risk
    c. The classes shown on the maps changed to vegetation classes (i.e. pasture, plantation forestry, and woody vegetation in the most erodible 10% of this class)
    d. Inclusion of stream bank erosion risk as outlined in clause 24a

The effect of this is to reduce the area shown as needing erosion management, but the basis of identification of which hillslope land qualifies as highest risk remains the same.

The incorporation of streambank erosion is useful and the data provided will probably provide a useful screening tool for where streambank erosion is likely to be more active.

47. Mr Willis also states (clause 313) "the identification of high and highest erosion risk land is problematic and greater farm-scale assessment is required". He recommends an approach where the erosion risk mapping is used as a guide and that identifying erosion risk is incorporated in Farm Environment Plan (FEP) analysis[28]. An Erosion and Sediment Management Plan is proposed to identify the risk of sediment loss and identify mitigation options[29]. In my opinion this is an appropriate approach but needs to be implemented using a non-regulatory (voluntary) approach, that does not pre-determine the need for erosion management based on a poor spatial definition of the land at risk.
48. Mr Watson also notes a number of objections to the erosion risk mapping (clause 254) and recommends deletion of any link between the forestry rules and policies in PC1 and the highest erosion risk land (plantation forestry) definition and mapping. He also recommends the maps of erosion risk in PC1 for woody vegetation and plantation forestry be modified as described in clause 29.
49. In my opinion there are better screening tools now available to assess landslide risk (susceptibility) and these should be implemented to provide far better spatial mapping of landslide risk prior to FEP mapping.

NATURAL STATE OBJECTIVES

50. GWRC appear to have a goal of returning hydrology and erosion to more natural rates by 2040.
51. Objective WH.02(b) in the notified version of PC1 states:

"The health and wellbeing of Te Whanganui-a-Tara's groundwater, rivers and natural wetlands and their margins are on a trajectory of measurable improvement towards wai

[28] This includes identification of priority erosion treatment land
[29] Schedules 33 and 34 outline requirements

ora, such that by 2040…… (b) the hydrology of rivers and erosion processes, including bank stability are improved and sources of sediment are reduced to a more natural level".

52. Similarly Objective P.02(b) in the notified version of PC1 states:

"Te Awarua-o-Porirua's groundwater, rivers, lakes and natural wetlands, and their margins are on a trajectory of measurable improvement towards wai ora, such that by 2040 ……. (b) erosion processes, including bank stability, are improved to significantly reduce the sedimentation rate in the harbour to a more natural level

53. In Schedules 33 (Vegetation Clearance Erosion and Sediment Management Plan) and 34 (Plantation Forestry Erosion and Sediment Management Plan) one of the objectives of both Schedules is to "avoid an increase in risk of loss of sediment to water relative to the risk of loss that exists from the land in a natural state".
54. Note that there is no definition of 'Natural State' in the GWRC NRP or in the RPS, nor in the NPS for Freshwater Management, nor in the RMA itself. While natural state is not defined, I take it to mean the pre-human state under original native vegetation (forest for most of the two whaitua).
55. In my opinion this objective is both inappropriate and unrealistic. Much of the land in these two whaitua would originally have been forested. Much of the forest has been removed and this will have increased both total runoff and flood flows, and likely increased sediment load from a range of processes including landslides and bank erosion. In addition, large parts of the whaitua have been developed for housing and roading and this will also have increased total runoff, peak flows and quickflow[30].
56. Therefore returning hydrology and erosion to more natural rates seems unrealistic and inappropriate to me under the current vegetation cover and land use patterns.

[30] See Fahey and Rowe 1992. Land use impacts. Pp. 265–284 in Waters of New Zealand, ed. Mosley MP, New Zealand Hydrological Society, Wellington.

57. The natural state objective is not mentioned in Mr Willis' Section 42A report. However, the section 42A report by Mr Watson on Forestry and Vegetation Clearance[31] acknowledges concerns regarding natural state by submitters (clause 261).
58. Mr Watson recommends removing Schedules 33 and 34 with their reference to the natural state objective and states that he also considers this objective to be unrealistic (clause 262).
59. I support the removal of the reference to "the hydrology of rivers and erosion processes, including bank stability are improved and sources of sediment are reduced to a more natural level" and removal of the reference in Schedules 33 and 34 to natural state[32].
60. WFF asked me to comment on the appropriateness of rules proposed by PC1 to achieve "natural state" by 2040. In my opinion any rules that attempt to return pastoral farmland to it's natural state, in terms of hydrology and erosion processes, is doomed to fail because much of the land has been transformed by the clearance of forest cover. In my opinion the goal of land management should be to minimize sediment generation to the extent that is possible under a pastoral farming regime, especially in the relatively stable hill country of these two whaitua.

SUMMARY COMMENTS

61. In my opinion the methodology for erosion "risk" assessment was not fit-for-purpose, particularly with respect to hillslope (landslide, surface) erosion. I also believe the assessment should be based on absolute risk, not relative risk within these two whaitua. Mr Willis recommends changes to the erosion risk maps (renamed Potential Erosion Risk) but recommends the simplified maps be incorporated in PC1.
62. Given the limitations of the erosion risk mapping to accurately assess erosion risk I recommend the erosion risk maps either:

[31] Watson S 2025. Section 42A Hearing Report Hearing Stream 3, Topic – Forestry and Vegetation clearance, prepared for Greater Wellington Regional Council for Plan Change 1 to the Natural Resources Plan for the Wellington region

[32] "The Erosion and Sediment Management Plan must demonstrate that the measures adopted to address the identified risks will:…..(2) avoid an increase in risk of loss of sediment to water relative to the risk of loss that exists from the land in a natural state"

a. be deleted;

b. be replaced by new maps using a quantitative landslide susceptibility modelling approach (incorporating connectivity into the assessment of erosion risk), and including bank erosion risk.

63. WFF asked me to comment on the extent to which improvements in data/models could assist better understanding of sources and smarter targeting of sediment control measures. In my opinion methods are now available for a much improved landslide risk analysis which could provide an improved screening tool for identifying the land requiring erosion control.

64. Mr Willis recommends an approach where the erosion risk mapping is used as a guide and that identifying erosion risk is incorporated in Farm Environment Plan (FEP) analysis through preparation of an Erosion and Sediment Management. In my opinion this is an appropriate approach but needs to be implemented using a non-regulatory (voluntary) approach, that does not pre-determine the need for erosion management based on what is currently a poor spatial definition of the land at risk.

65. Mr Willis discusses the necessity of erosion management conditions at clauses 306, 307 and 330–336 and notes that many submitters, including WFF, seek the removal of the proposed blanket approach. The proposed rules do appear to be a significant tightening of current land use restrictions.

66. I agree with WFF that the sediment-related rules in the notified version of PC1 were a significant over-reach and were not well supported by the data and models relied on. The modelling and mapping approach remains much the same in the revised maps of erosion risk, and remains not fit-for-purpose.

67. In my opinion a bespoke non-regulatory approach that primarily identifies erosion risk at farm scale via FEP analysis would allow erosion risk to be assessed accurately and the necessity of treatment options to be determined more appropriately. This type of approach is likely to be more successful than imposing a regulatory regime for land that is not inherently highly erodible.