BEFORE THE INDEPENDENT HEARINGS PANELS APPOINTED TO HEAR AND MAKE RECOMMENDATIONS ON SUBMISSIONS AND FURTHER SUBMISSIONS ON PROPOSED PLAN CHANGE 1 TO THE NATURAL RESOURCES PLAN FOR THE WELLINGTON REGION

UNDER	the Resource Management Act 1991 (the Act)
AND	
IN THE MATTER	of Hearing of Submissions and Further Submissions on Proposed Plan Change 1 to the Natural Resources Plan for the Wellington Region under Schedule 1 of the Act

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STATEMENT OF EVIDENCE OF THOMAS EDWARD NATION

ON BEHALF OF GREATER WELLINGTON REGIONAL COUNCIL

EROSION RISK MAPPING - TECHNICAL EVIDENCE

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

15 APRIL 2025

TABLE OF CONTENTS

INTRODUCTION

1 My full name is Thomas Edward Nation. I am a Director and Spatial Consultant at Collaborations.

2 I have undertaken a high-level review of submissions relevant to Hearing Stream 3; Rural land use activities, Forestry including vegetation clearance and Earthworks.

3 I have prepared this statement of evidence on behalf of Greater Wellington Regional Council (**the Council**) in respect of technical matters arising from the submissions and further submissions Proposed Change 1 to the Natural Resources Plan for the Wellington Region (**PC1**).

4 Specifically, this statement of evidence relates to the matters in the Section 42A Reports – Rural Land Use and Vegetation Clearance and Forestry.

QUALIFICATIONS AND EXPERIENCE

5 I hold a Bachelor of Science degree (**BSc**) with first class honours from the University of Canterbury.

6 I have 15 years' experience in Geographic Information Systems (GIS), specialising in environmental analysis. My experience covers a range of GIS science, including data capture, data processing and validation, spatial analysis and visualisation. Prior to joining Collaborations, I was the Wellington GIS Team Lead at Jacobs New Zealand.

7 I have provided technical GIS support to the Council for the Whaitua processes and have supported the Council in a GIS capacity over the last 5 years.

8 My experience includes preparing evidence for the High Court, Environment Court and evidence at Council-level hearings.

CODE OF CONDUCT

9 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

10 My evidence covers the following topics:

10.1 Background and summary of the PC1 Notified Erosion Risk Mapping.

10.2 A discussion on the limitations of the PC1 Notified Erosion Risk Mapping.

10.3 A description of the streambank erosion risk layer that formed part of the original technical work carried out by Collaborations.

10.4 A description of the revised erosion risk mapping requested by the Council in February 2025.

BACKGROUND OF THE NOTIFIED EROSION RISK MAPPING

11 Collaborations developed spatial erosion risk layers to support the Council's Proposed Change 1 (PC1, also known as Plan Change 1) and implementation of Te-Awarua-o-Porirua (TAoP) and Te-Whanganui-a-Tara (TWT) Whaitua Implementation Programmes (WIPs).

12 The Collaborations erosion risk mapping did not consider the RPS Change 1 definition of highly erodible land, which was being developed simultaneously. As a consequence of that timing, the Collaborations erosion risk mapping was not been designed to satisfy that definition. In the RPS Change 1, highly erodible land is based on the erosion susceptibility classification in the National Environmental Standards for Plantation Forestry 2017 which was generated at a national scale. Whereas the Collaborations erosion risk mapping was generated specifically for the Council using the Revised Universal Soil Loss Equation (RUSLE) at a much finer resolution.

13 The erosion risk mapping, which focussed on hillslope erosion (surficial erosion and shallow landslides), was originally carried out by Collaborations to support the Council land management team to identify erosion Critical Source Areas (CSAs) in the Takapu and Pouewe part Freshwater Management Units (part-FMUs) (Collaborations, 2023)[1,2] . The erosion risk mapping used methodologies and parameters partly derived from daily time-step sediment modelling undertaken for the Porirua Whaitua (dSedNet, described in Jacobs, 2019)[3] .

14 At the request of the Council, the Takapu and Pouewe erosion risk mapping was expanded to cover all of the TAoP and TWT Whaitua's to assist with the implementation of PC1. The work was documented in a technical memorandum[4] and provided to GRWC in a series of

GIS map layers. It is understood that the first revision (Rev1) of the aforementioned memorandum was uploaded to the Council's PC1 webpage which did not include the 'non-forestry woody vegetation erosion risk' detailed in paragraph 22.3. It is possible submitters may not have had access to the most recent revision (Rev2) of the document.

DESCRIPTION OF THE NOTIFIED EROSION RISK MAPPING

15 GIS mapping and analysis was carried out in ArcGIS Pro software across the TAoP and TWT Whaituas. The mapping was carried out using a range of publicly available data including a 1m resolution digital elevation model which was resampled to 5m. The mapping considered both hillslope erosion and streambank erosion. The resulting hillslope erosion risk layers have been adopted by the Council in the PC1 process and presented as maps 90-95 in the Council's Natural Resources Plan - Plan change 1 story map[5].

16 Hillslope erosion risk presented in the Collaborations mapping is the intersection of surficial erosion risk and shallow landslide erosion risk. Surficial erosion risk is determined based on the Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1997)[6]. Land at risk to shallow landslide erosion is defined as steep land (>26 degrees) without woody vegetation cover (DeRose 2013; Dymond et al. 2016)[7]. The council requested the final output as a single erosion risk layer as opposed to providing separate hillslope and landslide risk layers.

17 The raw output of the hillslope erosion analysis was a GIS layer representing a scale of potential erosion loss. The GIS layer was then split into nominal risk categories as requested by the Council and were based on area-quantiles calculated from the modelled surficial erosion loss rates: 'Highest risk' is the most erodible 10%, 'High risk' is the most erodible 30%. By definition, 'High risk' includes all 'Highest risk' land.

18 The risk area-quantiles (i.e. highest risk and high risk) represent relative risk and have been calculated at the Whaitua scale for specific land cover types (see Paragraph 22). This was carried out by classifying the erosion layer in each Whaitua into 10 equal areas defined by their modelled surficial erosion loss rate. The classification of high and highest risk is therefore relative and quantile 'breakpoints' are not based on a previously defined erosion rate.

19 Once mapped, the surficial erosion risk layers were intersected with a landslide risk layer to ensure that the mapped high and highest risk land was also potentially susceptible to landslide erosion. A landslide risk layer was generated by selecting land above 26 degrees

without vegetation cover. Dymond et al. 2016[7] used 26 degrees as a landsliding slope threshold in their SedNet model. In addition, land greater than 26 degrees is defined as 'steep' or 'very steep' in the New Zealand Land Resource Inventory (NZLRI) slope class layer[8] . Vegetation cover was assessed based on land cover attributes in the Land Cover Database version 5 (LCDB v5.0[9]) GIS layer. The intersection process removed a small amount of land that was in the highest or high-risk categories for hillslope erosion but was on land less than 26 degrees.

20 In general, high surficial erosion risk and shallow-landslide risk are spatially correlated on pastoral land. However, in some places, high surficial erosion rates are estimated for land that is not deemed to be at risk of landsliding, for example where there is high flow accumulation at the base of gullies. This land was precluded from the hillslope erosion risk layer which is why the risk mapping covers an area slightly smaller than the areal quantile value (e.g. 8% of pasture is in the 'highest risk' category instead of 10%).

21 In TAoP, the erosion risk quantiles are mostly relative to a single receiving environment, Porirua Harbour. In TWT, the relative erosion risk spans from the headwaters of the Hutt River in the north to Makara-Ohariu in the south.

22 Risk categories have been assigned to three land cover classes; pasture, forestry and non-forestry woody vegetation. Risk quantiles were calculated specific to each land cover, and as such, the risk categorisation is only relative within that land cover class. Land identified as 'Highest risk' on pasture will have a different erosion loss rate to 'Highest risk' forestry land. 'Highest risk' and 'High risk' erosion was mapped for land currently in pasture. Only the 'Highest risk' erosion was mapped for land in forestry and land covered by non-forestry woody vegetation:

22.1 Pasture erosion risk has been calculated for each Whaitua within the area defined by the LCDB v5.0 as "High-producing grassland" and "Low-producing grassland".

22.1.1 LCDB v5.0 is a multi-temporal, classification of New Zealand's land cover. Land cover features are described by a polygon boundary, a land cover code, and a land cover name at each nominal time step. The most recent timestep in Version 5 of the LCDB is 2018/2019.

22.2 Forestry erosion risk has been calculated for each Whaitua and is based on potential erosion risk on land currently in forestry, should that land be

converted to pasture. Forestry area is derived from the LCDB v5.0 categorisation of “Exotic Forest” and “Forest – Harvested”. The layer does not account for the harvest status or tree-age profile of forestry land, nor does it account for or attempt to model forestry harvest or harvest activities.

22.3 Non-forestry woody vegetation erosion risk has been calculated for each Whaitua and is based on non-forestry woody vegetation land covers (“Broadleaved Indigenous Hardwoods”, “Deciduous Hardwoods”, “Gorse and/or Broom”8, “Indigenous Forest”, “Manuka and/or Kanuka”, “Matagouri or Grey Scrub”, and “Mixed Exotic Shrubland”). The non-forestry woody vegetation erosion risk was created to estimate the area where vegetation removal may increase erosion risk. Currently protected land (where vegetation removal is already prohibited) was excluded from the analysis.

23 The erosion risk GIS layers, for each of the three land cover categories and for both Whaitua, were provided to the Council in GIS format to help with their PC1 preparation and analysis.

LIMITATIONS OF THE NOTIFIED EROSION RISK MAPPING

24 The risk layers are designed to spatially identify potential erosion risk and enable prioritisation of sediment mitigations to achieve sediment load reductions. The practicality, design, and cost to mitigate any land identified in the erosion risk mapping was not considered through the risk mapping exercise. The layers do not purport to map all sources of sediment within the PC1 area such as sediment generated from construction or farming/forestry operational activities.

25 The accuracy of the risk layers relies on various information sources and data sets. Any error in those data sets will also be present in the erosion risk layers. For example, the LCDB v5.0 land cover mapping used in the RUSLE analysis does not identify small pockets of vegetation or open earth that may influence local erosion risk. In addition, the LCDB v5.0 dataset is based on 2018/2019 landcover which may be different in 2024.

26 The risk layers are based on a 1m resolution digital elevation model, resampled to 5m to optimise processing, storage and load time of the risk layers. The resampling process will influence the precision and accuracy of some of the mapped pixels. In addition, there has not been any filtering applied to the risk pixels resulting in small, single pixel areas defined

as ‘High risk’ or ‘Highest risk’. An exercise of aggregating and/or filtering the smaller pixels could occur. However, no aggregation or filtering was undertaken.

27 The risk layers are based on surficial erosion rate, intersected with the landslide risk layer only. There remain erosion risks outside of the mapped at-risk areas (for example, where surficial erosion rates are high, but not deemed to be at-risk of landslides).

28 The risk area quantiles (i.e. highest risk and high risk) represent relative risk and have been calculated at the Whaitua scale. Redefining the scale at which the erosion mapping is considered will change the risk area quantiles i.e. the same piece of land might be considered ‘High risk’ of erosion when compared across a sub-catchment (such as one draining to a Target Attribute Site) but may sit in a different quantile and not considered to be ‘High risk’ when compared across the Whaitua.

29 The erosion risk mapping does not account for sediment delivery processes such as interception or deposition or assess connectivity to the stream network.

30 Earthworks, forestry harvest, or other land-disturbing activities are not considered. Similarly, already-implemented erosion control measures such as established pole planting or sediment retention bunds are not accounted for in the current iteration of the risk layers.

STREAMBANK EROSION RISK MAPPING

31 The published spatial index of streambank erosion susceptibility[10] provided by the Ministry for the Environment (MfE) was summarised for each of the Whaitua to identify the most erodible stream reaches.

32 The streambank erosion susceptibility index is based on stream power, channel sinuosity, soil erodibility, valley confinement, and proportional extent of riparian vegetation. The index is linked to the River Environments Classification (REC) version 2.5, with other data inputs estimated from measured relationships in NZ and national scale datasets such as the Fundamental Soils Layer, National 15m DEM, and EcoSat Woody.

33 Collaborations summarised the streambank erosion susceptibility index within each Whaitua and part-FMU to rank each REC reach from most to least susceptible.

34 The ranked streambank erosion susceptibility index data was included in mapping provided by Collaborations to the Council in 2023[4] but was not included in PC1 when

notified. The Council has since produced streambank erosion risk maps which are included in Appendix A.

35 There are several limitations associated with the streambank erosion susceptibility index. Riparian fencing is not accounted for in the index, and the extent of riparian vegetation is based on the EcoSat Woody land use classification, which is approximately 20 years old and relatively coarse (15m) resolution. Furthermore, the application of the index to lower order streams is uncertain due to a lack of calibration information, resulting in low index values due to lower estimated flow and greater levels of valley confinement. Further limitations of the layer are outlined in Smith & Betts (2021)[11].

REVISION OF THE NOTIFIED EROSION RISK MAPPING

36 A revised version of the hillslope erosion risk mapping was requested by the Council in February 2025. The request was for the 'High-risk' category (top 30%) to be removed from the pasture erosion risk mapping, leaving only the highest risk mapping. In addition, the word 'potential' was to be added to the risk terminology as an acknowledgement of the limitations identified above.

37 Advice was provided by Collaborations to the Council in February 2025 on how to modify the original data that accompanied the mapping memorandum provided to the council in September 2023[4]. This is the same data supply that included the streambank erosion data outlined in paragraph 34.

38 The revised 'potential erosion risk mapping' carried out by the Council, using the data provided by Collaborations, is illustrated in Appendix B. The maps now illustrate only the top 10% erosion risk land, calculated separately for each of the three land cover categories and referred to as 'potential erosion risk land'. The 'highest-risk' terminology has been removed.

CONCLUSION

39 Collaborations provided erosion risk mapping to the Council prior to notification of PC1. The erosion risk mapping represents hillslope erosion risk, defined as the intersection of the surficial RUSLE erosion analysis and the landslide erosion analysis.

40 Erosion risk categories for the hillslope erosion were based on area-quantiles calculated from the modelled surficial erosion loss rates relative to each Whaitua: 'Highest risk' is the

most erodible 10%, ‘High risk’ is the most erodible 30% (and includes the highest risk areas).

41 Erosion risk categories were assigned to three land cover classes: pasture, forestry and non-forestry woody vegetation. ‘Highest risk’ and ‘High risk’ erosion was mapped for land currently in pasture. The ‘Highest risk’ erosion was mapped for land in forestry and land covered by non-forestry woody vegetation.

42 The risk layers are designed to spatially identify potential erosion risk and enable prioritisation of sediment mitigations to achieve sediment load reductions. The practicality, design, and cost to mitigate any land identified in the erosion risk mapping was not considered. In addition, there are limitations with the input datasets as well as some of the processing assumptions, including the scale at which to define the risk quantiles.

43 A revised version of the erosion risk mapping has subsequently been prepared Appendix B

44 In respect of streambank erosion, Collaborations summarised the streambank erosion susceptibility index made available by MfE, within each Whaitua and part-FMU to rank each REC reach from most to least susceptible. This dataset was included in the mapping provided this to the council. The council have since produced stream bank erosion risk maps shown in Appendix A.

DATE: 15 APRIL 2025

THOMAS EDWARD NATION

DIRECTOR AND SPATIAL ANALYST AT COLLABORATIONS

[1] Collaborations, 2023. Sediment Reduction Implementation Plan for Pouewe and Takapu – Deliverable 1. Prepared for Greater Wellington Regional Council. 06 April 2023

[2] Collaborations, 2023. Erosion Risk Mapping for Plan Change 1 – Takapū and Pouewe Rural Property Analysis. Prepared for Greater Wellington Regional Council. 06 April 2023

[3] Jacobs. 2019. Porirua Whaitua Collaborative Modelling Project Baseline Technical Report. Project IZ080700. Prepared for Greater Wellington Regional Council.

[4] 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

[5] https://storymaps.arcgis.com/stories/ecd4158b2adf40f185f8897551b41d46

[6] Renard, K. G., Foster, G. R., Weesies, G. A., McCool, D. K., and Yoder, D. C. (1997). Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation, U.S Government Printing Office, Washington DC, 1997.

[7] Dymond, J. R., Herzig, A., Basher, L., Betts, H. D., Marden, M., Phillips, C. J., and Roygard, J. (2016). Development of a New Zealand SedNet model for assessment of catchment-wide soil-conservation works. Geomorphology, 257, 85-93.

[8] https://lris.scinfo.org.nz/layer/48064-nzlri-slope/

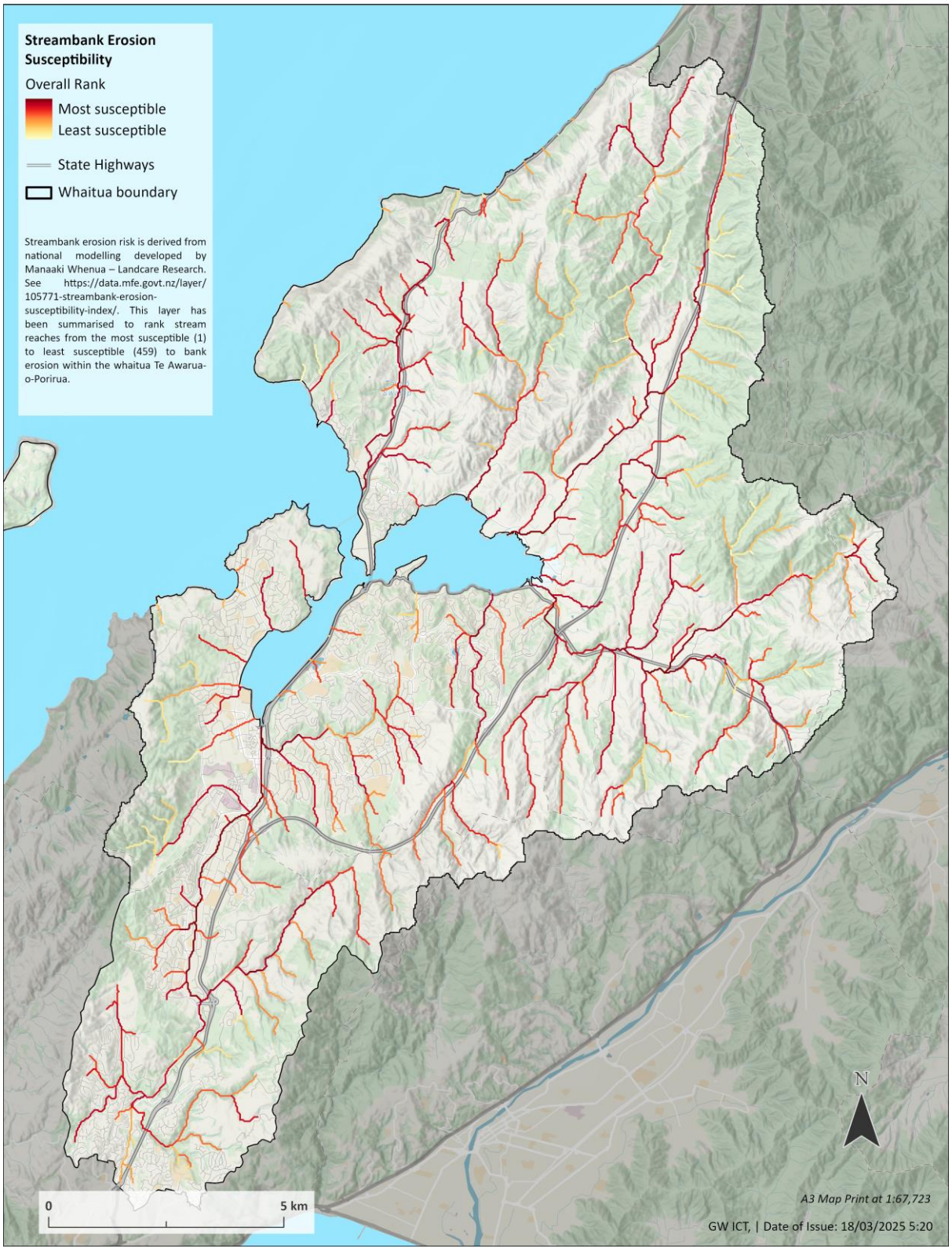
[9] https://lris.scinfo.org.nz/layer/104400-lcdb-v50-land-cover-database-version-50-mainland-new-zealand/

[10] https://data.mfe.govt.nz/layer/105771-streambank-erosion-susceptibility-index/

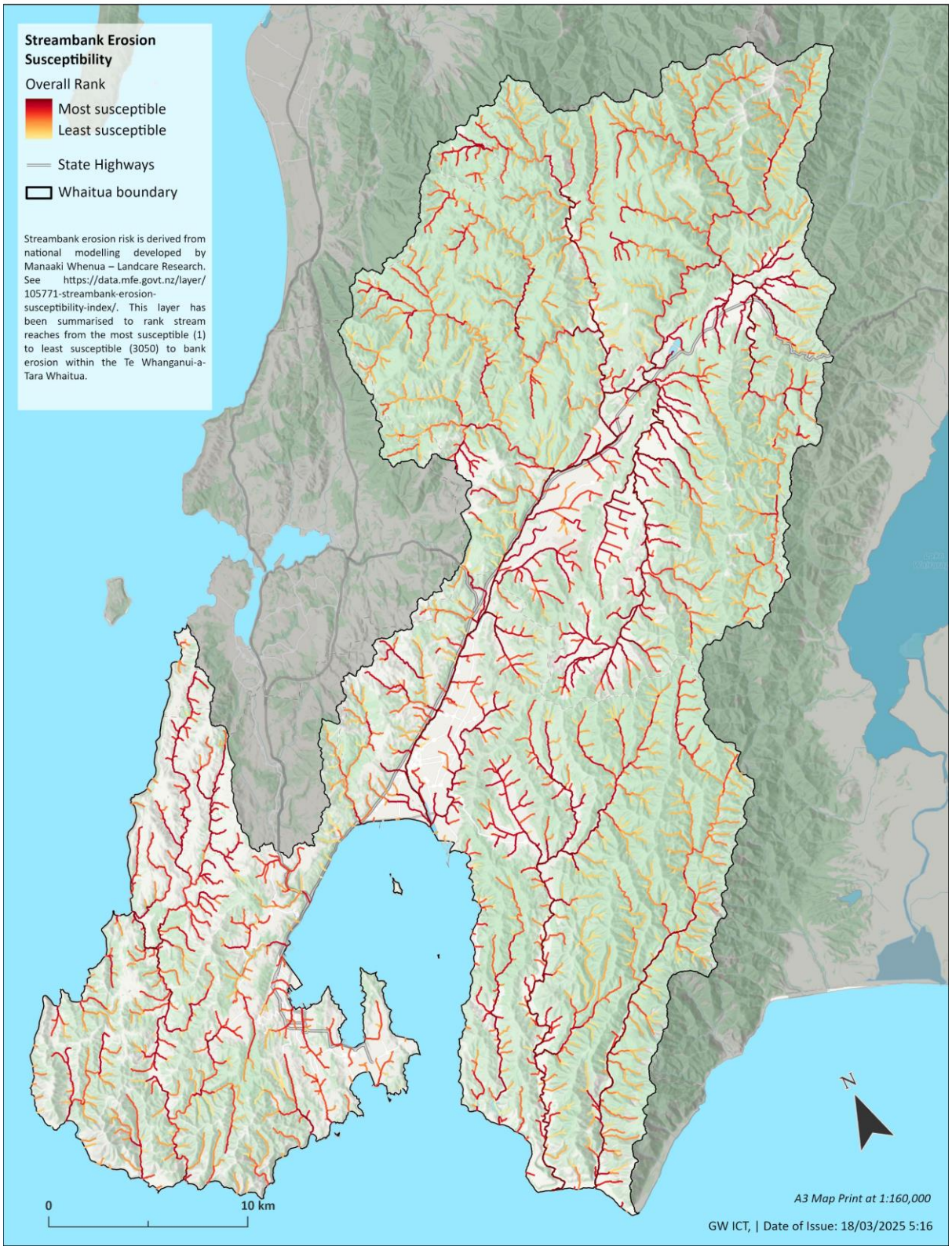
[11] Smith, H.,Betts, H. (2021). Memorandum on implementing a national index for susceptibility to streambank erosion. Prepared for: Ministry for the Environment. Contract Report: LC399

APPENDIX A – STREAMBANK EROSION RISK MAPS

Streambank Erosion Risk — Te Awarua-o-Porirua



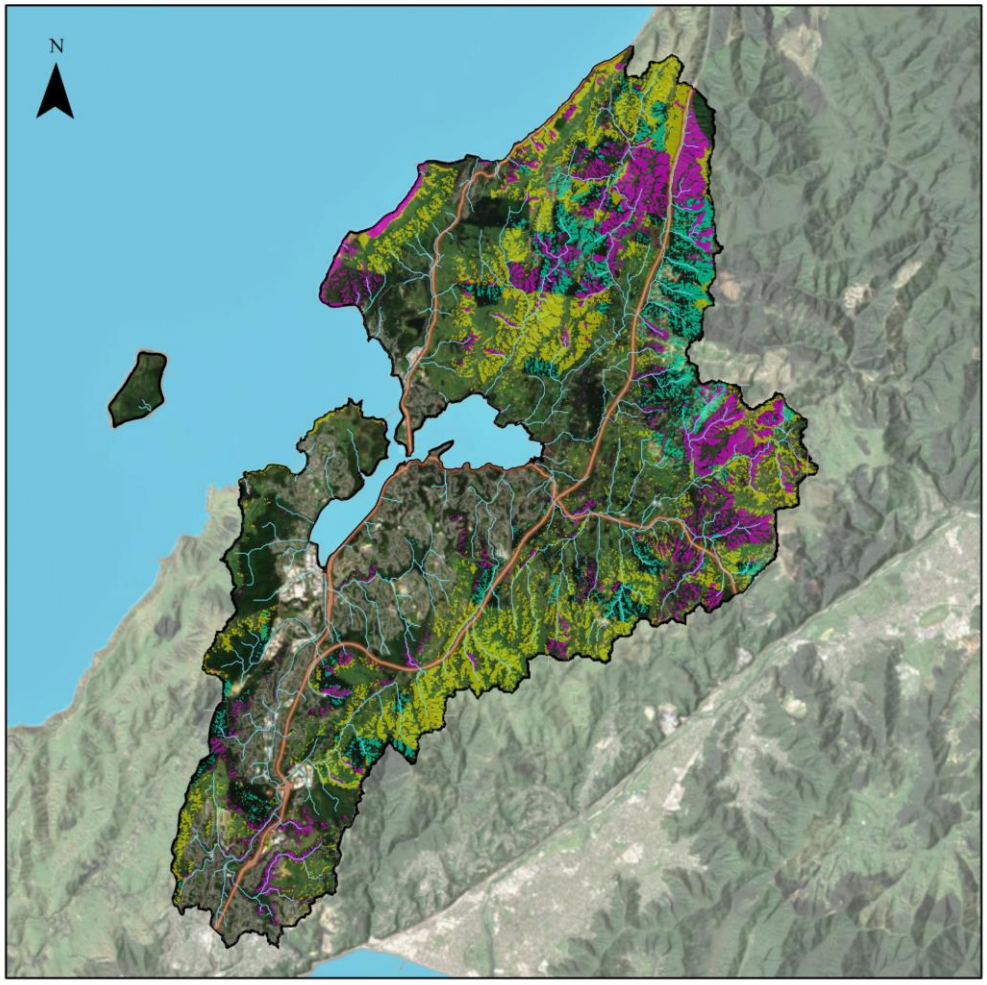
Streambank Erosion Risk — Te Whanganui-a-Tara



APPENDIX B – REVISED EROSION RISK MAPS

Potential Erosion Risk Land - Te Awarua-o-Porirua

Map XX



Potential Erosion Risk land - Te Awarua-o-Porirua

Pasture
Plantation Forestry
Woody Vegetation

State Highways
Whaitua boundary

0 2 4 8 km

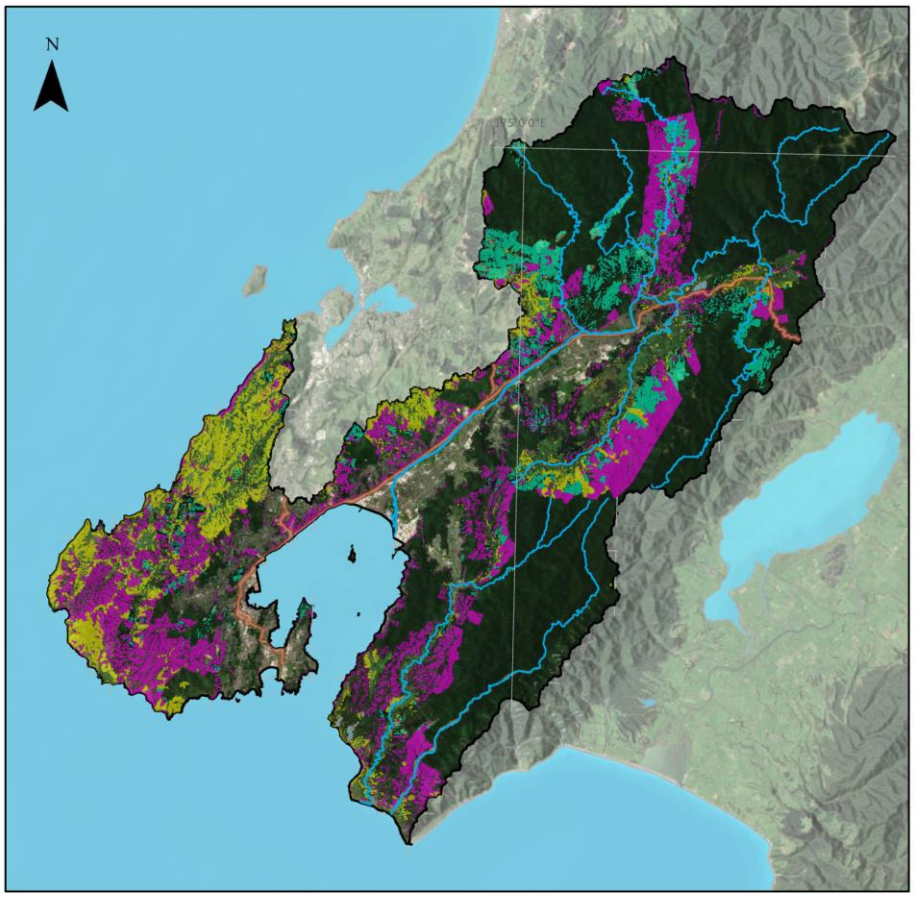
1:157,694

This version of the map is not complete. The version of this map available online through the online web map viewer shows the complete, detailed information on a GIS overlay that is not shown on this hard copy. The online version is available on the Council's website at https://experience.arcgis.com/experience/8ca4cb5241604ee0a981935b9be3fd4c/page/Natural-Resources-Plan/and can be accessed from the Council offices or public library. Please note that the online map does not include section 42A recommendations.

Greater Wellington
Te Pane Matua Taiao

High and highest erosion risk land - Te Whanganui-a-Tara

Map XX



Potential Erosion Risk land - Te Whanganui-a-Tara

- Pasture
- Plantation Forestry
- Woody Vegetation
- Rivers
- State Highways
- Whaitua boundary

0 5 10 20 km

1:368,605

This version of the map is not complete. The version of this map available online through the online web map viewer shows the complete, detailed information on a GIS overlay that is not shown on this hard copy. The online version is available on the Council's website at https://experience.arcgis.com/experience/8ca4cb5241604ee0a981935b9be3fd4c/page/Natural-Resources-Plan/and can be accessed from the Council offices or public library. Please note that the online map does not include section 42A recommendations.

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