Report of the Hawke's Bay Independent Flood Review

July 2024

HAWKE'S BAY
INDEPENDENT
FLOOD REVIEW
Pae Matawai Parawhenua

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Legal limitations of this report

This report has been prepared solely for the purposes stated in the report and should not be relied upon for any other purpose.

The statements and opinions expressed in this report have been made in good faith, and on the basis that all information provided to us and relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

We reserve the right, but will be under no obligation, to review or amend our report, if any additional information, which was in existence on the date of this report, was not brought to our attention, or subsequently comes to light.

Mihi

Nau mai haere e taku manu. E rere kia hāro haere i te takiwā kia mātai anō i te whenua i takahia rā i te tau ka hori ake nei. Kawea atu ēnei maioha āku ki ngā maunga whakahī o te iwi me ngā hapū o tēnei rohe, mai i raro i Whakapunake, ki Maungaharuru, ki Titi-o-kura, ki Kaweka, ki Ruahine rere atu ki Tawapūtahi, hoki ana mai ki Kahurānaki ki te pū o te whenua.

Kia tītaha ō parirau ka tau ai ki ngā marae me ngā kāinga i karawhiua kinotia e ngā hau mātakataka me ngā parawhenua mea. Pākatokato ana te ngākau aroha mō te hunga i riro, i ngaro ki te pō. Haere koutou hei whetū ki te rangi, kia tiaho iho mai ki runga i ō koutou whānau. Kapiti hono, tātai hono koutou te hunga mate ki a koutou.

Ka huri atu ki a tātou ngā kanohi ora, ngā waha kōrero o tēnā hapū, o tēnā marae i tae atu ai mātou. Ki a koutou o Tangoio me Petane, o Waiohiki, tēnei te mihi. Ki a koutou o Moteo me Timi Kara huri atu ki Omahu, ka nui ngā mihi. Kia huri atu ki Mataweka, ki Rongomaraeroa ki Pōrangahau, tēnā anō koutou katoa. Mō te manaaki i a mātou, mō koutou hoki i whakapuaki whakaaro mai i runga i te pōuri, te mamae, te pono, me te aroha. Kei te mihi, kei te mihi, ka nui te aroha, tēnā rawa atu koutou katoa.

E kore e mutu ngā mihi ki ngā tāngata katoa, takitahi mai, takirōpū mai rānei, i whai wā ki te huitahi me mātou. Ki ngā hapori me ngā whakahaere, ki te iti, ki te rahi. Tēnā koutou katoa huri noa, huri noa.

Come and go forth my bird. Take flight to soar above the region to view once more the areas that we have travelled over during the past year. Carry with you our warm greetings to the prestigious mountains of this region, from Whakapūnake in the north, to Maungaharuru, on to Titi-o-kura, to the Kaweka and Ruahine ranges flying onward to Tawapūtahi, before you return to Kahurānaki the sentinel of the land.

Tilt your wings to settle at those marae and homes that were devastated by such a destructive and violent storm. We acknowledge the anguish expressed for those whose lives were taken and lost to the darkness. Ascend and take your place amongst the stars, to shine down on your families. You, the dead, are joined together as one.

We acknowledge the living faces and speaking voices of each hapū and marae that we were privileged to visit. To you the whānau of Tangoio and Petane, of Waiohiki, we greet you. To the whānau of Moteo, Timi Kara and Omahu, please accept our heartfelt thanks. We also acknowledge the whānau of Mataweka Marae and Rongomaraeroa in Pōrangahau, thank you all. We thank you for hosting us, for expressing your thoughts with honesty and compassion despite the sadness and grief that prevailed at the time. We thank you all once again.

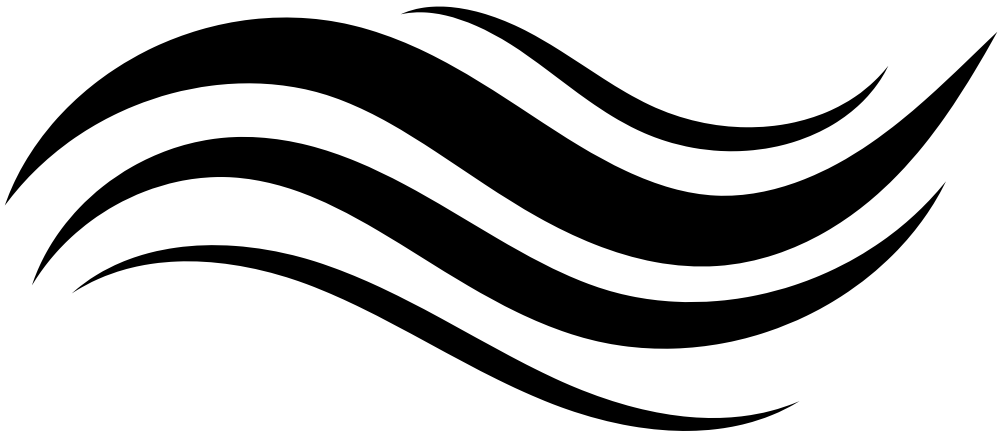
We will be forever grateful to all the people, communities and organisations that made the time to meet with us, regardless of number or size. We thank you all.

Acknowledgements

The Panel members wish to express their gratitude to Liz Read and Lesley Reidy who have provided extensive and invaluable logistical support, in both the information gathering and report writing phases of the Review.

The Panel also acknowledges Brian Morris, Lee Kershaw-Karaitiana and Montana Karena for their Te Reo Māori and tikanga Māori expertise and support.

Papaki kau ana ngā tai o mihi ki a koutou katoa.



Executive summary and recommendations

Executive summary

Cyclone Gabrielle

On the 13th and 14th of February 2023, Cyclone Gabrielle delivered an extraordinary amount of rainfall to the entire Hawke's Bay region, generating the largest flood flows on record for many of the region's rivers and leading to extensive, widespread inundation. For example, the combined flow[1] of the Tutaekuri and Ngaruroro Rivers has been estimated as one of the largest floods ever recorded in New Zealand, with a return period of approximately 1,000 years. Unsurprisingly, many of the flood protection schemes in the region were overwhelmed.

These immense flood flows resulted in deaths[2] and widespread destruction and devastation across the region, with financial losses in excess of $5 billion.[3]

Many marae, urupā and papakāinga were destroyed or extensively damaged, including Tangoio, Petane, Waiohiki, Omahu, Rongomaraeroa, Moteo and Takitimu.

Infrastructure was significantly affected, with 5.3 kilometres (km) of stopbanks breached, power outages affecting 75,000 people, six major road bridges and a rail bridge washed away and significant damage to the wider roading and rail network, pump stations and wastewater treatment plants.

Commercial and industrial premises were significantly affected and agriculture/farming, horticulture and viticulture were also massively impacted, with thousands of hectares of productive land covered by silt.

Residential and other buildings were also affected significantly, with almost 1,700 properties flood-affected, of which 326 properties are currently classified as Category 3 under the government's land categorisation framework, meaning that the use of these properties for residential purposes was assessed to have an intolerable risk to life from future flood events.

In its wake, Cyclone Gabrielle brought destruction and devastation to families, communities, businesses, infrastructure, whenua and taonga, and highlighted a lack of planning and preparation for an event of this magnitude and extent.

This review

In the aftermath of Cyclone Gabrielle, the Hawke's Bay Independent Flood Review – Pae Matawai Parawhenua was commissioned by Hawke's Bay Regional Council (HBRC) to investigate the circumstances and contributing factors that led to the flooding in the Hawke's Bay region during Cyclone Gabrielle.

The Review was deliberately established to be independent and impartial in looking at HBRC's flood management schemes, how each performed and the decisions made by HBRC during the cyclone. The Review was to consider and recommend options to increase the region's long-term flood resilience.

This report is the output of the Review.

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1 Accounting for out of channel flows from stopbank breaches
2 The deaths that occurred during Cyclone Gabrielle have been referred to the Coroner
3 HBRC (2023b). Hawke's Bay Regional Water Assessment 2023

Summary findings

The key findings of the Review are summarised under the following key headings:

- Structural works (stopbanks);
- Flood event management (flood forecasting advice on areas affected);
- Planning controls (preventing development in flood risk areas);
- River channel maintenance (gravel extraction, willow maintenance);
- Mana whenua (specific impacts arising from historical context);
- Community (resilience through collaboration);
- Funding and resourcing (central government and regional).

Structural works

Structural flood risk management works in the form of stopbanks are only evident on some of the region's rivers, in particular on the Heretaunga and Ruataniwha Plains, whereas there are no stopbanks on the Wairoa, Esk and Pōrangahau Rivers, along with many others. Since the flood event there has been a widespread desire to build new stopbanks, particularly in areas that currently have no protection. However, lessons must be learnt from the fact that the flood completely overwhelmed the stopbanks on the Heretaunga Plains system and the Waipawa River, and any new stopbanks need to be designed in ways that provide predictable and manageable performance during events that exceed their capacity.

Additionally, there was very limited planning and preparedness for an event that exceeded the capacity of the stopbanks. This was at least in part due to the overarching stopbank system design, and was particularly evident in the Heretaunga Plains system, where there were no formally designated spillways, diversions or overflows for events that exceeded the stopbanks' capacity. This resulted in residual risk to the entire floodplain, including the densely populated urban areas of Taradale, Hastings and Napier. It meant that more than 100,000 people were at risk, owing to there being no practical solution for evacuations prior to a flood arriving.

Flood event management

Across the region there were very few effective warnings and evacuations, and this resulted in a large number of people being exposed to extremely dangerous situations that ultimately led to deaths, physical injuries and emotional scars for innumerable others.

The lack of planning and preparedness for events exceeding the capacity of stopbanks was also apparent in the many unprotected floodplains of the region. Flood risk had been underestimated in a number of locations, because large historic floods had not been included in the analysis of flood size, and there was limited detail and a wider understanding of trigger levels and likely areas of inundation.

Compounding this were MetService rainfall forecasts that underestimated the actual rainfall, the failure of a repeater station supporting the telemetry system, the loss or damage of some water level and rainfall measuring equipment, communications outages and staff being overwhelmed by the scale of the event.

Planning controls

The fact that there were relatively new housing developments in areas of known flood risk suggests that lessons from the past have not been learnt and development has been allowed in high-hazard areas. Flood risk has been underestimated in some areas due to a lack of accounting for large historic flood events, the Esk Valley and Tangoio Beach being particularly relevant examples.

River channel maintenance

The magnitude of the event meant the degree of river maintenance, particularly gravel management, channel clearing and riparian management had a lesser impact on the overall performance of the region's river systems.

However, there is a need for a thorough assessment of the capacity of these systems in order to understand the recovery and future maintenance requirements for returning systems to the agreed levels of service. A future focus on effective long-term gravel management practices and appropriate vegetation management will be an essential part of this.

Mana whenua

Mana whenua were disproportionately affected by this flood event, with a number of marae, papakāinga and urupā and other taonga significantly affected due to their being located on marginal, flood-prone land adjacent to river channels. Petane and Tangoio Marae were particularly devastated and have subsequently been classified Category 3 (voluntary buy-out) zones. This presents significant challenges to hapū and marae, as the whenua that is affected is, in some cases, the last remaining of historically larger (and flood-free) landholdings.

Community

The sense of community spirit and resilience during and in the wake of the cyclone has been awe-inspiring, with numerous examples of extreme bravery and in the tireless clean-up work. Communities have rallied together, often centred around marae, to help those affected and to develop plans for the future. Genuine collaboration and partnership is needed between local and central government and communities, mana whenua and businesses to evaluate and progress options for better managing flood risk in the future.

Funding and resourcing

From a regional perspective, the cost of rebuilding and improving flood management infrastructure is likely to be unaffordable, so central government assistance will be needed. This is especially so given the need to re-imagine legacy systems so they are fit for purpose and reflect the evolving best practice of "Making Room for the River", and to ensure flood management systems are designed to standards that reflect the value of the assets at risk. Likewise, at a regional level there is a need to review and shift away from high levels of local targeted rate-based funding, particularly for small rural catchments.

Recommendations

Structural works

1. HBRC should prioritise the objective of safely conveying large floods from the mountains to the sea in order to minimise and prevent damage from floods and erosion.

2. HBRC should ensure that the residual risks associated with floods that exceed the design capacity of stopbank systems are identified, assessed and actively managed. This could be through a combination of planning controls, changes to stopbank systems (e.g. spillways) and event management (e.g. proactive evacuations).

3. When designing new flood management works or improvements to existing systems, HBRC should consider the evolving best practice of "Making Room for the River" in terms of lateral erosion and floodwaters. For example, secondary systems including spillways, diversions and storage areas should be considered with the objective of directing floodwater to identified areas with the lowest consequences to the communities of Hawke's Bay. In addition, these solutions should have known performance in super design events that enables effective event management including precautionary evacuations where appropriate.

4. HBRC should collaborate with mana whenua and other communities in developing fair and equitable flood management solutions. These solutions should recognise and compensate appropriately those properties that are adversely affected in order to achieve an overall community benefit.

5. HBRC should determine the design standard of improved flood management systems based on robust economic analysis to determine the minimum net cost accounting for the investment required for the flood mitigation works and the value of flood damages avoided due to those works. The widely applied 100-year, including climate change, should be considered the minimum standard and not the default standard. This will necessitate a consideration of the flood management standards and long-term budgets, an example being the 500-year flood standard for the entire Heretaunga Plains Scheme within the current Long Term Plan.

6. When designing flood management works or assessing the adequacy of existing works, HBRC should include historic floods that have not been measured as part of the systematic record in the analysis. For example, the inclusion of the 1938 flood flow estimate for the Esk Valley significantly affects the assigned frequency of the 2023 event. Similarly, for Pōrangahau the inclusion of the 1941 and 1953 flood events significantly changes the assessment of the 2023 flood frequency and the basis for what is a reasonable design standard for the future.

7. When assessing and designing flood management systems near river mouths, HBRC should incorporate scenarios that consider partial blockage situations, as well as a range of sea-level and storm-surge conditions. By way of example, at the Esk River mouth the interaction with the adverse coastal conditions in addition to significant debris loading is likely to have increased flood levels in the lower reach of the river.

8. When assessing and designing flood management systems near bridges, HBRC should incorporate scenarios that consider partial blockage situations and account for these in the design. The breaching of stopbanks immediately upstream of bridges was a notable feature of this event, with the breach at Awatoto being a clear example.

9. HBRC should ensure that where natural high ground forms part of the flood management system, it is identified and protected appropriately so that it maintains its functionality over time. For example, it was unclear whether the high ground upstream of Waiohiki marae was at the same level during the flood as it was when surveyed and assessed to be up to the 100-year design standard.

10. HBRC should undertake a review of activities allowed on river floodway berms and stopbanks to ensure that the flood management infrastructure is protected from damage and or ongoing maintenance requirements that would otherwise not be required. For example, the use of motorbikes and 4WD vehicles on the Waipawa and Ngaruroro Rivers.

11. HBRC should review the efficacy of deflection banks on stopbanks to ascertain their benefits and the risks of isolated turbulence that can contribute to increased flood levels and or erosive failures of stopbanks. This is particularly relevant on the Ngaruroro River, where stopbank breaches occurred where these features were located.

12. HBRC should review the alignment of access tracks over the crests of stopbanks, with a preference for their starting from the downstream end and heading up the stopbank to reduce turbulence that may affect stopbank performance.

13. HBRC should undertake regular monitoring and topping up of the stopbank crests around access tracks to ensure crest levels are maintained. The most notable example of this was the access track immediately upstream of the bridge across the Ngaruroro River at Omahu, where a breach occurred.

14. HBRC should complete a risk assessment of adverse stopbank alignments, including sharp bends and locations where stopbanks are in very close proximity to river channels. The risk assessment should include prioritised mitigation measures to manage these risks. One notable example is the Walker Road stopbank on the Waipawa River, which is perpendicular to the direction of river flow and very close to the active river channel.

Flood event management

15. HBRC should actively communicate and educate communities on the levels of flood risk to which they are exposed and assist them in improving their resilience to flooding, including, but not confined to, improving and updating the HBRC online Hazard Portal.

16. HBRC should ensure that flood risks are accurately quantified and that flood frequency assessments include significant past flood events.

17. HBRC should improve its systems and technology for monitoring and modelling rainfall in real time in order to provide more accurate and timely forecasts of river flows and associated flood inundation across the region. For example, communication stations should have adequate back-up power supplies to ensure continual operation when needed, and it should be clear when data is not being gathered or transmitted. Inundation maps for a range of events should also be readily available.

18. HBRC should identify specific trigger levels for alerts and recommended evacuations for known flood risk areas, document them in its Flood Manual[4] and communicate them to those who are affected.

19. HBRC should ensure that robust systems are in place to alert the community when trigger levels are being approached or exceeded and ensure Civil Defence has all the information it needs to undertake its functions. This could include providing greater public access to HBRC river flood forecast information.

20. HBRC should take a precautionary approach when providing forecast flood inundation information to Civil Defence. The use of "worst case scenario" terminology should be avoided as it may convey a potentially inaccurate and overly optimistic assessment of what may actually occur. All communications regarding potential flood inundation should be as clear and decisive as possible.

21. The Panel endorses the recommendations of the Hawke's Bay Regional Council Cyclone Recovery Committee Telemetry Review (August 2023), the Report of the Independent External Review for Hawke's Bay Civil Defence and Emergency Management Group (March 2024) and the Report of the Government Enquiry into the Response to the North Island Severe Weather Events (March 2024).

Planning controls

22. HBRC should urgently review the Regional Policy Statement so that it includes clear and directive objectives and policies regarding land use management in flood hazard areas.

23. HBRC should update and include the 2023 flood event as well as other notable historic floods in the assessment of flood frequency for use in identifying flood hazard areas. The underestimation of flood risk in the Esk Valley and Pōrangahau are examples of significant historic floods not being accounted for.

24. HBRC should ensure that Regional Policy Statement provisions:

    a. Identify and map areas subject to flood hazard risks, including scenarios that exceed the levels of service provided by flood management assets;

4 A document that describes key processes and activities for Regional Council staff and contractors in the lead up to and during flood events

b. Direct how the effects of climate change are to be taken into consideration when identifying flood hazard areas and assessing subdivision and land use applications;

c. Define unacceptable flood hazard risk;

d. Direct that district plans avoid unacceptable flood hazard risks, including, for example, through the use of prohibited activity rules;

e. Define when mitigation measures to manage flood hazard risks are appropriate and the types of mitigation that are appropriate;

f. Identify areas of high flood hazard risk where managed retreat is required.

25. The review of the Regional Policy Statement should ensure that new and intensified residential development and subdivision is prohibited in areas subject to unacceptable flood hazard.

26. The review of the Regional Policy Statement should ensure that direction is provided for the identification and management of residual flood risks resulting from ponding, stopbank breaches and overflow. The Panel recommends that the approach to residual risk adopted by Kāpiti Coast District Council is taken as best practice.

27. HBRC should urgently review the provisions of the Regional Resource Management Plan to ensure that the design of new structures, particularly bridges, minimises to the extent practicable the extent to which they constrict flood flows and act as debris barriers during floods. An example would be to explore options not involving/minimising the use of piles and raising bridge deck levels well above extreme flood levels.

28. HBRC should ensure it has sufficient financial and people resources to allow it to provide effective advocacy and technical input to planning processes and resource consent applications, to ensure that development does not occur in areas subject to unacceptable flood hazard risks.

29. HBRC should review current resource consents relating to the risks to flood management activities and assets and ensure there are appropriate consent conditions in place and that they are being complied with so that effects are appropriately managed. For example, the clean fill operation at the mouth of the Esk River should be reviewed.

River channel maintenance

30. HBRC should re-survey all river and stream channels within current scheme boundaries to assess whether they meet the currently agreed levels of service in the respective Asset Management Plans. From this work, a prioritised work programme should be developed to demonstrate how any systems that are not at their agreed service levels will be returned to those.

31. It is acknowledged that there will likely be a period of increased spending on river-channel maintenance to undertake the repairs/reinstatement required by the above, but when considering longer-term budgets, HBRC should review the annual maintenance budget and funding model in terms of regional versus local share to ensure that adequate levels of service are achieved and funding is affordable.

32. HBRC should be more proactive in managing gravel build-up where it is above design grade lines, and either extract it to maintain the agreed level of service or develop and implement alternative options. These should include but not be limited to being more directive regarding gravel extraction and removing contractors' ability to pick and choose locations based on convenience. Noting that the 2023 flood event will have likely changed river bed levels considerably; the Upper Tukituki system and the Tutaekuri River and lower Esk River were noted as locations where specific assessments and actions are needed.

33. HBRC should investigate options for more permanent river mouth openings using techniques such as constructing heavy guide banks/moles at locations where they are critical for flood conveyance and increased flood levels cannot be accommodated by upstream flood management works. During Cyclone Gabrielle the Esk River mouth was at least partially impeded and may have contributed to the extent of upstream flooding.

34. HBRC should evaluate the need to add maintenance of the Wairoa River channel to the scope of the existing Asset Management Plan for the area. This evaluation should include consideration of riparian vegetation management as well river-bed-level monitoring in line with the typical survey frequency (five-yearly) of the region's other main rivers.

35. Using the survey data noted above, HBRC should complete a geomorphic assessment of the bed-level trajectory for the lower Wairoa River for the purpose of assisting with the assessment of flood management infrastructure options for this area.

Mana whenua

36. HBRC should engage kanohi ki te kanohi (face to face) and at a rangatira ki te rangatira (leadership to leadership) level with mana whenua groups in the region, in addition to relying on existing advisory committees and groups.

37. HBRC should acknowledge the inequity whereby Māori land and communities have been marginalised by decisions and actions of central and local government for many decades and are often located on low-lying, flood-prone land (for example, Tangoio, Waiohiki and Omahu).

38. HBRC should recognise and provide for Māori communities and low-socio-economic areas that are disproportionately exposed to flood risk because flood protection in those areas does not satisfy HBRC's traditional cost/benefit approaches. HBRC should develop a new flood management model with mana whenua.

39. HBRC should engage urgently with communities on Category 3 land such as Petane Marae and Tangoio Marae and, with the Crown and territorial authorities, provide funding and assistance for the planning, consultation, purchase and potential rebuild of these marae and papakāinga on other land.

40. Where marae and papakāinga are unprotected in terms of flood protection works (two examples being marae at Pōrangahau and Wairoa), HBRC needs to partner with mana whenua groups at those places in looking at all options to render those communities safe and sustainable into the future. Options may include raising the floor levels of marae or moving communities to higher ground. HBRC needs to engage urgently with these communities and with the Crown provide funding and assistance for planning, consultation, purchasing and other measures necessary to manage flood risk effectively in these marae and papakāinga.

41. The Panel encourages HBRC to work proactively and in partnership with mana whenua in the development of recovery plans such as "Utaina: 10 Year Recovery Plan", which was developed by Piringa Hapū (Ngāti Hinemanu, Ngāi Te Upokoiri, Ngāti Honomōkai, Ngāti Mahuika) to restore and preserve a resilient natural environment.

Community

42. HBRC should communicate and collaborate effectively with communities, mana whenua and stakeholders in the development and implementation of flood risk management solutions for areas subject to flood risk.

43. HBRC should make more and better use of the local networks and knowledge that exist within communities as it leads the process of developing comprehensive flood risk management solutions and implements the physical works needed to improve flood resilience in Hawke's Bay.

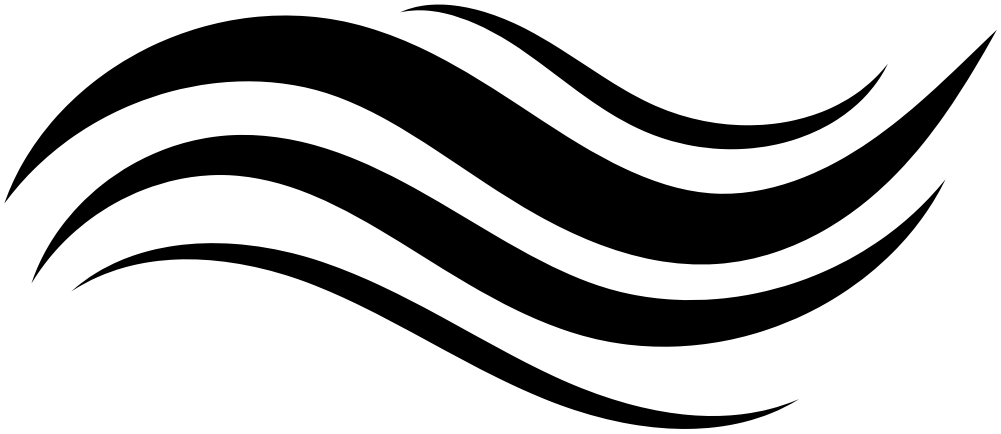
44. HBRC should develop a collaborative process for developing flood scheme design involving the regional and district councils, mana whenua and the wider community.

Funding and resourcing

45. HBRC should review the resourcing of its flood risk management activities to ensure it is sufficient to deliver the agreed level of service for day-to-day operations and has sufficient back-up and contingency plans to meet its flood event management responsibilities.

46. HBRC should continue to be proactive in working in partnership with central government to provide an affordable funding mechanism for new capital works and ongoing maintenance activities.

47. HBRC should review the funding of current and future river management schemes so that the targeted and regional rates contributions enable affordable and equitable outcomes.



CHAPTER 1:
Introduction

Advent of the Hawke's Bay Independent Flood Review – Pae Matawai Parawhenua[5]

In April 2023 Hawke's Bay Regional Council (HBRC) announced its intention to commission an independent review of the region's flood protection assets and drainage systems.

The scope of the review was to consider all Regional Council owned and operated flood-protection, flood-control and drainage systems during Cyclone Gabrielle. It included:

- Investigating the origin and purpose of each scheme, including its intended level of service, the severity of the Cyclone Gabrielle event relative to the scheme's purpose, and the scheme maintenance and operation before, during and in the immediate aftermath of Cyclone Gabrielle;
- Making recommendations for improvements to scheme levels of service and maintenance or operational requirements for future events, having regard to climate change.

The Review Panel was appointed and terms of reference confirmed in late July 2024 (see Appendix A: Terms of Reference and Appendix B: About the Panel).

Not only did Cyclone Gabrielle affect the entire region, but the magnitude of the flood was unprecedented. This was particularly so on the Heretaunga Plains, where the combined flow of the Tutaekuri and Ngaruroro Rivers exceeded 10,000 cubic metres per second (m^3/s) – approximately a 1,000-year return period[6] flood event.

The floodplains of Wairoa, Tangoio, Esk Valley, Waipawa and Pōrangahau were also extensively inundated, causing vast destruction to lives and livelihoods.

The information shared with the Panel at hui and by the community was extensive and extremely valuable, and we have endeavoured to reflect this in our reporting, particularly in cases of multiple commentary on a similar issue.

The Panel also received an extensive range of technical information from HBRC, which we interrogated carefully and, where appropriate, reference in our analysis. We express our gratitude to HBRC management for cooperating fully with the Panel's requests for information and for respecting the independence of the Panel and the Review process.

Within the context of an unprecedented whole-of-region event, our review took a strategic approach to assessing the performance of HBRC's assets, systems and processes and did not seek to undertake a detailed forensic analysis of each and every aspect of each and every waterway in the region.

By way of example, on the Heretaunga Plains the Review focused on the overall strategic design of the stopbank network and what that meant for how the flood event was managed, rather than attempting a detailed geotechnical analysis of the numerous stopbank breaches that occurred throughout the Heretaunga Plains stopbank network.

5 Refer Appendix F: About Pae Matawai Parawhenua
6 The return period is an estimate of the likelihood of an event to occur

The Panel focused on the key issues that became evident from our review of published information and feedback received from communities.

The Panel is satisfied that the key issues have been identified and that this review provides a road map for the future that sets out the lessons that HBRC and the community can employ to improve the region's resilience to flooding in the future.

Report structure

This report comprises 10 sections:

Chapter 1 is this introduction

Chapter 2 provides an overview of what happened in Hawke's Bay during Cyclone Gabrielle

Chapter 3 explains the process followed by the Panel in undertaking this Review

Chapter 4 sets out, by way of key themes and issues, the information provided to us

Chapter 5 provides an historical context of Hawke's Bay – Te Matau-a-Māui and its people

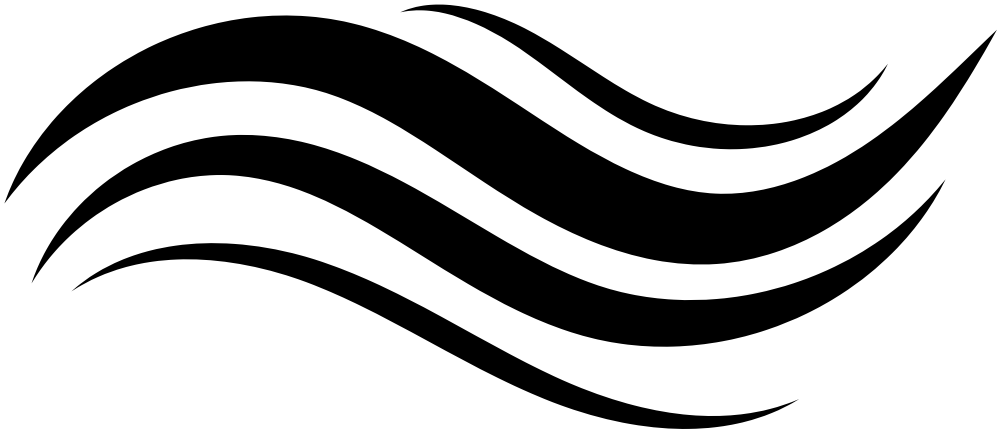
Chapter 6 summarises the flood management regimes in place in Hawke's Bay

Chapter 7 is a summary of the statutory and non-statutory framework within which HBRC undertakes flood management activities

Chapter 8 is a detailed evaluation of HBRC's performance prior to and during Cyclone Gabrielle

Chapter 9 assesses the adequacy of the Regional Planning Framework, with an emphasis on the Regional Policy Statement and its effectiveness

Chapter 10 sets out the Panel's conclusions and recommendations.



CHAPTER 2:
Cyclone Gabrielle – What happened

This chapter discusses the impacts of the cyclone on people, the land, businesses and regional infrastructure (flood management, power and communications, transport).

On the 13th and 14th of February 2023, Cyclone Gabrielle (See Figure. 2.1) delivered an extraordinary amount of rainfall to the entire Hawke's Bay Region, with rainfall depths of approximately 450 millimetres (mm) in Wairoa, over 500 mm in the Esk Valley, 300–350 mm in the Ngaruroro/Tutaekuri catchments[7] and 300 mm in southern areas[8] affecting the Waipawa and Pōrangahau catchments.

This rainfall generated the largest flood flows on record for most of the region's rivers, with return periods of approximately 1,000-years estimated[9] for the Tutaekuri, Ngaruroro, Waipawa and Pōrangahau Rivers. The combined flow[10] of the Tutaekuri and Ngaruroro Rivers (see Figure 2.2) has been estimated at 10,800 m^3/s, one of the largest floods ever recorded in New Zealand.

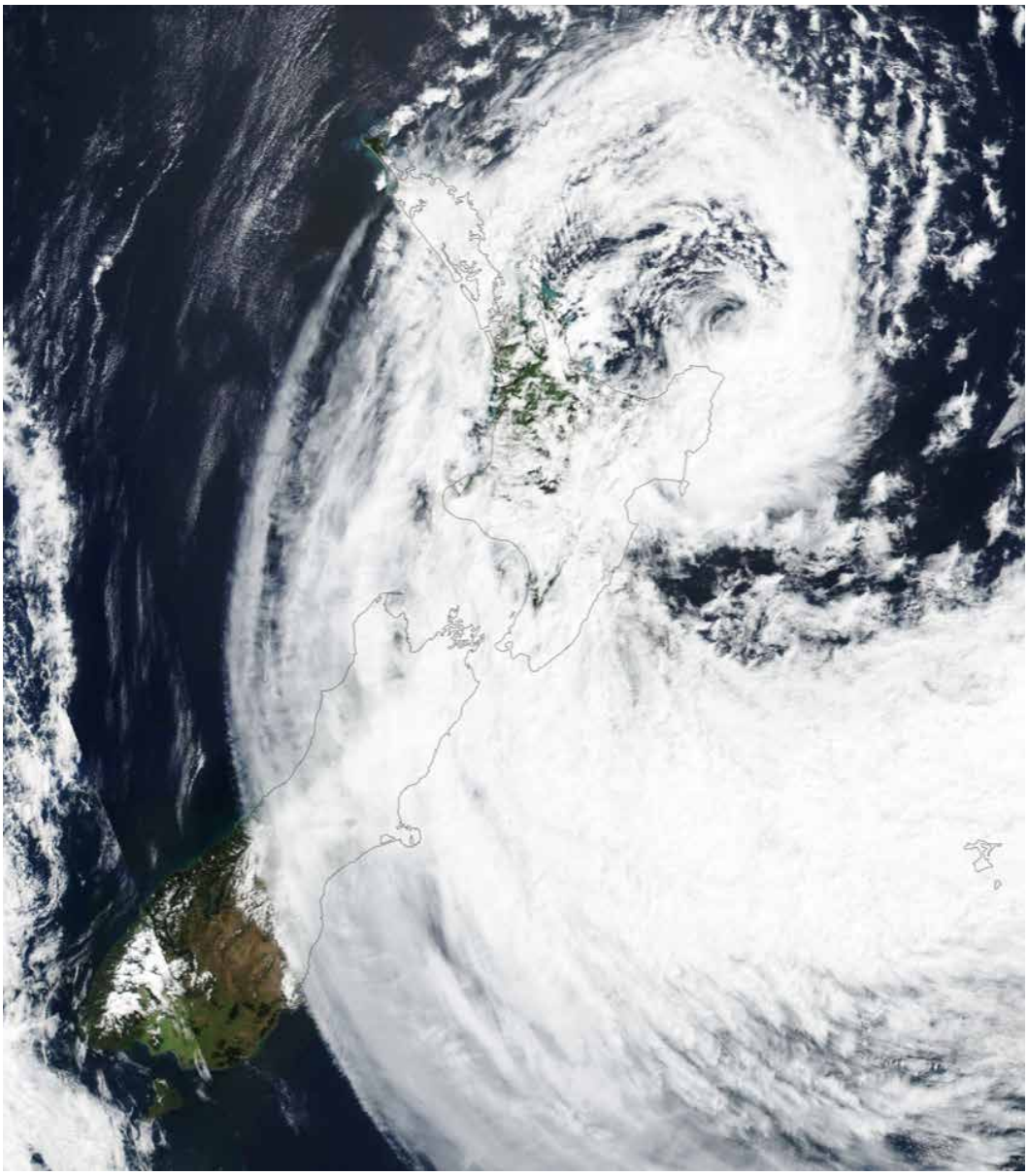


Figure 2.1 Satellite Image, February 14 2023[11]

7 HBRC (2023). Hawke's Bay Regional Council Cyclone Gabrielle. PowerPoint Presentation to Review Panel
8 Rainfall data from Moorcock raingauge 6am 13 Feb – 12pm 14 Feb. Accessed from https://www.hbrc.govt.nz/environment/rainfall/ on 14 March 2024
9 NIWA (2024). Extreme Value Analysis of Flood Flows. Letter Report 23 Feb 2024
10 Accounting for out of channel flows from stopbank breaches
11 Source https://earthobservatory.nasa.gov

Figure 2.2 Tutaekuri and Ngaruroro River mouths, 14 February 2023[12]

These immense flood flows resulted in deaths, widespread destruction and devastation across the region, with financial losses in excess of $5 billion.[13]

Many marae, urupā and papakāinga that were commonly located on the floodplains close to the rivers including Tangoio, Petane, Waiohiki, Omahu, Rongomaraeroa, Moteo and Takitimu were destroyed or damaged significantly.

Infrastructure was significantly affected, with 5.3 km of stopbanks breached, power outages affecting 40,000 properties, six major road bridges and a rail bridge washed away and significant damage to the wider roading and rail network, pump stations and wastewater treatment plants.

Commercial and industrial premises were significantly affected, with the Awatoto industrial area and the Pan Pac operation at Whirinaki suffering severe inundation.

Agriculture/farming, horticulture and viticulture were also massively affected, with $1.4 billion[14] in losses for 2023 in horticulture alone and thousands of hectares of productive land covered by silt.

Residential and other buildings were also significantly affected, with almost 1,700 properties in Hawke's Bay being RED, YELLOW or WHITE stickered as a result of the cyclone. Of those, 287 properties were declared no longer safe for residential use through their inclusion in the Category 3 (voluntary buy-out) designation.

Further details of the cyclone, the resulting flood flows and the impacts on people, property, land, infrastructure and businesses are provided in the following sections. Detailed descriptions of the HBRC flood management infrastructure and systems, along with an assessment of its performance during the flood event, are provided in subsequent chapters.

12 HBRC
13 HBRC (2023b). Hawke's Bay Regional Water Assessment 2023
14 Boston Consulting Group (2023). Hawke's Bay Horticultural Sector: Economic Recovery Following Cyclone Gabrielle

2.1 Rainfall

Extraordinary depths and intensities of rain fell during Cyclone Gabrielle throughout the Hawke's Bay region. From HBRC data provided to us, the largest depth of rainfall was measured at the Glengarry recorder site in the Esk Valley with a total 546 mm. Approximately 400 mm fell in 12 hours at a maximum intensity of 56 mm per hour (see Figure 2.3).

A number of other sites experienced rainfall depths exceeding 400 mm in 30 hours, including sites in the Wairoa, Tutaekuri and Ngaruroro catchments.

Many parts of the region experienced significantly more rainfall than that which occurred during Cyclone Bola in March 1988, especially in Pōrangahau, where the amount of rainfall was double that of the most intense 24-hour period during Bola.

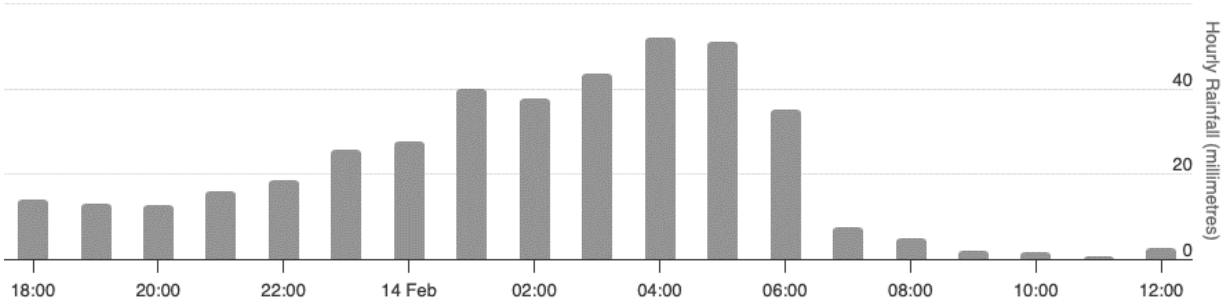


Figure 2.3 Hourly Rainfall Glengarry 1800 hrs 13 Feb – 1200hrs 14 Feb 2023[15]

The rainfall was also significantly greater than what had been forecast in the days leading up to the event and in the 24 hours prior to the peak rainfall occurring. The accuracy of rainfall forecasts is particularly important for HBRC in planning and prioritising flood event management tasks and providing advice to Civil Defence on the likely timing and extent of floodplain inundation for the purpose of actioning evacuations.

15 https://www.hbrc.govt.nz/environment/rainfall/

Table 2.1 Summary of predicted (forecast) and actual rainfall[16]

Site	River	Predicted (mm)	Observed (mm)
Glengarry	Esk	256.1	514.5
Fairview	Wairoa	235.5	449
LK4 Ngaroto Tutaekuri	Ngaruroro/Tutaekuri	228.9	415
Waipoapoa	Tukituki	192.4	409
Te Pohue No. 2 Climate	Esk	296.3	407.8
Pukeorapa Station	Wairoa	229.7	381.2
Te Koau	Ngaruroro/Tutaekuri	265.6	369
Ngahere HBRC	Ngaruroro/Tutaekuri	304.2	364.5
Waihau Climate	Ngaruroro/Tutaekuri	251	343.4
Maunganui	Esk	330.1	333.5
Ngaruroro River at Kuripapanga	Ngaruroro/Tutaekuri	314.3	328
Te Rangi	Esk	303.9	307
LK3 Burns Ngaruroro	Ngaruroro/Tutaekuri	299	302
Parks peak HBCB	Ngaruroro/Tutaekuri	286.2	296.5
Newstead	Heretaunga	189.1	286
Kopanga	Heretaunga	139.5	273.5
LK7 Poporangi	Ngaruroro/Tutaekuri	201.2	270.5
Glenwood HBRC	Tukituki	298.3	266.5
Kohatanui	Ngaruroro/Tutaekuri	219.7	263
Crownthorpe Climate	Ngaruroro/Tutaekuri	192.6	258
Kotemaori	Esk	227.9	255.4
Aniwaniwa Park HQ	Wairoa	262.1	246.5
Te Kaihi	Tukituki	155	237.5
Nga Tuhoe	Wairoa	186	232
Omakere Climate	Tukituki	156.9	228.2
Maraekakaho Stream D/S Tait Rd	Ngaruroro/Tutaekuri	142.9	224
Gwavas HQ Climate	Ngaruroro/Tutaekuri	166.3	224
Te Haroto Climate	Esk	247.4	223.8

16 HBRC (2023). Hawke's Bay Regional Council Cyclone Gabrielle. PowerPoint Presentation to Review Panel

A further impact on rainfall and flood forecasting was the loss of the main repeater[17] station at Kahuranaki which meant actual measured rainfall (as opposed to forecast) could not be used in real-time for HBRC's flood forecasting predictions and consequent advice to Civil Defence.

However, the nature of most catchments means there is very little time before upper catchment rainfall turns up as flood flows in the lower reaches of the rivers. Therefore, the use of actual rainfall data is somewhat limited for providing advice on evacuations. This is discussed in greater detail in the later chapter assessing the performance of the HBRC systems for each of the major catchments where flood forecasting was done.

2.2 River flows

The intense and extensive rainfall across the region generated the largest flood flows ever recorded in many of the region's rivers, with flood return periods of approximately 1,000 years for the Tutaekuri, Ngaruroro, Waipawa and Pōrangahau Rivers.

NIWA completed an initial summary report[18] and subsequently a more detailed technical report[19] assessing the flood flows that occurred during the cyclone. It is worth noting several key limitations in the analysis of issues that arose during the event.

Firstly, a number of the water-level recorder sites used for estimating flood flows were washed away. This meant that, subsequent to the cyclone, peak water levels could only be estimated based on observed flood debris lines and hydraulic modelling, and an attempt to match those lines using reasonable assumptions of the channel morphology and roughness during the event.

This is particularly challenging for very large floods due to the likelihood of significant scour occurring during the peak, as well as large debris in the flow contributing to turbulence, which increases the roughness.

Further, in almost all cases the rivers flowed out of their normal channels and across floodplains and through numerous stopbank breaches on the Heretaunga Plains system. The extent of these overflows and breakouts also had to be estimated to determine the total flood size.

Another key feature of the analysis is the exclusion of historic floods that occurred before water levels were systematically recorded. By way of example, it is likely that the largest flood to ever occur in the Esk River was in 1938, with an estimated peak flow of 2,200 m^3/s. However, the systematic record started later, in November 1963. If the 1938 flood were included in the analysis, it would have significantly affected the extent and degree of flood hazards identified in the valley and the flood return period attributed to the February 2023 event.

Where possible, NIWA's recent review has integrated these historic floods with the flood frequency analysis. Its assessed flood return periods reflect this more accurate form of analysis. It is also worth noting that once the February 2023 event is included in the analysis, the flood return period assigned to the Esk River will reduce.

17 Communication station that transmits data from HBRC remote rainfall sites back to main office systems
18 NIWA (2024). Extreme Value Analysis of Flood Flows. Letter Report 23 Feb 2024
19 NIWA (2024). Flood Frequency in the Hawke's Bay Region following Cyclone Gabrielle

For the purposes of this report, the flood return period based on the pre-2023 flood frequency analysis is quoted, because that was the information in the summary statistics in use by HBRC at the time. A summary of the major rivers with the highest flood return periods is provided in Table 2.2. The revised figures (which include the influence of Cyclone Gabrielle) subsequently produced by NIWA are also shown, for comparison.

Table 2.2 Summary of estimated flood flows and return periods[20]

River Site	Flood flow	Flood return period pre-cyclone	Flood return period post-cyclone
Wairoa River at Marumaru	4,100 m^3/s	250 years	120 years
Esk River at Waipunga	2,175 m^3/s	220 years	180 years
Tutaekuri River at Puketapu	4,800 m^3/s	980 years	400 years
Ngaruroro River at Fernhill	6,000 m^3/s	> 1000 years	480 years
Waipawa River at RDS	1,810 m^3/s	> 1000 years	120 years
Pōrangahau River at Saleyards	1,590 m^3/s	> 1000 years	80 years

More detailed discussion, including historic floods in each of the main catchments is provided in Chapter 8 of this report.

In addition to the unprecedented river flows, the sea conditions were also significant during the cyclone, with the Port of Napier's wave buoy recording significant wave heights of up to 6 metres (m) during the cyclone[21] on top of a storm surge of 0.5 m which combined with large volumes of trees and woody debris to cause partial blockages in the lower reaches of some rivers and at river mouths.

2.3 Effects on people

People died in Hawke's Bay during this flood event, and we extend our deepest respect and sympathy to the families, friends and communities who lost loved ones.

Given the extreme nature of this flood event, the vast area and the number of people affected, and the flood's impact happening in the middle of the night in many areas, it is miraculous that the death toll was not significantly higher.

This speaks to the resilience and strength of those who fought for their and their families' lives as they swam, waded and did whatever they needed to stay alive on the night and the following day of this disaster. As well as the lives lost during this event, a large number of people sustained injuries, with ACC reporting more than 2,000 claims[22] including for soft tissue injuries, fractures and concussions.

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20 NIWA (2024). Extreme Value Analysis of Flood Flows. Letter Report 23 Feb 2024

21 MetOcean Solutions. (2023, April 12). A 3000-year wave height event during Cyclone Gabrielle https://www.metocean.co.nz/news/2023/4/12/a-3000-year-wave-height-event-during-cyclone-gabrielle#:~:text=The%20highest%20measured%20significant%20wave,forecast%20height%20of%205.4%20m

22 ACC (2024) https://www.acc.co.nz/newsroom/stories/recovering-from-cyclone-gabrielle-with-rongoa-maori

Aside from the direct physical impacts of the flood, the reports of ongoing mental health impacts came through prominently from our hui with community and mana whenua. People dealing with the loss of family members, their homes and livelihoods and those of their friends and neighbours put an immense amount of stress on them and their communities. Stories of severe anxiety anytime there is rain, particularly for children, were also highlighted to us.

In hearing all the stories of destruction, devastation and despair, we were constantly impressed by the strong sense of community that emerged among neighbours and people from further afield – many risking their lives to rescue people during the event and then providing ongoing support through the clean-up and recovery. This community support and collaboration was often centred around marae, with whole communities welcomed and supported.

This sense of community and local understanding of what happens during extreme flood events is something that HBRC needs to harness as it works towards improving the flood resilience in Hawke's Bay. The networks and knowledge within communities need to be integrated with the council's approach.

2.4 Effects on mana whenua

Based on the hui and haerenga the Panel undertook over nine months, it is clear that mana whenua have been disproportionately affected by this flood event. There are many examples of marae, papakāinga and urupā located on marginal floodplain land in close proximity to rivers that were catastrophically inundated during this event.

The Panel observed that, typically, the land currently held by Māori communities is what was left of much larger holdings prior to European settlement, and that prior to the arrival of pākehā the land and resources from the mountains to the sea were often used seasonally, with more temporary types of kāinga (accommodation) that could be readily re-built if damaged by floods.

During wet periods Māori would travel to the elevated parts of their whenua to avoid the floods, then return once the floodplains had dried out. By way of example, the Panel met with representatives of Maungaharuru Tangitū Trust who told us their whakataukī: *Ka tuwhera a Maungaharuru, ka kati a Tangitū, ka tuwhera a Tangitū, ka kati a Maungaharuru – When the season of Maungaharuru opens, the season of Tangitū closes, when the season of Tangitū opens, the season of Maungaharuru closes*. This whakatauakī describes the takiwā and abundant resources on the coast at Tangitū that, when combined with those available in inland areas at Maungaharuru, meant the hapū of this area could move seasonally throughout their rohe and be nourished all year round from different sources in their rohe.[23]

The kōrero that we were given was that, with little to no high-country lands left in their landholdings because of pākehā occupation, the low-lying land next to rivers was often all that remained and, by default, became the places where more permanent and modern marae and papakāinga were constructed. In many places there were known flood risks and no structural flood defences to manage them.

23 Maungaharuru Tangitu Deed of Settlement, 25 May 2013, p 9: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/ https://tangoio.maori.nz/wp-content/uploads/2015/12/Maungaharuru-TangituHapuDOS.pdf

A number of locations that were flooded have been designated Category 3, which is challenging for marae, hapū and iwi due to the tension between a desire to remain on those last remaining areas of whenua and the risks associated with staying. The Panel was advised by some mana whenua groups that the land classifications post-cyclone are seen as another form of raupatu (confiscation) of their land.

The Panel met whānau of Waiohiki, who noted that of the 100 homes in the papakāinga, approximately 90 were either RED or YELLOW stickered.

A more detailed discussion of these issues is provided in Chapter 8 of this report.

The Panel was advised of the following damage to marae, papakāinga and urupā:

- Takitimu Marae – floodwaters through buildings;
- Tangoio Marae, kohanga reo and papakāinga – significant depth of floodwaters through buildings now Category 3;
- Petane Marae and Urupā – extreme depth of floodwaters > 3 m through buildings and urupā buried in 2 m+ of silt now Category 3;
- Moteo Marae – significant depth of floodwaters through buildings;
- Waiohiki papakāinga – significant depth of floodwaters through the kohanga reo, whānau homes and buildings in the papakāinga;
- Omahu Marae and urupā – significant depth of floodwaters through whānau homes, urupā and buildings in the papakāinga;
- Rongomaraeroa Marae and papakāinga – flooding of marae buildings and kaumātua housing.

Figure 2.4 Tangoio Marae[24]

2.5 Effects on land

Across the region the land was massively affected by the cyclone, with landslides from the hill country generating enormous sediment loads in the rivers, which then spread out and inundated floodplains in vast depths of silt.

It has been estimated that there were over 300,000 landslides in the East Coast region of the North Island, with each estimated to contain 1,000 tonnes of soil.[25] This soil, mobilised and transported by the unprecedented flood flows, then deposited on downstream floodplains. In the Esk Valley alone there is an estimated 5.7 million tonnes of silt.[26]

24 Accessed from Instagram on 10 June 2024 https://www.instagram.com/cyclone_gabrielle/
25 HBRC (2024). Restoring our Environment – Our Cyclone Gabrielle Recovery Journey
26 Manaaki Whenua Landcare Research (2023). Rapid Assessment of Land Damage

Figure 2.5 Typical landsliding[27]

This silt has buried entire floodplains and anything in its path, including houses, community facilities, schools (see Figure 2.6), farm fencing, buildings, equipment, apple trees, grape vines and much more. The cost is two-fold: the immediate losses caused by the silt and floodwaters; then the cost to remove or remediate the land for future productive use.

27 Accessed from Instragram on 10 June 2024 https://www.instagram.com/cyclone_gabrielle/

Figure 2.6 Hukarere Girls' College, Esk Valley[28]

2.6 Effects on business

Businesses across the region were hugely affected by this event, which resulted in significant financial costs for business owners and consequent economic losses to the region. This is particularly evidenced at specific point failure locations at Pan Pac and in the Awatoto industrial area, with more than $600 million in damage caused to businesses in these two locations alone.

Wider effects, particularly on the horticultural sector, occurred particularly in Esk Valley, Dartmoor and Pakowhai (see Figure 2.7), with the total loss estimated at $1.4 billion.[29]

28 Accessed from Instagram on 10 June 2024 https://www.instagram.com/cyclone_gabrielle/
29 Boston Consulting Group (2023). Hawke's Bay Horticultural Sector: Economic Recovery Following Cyclone Gabrielle

The $750 million per annum tourism and events industries were also severely affected, with many major events such as the Napier Art Deco Festival cancelled during 2023 and ongoing challenges in attracting people back to the region post-cyclone.

This is to say nothing of the wider effects to the local economy resulting from infrastructure damage, supply chain and transport disruption (for example, roads, bridges, power substations).

Figure 2.7 Pakowhai[30]

2.7 Effects on infrastructure

The effects and costs associated with infrastructure damage were substantial. Almost every type of infrastructure was affected, with significant and lengthy projects required to return them to pre-flood levels of service, and significant time and investment required to work towards building a greater resilience to future flood events into critical regional infrastructure. A high-level summary of the effects on key infrastructure is provided below.

2.7.1 Flood management infrastructure

In most cases the HBRC flood management infrastructure, particularly stopbanks (see Figure 2.8), was overwhelmed by this event, which in many locations was an order of magnitude greater than their design standards.

Significant damage occurred to the stopbanking network, with 5.3 km breached and a further 28 km weakened by the flood event.

30 Accessed from Instagram on 10 June 2024 https://www.instagram.com/cyclone_gabrielle/

Drainage pump stations were inundated, up to their roofs in places, destroying electrical equipment, and drainage channels were completely filled with silt in some locations.

Most of the damaged flood management infrastructure has been reinstated to the previous level of service, as outlined in the HBRC Flood Scheme Repairs Strategy, including the repair and reinstatement of 35 rain and river-level monitoring sites that were damaged during the event.[31]

Figure 2.8 Ngaruroro Stopbank Breach Pakowhai[32]

A detailed assessment of the performance of the HBRC flood management infrastructure is provided in Chapter 8.

2.7.2 Power and communications

Flood damage to the national grid operator Transpower's Redclyffe Substation (see Figure 2.9), which connects Napier and parts of Hastings to the national power grid, caused a grid emergency. This, combined with damage to the Unison Networks network, saw a peak of 75,000 customers without power in the days following the cyclone. Three zone substations were taken out of service due to flood damage, two fibre cables were cut and hundreds of power poles were damaged.[33]

31 HBRC (2023). Hawke's Bay Regional Council Cyclone Gabrielle. PowerPoint Presentation to Review Panel
32 HBRC
33 Unison (2023). Annual Report

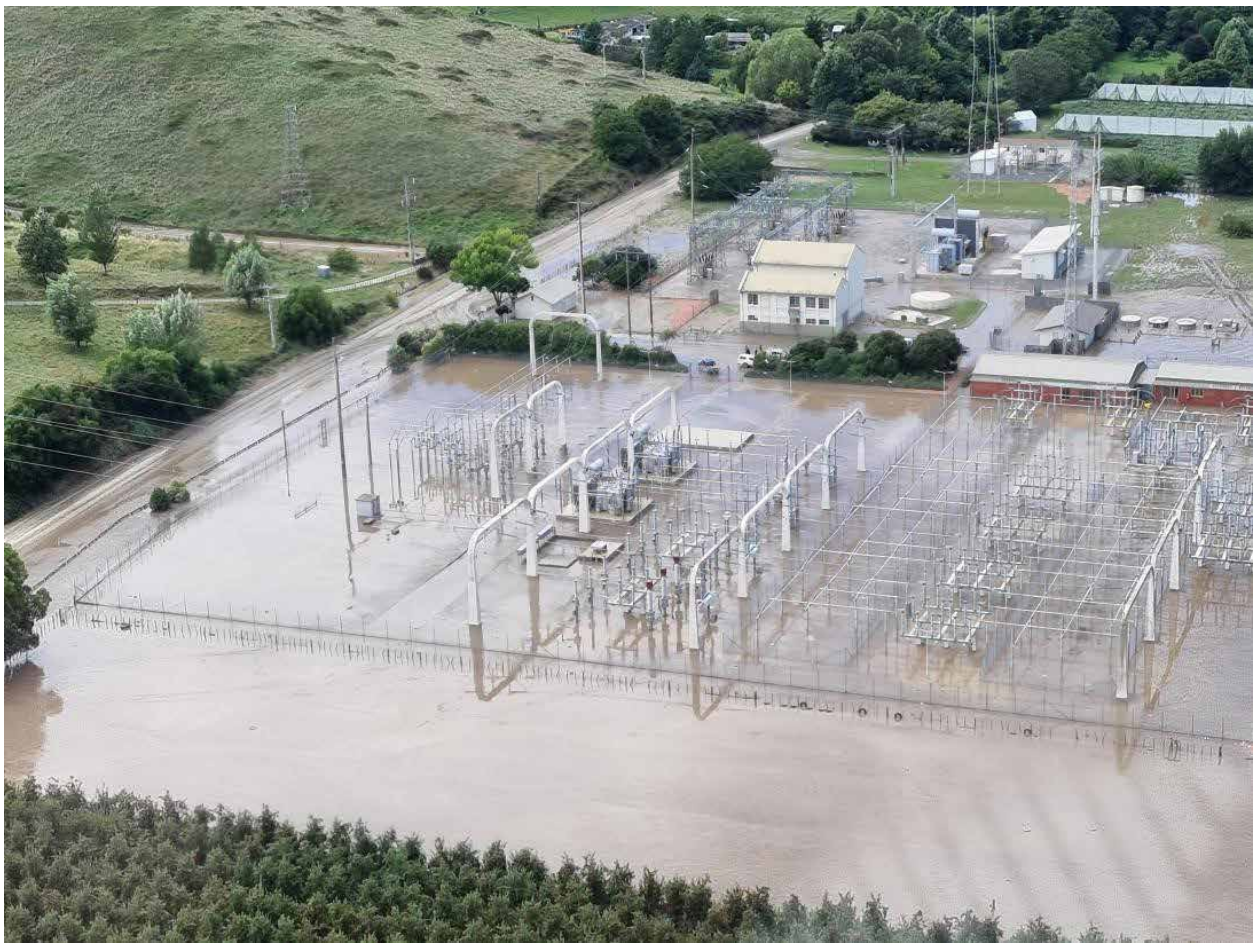


Figure 2.9 Transpower Redclyffe Substation[34]

2.7.3 Transport infrastructure

The Hawke's Bay transport network was significantly affected by this event, with more than 25 bridges completely destroyed (see Figure 2.10, for example) and a further 20 severely damaged. Thousands of small culvert crossings were destroyed or damaged, as well as hundreds of kilometres of road.[35]

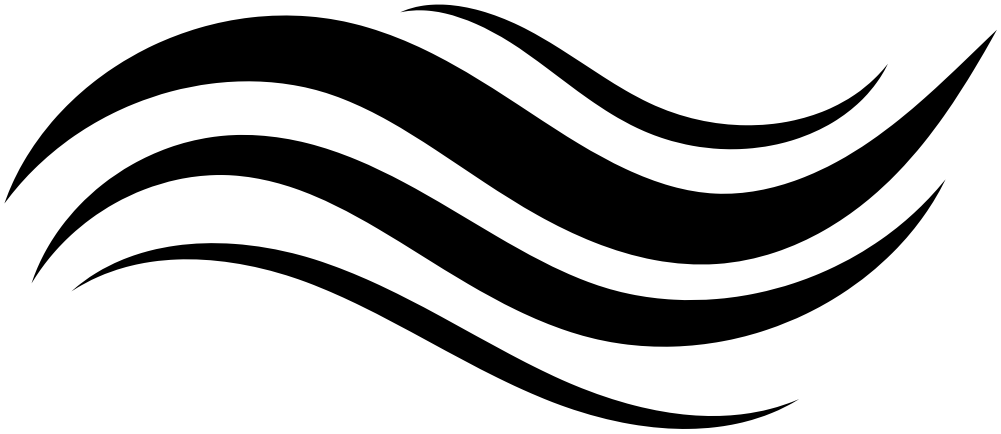
In the immediate aftermath of the flood, several sections of state highway (SH) across the region were closed, including SH2 Napier to Gisborne, SH2 Napier to Hastings, SH5 Napier to Taupō, SH2 Napier to Wairoa, SH2 Wairoa to Gisborne, the Hawke's Bay Expressway, sections of SH51 and SH50, and SH38 Wairoa to Lake Waikaremoana.

34 Accessed from https://www.transpower.co.nz/news/transpower-expects-complete-bypass-flooded-substation-today
35 HBRC (2024). Restoring our Environment – Our Cyclone Gabrielle Recovery Journey

Figure 2.10 Brookfields Bridge[36]

The rail network north from Napier to Wairoa was devastated by this event, with 300 sites sustaining damage and full track replacements required in some sections of Esk Valley.[37] In addition to this, Rail Bridge 217 at Awatoto failed, likely due to this being a 1,000-year flood event at that location, as well as significant debris loading.

36 NZ Defence Force
37 KiwiRail (2023). Hawke's Bay Cyclone Gabrielle Rail Recovery. July 2023 Newsletter



CHAPTER 3:
Review process

This chapter explains the process by which the Review was undertaken and the approach the Panel took to gathering information and evidence.

The Hawke's Bay Independent Flood Review – Pae Matawai Parawhenua involved significant information gathering and fact finding over a nine-month period, to deliver on the purpose and scope of the Review as set out in the Terms of Reference (see Appendix A, Terms of Reference).

The Review began in August 2023 following the appointment of the Review Panel members, and concluded with this final report presented to HBRC on the 24th of July 2024.

3.1 August 2023 – December 2023

Once appointed in late July 2023, one of the Panel's first priorities was to determine the process we would use to undertake the Review and, importantly, how best to gather all possible information to inform our work.

The Panel were very aware that while information from HBRC, MetService and NIWA would be critical, so too would be the insights, historical perspectives and experiences of those who had experienced the flooding first-hand.

To help us decide how best to engage with flood-affected communities, the Panel held a series of initial meetings with mana whenua leaders and a range of community, local government and industry representative groups across the Hawke's Bay region.

The Panel sought their input and incorporated the feedback into the Review process so that it would allow the widest possible community contributions. The feedback from these meetings helped inform the process we adopted (see Figure 3.1) and meant we adopted an information-gathering process with the community based on:

- Marae-based hui and whenua site visits hosted by marae communities;
- Meetings and site visits with flood-affected industry and community groups;
- Meetings with major infrastructure and service providers;
- Public information-gathering through a website portal.

We sincerely thank everyone who helped us to connect with communities, and all those who shared their experiences, information and evidence of the flood impacts on them, their whānau, their homes and businesses and their whenua.

A full list of the groups with whom the Panel met is in Appendix C of this report.

3.1.1 Marae-based hui and whenua site visits hosted by marae communities

Information gathering with mana whenua included introductory meetings with leaders from Mana Ahuriri Trust, Maungaharuru Tangitū Trust, Ngāti Kahungunu Iwi Inc, Tamatea Pōkai Whenua, Ngāti Kere Hapū Authority, Te Taiwhenua o Tamatea (Tamatea/Kahungunu), Rongomaraeroa Marae, Waiohiki Marae, Tangoio Marae, Petane Marae, Mataweka Marae and Omahu Marae.

These meetings provided an opportunity for us to introduce the Panel members and the purpose of the Review, share the Review terms of reference and seek guidance on the best way to engage with flood-affected mana whenua.

Feedback from these hui encouraged a marae-based approach to gather unique insights into the experiences of those living on the whenua for generations, kanohi ki te kanohi (face-to-face).

The Panel reached out to marae across Te Matau a Māui and were invited to a number of hui to hear from representatives of those directly affected, gather historical knowledge and hikoi with local communities to view key sites. We acknowledge that mana whenua communities had many competing priorities in the aftermath of Cyclone Gabrielle and not all were able to engage with us.

The Panel acknowledges those who helped to organise and attended these hui and the generous spirit in which knowledge was shared with us. To the many people who took time away from jobs, whānau and other commitments to assist us, we express our thanks.

3.1.2 Meetings and site visits with flood-affected industry and community groups

The Panel met with representatives of industry organisations, including the Awatoto Business Cyclone Recovery Group, the Whirinaki Business Cyclone Recovery Group and the Hawke's Bay Horticulture Advisory Group, to better understand the impacts of the flooding on key economic industries in the region. The Hawke's Bay Rural Advisory Group also provided topline insights to the Panel.

Representatives of cyclone-affected communities also met with the Panel and we thank those of Pakowhai, Puketapu, Dartmoor, Whirinaki, Esk Valley and Bay View for their time in sharing insights and showing the Panel many flood-affected areas. We were acutely aware that this was one of several reviews to which you were asked to contribute in the midst of rebuilding your lives and livelihoods. We thank you sincerely for the time you took to meet with us and contribute to this review.

3.1.3 Meetings with major infrastructure and service providers

The Panel met with major infrastructure providers affected by the flooding and responsible for the restoration of critical network services across the region. The organisations included Transpower, Genesis Energy, Contact Energy, Unison Networks, Waka Kotahi New Zealand Transport Agency and KiwiRail.

The major infrastructure providers impacted by the flooding had unique perspectives due to their involvement during the cyclone and in the immediate hours and days of the response and into the recovery phase. In particular, their teams working on the ground to restore services witnessed aspects of the flooding and recorded significant data relevant to this review – such as inundation levels and the time and nature of key infrastructure failures.

The infrastructure providers were able to share valuable information on and insights into flood risks prior to Cyclone Gabrielle, the preventive/protective measures that were in place, what was and should be planned to improve infrastructure resilience, land use and river management, and how infrastructure providers worked with HBRC.

3.1.4 Public information gathering

From October 2023 to the end of December 2023, the Hawke's Bay community was invited to share relevant information through the Review website. The call for information was communicated through print and digital advertising and via mailing lists, iwi and marae and community and industry groups.

The Review website received 109 contributions from individuals, organisations, businesses, catchment groups and marae and iwi groups, of whom many were directly affected by the flooding. We sincerely thank everyone who took time to share their insights, experiences, photos and videos with us. The key themes from those contributions are summarised in Chapter 4 of this report.

3.1.5 Information from Hawke's Bay Regional Council

At the Panel's request, we received and reviewed a large volume of technical information and reports provided by HBRC. These were specifically related to river and flood management systems and processes and river flow modelling, and included data captured by HBRC during the event.

The Panel took the view that it was important that all disclosable information provided by HBRC should be made available to the public. Except where HBRC requested that information be withheld, all HBRC reports and documents were published on the Review website. A full list of the disclosable information provided by HBRC is in Appendix C of this report.

We express our gratitude to HBRC management for cooperating fully with the Panel's requests and for respecting the independence of the Panel members and our review process.

3.1.6 Information from MetService and NIWA

A list of the information provided by MetService and NIWA is in Appendix C of this report.

3.2 January 2024 – July 2024

After an analysis of all the information gathered, on the 16th of February 2024 the Panel raised a number of follow-up questions with HBRC. HBRC responded to those questions on the 15th of April. These were published on the Review website and are provided in Appendix C of this report.

In designing the process for this review, the Panel allowed time to re-engage with communities and submitters in April/May 2024 if follow-up discussions were considered warranted. Based on the comprehensive information received from communities, together with the initial and follow-up information provided by HBRC, alongside the MetService and NIWA reports, the Panel determined we had sufficient information to complete the Review without any further engagement.

It should be noted that the Review was originally scheduled for completion by late June 2024, but was extended by a month in agreement with HBRC due to the volume of information provided by HBRC, the community and mana whenua, and to allow time for HBRC to respond to the additional information asked of it in February 2024.

Informed by public, mana whenua and community feedback, the process followed by the Panel is summarised in Figure 3.1 Review Process Framework.

HAWKE'S BAY INDEPENDENT FLOOD REVIEW
Pae Matawai Parawhenua

Review Elements and Sequencing

Updated April 2024
(to reflect the volume of information the Panel needs to review)

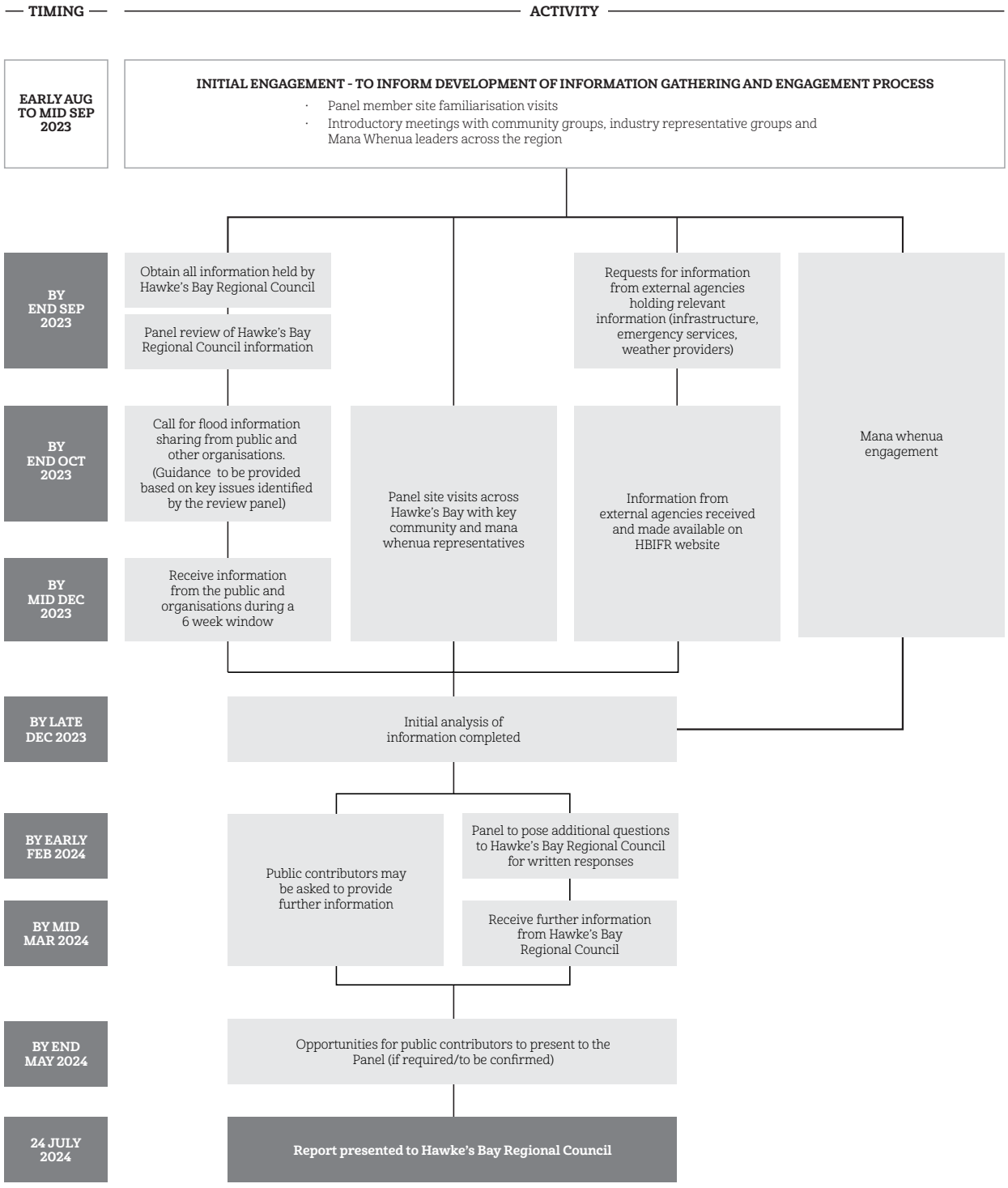
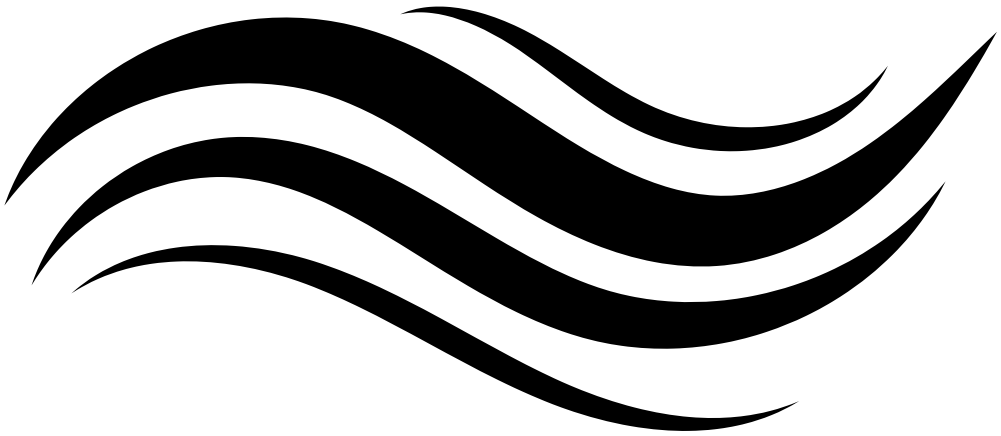


Figure 3.1 Review Process Framework



CHAPTER 4:
Information received and reviewed, key themes and issues raised

In this chapter, the information received and reviewed is discussed in detail, and the Panel's conclusions drawn from it are set out.

4.1 Information received

From October to mid-December 2023, the Panel invited home, business and property owners, iwi/hapū, communities, business groups and regional infrastructure owners affected by flooding from Cyclone Gabrielle to confidentially contribute information relevant to the Review.

Inviting the public to provide information was an important part of the fact-finding phase of the Review process, and the Panel was keen to hear from people about:

- Their experiences of river management and the maintenance of flood management assets prior to the cyclone;
- What they saw happen to rivers and flood management assets during the cyclone;
- Their ideas on how flood risk could be better managed in future.

The Review website had a simple-to-use portal where people could answer specific questions either in writing or with a voice recording, with options to do so in English and Te Reo Māori, and upload photos and videos.

The information received, alongside the information from HBRC, MetService, NIWA, mana whenua and infrastructure providers was used to inform this report and recommendations.

4.2 Key themes from public information

The Panel notes that while not every piece of individual feedback can be discussed in this section, the themes covered are representative of the information shared with us.

We have also respected the privacy of individuals and organisations, which was the basis on which we invited people to contribute information to us.

Seven clear themes emerged from the information provided through the public information portal.

River maintenance	Gravel extraction, vegetation island management, planting, debris removal, bridges
River mouth management	Maintenance, size of river mouth, debris management
Floodplain management	Land use, residential and other development, allowable activities, river pathways
Stopbanks	Maintenance and monitoring, stopbank height, access to stopbanks for recreational use, stopbank network extent
Drains and culverts	Maintenance, clearing, capacity for flow of water
Warning systems	Monitoring coverage, decision-making and communication
Council planning	Preparedness, strategic approach to permitted land use

4.2.1 River maintenance

4.2.1.1 Gravel extraction, vegetation island management, planting, debris removal, bridges

Extensive feedback was received from the community and businesses concerned with how rivers and streams across the region were managed in the months and years preceding Cyclone Gabrielle.

Day-to-day river management is one of the most visible aspects of any region's flood management activities, and feedback from flood-affected communities was unequivocal: gravel extraction and debris removal from river channels appeared insufficient.

While many references to gravel build-up were of a general nature, examples referred to visual changes people noted in sections of river familiar to them – those that were close to their homes, local communities or workplaces.

Observations included:

- Sections of river that, over time, had been affected by the build-up of gravel, creating a large vegetation island that had impeded the river path;
- An increased presence of vegetation debris, such as forestry slash and willow in river channels and build-up around bridges;
- Logs that had been pulled from river channels being left on nearby berms;
- The management of the biosecurity threat of Chilean Needle Grass in Waipawa leading to limited gravel extraction in the Waipawa River over a period of time.

There were also comments on what had *not* been seen in the way of river maintenance, with a number of observations noting a lack of sightings of HBRC activity in parts of rivers as frequently as people felt there should be, particularly given their observations of gravel and vegetation build-up.

4.2.1.2 Maintenance, size of river mouths, debris management

Considerable commentary was received on the management of river mouths in the region – particularly how they were managed in times of flood.

Members of the community and businesses noted that, during Cyclone Gabrielle, river mouths in a number of locations were severely restricted relative to river flows, creating a series of choke points.

Some of this was due to the sheer volume of water, but it was noted that river mouths in some areas should have been cleared, more gravel extracted and debris removed prior to Cyclone Gabrielle, in anticipation of increased water flows.

Examples of observations were:

- The Esk River mouth being blocked or severely restricted relative to river flow from the catchment area, meaning floodwater had nowhere to go but back into the Esk Valley;

- A lack of maintenance at Tukituki river mouth at Haumoana – especially of stormwater drains and the sea crest, as well as a broken water retention diversion gate. This was compounded by large water flows combined with high-tide waves that overtopped the sea crest and filled the nearby lagoon. Residents expressed concern that Haumoana relied on flood-mitigation pumps to protect low-lying homes, but when power was lost during the cyclone, the pumps failed and a back-up diesel tractor pump, brought in before the cyclone hit, quickly ran out of fuel;
- A desire for clearly communicated plans for managing river mouths for the long term, particularly from communities living close to these areas.

4.2.2 Floodplain management

4.2.2.1 Land use, residential and other development, allowable activities, river pathways

A range of feedback was received on activities on floodplain and flood-prone land, and what the region needs to be more resilient to future flooding events.

Contributors felt strongly that there need to be changes made to the types of activity that could and should take place in areas prone to flooding, particularly if flood events occur more often. The feedback was that more frequent flooding requires more room for rivers to move and flood safely, rather than trying to contain them within narrow corridors.

In particular, contributors noted that residential development on flood plains should be restricted, and closer consideration should be given to what commercial activities and infrastructure should be built. While in some cases it is unavoidable to have assets on vulnerable land – for example, serving isolated communities and geographically challenging terrain – resilience investment needs to reflect the community's appetite for risk and ability to fund it over the long term.

Feedback also noted that any flood plain areas proposed for changes of use needed to be considered in a fair and reasonable manner so that affected land and property owners are not unduly disadvantaged.

Suggestions for future-focused flood plain management included the following:

- Making more space for rivers where possible, allowing them to flood safely while restoring habitat, natural groundwater recharge and flood plain function;
- Land use change to mitigate flood flows or the provision of floodplain areas within the network;
- Use floodplains and riverside land for farming and cropping only – not infrastructure.

4.2.3 Stopbanks

4.2.3.1 Maintenance and monitoring, stopbank height, access to stopbanks for recreational use, stopbank framework

The Hawke's Bay stopbank network is extensive and highly visible due to its close proximity to many communities.

Feedback from mana whenua, the community and businesses highlighted several areas of concern in relation to stopbank maintenance, stopbank height, network coverage and how stopbanks are used by the community – particularly for recreational purposes.

There was concern that allowing cyclists and, in some areas, motorbikes to use the stopbanks for recreational purposes could be affecting the structural integrity of the network, particularly in areas of heavy use. Feedback from Central Hawke's Bay also noted vehicles driving over a stopbank to access the river and suggested that developing one dedicated river access point for vehicles could alleviate the issue.

Community feedback expressed concern that the current stopbank network is not high enough, and advocated that the network be raised to cope with greater river flows and higher water levels.

Several pieces of feedback also suggested that while HBRC is currently repairing the stopbank network, consideration should be given to a comprehensive reassessment of the role of stopbanks per se.

Specific suggestions for the future management of stopbanks included:

- Limiting access for recreational use;
- Reducing vehicle river access points;
- Reassessing the current configuration of stopbank protections across the region in light of the trajectory of river flows and areas where stopbank design and coverage were insufficient or failed during Cyclone Gabrielle.

4.2.4 Drains and culverts

4.2.4.1 Maintenance, clearing, capacity for flow of water

Contributors expressed concern about the maintenance and capacity of drains and culverts.

Feedback was generally consistent that drains and culverts simply could not keep up with the volume of water flowing through them during the flood event, and as a result water backed up and flooded properties.

Another consistent theme was that many drains were not regularly maintained and cleared, and quickly blocked as a result.

Feedback highlighted a range of views on who should take responsibility for drain clearing, but there were a number of suggestions that cleaning out private drains and sharing culvert management between councils and property owners would likely be an effective and efficient way to better maintain them longer term. As one contributor noted, locals are likely to have better knowledge of problem areas and have the ability to take action immediately.

Specific suggestions for the future management of drains and culverts included:

- Design for larger culverts being required in future;
- Share culvert maintenance with locals and clearly communicate this expectation to landowners and property managers;
- Develop a joined-up stormwater plan between councils.

4.2.5 Warning systems

4.2.5.1 Monitoring coverage, decision-making and communication

People who commented on monitoring and warning systems felt that these measures were inadequate and authorities were too slow to warn local communities of rising river levels.

While HBRC is not responsible for evacuation decisions, those in flood-affected areas felt information-sharing and coordination between key agencies, including HBRC (with responsibility for river-level monitoring) wasn't good enough during Cyclone Gabrielle and, as a result, evacuation advice was not forthcoming or was sent too late.

For example, one person noted they received an evacuation text at 5.30am when peak flooding occurred at 3am.

Role clarity was also raised as a key concern – people weren't sure who was in charge, who had the best flood monitoring information and why communities, particularly those close to rivers, were not warned earlier about the need to mobilise.

4.2.6 Council planning

4.2.6.1 Preparedness, strategic approach

Commentary on the role of HBRC primarily focused on what could have been done differently prior to Cyclone Gabrielle to both keep communities safer and prepare them better, and what people would like to see happen in future to make the region more resilient to flood risk.

4.2.6.2 Preparedness

Contributors questioned why, given previous flooding in the region (historically and recently), Hawke's Bay was not better prepared.

While this responsibility does not sit solely with HBRC, people expressed disappointment at what they perceived to be a lack of attention to river and river mouth management and monitoring in particular, meaning confidence in HBRC's ability to manage river assets during future flood events is low.

For some communities there was deep disappointment that a number of (in the communities' view) preventable issues had not been addressed by HBRC well prior to the cyclone. By way of example, contributors from Haumoana referenced a lack of river mouth maintenance, failing stormwater systems and that the Haumoana pump station had not been upgraded in years. The community believed that this had resulted in considerably more flooding and trauma for residents than needed to be the case.

A greater visibility of HBRC activity in the region, better reporting and increased and fit-for-purpose monitoring are considered key components of future preparedness.

4.2.6.3 Strategic approach

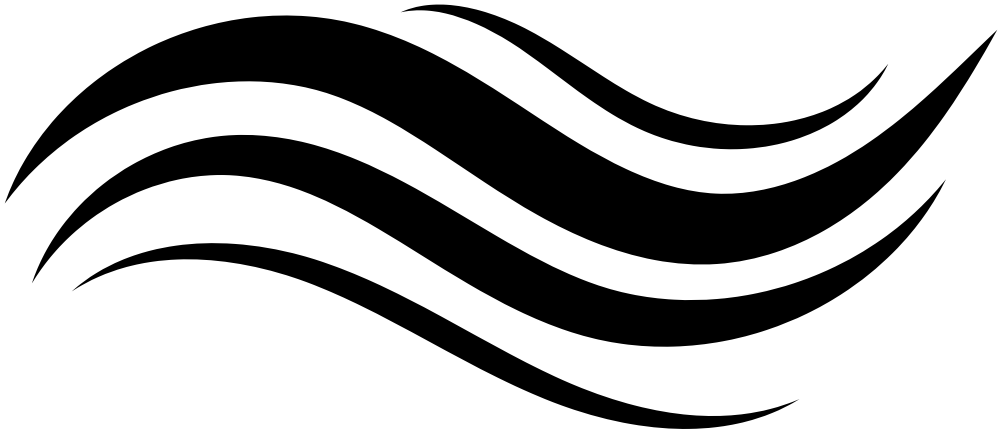
Feedback indicated an appetite for a clearly communicated, long-term, strategic approach to the management of future weather events that takes account of the "new normal" of larger, more potentially destructive events.

In particular, communities and businesses want to see more information-sharing and coordination for flood scheme assets from HBRC to satisfy community expectations, and greater coordination between HBRC and local councils on flood management.

Better communication with the community and people with networks and knowledge in each catchment came through as a key priority.

Specific suggestions for long-term strategic planning included:

- The development of a well-funded long term plan for river maintenance and river protection schemes throughout Hawke's Bay, including but not limited to a continued monitoring and extraction of gravel, dredging of river beds and widening of river mouths, stopbank maintenance and a consideration of storage and floodway systems to reduce peak flows during flood events. The community expects a stronger partnership between HBRC and councils to advocate to government regarding the required funding and expertise;
- A stronger focus on a joint council/community understanding of "who is responsible for what" when it comes to flood management systems and processes;
- Restore Catchment Boards or look at creating groups like Catchment Boards that look after the rivers and involve people with historical knowledge and knowledge of river management;
- Better coordination of stormwater planning and management between all Hawke's Bay councils, particularly in relation to new subdivisions, to ensure the system can cope and a consistent approach is applied;
- A more conservative approach to consenting for building activity on flood plains and in flood-prone areas;
- A focus on wetland restoration, ways the natural environment can hold water, and more managed planting.



CHAPTER 5:
Historical context – Land and people

This section describes some of the patterns of early settlement and the physical features of the Hawke's Bay landscape to provide context for the particular contemporary challenges for mana whenua in terms of their whenua, their vulnerability to flooding and their future planning for resilience.

Case studies provide examples of why mana whenua were disproportionately affected by Cyclone Gabrielle, and why this report makes specific recommendations to address the future resilience of mana whenua and marae.

5.1 Hawke's Bay

While the region is now commonly known as "Hawke's Bay" the Māori name is Te Matau a Māui. This name comes from kōrero tuku iho (inherited oral traditions) that the area is the hook of the jaw bone Māui used to haul up the North Island (Te Ika-a-Māui – Māui's fish) from under the sea. Lieutenant James Cook gave the name Hawke's Bay to the region after Sir Edward Hawke, First Lord of the Admiralty from 1766 to 1771.[38]

5.2 Early settlement

The region was originally settled by people of the Kurahaupō waka, descendants of Whatonga who were known as the people of Toi.[39]

Ngāti Kahungunu of Tākitumu waka claim descent from both the earliest-known settlers of the region and the eponymous ancestor Kahungunu and his people, who arrived later.[40] Kahungunu was an influential and reputedly handsome leader who travelled down the east coast, making a series of strategic marriage alliances with wahine rangatira (high-born women) as he went. He finally settled at Nukutaurua (Māhia Peninsula), the home of his fourth wife, Rongomaiwahine.[41]

The descendants of Kahungunu populated Te Wairoa and spread south into Hawke's Bay and Wairarapa. Some descendants on the Māhia Peninsula identify as Ngāti Rongomaiwahine rather than Ngāti Kahungunu. The Ngāti Pāhauwera confederation of hapū exercised customary interests in northern Hawke's Bay.[42]

Rangitāne later settled in Heretaunga, but after Ngāti Kahungunu arrived they migrated further south to Tāmaki-nui-a-Rua (around Dannevirke), where the Hawke's Bay section of the tribe was based.

Settlements were established on the coast from Māhia in the north to Pōrangahau in the south, and along rivers and waterways inland. Heretaunga and Te Whanganui-a-Orotū (Napier's inner harbour) were two important early settlement areas. As discussed below, Te Whanganui-a-Orotū was a valued source of food and resources.[43]

Ngāti Kahungunu became the largest tribal group in Hawke's Bay through a combination of warfare and strategic marriage. However, the people did not consider themselves as belonging to one united iwi called Ngāti Kahungunu until the late 18th century. Māori society in the region was based around hapū in the immediate community who maintained distinct identities. This is said to have changed because of struggles with other tribes over land, combined with the arrival of Europeans in New Zealand.[44]

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38 Kerryn Pollock, 'Hawke's Bay region - Overview', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/hawkes-bay-region/page-1 (accessed 20 May 2024); https://www.linz.govt.nz/our-work/new-zealand-geographic-board/place-name-stories/place-names-cooks-voyages/hawke-bay-and-hawkes-bay

39 Hastings District Plan, Section 2.0, p 2.1: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.hastingsdc.govt.nz/assets/Document-Library/District-Plan/Part-A-Introduction-and-strategies/History-of-Settlement-and-Development.pdf

40 Kerryn Pollock, 'Hawke's Bay region - Māori settlement and occupation', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/hawkes-bay-region/page-4 (accessed 20 May 2024)

41 Mere Whaanga, 'Ngāti Kahungunu - Ancestors', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/ngati-kahungunu/page-2 (accessed 20 May 2024)

42 Preamble at [3], Ngāti Pāhauwera Claims Settlement Act 2012

43 History Timeline of Napier and Hawke's Bay: A partial timeline of Napier and Hawke's Bay 1769-1974, Napier Library: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.napierlibrary.co.nz/assets/Uploads/History-Timeline-of-Napier-and-Hawkes-Bay.pdf (accessed 21 May 2024)

44 Kerryn Pollock, 'Hawke's Bay region - Māori settlement and occupation', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/hawkes-bay-region/page-4 (accessed 20 May 2024)

5.3 Early years of Māori and Pākehā interaction

Whalers and traders were the first Europeans to come to Hawke's Bay after Cook's voyages. Whaling stations were set up on tribal land in the 1830s, and Ngāti Kahungunu began commercial whaling, farming and market gardening.[45] Traders and missionaries also arrived in the 1840s. They were followed by the first pastoral runholders in 1849. Sheep, and later beef cattle, were farmed on large stations. Beginning with Napier, towns were founded from the 1860s.[46]

In the 1840s and 1850s the hapū experienced social and economic changes. For example, the arrival of Christianity led to the construction of churches at Petane, Tangoio, Aropaoanui and other kāinga. In the 1840s there were whaling stations at Moeangiangi and Whakaari (Tangoio). Some men from Tangoio were involved in commercial whaling at Te Māhia. Wheat and maize were shipped from Tangoio to Napier.[47]

5.4 Whenua and resources

The rohe (territory) of Ngāti Kahungunu extends "mai i Paritu – tai atu ki Turakirae" – from Paritu in the north to Turakirae in the south, from the mountains to the coast and from the coast to Hawaiiki.[48] The numerous rivers, lakes and harbours within the Ngāti Kahungunu rohe were important highways as well as sources of food and resources.[49]

The names of the rivers, streams, natural features, fauna and flora of the rohe illustrate the long association between the land and the people it sustained.[50] Many names of significant places, awa and whenua of the region are based on kōrero tuku iho – traditional histories that have been handed down by way of oral tradition through generations.

5.5 Mountains

The landscape of Hawke's Bay is made up of a central area of flat land flanked by hills and ranges. The Ruahine, Kaweka and Huiarau mountain ranges form a boundary to the west and north-west.[51] From northern Wairarapa into Hawke's Bay is an area of flat land made up of soft, sedimentary rocks deposited by rivers. The plains are narrow in southern Hawke's Bay but widen into the Ruataniwha and Heretaunga plains south of Napier.

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45 Mere Whaanga, 'Ngāti Kahungunu', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/ngati-kahungunu (accessed 1 June 2024)

46 Kerryn Pollock, 'Hawke's Bay region - Overview', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/hawkes-bay-region/page-1 (accessed 31 May 2024)

47 Maungaharuru Tangitu Deed of Settlement, p 14 chrome extension://efaidnbmnnnibpcajpcglclefindmkaj/https://tangoio.maori.nz/wp-content/uploads/2017/01/Deed-Historical-Account.pdf

48 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.hbrc.govt.nz/assets/Document-Library/Plans/Iwi-Hapu-Management-plans/20130213-Kahungunu-ki-Uta-Kahungunu-ki-Tai-Marine-and-Freshwater-Strategic-Plan.pdf p 7

49 Mere Whaanga, 'Ngāti Kahungunu - Tribes and lands', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/ngati-kahungunu/page-1 (accessed 20 May 2024)

50 Heretaunga Tamatea Deed of Settlement, 26 September 2015, p 2

51 Kerryn Pollock, 'Hawke's Bay region - Landscape and climate', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/interactive/23825/hawkes-bay-landforms (accessed 30 May 2024)

5.6 Lakes and lagoons

The chain of lagoons between Wairoa and Māhia Peninsula form the biggest wetland system on the east coast of the North Island. The drainage of lakes and swamps in the 19th and 20th centuries removed important food sources of the hapū and iwi of the region. For example, lake Whatuma, which derives its name from its use as a bountiful source of kai, particularly eels, was subjected to extensive draining during the 1950s.[52]

5.7 Te Whanganui a Orotu

Te Whanganui ā Orotu was the estuarine lagoon that formerly occupied a large area north and east of Napier until the Hawke's Bay earthquake in 1931. The estuary was a vitally important fishing and resource-gathering area for hapū and they made continued efforts to protect their position regarding the lagoon.[53]

The two major pā guarding this area were Ōtātara and Heipipi, but there were many others, as well as extensive settlements on its shores. Te Whanganui ā Orotu contained shellfish beds and fishing grounds, and the surrounding rivers, streams and swamps provided eels, freshwater fish, flax and raupō (bullrush). Te Whanganui ā Orotu was also abundant with birds prized by those living on its shores.[54] Islands in the lagoon were used as fishing bases, and the fertile land on the shores was favoured for house sites and cultivations.[55]

5.8 Rivers

The region has six major river systems fed by water and sediment from the mountain ranges. The Wairoa, Mohaka and Esk Rivers run down from the ranges in the north of the region. The Tutaekuri, Ngaruroro and Tukituki Rivers flow through the central plains. All of these awa drain into the sea on the east coast.

The river now referred to as "Ngaruroro" has had many names. "Ngā Ngaru o ngā Upokororo" refers to waves made by startled whitebait as they were pursued up the lower reaches of the awa by species such as kahawai.[56]

The Tutaekuri River is one of several rivers with catchments at the inland ranges and outlets on the sea coast (or coastal lagoon). These rivers, of which the Tutaekuri is the fifth largest in Hawke's Bay (the Wairoa, Mohaka, Tukituki and Ngaruroro Rivers all carry more water), are the vehicles by which rainwater, shingle and sediment are carried from the ranges and hill country to the eastern coast.[57]

All of the region's larger rivers flood, and historically the periodic flooding of the Tutaekuri, Ngaruroro and Tukituki (for example) was responsible for the region's present-day reputation as

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52 Heretaunga Tamatea Deed of Settlement, 26 September 2015, p 46
53 Maungaharuru Tangitu Deed of Settlement, 25 May 2013, p 10
54 Waitangi Tribunal. Te Whanganui-a-Orotu Report, Government Printer, Wellington, 1995, p 3
55 Maungaharuru-Tangitu Deed of Settlement 25 May 2013, p 10
56 Ngaruroro Values and Attributes Report, 28 October 2016, p 1 https://www.kahungunu.iwi.nz/kahungunu-plans
57 Dean Cowie, "The River, the Reserve, the Trustee, and the Taking: An Historical Report on Aspects of the Waiohiki (Wai 168) Claim", May 1997, p 1

the food bowl of Aotearoa New Zealand. The sediment left when floodwaters retreated helped create the fertile Ahuriri/Heretaunga plains. It was these alluvial plains, with their proximity to Napier and suitability for intensive development, that European settlers were keen to own. However, they soon discovered that the very reason for the plains' fertility also contributed to their difficulty in being successfully developed. Floods frequently caused damage to crops and washed away livestock, buildings, roads and fences. The history of the lower reaches of the River from the 1860s, therefore, is dominated by the desire of Hawke's Bay settlers to physically control the flow and direction of water in the river.[58]

5.9 Land and resource loss – case studies

As part of the review, the Panel met with several hapū and marae communities, post-settlement governance entities and Taiwhenua groups. Each community had its own kōrero tuku iho related to the whenua, awa and resources in its rohe. In the time available, the Panel was not able to capture or describe all of these kōrero. We set out below some case studies as examples of how mana whenua have grappled with changes in the landscape and the loss of their land and resources due to actions and inactions by the Crown and its agents, and how this led to mana whenua being disproportionately affected by Cyclone Gabrielle.

5.9.1 Ngatarawa

From the 1860s, the Crown promoted legislation that empowered Hawke's Bay local bodies to modify rivers and streams for flood-control purposes without consulting local Māori. For example, in 1898 the Crown compulsorily acquired about 146 acres (59 hectares) from Māori owners of subdivisions of the Ngatarawa block in order to carry out river-control works designed to protect the Napier-Kopua railway from flooding. In September 1912 the Crown declared that it no longer required the land for railway purposes, and declared the area to be Crown land. The following year the Crown reserved the land for the improvement of the Ngarururoro River, and vested it in the Hawke's Bay Rivers Board.[59]

5.9.2 Maungaharuru-Tangitū hapū lands

In the early 1850s the Crown decided to acquire a large amount of land in Hawke's Bay, and was keen to purchase land for settlement rather than allow Māori to lease it to settlers. Negotiations for large-scale land purchases began in 1851, and among the first acquisitions were 265,000 acres at Ahuriri and 85,700 acres at Mohaka.[60]

The claim of Maungaharuru-Tangitū hapū to the Waitangi Tribunal over Te Whanganui ā Orotu related to the loss and despoliation of the lagoon and its islands. Claimants before the Waitangi Tribunal argued that they had never sold the lagoon or its islands, and that the Crown had taken them by asserting that Te Whanganui ā Orotu had been included in the Ahuriri purchase of 1851. The Tribunal agreed that the claim was well founded and made a number of recommendations for remedies.[61]

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58 Dean Cowie, "The River, the Reserve, the Trustee, and the Taking: An Historical Report on Aspects of the Waiohiki (Wai 168) Claim", May 1997, p 1
59 Maungaharuru-Tangitu Deed of Settlement, p 16
60 Maungaharuru Tangitu Deed of Settlement, p 16
61 Maungaharuru Tangitu Deed of Settlement, p 10

The Waitangi Tribunal also made a number of findings including that:[62]

- The Crown negotiated unscrupulously to purchase land at Ahuriri and Mohaka in 1851, and negligently failed to involve the hapū in the negotiations for Ahuriri;
- The Crown was against assisting Māori to develop their land. Its fixation on acquiring Māori land meant, that in the end, Māori were left with precious little land to develop;
- The Crown unlawfully confiscated land from the hapū, and had no basis for depriving the hapū of ownership of the Tangoio and Maungaharuru blocks within the boundaries of the confiscation.

In the 20th century the principal kāinga and location for the marae of the hapū was at Tangoio. As the Crown confiscated and acquired hapū land, the hapū were pushed to smaller land holdings in a low-lying area that was prone to severe flooding. The risk of flooding increased because of deforestation carried out on surrounding lands.[63]

A series of devastating floods forced many whānau to move away from their tribal lands. On Anzac Day in April 1938, severe flooding in the Esk and Tangoio valleys damaged all the buildings at Tangoio apart from the schoolhouse and the school. All fences were destroyed and there were substantial losses of stock and other property.[64]

In June 1963, a serious flood led the District Commissioner of Works to declare the Tangoio valley unsafe for habitation. The valley was covered with silt to a depth of 900 mm. Forty houses were flooded and many settlers and whānau had decided to evacuate the area permanently. However, a total evacuation of the area was difficult to achieve as some whānau did not want to leave their kāinga and marae.[65] The marae at Tangoio has continued to be vulnerable to flooding and in Cyclone Gabrielle was almost completely destroyed.

5.9.3 Ngaruroro and Tukituki Rivers

The Ngaruroro and Tukituki Rivers were subject to extensive modification by bodies such as the Hawke's Bay Rivers Board in the 20th century. Between the mid-1930s and the 1980s, local authorities took several hundred acres of Māori-owned riparian land under the Public Works Act along the Ngaruroro, Tutaekuri, and Tukituki Rivers for river control purposes.

On several occasions mana whenua objected to these takings on the basis that the land was necessary for their economic well-being, that the proposed flood controls would not work, and that the flood-protection scheme would have negative effects on their kainga and remaining land.

However, the ability of mana whenua to influence decisions on the management of waterways in their rohe was limited by their lack of representation on the Hawke's Bay Rivers Board or the Hawke's Bay Catchment Board. Changes to the structure and course of the major rivers of Heretaunga Tamatea reduced the diversity of habitats, and diminished the diversity of native fish species.[66]

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62 Maungaharuru Tangitu Deed of Settlement, pp 11-12
63 Maungaharuru Tangitu Deed of Settlement, p 34
64 Maungaharuru Tangitu Deed of Settlement, p 35
65 Maungaharuru Tangitu Deed of Settlement, p 35
66 Heretaunga Tamatea Deed of Settlement, 26 September 2015, p 46

5.9.4 Waiohiki

In the 1880s, the Māori community at Waiohiki advised the Crown of their desire to have Waiohiki reserved as a permanent kainga. The law at that time required all Māori reserved lands to be brought under the auspices of the Public Trustee.

The paramount Waiohiki chief, Tareha Te Moananui, had died in 1880, leaving a legacy of wanting to have the land reserved. However, there was little legal protection for Māori customary land at the time. It appears, therefore, that Waiohiki Māori placed their trust in the Crown's decision to have the Public Trustee become the guardian of their land.[67] The land was intended to be inalienable; however, in 1934-1935 an area of 183 acres of the Waiohiki reserve was taken by the Hawke's Bay Rivers Board for the purposes of controlling the floodwaters of the Tutaekuri River.[68]

The taking was opposed by the Māori owners and served to cut the local hapū off from the river frontage. The taking resulted in litigation, and ultimately the hapū at Waiohiki had no involvement in river management processes, there was doubt about whether Māori were aware that the land would be permanently taken, and the taking of the land was not necessary for the success of the river control scheme as a whole.[69]

These case studies provide examples of why mana whenua have been disproportionately impacted by Cyclone Gabrielle, and why this report makes specific recommendations to address the future resilience of mana whenua and marae.

5.10 Contemporary mana whenua

In terms of the modern mana whenua dynamic, HBRC notes on its website the following summary:[70]

- Māori represent over a quarter of the region's population;
- There are 11 iwi groups, 91 hapū and 79 marae throughout Hawke's Bay;
- Eight iwi groups are represented post-settlement governance entities on the Hawke's Bay Regional Planning Committee;
- Ngāti Kahungunu, together with the Rongomaiwahine coastal area, is said to be from Paritū north of Mahia to Tūrakirae on the Wellington south coast. Ngāti Kahungunu Iwi Inc comprises six Taiwhenua with governance entities and operations on the ground, of which four are within the region;
- 6.8% of Hawke's Bay's people speak Te Reo Māori;
- Over 11% of Hawke's Bay's 1.42 million hectares is Māori freehold land;
- There has been $447 million of financial redress in recent Treaty settlements. This will increase with future settlements.

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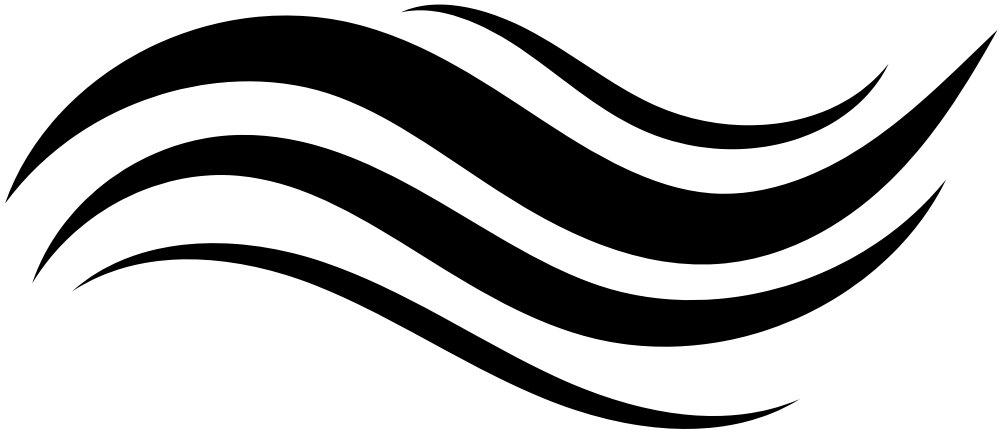
67 Dean Cowie, "The River, the Reserve, the Trustee, and the Taking: An Historical Report on Aspects of the Waiohiki (Wai 168) Claim", May 1997, pp 17-18

68 Dean Cowie, "The River, the Reserve, the Trustee, and the Taking: An Historical Report on Aspects of the Waiohiki (Wai 168) Claim", May 1997, pp 30-31

69 Dean Cowie, "The River, the Reserve, the Trustee, and the Taking: An Historical Report on Aspects of the Waiohiki (Wai 168) Claim", May 1997, pp 41-42

70 https://www.hbrc.govt.nz/our-council/tangata-whenua/



CHAPTER 6:
Hawke's Bay Regional Council's Flood Protection Schemes

This chapter explains the major flood-protection schemes managed by Hawke's Bay Regional Council.

HBRC provides 25 flood-control and drainage schemes in Hawke's Bay to reduce the risk of flood and erosion damage. The assets within these schemes are summarised as follows:

- Population served – 166,368;
- Insured value of assets – $215 million;
- Net present value of avoided damages – $28 billion;[71]
- 249 km of stopbanks and deflection banks;
- 577 km of river, stream and drainage channels;
- 287 km of willow, poplar and native trees on the river banks – "live edge protection" – to reduce erosion and slow floodwaters;
- 196 structures, including culverts, floodgates, control gates, weirs, rock groynes and pipelines;
- Five detention dams;
- 18 pump stations, seven mobile pumps and two emergency generators;
- 760 hectares of land, including river berms and land underlying other scheme assets.

All of these Schemes have detailed Asset Management Plans (AMP) that describe the assets and maintenance activities for each.

Also provided in each AMP is the management philosophy for its ongoing operation, the current level of service (e.g. 100-year) and other matters such as asset value, ongoing costs, funding arrangements and capital works programmes.

Based on the information provided by HBRC, community and mana whenua, the Panel has focused its attention on the eight schemes summarised in Table 6.1 below.

Table 6.1 Summary of schemes

Scheme	Assets	Level of service	Asset value	Annual maintenance	Targeted/ general rate
Wairoa[72]	Channel	Nil	N/A	Nil	N/A
Paeroa	Channel	5-year	$3M	$12K	87.5/12.5
Te Ngarue/Tangoio	Channel	2-year	N/A	$11K	90/10
Esk	Channel	2-year	$0.5M	$30K	87.5/12.5
Whirinaki	Stopbanks	500-year	$1.2M	$20K	87.5/12.5

71 Tonkin & Taylor (2018). Hiding in Plain Sight - An overview of current practices, national benefits and future challenges of our flood protection, river control and land drainage schemes

72 Excluding Northern drainage Schemes

Scheme	Assets	Level of service	Asset value	Annual maintenance	Targeted/ general rate
Heretaunga Plains	Stopbanks	100-year Taradale 500-year	$82M	$8M	70/30
Upper Tukituki	Stopbanks	100-year	$34M	$1M	82.5/17.5
Pōrangahau	Channel	2-year	N/A	$50K	90/10

In addition to these major schemes, HBRC maintains the following small schemes:

- Kopuawhara Stream Flood Control Scheme;
- Opoho Drainage Scheme;
- Ohuia Drainage Scheme;
- Northern Minor Works (includes Tawhara);
- Te Awanga Flood Control Scheme;
- Poukawa Catchment Control Scheme;
- Makara Catchment Control Scheme.

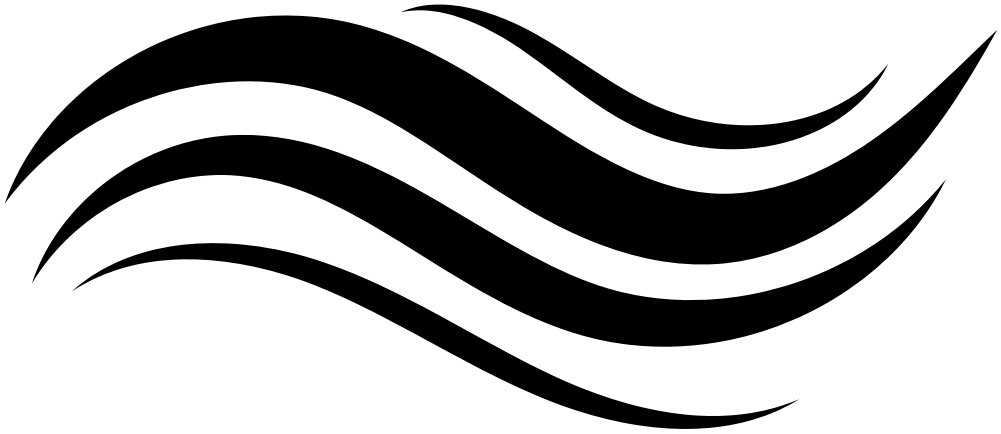
Encompassed within the Heretaunga Plains Scheme are the following drainage schemes:

- Napier/Meeanee/Puketapu;
- Brookfields/Awatoto;
- Pakowhai;
- Muddy Creek;
- Haumoana;
- Karamu and Tributaries;
- Raupare-Twyford;
- Tutaekuri-Waimate/Moteo;
- Puninga.

We note that the purpose of these drainage schemes is for land drainage and not managing extreme flood events. The drainage runoff rates for which these schemes are designed for are as follows:

- Rural Catchments Gravity 50 mm/ha/day;
- Rural Catchments Pumped 32 mm/ha/day;
- Urban Catchments 50 mm/ha/day.

Clearly, these drainage design runoff rates were significantly exceeded by this flood event. Large-scale remedial works, repairs on pumps stations and the desilting of drainage channels have been undertaken by HBRC as part of Phase 1 (0 – nine months) of the post-flood-event Scheme Repairs Project.



CHAPTER 7:
Framework for flood risk management

This chapter explains the framework for flood risk management in Aotearoa New Zealand; that is, the framework governing the way HBRC undertakes its flood risk management functions and responsibilities, including statutory and non-statutory requirements, and accepted best practice based on New Zealand standards and industry guidelines.

The Panel notes that this chapter (and the remainder of this report) is not intended to provide legal advice or submissions, including a legal assessment of whether statutory/legal frameworks have or have not been complied with. Rather the purpose of this chapter is to provide a high level overview of the planning and policy framework relevant to the management of flood risk. Any opinions or views expressed about the effectiveness of this framework in managing flood risk are the Panel's own and are clearly delineated as such in this report.

The legal framework for natural hazard management is spread across a number of statutes and organisations. From a flood hazard risk and management perspective, the main frameworks are set out in the Soil Conservation and Rivers Control Act 1941 (SCRCA) and the Resource Management Act 1991 (RMA). Other relevant legislation includes the Local Government Act 2002 (LGA), the Local Government Official Information and Meetings Act 1987 (LGOIMA), the Building Act 2004 and the Civil Defence Emergency Management Act 2002 (CDEMA). The Land Drainage Act 1908 and Local Government (Rating) Act 2002 also have roles to play in flood management operations and funding thereof, respectively, but are not commented on further.

The following section identifies the roles and responsibilities of both regional and territorial authorities in managing floods, then analyses the Hawke's Bay situation.

7.1 Local Government Act 2002

The LGA sets out the purpose, framework and powers under which local authorities operate. Many of a local authority's day-to-day obligations are discharged through the various statutory documents mandated by the LGA, including Long Term Plans, Annual Plans and AMPs.

In particular, the LGA:

- Gives district councils the power to make bylaws, including for the purpose of protecting, promoting, and maintaining public health and safety[73] and land drainage;[74]
- Provides for regional councils to make bylaws in relation to flood protection and flood control works undertaken by, or on behalf of, the regional council;[75]
- Requires every local authority to prepare a Long Term Plan[76] every three years that provides a long-term focus of at least 10 years for the local authority's decisions and activities. Amongst other things, a Long Term Plan must, to the extent determined appropriate by the local authority, identify:[77] the local authority's flood protection and control works and the rationale for their delivery; the capital expenditure requirements; the intended levels of service (design standard); the community outcomes for the district or region; steps intended to be taken to foster the development of Māori capacity to contribute to decision-making, a financial strategy and an infrastructure strategy;
- Requires that the financial strategy in the Long Term Plan include the expected capital expenditure on flood-protection and flood-control works that is required to maintain the levels of service currently provided by the local authority;[78]

73 Section 145 LGA
74 Section 146 LGA
75 Section 149 LGA
76 Section 93 LGA
77 Part 1 – Schedule 10 LGA
78 Section 101A(3)(a)(i) LGA

- Requires the infrastructure strategy in the Long Term Plan to outline, for a period of at least 30 consecutive financial years: the significant infrastructure issues; the options for managing those issues and the implications of each; how infrastructure assets will be managed (including their renewal, replacement, provision for growth, changes in levels of service and providing for resilience of infrastructure assets to natural hazard risks),[79] noting that "Infrastructure assets" include flood protection and control works;
- Requires every local authority to prepare an Annual Plan,[80] which in effect is the local authority's annual budget.

7.2 Local Government Official Information and Meetings Act 1987

Under the LGOIMA, the principle is that information shall be made available on request unless there are good reasons for withholding it, as specified under the Act. Unless there are circumstances justifying information being withheld, on request regional councils are obliged to disclose known information on a range of matters, including potential inundation (flooding), that affects any property. District councils are also required to maintain records of known natural hazards, and to make that information known through any Land Information Memorandum (LIM) that is sought in respect of any property.[81] There are amendments to LGOIMA taking effect in 2025 to require more specific information on LIMs in relation to natural hazards. HBRC does not however issue LIMs as that is the responsibility of city and district councils.

7.3 Soil Conservation and Rivers Control Act 1941

The SCRCA assigned powers, functions and duties to Catchment Boards. The 1989 local government reorganisation orders assigned the Catchment Board role to regional councils.

Although the SCRCA was heavily amended by the RMA, it still sets out the general discretionary functions and powers of Catchment Boards.[82] These include: minimising and preventing damage by floods[83]; constructing, reconstructing, altering, repairing and maintaining works for controlling or regulating the flow of water towards and into and in and from watercourses; preventing or lessening any likelihood of the overflow or breaking of the banks of any watercourse; and preventing or lessening any damage that may be occasioned by any such overflow or breaking of the banks.

To fulfill its functions under the SCRCA, HBRC has the discretionary powers, rights and privileges provided in section 126:

79 Section 101B LGA
80 Section 95, Part 2 – Schedule 10 LGA
81 Section 44A LGOIMA
82 Section 126
83 Section 10(c)

Section 126 General Powers of Catchment Boards

1) It shall be a function of every Catchment Board to minimise and prevent damage within its district by floods and erosion.

2) Each Board shall have all such powers, rights, and privileges as may reasonably be necessary or expedient to enable it to carry out its functions, and in particular each Board shall have power to construct, reconstruct, alter, repair, and maintain all such works and do and execute all such other acts and deeds including the breaching of any stopbank as may in the opinion of the Board be necessary or expedient for—

   a) preventing or lessening any likelihood of the overflow or breaking of the banks of any watercourse:

   b) preventing or lessening any damage which may be occasioned by any such overflow or breaking of the banks.

The SCRCA also gives regional councils a discretionary power[84] to undertake the "maintenance and improvement of watercourses and defences against water".

The functions, powers and duties of the HBRC under the SCRCA are subject to the RMA[85] as well as to funding approval from the community through the Long Term Plan processes specified in the LGA.

In summary, the SCRCA sets out the functions of regional councils to minimise and prevent damage by floods.

7.4 Resource Management Act 1991

7.4.1 Regional policy and planning framework

7.4.1.1 Regional council functions

The RMA sets out a framework for the sustainable management of the environment, including natural hazards, and includes, as a matter of national importance, the management of significant risks from natural hazards.[86]

Anyone exercising powers under the RMA is required to give effect to matters of national importance, including, relevantly, the management of significant natural hazards. Under the RMA, both regional and territorial authorities have discretionary powers for controlling the use of land to avoid or mitigate natural hazards (including flood hazard risk and management).

84 Section 133
85 Section 10A
86 Section 6(h)

A regional council's functions under the RMA include:

- Establishing, implementing and reviewing objectives, policies and methods to achieve the integrated management of the region's natural and physical resources;[87]
- The control of the use of land for avoiding or mitigating natural hazards;[88]
- In relation to any bed of a water body, the control of the introduction or planting for avoiding or mitigating natural hazards.[89]

7.4.1.2 Key regional council policy and planning documents

A key mechanism for achieving the integrated management of the region's natural and physical resources, including natural hazard management, is through the Regional Policy Statement (RPS). The RPS enables regional councils to provide broad direction and frameworks for resource management within their regions.

An RPS must (among other things) state:[90]

- The significant resource management issues for the region;
- The resource management issues of significance to iwi authorities in the region;
- The objectives sought to be achieved by the statement;
- The policies for the issues and objectives, and explanations of those policies;
- The methods (excluding rules) used, or to be used, to implement the policies;
- The local authority responsible for specifying the objectives, policies and methods for land use control in respect of natural hazards;
- Any other information required for the purpose of the regional council's functions, powers and duties under the RMA.

Regional councils must commence a review the provisions of their RPSs every 10 years.[91]

The RPS must be "given effect to" by councils when they prepare their regional and district plans. The term "give effect to" provides firm direction to councils as to how land use must be controlled to avoid or mitigate natural hazards. Depending on the drafting, it is in essence binding on councils.

The explicitness of the direction in the RPS determines how much discretion individual local councils will have in carrying out their land use planning functions under the RMA. While an RPS cannot contain rules, a policy can be akin to a rule[92] in that it can identify a course of action that could be as broad or narrow and flexible or inflexible as the circumstances warrant.

Furthermore, for any resource consent applications that are discretionary or non-complying, the consenting authority must have regard to the relevant provisions of an RPS.

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87 Section 30(1)(a) RMA
88 Section 30(1)(c)(iv) RMA
89 Section 30(1)(g)(iv) RMA
90 Section 62(1) RMA
91 Section 79(1) RMA
92 Environmental Defence Society Inc v New Zealand King Salmon Company Ltd [2014] NZSC 38, (2014) 17 ELRNZ 442, [2014] 1 NZLR 593, [2014] NZRMA 195

Currently, the only relevant national policy direction on natural hazard management from central government is the New Zealand Coastal Policy Statement, the scope of which is confined to managing coastal hazards. The Panel considers that it is only tangentially relevant when considering natural hazards more generally, and in relation to flooding. In the Panel's view, there is a clear vacuum of national RMA direction in relation to natural hazards.

Since November 2022, when preparing an RPS, a regional council must also have regard to the National Adaptation Plan prepared under the Climate Change Response Act 2002 (see below), and management plans prepared under other Acts. While these plans serve to recognise the importance of planning decisions for driving climate-resilient development in the right locations, their purpose is not to direct how land use should be controlled to avoid or mitigate natural hazards. The current National Adaptation Plan does, however, specifically direct councils to use certain climate change scenarios when undertaking detailed hazard and risk assessments and stress test their plans, policies and strategies against a range of scenarios.[93]

In summary, the only national-level statutory direction available to regional councils when undertaking their natural hazard management functions under the RMA is the generic requirement in section 6(h): that the management of significant natural hazards is a matter of national importance, which designmakers must recognise and provide for in exercising relevant powers under the act.

A regional council may, but is not obliged to (unless directed to do so by the Minister for the Environment), prepare a regional plan to assist it in carrying out its functions under the RMA. However, a regional council is required to consider the "desirability of preparing a regional plan" when, among other things, risks from natural hazards arise or are likely to arise.[94]

A regional plan must state:

- The objectives for the region;
- The policies to implement the objectives;
- The rules (if any) to implement the policies.

Specific details of the Hawke's Bay RPS and Regional Resource Management Plan (RRMP) are set out in Section 10 below.

7.4.2 Other RMA provisions

7.4.2.1 National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater Management 2020 (NPSFM) does not contain any objectives or policies relevant to natural hazards or refer to hazards. It does, however, introduce the fundamental concept of Te Mana o te Wai to the management of freshwater, as set out below.

93 Aotearoa New Zealand's First National Adaptation Plan – Chapter 4
94 Section 65(3)(c) RMA

Te Mana ō te Wai

The meaning and application of Te Mana o te Wai have been strengthened and clarified in the most recent (2020) revision of the NPSFM. It is useful to reference the six principles of Te Mana o te Wai:

Mana whakahaere	The power, authority, and obligations of tangata whenua to make decisions that maintain, protect, and sustain the health and well-being of, and their relationship with, freshwater.
Kaitiakitanga	The obligation of tangata whenua to preserve, restore, enhance, and sustainably use freshwater for the benefit of present and future generations.
Manaakitanga	The process by which tangata whenua show respect, generosity, and care for freshwater and for others.
Governance	The responsibility of those with authority for making decisions about freshwater to do so in a way that prioritises the health and well-being of freshwater now and into the future.
Stewardship	The obligation of all New Zealanders to manage freshwater in a way that ensures it sustains present and future generations.
Care and respect	The responsibility of all New Zealanders to care for freshwater in providing for the health of the nation.

These six principles are applied under a hierarchy of obligations[95] that prioritises:

1. First, the health and wellbeing of water bodies and freshwater ecosystems;

2. Second, the health needs of people (such as drinking water);

3. Third, the ability of people and communities to provide for their social, economic, and cultural wellbeing, now and in the future.

It is acknowledged that by its very nature Te Mana o te Wai is focused on the water within awa (rivers), but that a more holistic view incorporating the beds, banks and floodplains will often be needed to truly provide a healthy, well-functioning river system.[96]

It is up to regional and district councils to work with iwi partners and communities to interpret and apply the above principles and hierarchy to RPSs, regional plans and district plans respectively. Specifically, regional councils must give effect to the suite of National Policy Statements including the NPSFM and Te Mana o te Wai, and Ministry for the Environment guidance suggests this can be achieved by applying the five requirements shown overleaf in Figure 7.1.

95 Section 5 National Policy Statement For Freshwater Management 2020
96 Ian Fuller pers comm 6 April 2023

Figure 7.1 Requirements for regional councils to give effect to Te Mana o te Wai[97]

As noted above, the key obligation of Te Mana o te Wai is to prioritise the health and wellbeing of rivers. The Panel considers that flood risk management activities, particularly those that require modification and works around the rivers, need to consider Te Mana o te Wai and that the evolving best practice of "Making Room for the River" provides a solid basis for working together with iwi partners, communities and stakeholders to develop sustainable solutions to flood and erosion risk-management problems. Importantly however, the NPSFM does not provide any specific guidance on natural hazards.

7.4.3 National Environmental Standards

National Environmental Standards (NES) are regulations that prescribe technical standards, methods or rules for land use and subdivision, the use of coastal marine areas and beds of lakes and rivers, and water takes and discharges.

Two NES that are relevant to regional councils and their responsibility for managing and identifying natural hazard risks are the National Environmental Standards for Freshwater Regulations 2020 (NESFW) and the National Environmental Standards for Commercial Forestry Amendment Regulations 2023. The relevant provisions are outlined briefly below.

97 Ministry for the Environment (2020) Te Mana o te Wai factsheet, Pub No:Info 968

7.4.3.1 National Environmental Standards for Freshwater Regulations 2020

The standards relating to natural hazard management within the NESFW include:

- Provision for flood-control protection and drainage works as permitted activities, subject to compliance with conditions (section 46);
- Vegetation clearance, earthworks and the taking, use, damming, diversion or discharge of water within, or within a 10-100 m setback from a natural inland wetland as permitted activities, subject to compliance with conditions, for the purpose of natural hazard works (which have a specific definition) (section 51);
- Conditions on resource consents for works in, over or under a river to include monitoring of the structure each time a significant natural hazard affects the structure (section 69).

7.4.3.2 National Environmental Standards for Commercial Forestry Amendment Regulations 2023

Updated forestry regulations came into force in November 2023, nine months after Cyclone Gabrielle. They replaced the 2018 NES for Plantation Forestry and followed consultation and recommendations from the Ministerial Inquiry into Land Use in the Tairāwhiti and Wairoa districts.

The amended regulations give councils more discretionary control over commercial forestry, including through clearing rules on harvesting practices and new requirements to remove slash from erosion-prone land, assess the risks of wilding conifers and establish setbacks from waterways, which were not included in the previous NES for Plantation Forestry.

7.4.4 National Policy Statement for Urban Development 2020

The National Policy Statement for Urban Development 2020 (NPSUD) sets out the objectives and policies for planning for well-functioning urban environments. It replaces the National Policy Statement on Urban Development Capacity 2016.

The primary focus of the NPSUD is to enable well-functioning urban environments. It requires local authorities to provide sufficient development capacity and adopt plans that enable greater intensity of urban development. In providing for this, Policy 1 requires planning decisions to contribute to well-functioning urban environments that, among other things, are resilient to the likely current and future effects of climate change. Likewise, Policy 6 requires decision-makers to have particular regard to the likely and future effects of climate change. However, like the NPSFM, it does not refer to natural hazards.

Napier City Council, Hastings District Council and HBRC are currently preparing a joint Future Development Strategy to meet the requirements of the NPSUD.

7.4.5 New Zealand Coastal Policy Statement 2010 (NZCPS)

RPSs, regional plans and district plans must give effect to the NZCPS. The NZCPS specifically includes natural hazards in Policies 24 (identification of coastal hazards) and 25 (subdivision, use and development in areas of coastal hazard risk).

In particular, Policy 25 states:

In areas potentially affected by coastal hazards over at least the next 100 years:

- Avoid increasing the risk of social, environmental and economic harm from coastal hazards;
- Avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards.

7.4.6 National Adaptation Plan

The National Adaptation Plan (NAP) is required under the Climate Change Response Act 2002. The purpose of the NAP is to set out New Zealand's long-term strategy to help New Zealanders adapt to the changing climate and its effects. When preparing or changing an RPS or regional plan, the regional council must have regard to the NAP.[98] Territorial authorities have a similar obligation when preparing or changing a district plan.

The NAP is not directive but is to be considered when preparing RPSs, regional plans and district plans. The NAP states that councils should use their existing powers to drive climate-resilient development in the right places. It sets out climate scenarios and recommends regional councils use these scenarios when making or amending RPSs and regional plans.[99]

7.5 Other relevant legislation

7.5.1 Civil Defence Emergency Management Act 2002

The purpose of the CDEMA includes to:[100]

- Improve and promote the sustainable management of hazards in a way that contributes to the social, economic, cultural and environmental wellbeing and safety of the public and also to the protection of property;
- Encourage and enable communities to achieve acceptable levels of risk;
- Provide for planning and preparation for emergencies and for response and recovery in the event of an emergency;
- Require local authorities to coordinate, through regional groups, planning, programmes and activities related to civil defence emergency management across the areas of reduction, readiness, response and recovery, and encourage cooperation and joint action within those regional groups;
- Provide a basis for the integration of national and local civil defence emergency management planning and activity through the alignment of local planning with a national strategy and national plan

98 Section 61 RMA
99 National Adaptation Plan Chapter 4
100 Section 3, Civil Defence Emergency Management Act 2002

- Encourage the coordination of emergency management, planning and activities related to civil defence emergency management across the wide range of agencies and organisations preventing or managing emergencies under this Act.

The functions of the Director of Civil Defence Emergency Management include identifying hazards and risks that are considered of national importance.[101]

The functions of a Civil Defence Emergency Management Group, and of each member, in relation to relevant hazards and risks are to identify, assess and manage those hazards and risks, consult and communicate on risks, and identify and implement cost-effective risk reductions.[102]

HBRC is a member of the Hawke's Bay Civil Defence Emergency Management (CDEM) Group.

The Panel notes here that the effectiveness of the local or CDEM Group responses to the flood event, including the timing and notification of evacuation and warnings to the public, are beyond the scope of this report because the responsibility for these responses does not sit with the HBRC. The Panel therefore only refers to the responses in this report in so far as is necessary for context and when assessing the adequacy and timeliness of the information HBRC obtained and provided to the CDEM Group to inform the responses. This report does not assess or comment on the performance of entities beyond the HBRC.

7.5.2 Building Act 2004

A building consent authority must refuse to grant consent for the construction of a building or major alterations to a building if the land on which the building work is to be carried out is subject or is likely to be subject to one or more natural hazards or the building work is likely to accelerate, worsen or result in a natural hazard on that land or any other property.[103]

The Panel notes that a building consent authority does not need to refuse to grant consent if they are satisfied that adequate provision has been made to protect the land, building work or other property from the natural hazard or hazards, or restore any damage to that land or other property as a result of the building work.[104]

7.6 Flood risk management standards/guidelines

In addition to the legal framework setting out a council's statutory functions and duties in relation to flood risk management, a range of standards and guidelines set out best practice for a council when discharging its functions and duties in relation to flood management.

To provide a context for the elements of flood hazard management described in this section, a brief introduction to the recommended process and the specific tools used to manage flood hazards in New Zealand is provided below.

101 Section 8, Civil Defence Emergency Management Act 2002
102 Section 17, Civil Defence Emergency Management Act 2002
103 Section 71(1) Building Act
104 Section 71 Building Act

The recommended process for managing flood risk in New Zealand is explained in the New Zealand Standard NZS 9401:2008 Managing Flood Risk – A Process Standard. The overall process has three key phases:

- Establish the context;
- Understand the risk and treatment options;
- Achieve sustainable solutions.

Throughout each phase there is communication, consultation and collaboration occurring in parallel with monitoring, reviewing and adaptation.

In accordance with the Standard, implementation of the overall process should produce the following six sustainable flood risk management outcomes, as described in NZS 9401:2008:

- Engaging communities and stakeholders;
- Understanding natural systems and catchment processes;
- Understanding the interaction of natural and social systems;
- Decision-making at the local level;
- All possible forms and levels of management;
- Residual risk.

Four key categories of tools for managing flood risk, along with examples of each, are provided in the table below. They have been summarised from the New South Wales Government's Floodplain Development Manual (2005) and the Greater Wellington Regional Council's Guidelines for Floodplain Management Planning (2015).

In the Panel's assessment, effective flood hazard management requires a consideration of all four categories of tools for the full range of flood events up to very extreme events beyond the capacity of any primary structural works. It is the development, agreement on and implementation of a comprehensive suite of tools that provides the overall flood risk management solution.

Table 7.1: Tools for managing flood risk[105]

1. River management & maintenance	– Tree pruning, blockage removal (within main channel) – River bed and beach recontouring (with bulldozers or excavators) – Gravel extraction, sand/silt dredging – Weed spraying/removal (aquatic and terrestrial) – Hard river-bank protection (groynes, rock revetments) – Planted willow buffer zones and other riparian planting for erosion protection and habitat

105 New South Wales Government, 2005; Greater Wellington Regional Council, 2015

2. Structural works	– Stopbanks – Flood diversion channels (overland flow paths) – Non-return valves on large culverts (flap gates) – Detention dams – Floodplain storage compartments – Pump stations – Raising or flood-proofing buildings
3. Planning and land use controls	– Flood hazard maps or zones (often included in district plan) – Restrictions on subdivision or building – Minimum floor levels – Designations – Voluntary or compulsory property purchase
4. Event management	– Flood risk awareness and education – Community readiness – Flood forecasting and warning – Evacuation triggers and procedures – Inspection of key structures (e.g. floodgates, stopbanks) – Planned emergency works (e.g. deployment of sandbags, installation of temporary flood barriers, portable flood pumps) – Asset monitoring and reactive emergency works (e.g. additional earth reinforcement of stopbanks for seepage and heave, rock placement for erosion) – Insurance

In the Panel's view, depending on the existing land uses and zoning in a district plan, it could be appropriate for flood risk to be managed by non-structural, non-intervention means, such as planning controls and emergency management procedures. In the Panel's experience, this is often the case in rural areas where land use is more resilient to inundation from floods; whereas in built-up urban areas, there is usually the need for more active management of water channels, including extracting sediment and removing weeds and other detrimental vegetation that could block the channel during flood flows. It is also common to have stopbanks on either side of the channel to reduce the frequency of inundation of the surrounding floodplain.

In situations where there is active channel management and stopbanks, the non-structural planning controls and emergency management options are, in the Panel's view, critically important for managing the risks of events greater than the design standard of the structural works, and the risk of structural works failing in events below their design standards.

Different design standards can be applied for river-channel maintenance works and structural works such as those for stopbanks, with flood risks above these design standards managed with non-structural tools such as planning controls (district plan) and emergency management (evacuations, temporary works, resilience). Figure 7.2 provides example combinations of options across the four categories of tools to manage flood hazards, from the smallest (2-year return period) to the largest (PMF – probable maximum flood) flood events.

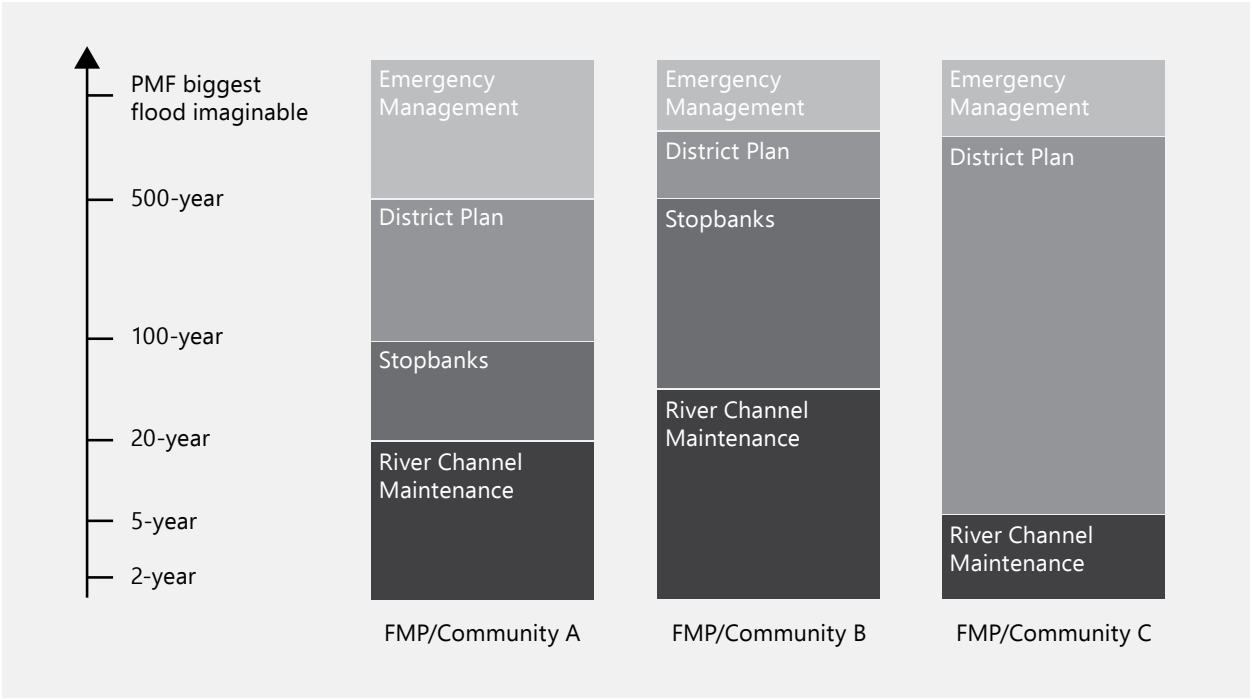


Figure 7.2 Combinations of flood risk management tools over the continuum of flood events[106]

Developing a comprehensive solution covering all available tools is where the process becomes particularly complex, as the selection of the option for each category is dependent on the options that have been selected for the other categories throughout the area being managed. For example, it may be perceived as relatively straightforward to manage risks at an isolated location by building a stopbank, but this will result in more floodwater being confined within the main channel.

This will then likely increase the risk further downstream and transfer it from one location to another. In some cases this may be advantageous, for example if the risk is transferred from areas with significant consequences associated with flooding (e.g. residential, commercial) to areas with lesser consequences (e.g. open green space). In the Panel's opinion, added to the complexity are the legislative and policy considerations set out above, and further, within an RMA context, it can be difficult to shift a hazard for the benefit of one area if doing so will be to the detriment of another.

It is for this reason the Panel considers that flood hazard management is not effective if it is undertaken in an ad-hoc and isolated manner, and comprehensive floodplain or catchment scale planning is needed to ensure that flood management "solutions" do not simply transfer flood issues from one area to another in an ad-hoc manner.

106 Greater Wellington Regional Council (2015). Guidelines for Floodplain Management Planning

As well, very careful consideration should be given to any solution that requires stopbanks, as they can increase the flood risk for two reasons:

1. Land use intensification typically follows their construction;

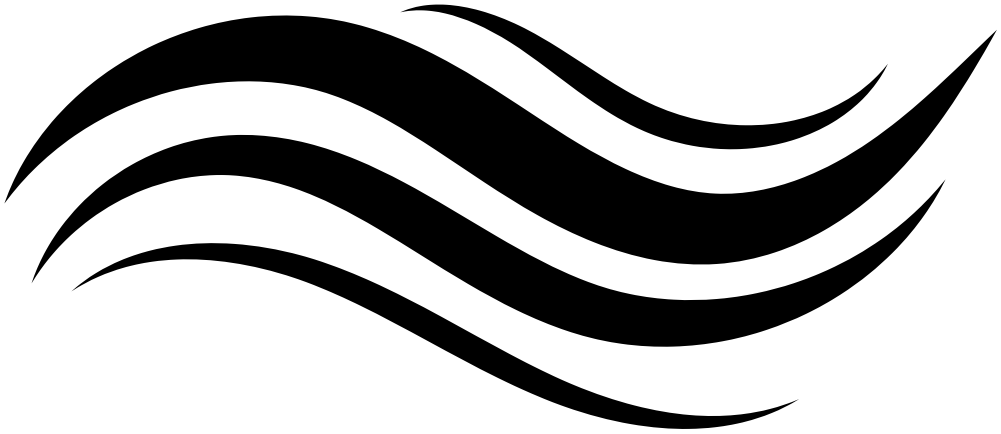
2. They will overtop or fail when an event exceeds their design capacity, resulting in the inundation of surrounding areas.

The evidence for this is clearly documented in the seminal publication of the National Water and Soil Conservation Authority by Dr Neil Ericksen (Water & Soil Directorate, Ministry of Works & Development) called "Creating Flood Disasters? New Zealand's need for a new approach to urban flood risk management".

The title of the publication is a direct reference to the flood disasters that can be created by building stopbanks. In the Panel's view, it highlights that, while stopbanks remain prevalent throughout New Zealand's, and the world's, developed floodplains, it is critical that we manage the risks of events that exceed the capacity of stopbanks through planning controls and emergency management, and avoid the construction or raising of stopbanks wherever possible, especially at greenfield sites.

The Panel considers that a final point to note on the overall framework for flood risk management is to recognise the principles provided in the guideline, "Preparing for Future Flooding: A Guide for Local Government in New Zealand" (Ministry for the Environment, 2010). A summary of these guiding principles is provided below:

- Take a precautionary approach;
- Use flexible or adaptive management options;
- Use no or low regrets options;
- Avoid making decisions that potentially compromise future options;
- Progressive risk reduction;
- Integrated sustainable approach.



CHAPTER 8:
Evaluation of HBRC performance

This chapter sets out a detailed assessment of HBRC's performance in undertaking its flood risk management functions prior to and during Cyclone Gabrielle.

We first provide a regional overview of HBRC's activities and responsibilities in relation to river maintenance, structural assets and event management.

A catchment-specific assessment is then provided for each of the major catchments affected by the February 2023 flood. For each catchment we provide a summary of the key issues considered and the relevant data sources for each, including:

- **The historical context** in terms of the development of the flood risk management infrastructure for that river, as well as significant past flood events;
- An analysis of the **river maintenance** and **structural assets** (if any), including how the condition and performance of these features relate to the agreed level of service in the respective Asset Management Plan (AMP) for that river;
- The **land use context** of flood-affected areas, especially those areas that are now subject to the land categorisation process;
- A summarised timeline of HBRC's **event management**, including communications related to the predicted size of the flood and likely inundation areas, together with comments on the accuracy and timeliness of this information.

The Panel notes that HBRC does not have responsibility for the local or CDEM Group responses to the event, including the timing and notification of evacuation and warnings to the public. For this reason the effectiveness of the CDEM responses are beyond the scope of this report and has not therefore been assessed by the Panel. In this report the Panel only refers to the CDEM responses including, notification of evacuation and warnings, in so far as is necessary to provide relevant context and when assessing the adequacy and timeliness of the information HBRC obtained and provided to the CDEM Group to inform the evacuation and warning notices. This report does not assess or comment on the performance of entities beyond the HBRC.

8.1 Regional overview

As discussed in Chapter 6, HBRC provides 25 flood-control and drainage schemes across the region. Each scheme has a detailed AMP that describes the assets and maintenance activities in that area.

Of note, not all catchments have AMPs, and within catchments where there are AMPs they do not cover the entire catchments but instead have defined "scheme" areas where targeted rates are collected to contribute to the funding of works.

Furthermore, within a scheme covered by an AMP, there may not be any structural assets and the flood management activity may be limited to river maintenance.

8.1.1 River maintenance

River maintenance encompasses a wide range of activities, but for the purposes of this assessment the focus is on the following four areas:

- Maintaining a relatively clear main river channel (i.e. not choked with willows);

- Maintaining healthy vegetated buffers/margins along the river channel;
- Undertaking bed-level management (gravel extraction);
- River mouth openings.

These four activities have the greatest impacts on how a river functions during a flood, and can significantly affect the river's capacity and lateral erosion, which may in turn affect stopbank integrity.

Keeping main channels clear of vegetation allows the efficient conveyance of floodwaters. This has been done by examining aerial photography in 2021-2022.[107] Examples are included in Appendix E to demonstrate where this has been adequate or not. Without diminishing the importance of this maintenance activity, it must be acknowledged that the scale of this flood event was much larger than the levels of service agreed in the respective AMPs. The relative impacts of any minor blockages to the main channel are likely to be minimal when a flood is covering the entire floodplain at significant depth.

Likewise, the performance of riparian buffer plantings is assessed in the context of an event that was, in some cases, of an order of magnitude greater than the design standard. The aerial photographs[108] taken in the weeks following the event provide a useful indication of the stability and performance of these riparian margins at a sample of locations.

River-bed-level management, particularly of the large gravel-bed rivers, was a notable element of community feedback, and is examined in detail for each river using the latest available cross-section survey and analysis.

The performance and functioning of river mouths is also considered in terms of inspections and observations completed prior to the event and any works undertaken during the event, noting that for an event of this size coinciding with large storm surges and waves, any physical works during peak flood flows would be extremely dangerous.

It is important to note that this analysis is based on information that includes river-bed-level surveys prior to the 2023 flood event, and that river channels and berms will have significantly changed due to the floodwater and sediment that came with this event.

A thorough re-survey and analysis of all the major river systems should be done to understand the current river-bed and berm levels and how they relate to the currently agreed levels of service and the extent of remedial work that is required.

8.1.2 Structural assets

The most common and relevant structural assets are stopbanks, and it is stopbanks that are the primary focus of the following assessment. There are also some areas where the performance of flood pumps is relevant and commented on. The design standards for structural assets within catchments, where they exist, are described in the relevant HBRC AMP for each catchment.

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107 LINZ (2022). Hawke's Bay 0.3 m Rural Aerial Photos (2021-2022). https://data.linz.govt.nz/data/
108 LINZ (2023). https://data.linz.govt.nz/layer/112726-hawkes-bay-010m-cyclone-gabrielle-aerial-photos-2023/

For stopbanks, the level of service is typically described in terms of the floodwater that can be contained by the stopbanks without overtopping or breaching by erosion. There will usually be an allowance for "freeboard" within the design standard, which accounts for uncertainty in the design calculations/modelling and the natural variability inherent in the river system.

The size and expected return period of a flood is the key variable to be considered in assessing the performance of stopbanks. NIWA has completed a thorough investigation[109] of the flood sizes and return periods in all of Hawke's Bay's major catchments and it is the subsequent data that the Panel has used as a reference for the assessment of stopbank performance during Cyclone Gabrielle.

Included in the assessment of stopbank performance is the ability of the stopbanking system to accommodate floods that exceed the design standard. In almost all cases, the stopbanking system is of the same nominal design standard (a 100-year return period) and there are no secondary systems or defined overflow points.

Not only is this problematic in terms of the failure of the stopbanks, it also makes effective flood event management extremely difficult, if not impossible. This is highlighted in the following response from HBRC to a question from the Panel, and underlines why a different approach needs to be considered for stopbank design.

> *"The seemingly random nature of stopbank breaches results in planning with trigger levels as an impossible task, as the variables that cause the breaches are not known beforehand".*[110]

This highlights the direct link between stopbank design and effective event management, particularly with regard to evacuation planning and advice. This is discussed further below.

8.1.3 Event management

One of the most critical activities HBRC undertakes during the lead-up to any heavy rain event is forecasting river flows and interpreting this information to provide advice on areas at risk of being flooded, so that Civil Defence can make decisions and initiate evacuations where required.

Understanding which areas are likely to be at risk in a particular size of flood event should be understood prior to the event occurring. This allows appropriate plans to be developed and for those who are going to be affected to be aware that they need to be ready for an evacuation order.

An important element of this forecasting and advisory role is the availability of real-time rainfall and river-flow information from HBRC's monitoring network. This network has been the subject of specific reviews.[111,112]

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109 NIWA (2024). Extreme Value Analysis of Cyclone Gabrielle in Hawke's Bay
110 HBRC response to Q33 from the Panel
111 Apex Communications Limited (2023). Telemetry Review
112 Horrell. G. (2023). Review of Hawke's Bay Regional Council Telemetry System

Of the catchments assessed in this review, it was the failure of the Kahuranaki repeater at 12:30am on the 14th of February that is of the greatest significance.

Mains power supply was lost, with the back-up generator then failing, followed by the batteries only operating for a short period before running out.[113]

This meant that 50% of the telemetered rainfall and river sites across the region were unable to provide live data during the event.[114] With only limited data available, HBRC's ability to provide accurate forecasts and advice was significantly compromised. In addition, a number of river-flow gauges were washed away during the flood as they were attached to bridges that collapsed.

A major communication problem also occurred with the MetService Mahia rain radar equipment, whereby the data was not being shown on the MetService website for many hours, preventing HBRC's forecasters from using the data normally available in their river level forecasts.

Notwithstanding these system failures and again acknowledging the magnitude of this event, the information that was available up to the point of failure and how it was communicated is assessed for each of the catchments discussed.

We note it is not HBRC's responsibility to decide whether to initiate an evacuation; this sits within Civil Defence. However HBRC has responsibility for providing timely and accurate information to Civil Defence so that it can undertake its functions. A review[115] of the Hawke's Bay Civil Defence Emergency Management Group response was completed and is a key area of overlap in terms of the HBRC advisory role, particularly in the early stages of the event. A national review[116] was also completed, the conclusions and recommendations of which are also relevant to HBRC's advisory responsibilities during a flood event. The Panel has therefore assessed HBRC's performance in providing timely and accurate information to Civil Defence for each catchment.

8.2 Wairoa

The Wairoa River has the largest catchment of any river within Hawke's Bay and the floodplain has been inundated a number of times in the recent past. The May 1914 flood, estimated[117] at 6,650 m^3/s, is likely to have been larger than the 2023 flood, which preliminary estimates have assessed[118] as 6,200 m^3/s; being approximately a 100-year design flood.[119] Cyclone Bola in 1988 was estimated at 5,000 m^3/s, being around a 30-year flood, but the largest flood of the past century is likely to have been the 1948 flood, which was estimated at 8,200 m^3/s.

The main channel is relatively entrenched, but once the river flow exceeds around 4,300 m^3/s, being a 20-year event, floodwaters start to break out and spill through the North Clyde area (See Appendix D Figure D1). This represents a relatively low standard of protection for North Clyde, which includes residential, commercial, marae and Papakāinga land uses.

113 Apex Communications Limited (2023). Telemetry Review
114 Horrell. G. (2023). Review of Hawke's Bay Regional Council Telemetry System
115 Bush International Consulting (2024). Hawke's Bay Civil Defence and Emergency Management Group Response to Cyclone Gabrielle
116 Mateparae. J., Ombler, J., Greene, J., Hunia, R. (2024). Report of the Government Inquiry into the Response to the North Island Severe Weather Events
117 The Soil Conservation & Rivers Control Council (1957). Floods in New Zealand 1920-53
118 NIWA (2024). Extreme Value Analysis of Flood Flows. Letter Report 23 Feb 2024
119 HBRC (1994). Wairoa Floodplain Management Plan – Progress Report to July 1994

In the 1990s HBRC embarked on developing a Floodplain Management Plan for Wairoa that included stopbanking options and recognised the importance of flood warnings and evacuations. However, due to affordability constraints, none of the stopbanking proposals was progressed, leaving the North Clyde community exposed to flooding from events greater than a 20-year flood and reliant on flood warnings and evacuations to manage its safety.

In this context the assessment of HBRC's assets and processes is undertaken for Wairoa, with a particular focus on flood warnings alongside other key issues raised by the community through submissions, being:

- The siltation of the river and the need for dredging;
- The blockage of the river mouth;
- The maintenance of Awatere Stream;
- The effects of the Genesis Energy hydropower operations.

It is noted that Wairoa District Council commissioned its own independent review[120] of Cyclone Gabrielle and made its own submission[121] to this review. The Panel acknowledges the work of the Wairoa District Council review and does not seek to repeat the findings here.

It is also noted that the Wairoa District Council review, with its local focus, has gone into much greater detail than this regionally focused review. Nevertheless, the issues that have arisen in Wairoa are presented in this report, while lessons learned from the rest of the region are very valuable and relevant as flood defences for Wairoa are contemplated and implemented.

8.2.1 River maintenance

To consider the maintenance of the main Wairoa River channel, it must be highlighted that apart from the rock rip rap near the river mouth there is no scope within the Northern Minor Works in the Wairoa Rivers & Streams Scheme AMP to undertake channel maintenance or clearing on the Wairoa River channel. It is noted on page 22 of the Wairoa District Council review that there appeared to be quantities of poplar-tree debris on the river banks of the Wairoa following the flood. It is not clear whether there is a need for river maintenance activities, particularly willow/poplar management on the Wairoa River and it is recommended that this be considered and assessed by HBRC.

A key theme that was raised by the community through submissions was the suspected siltation of the river channel and a desire to see this silt dredged out. There appears to be a lack of evidence to support a conclusion that there is a persistent aggradation issue in the lower reaches of the Wairoa River, and 1994 work[122] by HBRC noted a period of degradation (channel-bed lowering) of 1.2 m from 1978 to 1988, followed by a period of aggradation from 1998 to 1993. The Panel has not been provided with any recent river-bed level surveys to confirm current trends and it is likely that significant river-bed mobilisation and scour occurs during the peaks of large flood events, with deposition occurring as the flood flows recede.

120 Strome Advisory Limited (2024). Wairoa Cyclone Gabrielle Review
121 Wairoa District Council (2024). Wairoa District Council Submission to the Hawke's Bay Independent Review Panel
122 HBRC (1994). Wairoa Floodplain Management Plan – Progress Report to July 1994

Citing again the 1994 work, it is noted that the riverbed actually had an adverse (going uphill) grade from the Railway Bridge down to the main town bridge and that this lower reach will likely be an area where sediment deposits. There is the possibility that this will increase in the future as sea-level rise reduces the ability of the river to transport sediment through its lower reaches and out to sea. Given the nature of this sediment, being fine grained sand and silt, the volumes being transported (circa 1 MT/year)[123] by the river would mean that any ongoing dredging operations would be prohibitively expensive.

However, understanding the likely changes in the Wairoa River bed over time is fundamentally important to the design and future effectiveness of any flood defences (particularly stopbanks) constructed within the lower reaches of the Wairoa River. Therefore, it is recommended that HBRC re-survey the lower reaches of the river and complete a geomorphic assessment to understand the likely future trajectory of the Wairoa River bed levels to inform the design of the structural flood defence project currently under consideration.

Another common issue raised by the community was the position and degree of the opening of the river mouth. As noted in HBRC's response to Q12 from the Panel (see Appendix C), river mouth openings are managed in accordance with the HBRC Lagoon & River Mouth Instructions and all of the key river mouths were assessed in the days leading up to the cyclone. From the Wairoa District Council review it was noted that the river mouth location was in fact open and in a favourable position[124] during this flood and that it is unlikely to have adversely affected upstream flood levels. HBRC's ongoing management of the river mouth is clearly a priority, and the draft HBRC Long Term Plan includes a budget for installing cameras at key river mouth locations to monitor conditions and inform interventions when it is safe to do so.

A number of submitters made comments about a lack of maintenance of Awatere Stream, which runs from around the airport through North Clyde to discharge into the Wairoa River just upstream of the 90-degree bend in the river before it heads to the sea. It is noted that the maintenance of Awatere Stream is covered by the Paeroa Drainage Scheme, with agreed levels of service described in the AMP[125] for this scheme.

The key performance requirements for Awatere Stream and the other drains within the Paeroa Drainage Scheme are as follows:

- The managed waterways will convey their design flood flows (50 mm of runoff per hectare per day, which equates to a five-year return period event) for extended periods, without overflow on to adjacent land, and with an acceptable low risk of damage to the channel;
- Grass and weed growth in the base of the drainage channels shall be controlled and any undesirable species eliminated to maintain the efficiency of the channels;
- Excess siltation or impediments will be excavated from the drainage channels to maintain their design grade and thus their ability to convey the design flow.

As noted in HBRC's response to Q11 from the Panel (see Appendix C), Awatere Stream and connected drainage networks are currently being re-surveyed to identify where drain clearing is required, with this process expected to be completed by 2026. Aside from the visual observations

123 NIWA (2019). Updated Sediment Load Estimator for New Zealand
124 Pg 27 Strome (2024)
125 HBRC (2021). Paeroa Drainage Scheme Asset Management Plan. HBRC Publication No. 5547_4

of the community, there is a lack of evidence to support any conclusions around excess siltation, impediments or weed growth significantly contributing to the inundation of surrounding property. This is largely due to the likelihood of the floodwaters overflowing from the main Wairoa River channel then entering the Awatere Stream system and completely overwhelming it.

It is beyond the scope of this review to look in detail at the relative contribution of Wairoa River floodwaters to the Awatere Stream system and whether the degree of maintenance affected its performance, particularly noting the relatively low agreed level of service (five-year event) relative to the size of this event (50-80-year event, Wairoa River).

Other recent river channel works of note include the anchored steel sheet piles constructed as part of the Resilient River Communities Programme[126] completed in 2022. This work included construction of approximately 75 m of river bank protection on the Wairoa River from River Parade Road and Carroll Street, with project costs mostly funded by the Government's COVID-19 Recovery and Response Fund and the remaining costs shared between Wairoa District Council and HBRC.

8.2.2 Structural assets

There are no structural flood management assets on the Wairoa River. HBRC has developed proposals in the past, including stopbanks on the right bank providing protection for the main town, and stopbanks and diversion channels on the left bank to protect the North Clyde area. None of these proposals was developed further due to funding limitations.

In August 2023, central government provided funding of $70 million for a flood protection scheme for Wairoa, which is to be a collaboration between HBRC, Wairoa District Council and Tātau Tātau o Te Wairoa.[127]

The Panel understands that the proposals are being developed by WSP and are based on the original stopbank scheme concepts developed in the 1990s by HBRC. The Panel encourages Wairoa District Council, HBRC, Tātau Tātau o Te Wairoa and the Wairoa community to take note of the lessons learnt from this event, particularly with regards to the Heretaunga Plains stopbanking system, to ensure an effective and reliable solution is developed for Wairoa.

8.2.3 Land use context

The well known flood hazard,[128] born from the experience of large floods in the past 100-years and combined with the lack of structural flood defences, has made the flood risk relatively high, particularly for the left bank including the North Clyde area, and around the confluence of the Waiau and Wairoa Rivers at Frasertown.

An inspection of aerial photographs from the 1980s until now indicates there has been limited additional development in these areas, so it would appear that the flood hazard has been

126 HBRC Website (2022). Wairoa River Scheme – River Parade Erosion Control. https://www.hbrc.govt.nz/services/flood-control/resilient-river-communities/
127 Wairoa District Council (2023). Planning for flood protection solutions underway for Hawke's Bay. Press Release 15 August 2023
128 See HBRC flood maps APPENDIX D Figures D2 & D4

acknowledged and land use has been regulated appropriately. However, notwithstanding this positive comment, the existing development in these areas includes residential, commercial and mana whenua assets that remain at risk.

As of the 12th of April 2024, the North Clyde area, as well as the low terrace on the right bank upstream of the town bridge, is provisionally designated Category 2C. Further development of the flood protection options is required to move these areas to confirmed Category 2C and eventually to Category 1 on the completion of the work. The same applies to locations in Frasertown.

8.2.4 Event management

With the known flood hazard and a lack of structural flood defences, the North Clyde area is particularly reliant on effective flood warnings and evacuations to manage flood risks. Flooding in this area occurs when the river flow exceeds 4,300 m^3/s, being around a 20-year flood event.

On the 13th of February at 12:45pm, HBRC issued information predicting a 5–10-year flood event in the Wairoa River, based on the forecast rainfall data available at the time. A flood of this size would be an "ORANGE" level alert, given that it was predicted to exceed the five-year return period flood size but would not be expected to cause out of channel flows, which require a 20-year return period flood.

A further update to the forecast was issued at 11:30pm, predicting a slightly smaller event of somewhere between a two-year and five-year flood event, with a peak level on Tuesday morning just above the "GREEN" warning level (see Figure 8.1).

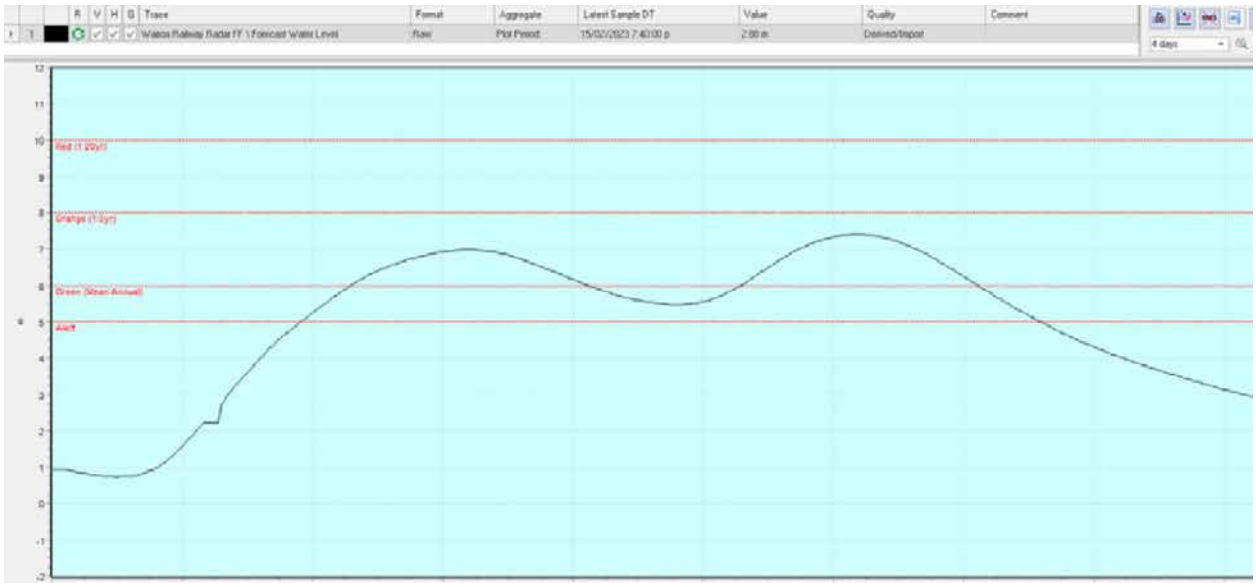

Figure 8.1 Flood forecast for Wairoa River[129]

At about the same time that this forecast was sent, all HBRC and CDEM communications to Wairoa personnel were lost, meaning that this and further communications from HBRC flood forecasters were not received by personnel on the ground. HBRC continued to provide updates and advice

129 Issued by HBRC at 12:30pm 13 February 2023

despite this loss in communications and at 1:24am an email[130] was sent from HBRC to CDEM and Wairoa District Council advising that the upper catchment tributaries of the Wairoa River were in significant flood. They included the Hangaroa River reaching the 50-year flood level, the Ruakituri River just below the 20-year level and the Wairoa River at Marumaru above the 5-year level and rising.

At this point it was clear this was going to be a significant event, exceeding the forecast issued earlier in the day. At 1:52am HBRC provided an updated forecast for the lower Wairoa River (at the Railway Bridge), stating it was going to exceed "ORANGE" levels and possibly reach "RED" by 5am. At 4:30am reports from Fire and Emergency New Zealand (FENZ) stated that the Wairoa River had broken its banks. At 8:54am Wairoa District Council declared a State of Emergency.

Being the middle of the night at the point it became clear this was a significant event, with only a matter of hours to take any action and with the loss of direct communication from HBRC to personnel on the ground, the scope of what Wairoa District Council/CDEM could achieve in the way of warnings or evacuations was significantly limited. The fundamental issue was the discrepancy between the forecast rainfall and what actually occurred. This is clearly stated in HBRC's response to Q35 from the Panel:

> *"Firstly, in the eastern catchment of Wairoa, significantly more rain fell than was forecast by MetService. For example, at Fairview, the MetService forecast was for 235 mm of rain, and the measured rainfall was 449 mm. Pukeorapa was similar with a forecast of 230 mm, and observed rainfall of 381 mm. The forecast river levels using the MetService forecast rainfall resulted in lower river levels than what was observed, and the out of channel flow through North Clyde was not forecast by HBRC flood forecasters".*

This highlights the fact that forecast rainfall data will always have a degree of uncertainty associated with it, and without a reliable telemetry system, measured rainfall cannot be integrated with a flood forecast to improve its accuracy and timeliness.

The Panel supports the recommendations of the telemetry system reviews and encourages HBRC to improve the resilience of its rainfall and river-flow data collection and communication systems. The Panel also recommends a more precautionary approach when using forecast rainfall data, to reflect the uncertainty in the data.

8.3 Tangoio – Te Ngarue Stream

The Te Ngarue catchment has a long history of flooding, with notable flood events in 1851, 1924, 1938, 1956, 1963 and Cyclone Bola in 1988. The 1963 flood resulted in 40 houses being inundated, the valley floor being covered by silt close to 1 m deep and the District Commissioner of Works declaring the valley unsafe for habitation.[131]

There is no river flow monitoring station on Te Ngarue Stream, so it is difficult to say precisely how large this recent flood event was compared to past events. However, based on observations

130 DRAFT HBRC Timeline Cyclone Gabrielle 23 November 2023
131 Cited in Clode. G (2008). Statement of Evidence – Private Plan Change 31 Tangoio Coastal Residential Rezoning

from locals and inspections of the aftermath, it appears it was most probably one of the largest ever witnessed.

Notwithstanding the evident flood risk, at the time of Cyclone Gabrielle the valley was inhabited and home to the Tangoio Marae, urupā, kohanga reo and papakāinga, as well as other residents further downstream, including within a 37-lot residential coastal subdivision approved by Hastings District Council in 2019.

Prior to the cyclone, the entire valley floor had been classified as "River Hazard" in the Hastings District Plan, and effectively this same area has now been classified as a Category 3 area for voluntary buy-out, echoing the 1963 declaration from the District Commissioner of Works.

Our assessment of the effectiveness of the HBRC systems and processes focuses on the river maintenance standards agreed in the Te Ngarue AMP, flood event management activities and input to Hastings District Council plan change and subdivision processes. It is noted that there are no stopbanks or pump stations managed by HBRC within this catchment and the only assets are the stream and drainage channels.

The Panel also acknowledges the community of Aropaoanui in the catchment to the north of Tangoio, which was significantly affected during the cyclone and subsequently assessed to be within the Category 3 land classification (see Appendix D, Figure D5). The Panel visited the Aropaoanui Valley as part of its haerenga in February 2024. It is understood that residents are working with a range of agencies including HBRC to relocate to habitable dwellings outside the Category 3 zone.

8.3.1 River maintenance

The Te Ngarue Flood Control Scheme was established in 1999, but only covers the lower 3 km of stream channel from the Tangoio Settlement Road bridge to the outlet in the sea. The Tangoio marae and kohanga reo, as well as a number of dwellings, are located upstream of the scheme boundary.

The goals of the Te Ngarue scheme as stated in the AMP[132] are:

- Enable landowners directly benefiting from the scheme to improve production from their land by reducing the frequency and duration of flooding of the land adjacent to the waterways managed under the scheme by maintaining the channels free of unwanted vegetation;
- Protection of community assets and communication links by reducing the frequency of flooding and damage to the roading network.

The agreed levels of service with regard to maintenance of the stream channels is as follows:

> *"Channels to be clear of vegetation and other blockages to maintain the efficiency of the channels. Minor siltation or impediments will be excavated from the channels to maintain their efficiency."*

132 HBRC (2021). Te Ngarue Flood Control Scheme Asset Management Plan. HBRC Publication No. 5547_6

From inspection of the aerial photographs taken prior to the cyclone, it appears that there were a number of locations where willows were at least partially blocking the stream channel (see Appendix E, Figure E2). Although these could have somewhat impeded flows, it is unlikely that their removal prior to the cyclone would have affected the extent and duration of the flooding across the entire valley floor.

It is noted from the HBRC response[133] to the Panel's questions that maintenance budgets are assessed and adjusted annually based on the changing needs of the scheme as well as accounting for inflation. The opinion of local residents is that the budget was insufficient for the maintenance needed on the willows growing within the channel and that there were a number of at least partial blockages.

Community feedback suggested that the river mouth was at least partially blocked during the cyclone, which contributed to the extent and duration of flooding, particularly in the floodplain close to the coast.

In response to the Panel's questions, HBRC stated that the Te Ngarue Stream mouth was inspected prior to the event and deemed to be functioning well. HBRC also stated that the extreme sea- and river-flow conditions made the nearby Esk River impossible to clear safely during the event and it is reasonable to assume that the same applied to the Te Ngarue Stream mouth.

Some whānau the Panel met with also described the Category 3 designation of the area as a further raupatu (confiscation) similar to that endured by their ancestors in the 19th century.

8.3.2 Structural assets

As previously noted, there are no HBRC structural assets (i.e. stopbanks) on Te Ngarue Stream. There had been previously, and subsequent to the flood more extensive "informal" stopbanks were constructed from silt deposits, but these will offer very limited protection from a flood that covers the entire valley floor. The work[134] previously undertaken by the Maungaharuru Tangitū Trust exploring options for relocation, raising and protecting the marae and surrounding land is acknowledged, as are the funding and affordability challenges of progressing these proposals.

8.3.3 Land use context

The coastal subdivision on the edge of the Te Ngarue floodplain is an example of high-risk land development occurring in an area of known flood risk.

Despite technical advice to the contrary, a plan change and subsequent subdivision consent were approved[135] by Hastings District Council, with flood mitigation by way of a minimum floor level of 15.7 mRL. The subdivision, on which several dwellings had already been constructed, is now in the Category 3 area that encompasses the entire Te Ngarue floodplain (see Appendix D, Figure D4).

133 HBRC (2024). Responses to Questions from the Hawke's Bay Independent Flood Review
134 Summarised in - Maungaharuru Tangitū (2018). Marae Options Information Booklet
135 Hastings District Council (2008). Decision on Proposed District Plan Change 31

8.3.4 Event management

In an email from HBRC sent at 11:22am on the 13th of February, the flood map of the Te Ngarue floodplain was circulated as information for areas potentially at risk. At 12:35pm a further email was sent, with Te Ngarue identified and a reference to "small stream flash flooding". As part of this correspondence, reference was given to the need for plotting on proper maps, which gives some indication of the general lack of preparedness.

At 12:45pm on the 13 of February, an update was provided covering Esk/Waipatiki/Aropaonui/Te Ngarue and other coastal areas, with the key message being "substantial rain today with intensities increasing throughout the day, peaking this evening at up to approximately 30 mm/hr".

Feedback from various hui and members of the Tangoio community noted that there were no warnings or notifications of evacuations; instead the community only realised the extent of the flood when water started entering their houses.

Further details on the discrepancies between forecast and actual rainfall are described in the following section.

8.4 Esk Valley

The Esk Valley was arguably the most severely impacted area during this event, with complete devastation across the whole valley floor, loss of life and approximately 50 people spending the night on rooftops or other high ground before being rescued by Search and Rescue, New Zealand Defence Force personnel and other members of the community. Homes, vineyards, orchards and a school (Hukarere Girls' College) were destroyed during the flood, as was Petane marae, with the nearby urupā buried in more than 2 m of silt.

In addition to these tragedies, the industrial zone in Whirinaki, which contained approximately $2 billion in assets from the Pan Pac timber and pulp mill, the Contact Energy Whirinaki Power Station and the Transpower substation were significantly affected by floodwater, silt and debris. It is noted that a Whirinaki Resilience Project is working towards improving flood risk management for this area.

The flood size has been estimated[136] at 2,175 m^3/s with NIWA analysis[137] suggesting an approximate 200-year return period. However, this was not the first time a devastating flood had hit the Esk Valley; in March 1924, 419 mm of rainfall fell in nine hours and the Esk River rose 5 m and flooded the entire valley, washed out the railway embankment.[138]

Again in 1938, a flood estimated[139] at 2,235 m^3/s inundated the whole valley, leaving silt deposits up to 3 m deep (See Figure 8.2).

136 PDP Modelling cited in NIWA (2024) Extreme Value Analysis of Hawke's Bay Flood Flows During Cyclone Gabrielle
137 NIWA (2024). Extreme Value Analysis of Cyclone Gabrielle in Hawke's Bay
138 The Soil Conservation & Rivers Control Council (1957). Floods in New Zealand 1920-53
139 Adjusted based on ratio of catchment area Q/A0.8 from estimated flow of 1830 m^3/s at the Railway Bridge from SCRCC (1957). Floods in New Zealand 1920-53

Figure 8.2 Esk Valley, April 1938[140]

There is uncertainty about the estimated flood sizes of the 2023 and 1938 floods but both were certainly large enough to inundate the entire valley floor and bury it in large depths of silt.

The information provided to date suggests that the peak of the 1938 flood was slightly bigger than that of the 2023 flood and, based on a simple plotting position analysis,[141] the return period of the 2023 flood was 100-years. However, if the 2023 flood was in fact larger, the simplified return period as a plotting position would be close to 300-years. It is understood that further detailed analysis is being undertaken on the flood hydrology of the Esk River but for the purposes of this assessment the NIWA estimate of a 200-year flood return period has been adopted, reflecting the approximate plotting positions of this event, whether it was the largest or second-largest event of the past 150 years.

HBRC's response to Q21 from the Panel stated that, based on its analysis[142] in 2013, the 500-year return period event was determined to be 1,340 m^3/s. However, once the 2023 and 1938 floods are included, the frequency analysis is very different (see Figure 8.3), and PDP concluded[143] that a discharge of 1,823 m^3/s should be used for the 100-year flood flow estimate. This is also more aligned with the NIWA frequency analysis and more closely aligns with the fact that there have been two flood events of approximately 2,200 m^3/s in the past 100–150 years.

The return period of the flood is of particular importance for assessing the performance of the Whirinaki Scheme, which has a stated[144] level of service of a 500+ year return period for the stopbanks. This is discussed further below.

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140 Ivan Hall accessed from https://collection.mtghawkesbay.com/objects/95629/esk-valley-flood
141 Gringorten plotting position 1/P = (i – 0.44)/(n + 0.12) where i is rank, n is length of record assumed to be 156 years
142 Assuming a Gumbel Distribution
143 Pg 11 para 1, PDP (2023)
144 HBRC (2021). Esk River & Whirinaki Drainage Flood Control Scheme – Asset Management Plan

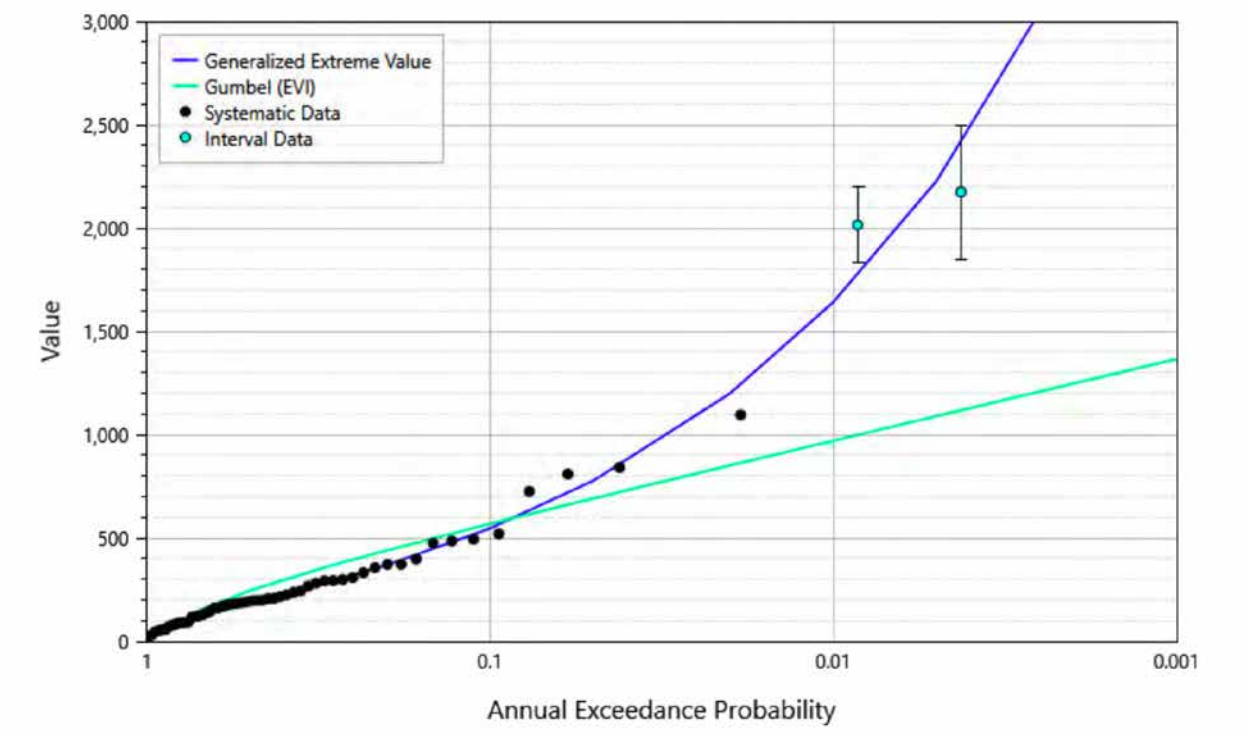

Figure 8.3 Esk at Waipunga Bridge flood frequency analysis[145]

8.4.1 River maintenance

The Esk River and Whirinaki Drainage Scheme was established in 1996, and the current scheme goals, objectives and levels of service are described in the current (2021) AMP. The Esk River scheme starts at the river mouth and extends 8.6 km upstream to the confluence with the Mangakopikopiko River. In terms of river maintenance the key activities are clearing the channel of excessive willow and other vegetation growth, and maintaining 10-20 m wide willow buffers on the river banks.

The scheme goals are supported by the following objectives:

- To contain the 2-year return period flood (215 m^3/s) within the confines of the active river channel while suffering minimal damage;
- Once the 2-year return period flood level is exceeded, to minimise the effects of flooding, damage and the deposition of debris on properties along the section of the Esk River within the scheme boundaries.[146]

There are no stopbanks within the Esk River scheme, and once a flood exceeds the 2-year return period the floodplain begins to be inundated.

The Whirinaki Drainage Scheme includes the vegetation maintenance requirements of the Esk Scheme and also includes stopbanks and natural high ground with levels of service stated in the AMP of 500+ year return period. The performance of the stopbanks is discussed below in the section dealing with structural assets.

145 PDP (2023). Esk River Hydraulic Model. Report for HBRC
146 HBRC (2021). Esk River & Whirinaki Drainage Flood Control Scheme – Asset Management Plan

From inspection of the 2021-2022 aerial photos (see Appendix E Figure E3) there appear to be some locations within the scheme boundaries where willows are encroaching into the channel. However, given that this event was of an order of magnitude greater than the level of service for channel maintenance, HBRC concluded[147] that the effects of a greater degree of channel maintenance would have been minor. The Panel concurs with this conclusion, but recommends that HBRC review its maintenance budgets to ensure that agreed levels of service in terms of vegetation maintenance in river channels can be met.

River and stream mouth openings are not part of the Esk River and Whirinaki Drainage Scheme but are managed through the HBRC Lagoon and River Mouth Instructions protocol. The Esk River mouth was inspected at around 5pm on the 13th of February, with HBRC officers assessing the river to be "full, and the mouth open".[148] However, during the event tree debris combined with the large easterly swell resulted in the river mouth partially blocking. HBRC has estimated[149] that this increased water levels in the downstream reach of the river by at least 1 m over and above what would have been expected with an open river mouth.

Once an event of this magnitude is underway, it is not safe or practical to remove tree debris or gravel blockages from the river mouth. It is for this reason that some degree of blockage should be considered when testing design scenarios. Likewise, considering combinations of sea-level conditions and river flood flows is also recommended when designing works in the lower reaches of the Esk River/Whirinaki.

Alternatively, if increased flood levels cannot be accommodated by upstream flood management works, options could be considered for a more permanent solution at the river mouth, with the use of heavy rock guide banks/moles to fix the location and keep the mouth open at all times.

Riverbed-level maintenance, by way of gravel management, has been assessed by reviewing the most recent HBRC analysis[150] based on the 2022 survey of riverbed levels. From upstream of SH2 the riverbed has degraded (lowered) since the 1997 baseline, with most reaches being at least 0.5 m below the design grade line. However, downstream of SH2, bed levels were up to 1.5 m above the design grade with an excess of 20,000 m^3 (see Figure 8.4). HBRC also noted[151] that there is a consented hard fill site on private land adjacent to the river mouth that would likely influence the river width/capacity through this reach.

It is possible that the excess gravel in this reach contributed to the blockage that occurred during the event. Noting the interface with coastal processes and the river mouth opening protocols, HBRC should consider strategic gravel extraction in river mouth zones where there is excess gravel and also monitor consented activities in these locations to ensure compliance and that there are no adverse effects occurring due to restrictions in channel capacity.

147 HBRC response to Q1 from the Panel
148 HBRC response to Q12 from the Panel
149 HBRC response to Q13 from the Panel
150 HBRC (2023). Gravel Allocation 2023/2024. Asset Management Group Technical Report
151 HBRC response to Q13 from the Panel

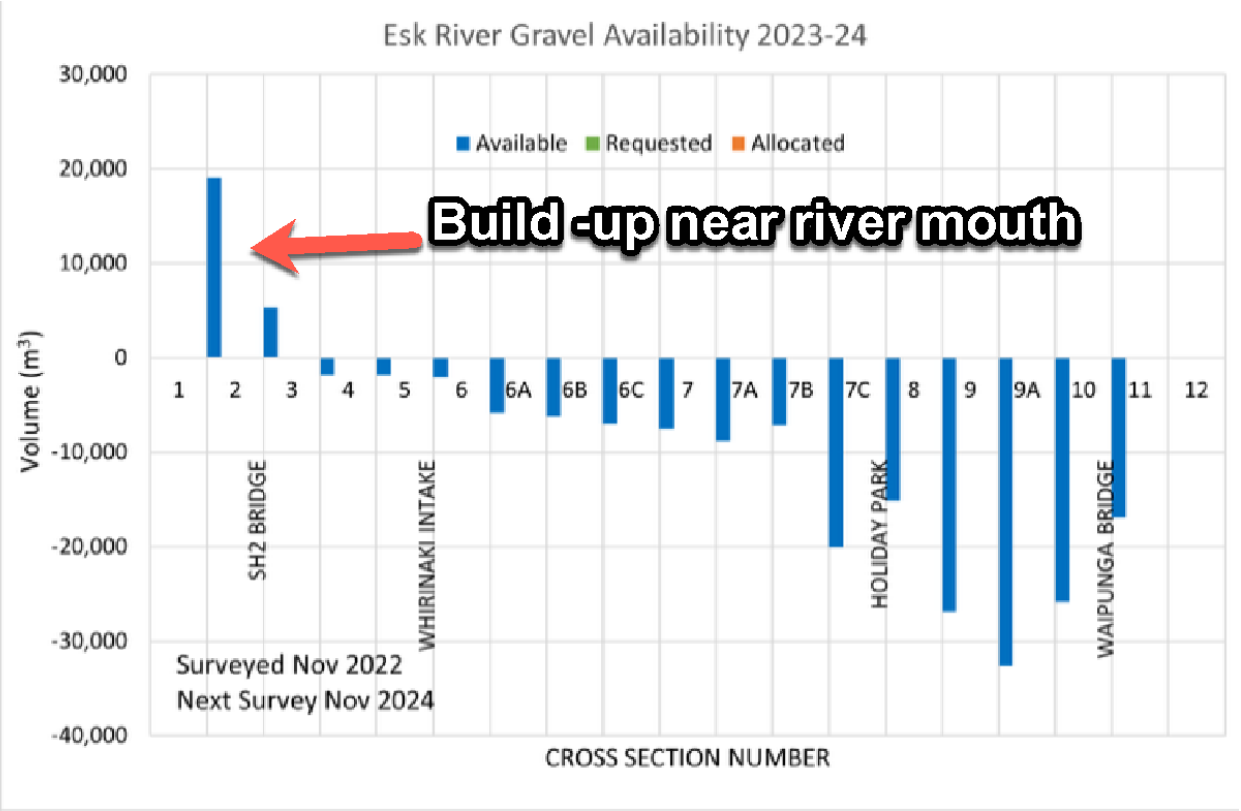

Figure 8.4 Esk River gravel availability[152]

8.4.2 Structural assets

The key structural assets considered in this catchment are the Whirinaki Drain stopbanks. The Whirinaki Scheme goals and objectives as stated in the AMP[153] are as follows:

- The Whirinaki Drain stopbanks and associated high ground upstream of SH2 will contain the 500+ year return period flood, providing protection specifically for the Whirinaki Power Station and mill;
- The other drainage channels will be maintained to convey flows for extended periods, with an acceptable low risk of damage to the channel.

As previously noted, the 2023 flood has been assessed by NIWA to be approximately a 200-year event, being less than the 500+ year return period level of service agreed in the AMP. During this event the Whirinaki industrial area was significantly inundated, as shown in Figure 8.5. HBRC noted in its response to Q21 the possibility of higher-than-expected flood levels by up to 1 m in the lower reaches of the Esk River and in the Whirinaki Drainage Scheme due to debris blocking the river mouth and the large easterly swell.

The question of whether the combined probability of a 200-year flood with partial blockage of the river mouth and a storm surge of 0.6 m exceeded the 500+ year return period level of service for Whirinaki Scheme is beyond the scope of this review. The Panel recommends that a combination

152 HBRC (2023). Gravel Allocation 2023/2024. Asset Management Group Technical Report
153 HBRC (2021). Esk River & Whirinaki Drainage Flood Control Scheme – Asset Management Plan

of scenarios be considered in the design of the flood-protection infrastructure being considered as part of the Whirinaki Resilience Project.

Figure 8.5 Whirinaki industrial area February 2023[154]

8.4.3 Land use context

Given that the entire Esk Valley floodplain was inundated to a significant depth in 1938 and is identified as a flood hazard zone by HBRC's Hazard Portal (see Appendix D, Figure D6), it is concerning to see the extent of residential development that has been allowed to occur within the floodplain.

It is understood that HBRC provided minimum floor levels above what it considered to be the design 100-year flood in relation to development within the floodplain. As previously noted, the HBRC assessment of the 100-year flood did not include the 1938 flood, and as such it underestimated the flood hazard evident within the floodplain. In addition, flood maps[155] that HBRC provided to Hastings District Council and Napier City Council in 2013 were not included in the respective district plans as it was assumed that they would "not sit so easily with those landowners".[156]

For Esk Valley, the entire floodplain that was previously a known flood hazard zone is now zoned Category 3 within the land categorisation process.

8.4.4 Event management

Given the well-known and severe flood hazard in the Esk Valley and the number of residents affected, it would be reasonable to expect a well-understood and effective emergency management plan

154 NZ Defence Force
155 Figure 42.1 HBRC response to Q42 from the Panel
156 HBRC response to Q42 from the Panel

to be in place. From a review of the HBRC Flood Manual 2015 and HBRC's correspondence with other agencies during the event, this does not appear to be the case.

Below is a timeline summary of events relevant to the Esk Valley, with commentary provided at critical times. Items in italics have been copied from records of communications provided by HBRC.[157]

10:13pm, 12 February. Email from HBRC to CDEM:

> *Esk/Waipatiki/Arapaoanui/Te Ngarue and other coastal areas – substantial rain starting early Monday to Tuesday, still wet on late Tuesday to Wed. morn.*
>
> *See Esk flood hazard map below.*
>
> *Esk Flood Hazard*
>
> *If rainfall is consistent with forecast, there is likely to be flooding similar to the extents shown on the flood hazard maps as shown below (this is not actual flooding). Houses on Shaw Road may be at risk. Could be similar to March 2018.*
>
> *Campgrounds have already been evacuated.*

It is highlighted at this point (10:13pm, 12 February) that HBRC has issued advice that it expects flooding to the extents shown in the flood hazard maps. It is highlighted that HBRC's responsibility is to provide advice on predicted flood flows and areas affected, not to action evacuations, which is the responsibility of the territorial authorities and Civil Defence.

The above information is updated and re-issued at 12:48pm the next day, largely repeating the same predictions and again circulating the Esk flood hazard map

12:48pm, 13 February. Email from HBRC to CDEM:

> *Esk/Waipatiki/Aropaoanui /Te Ngaru and other coastal areas*
>
> *18. Substantial rain today with intensities increasing throughout the day, peaking this evening up to approx. 30 mm/hr.*
>
> *19. Heavy rain predicted to ease briefly Tuesday morning and then further rain expected to ramp up again and continue through to early Wednesday morning.*
>
> *20. See Esk flood hazard map below.*
>
> *If rainfall is consistent with forecast, there is likely to be flooding similar to the extents shown on the flood hazard maps as shown below (this is not actual flooding).*
>
> *22. Houses on Shaw Road may be at risk.*
>
> *23. Could be similar to March 2018.*
>
> *24. Campgrounds have already been evacuated.*

157 HBRC (2023). HBRC Comms 13 February Redacted version for OIA request

As the day continues, the information clarifying and escalating the risks continues as the time to do anything about it in terms of evacuations reduces.

3:54pm, 13 February. Email from HBRC to CDEM:

> *Email notifying that MetService increased rainfall warning level for Hawke's Bay from Orange to Red at 3:45pm*

7:07pm, 13 February. Email from HBRC Incident Response Manager to HBRC Flood Forecasters:

> *"Had a question on flow/stage of Mangaone and Esk during 2018 Floods. They (HDC EOC) are monitoring the river levels but need some context of the flooding extent – Can you provide any intel on this??"*

The escalation to a "RED" rainfall warning from MetService at 3:45pm is clearly escalating the risk, but the lack of awareness from emergency operations is highlighted in an email at 7:07pm, which indicates Hastings District Council may not have clearly understood the advice provided by HBRC the previous evening or from earlier in the day. In the HBRC response to questions from the Panel, it stated that, "We believe HBRC was sending many signals that this event was likely to be very large. As it happened, the event was still significantly larger than we had foreseen."

This statement, and the word "signals", highlights the lack of clarity and decisiveness in the communications from HBRC and what was expected to happen.

7:50pm, 13 February. Email from HBRC to CDEM:

> *The Esk River is also of serious concern.*
>
> *Esk at Waipunga is at 4.67 m at 7pm, rising fast. Peak level in 2018 was 7.16 m.*

8:33pm, 13 February. CDEM Facebook post:

> *"Be ready to evacuate in a hurry. Self-evacuate if you feel unsafe."*

10:32pm, 13 February. Email from FENZ:

> *FENZ resources deploying to Shaw Road to confirm houses in this road have all self evacuated and assess all properties within the flood zone shown on map and advise people to evacuate to Pukemokimoki Marae/Riverbend Road. Hukarere Girls' College has self evacuated (confirmed by Police), Esk Campground also self evacuated – camp manager Dan Gale is onsite and would like contact.*
>
> *Email from FENZ released as part of Official Information Act request.*

11:30pm, 13 February. Email from HBRC to CDEM:

> *At 11:30pm on Monday 13th of February Esk River at "RED" 20-year flood level and rising.*
> *4. The Esk River has risen quickly and has hit the 20-year (Red) flood level in the lower reaches at our Waipunga Bridge site.*
> *5. Further potential 100 to 170 mm of rainfall expected overnight.*
> *6. Campgrounds have already been evacuated.*
> *7. Houses on Shaw Road at risk.*

2:10am, 14 February. HBRC Email to Hastings District Council and CDEM:

> *Esk at Waipunga now 8.19 m – highest ever measured at Esk, identified additional houses at risk on map along Shaw Road. NOTE: email was resent at 2:25 with the yellow oval in the correct location identifying the houses and a further note that probably best to consider ANY house in Esk Valley may be at risk.*

The flood is now at full flow and has exceeded the initial predictions. It is too late for people to leave safely now and conditions are very dangerous for residents on their roofs as well as rescuers in boats, helicopters and Unimogs.

At 4:05am a state of local emergency was declared over the Hastings District followed by Napier City Council at 4:31am. At 5.15am a state of emergency was declared by the CDEM Group over the Hawke's Bay region, superseding the earlier district-level declarations.

5:19am, 14 February. First EMA sent from Portal re flooding in Esk Valley:

> *"Civil Defence Flood warning: There is serious flooding risk in the Esk Valley which is still rising. Leave now if you are in a low lying area near the Esk River in Bay View. Go to higher ground and stay with family or friends. Call 111 if you are in imminent danger. Do not drive or walk through floodwater. The water may have washed away parts of the road and may contain debris. Treat all floodwater as contaminated and unsafe. Stay away from flooded areas until Civil Defence gives the all-clear."*
>
> *Vodafone 6 / 2 Degrees 3 / Spark 13*

8:43am, 14 February. State of National Emergency declared for Northland, Auckland, Waikato, Bay of Plenty, Tairawhiti, Hawke's Bay

As dawn arrives on Tuesday the 14th of February, the first EMA is issued for the Esk Valley. This is more than 30 hours after the initial advice from HBRC on Sunday night that it expected the floodplain to be inundated to the 100-year flood extent shown on flood maps. From meetings with residents who spent the night on their roofs, the EMA was received as they were watching floodwaters recede and waiting to be rescued by boat or helicopter (see Figure 8.6).

Figure 8.6 Esk Valley 14 February 2023[158]

As could be expected, there were some differences between the forecast rainfall and what actually occurred during the event, with the forecast "underestimated in part of the mid and lower

158 Photograph from New Zealand Defence Force

catchment, and well estimated in the upper portion".[159] A comparison of forecast to actual rainfall is provided in Table 8.1, which quantifies the differences across the Esk River catchment and is consistent with the summary provided by HBRC in response to the Panel's questions.

Table 8.1 – Forecast rainfall vs actual rainfall Esk River Catchment[160]

Esk Catchment Rainfall Stations	Forecast rainfall (mm)	Actual rainfall (mm)	% Difference
Glengarry	256	515	101%
Te Pohue No.2 Climate	296	408	38%
Maunganui	330	334	1%
Te Rangi	304	307	1%
Kotemaori	228	255	12%
Te Haroto Climate	247	224	-10%

HBRC flood forecasters were interpreting the rainfall forecast amounts in the Esk Valley to be a "worst case scenario",[161] with 300 mm of rainfall in 21 hours being greater than a 50-year event. It was within this context of "worst case scenario" that the 100-year flood hazard maps were sent to territorial authorities and Civil Defence at 10:13pm on the Sunday prior to the flood and again at 12:45pm on the Monday before the flood. The final outcome from the additional rain falling in the mid and lower catchment was a flood event that exceeded the predictions but was likely in the order of a 200-year event.

Some of the language used in the communication of risk provided in the forecast and highlighted with the 100-year-flood hazard maps may have reduced the scope and urgency of evacuation efforts, because it was possibly interpreted as being unlikely to occur. The use of "may be at risk" and "could be similar to March 2018" is problematic in this context as it does not provide clarity for taking action and opens the door for hopeful speculation rather than precautionary action. When dealing with high-consequence events where there are levels of uncertainty, the only context can be precautionary and communications must be clear and decisive. There is clearly a balance in terms of the disruption caused by unnecessary evacuations, but in this case the threshold for precautionary action would appear to have been exceeded.

The Panel concludes that HBRC provided reasonably accurate and timely advice regarding the predicted flood flows and area of inundation in the Esk Valley, but that some of the language used in the communication of this risk contributed to uncertainty for those agencies responsible for managing warnings and evacuation efforts. It is recommended that a more precautionary approach that uses clear and decisive language be taken for future advice to territorial authorities and Civil Defence on the likelihood and extent of forecast flood inundation.

159 HBRC response to Q31 from the Panel
160 HBRC (2023). PowerPoint Presentation to Review Panel July 2023
161 HBRC response to Q31 from the Panel

8.5 Heretaunga Plains

The Heretaunga Plains, being formed from the overlapping floodplains and alluvial fans of the Ngaruroro and Tutaekuri Rivers, has always been prone to flooding. The June 1867 flood was observed by mana whenua as the largest flood in living memory and the largest since early European occupation from the mid-1840s.[162] Some 400 mm of rain fell in four days, combined with heavy seas impeding the river mouths, resulting in silt deposits of up to 0.5 m across parts of the plains. Waitangi Bridge was washed away and the Tutaekuri and Ngararoro Rivers overflowed and submerged most of Pakowhai as well as Clive and Napier.

Early European settlers quickly realised that the flooding issues of the Heretaunga Plains would need to be managed if the land were to be used productively and the towns of Hastings and Napier were to be allowed to develop. Initial attempts were undertaken by the individual River Boards of Taradale, Papakura, Pukahu, Meanee and Clive. Localised works were undertaken to protect their own patches, which typically pushed floodwaters to neighbouring communities' land. This was typical of this era, with "stopbank wars" common. These saw Boards increasing the heights of their own stopbanks to ensure they were higher than those of neighbouring Boards, which were doing the same thing.

These localised works were largely ineffective, with the major floods of 1897 and 1917 overwhelming stopbanks and washing away bridges and as a result Napier being inundated by over 1 m. In the early 1900s more comprehensive plans were developed, recognising the need for collective action but still resulting in some communities being worse off due to the diversion of more floodwater into their districts. This was particularly the case on the Tutaekuri River, with proposed stopbanks at Moteo increasing the flood risk for Dartmoor and a major diversion at Powdrell's Bend diverting the whole river down towards Clive and Pakowhai.

The major sticking point was the Powdrell's Bend diversion, which would change the lower course of the Tutaekuri River, which at the time meandered down through a relatively small channel to the Ahuriri Estuary to exit at the port to the north of Bluff Hill. The Napier Harbour Board was supportive of this idea, as it was thought the Tutaekuri was causing the harbour to silt up.[163] This scheme also provided protection to the developing town of Napier.

The debate on the original comprehensive scheme is still relevant today, as it is fundamentally about trading off flood risks between different areas. Although there may be a net economic benefit in reducing flood risk in one area while increasing it in another, the community and political pressure to provide equal levels of protection will likely result in a sub-optimal system in terms of minimising flood losses.

In the end, the original debate was resolved by the 1931 earthquake, which resulted in an uplift of 1.5 m in the Ahuriri Estuary. This completely compromised the Tutaekuri River outlet and effectively left engineers no choice but to construct a new channel and divert it from Powdrell's Bend to the sea at Waitangi. The key features of the schemes being considered at this time are shown in Appendix D, Figure D.

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162 The Soil Conservation & Rivers Control Council (1957). Floods in New Zealand 1920-53

163 Cowie. D. (1997). The River, the Reserve, the Trustee, and the Taking. An Historical Report on Aspects of the Waiohiki (Wai 168) Claim

The scheme works were undertaken through the mid-1930s, but were generally overwhelmed by the 1938 flood, which was estimated at 3,550 m^3/s in the Ngaruroro River and 2,100 m^3/s in the Tutaekuri River.[164] The flood inundated large areas of Meeanee, Taradale and Papakura and flooded Clive, Napier and Hastings at depths of up to 1 m.[165] By 1940 the works of this original scheme were complete and the Tutaekuri River had its own independent river mouth at Waitangi and a channel capacity of 2,300 m^3/s. The Ngaruroro River had an overflow channel on the left bank at Pakowhai, with a capacity of 2,300 m^3/s, with 1,400 m^3/s remaining in the original channel, which rejoined the overflow channel at the mouth.[166]

Issues with this scheme included the aggradation of the lower Ngaruroro River channel due to the reduction in sediment transport capacity from the spilling of water into the overflow channel, as well as aggradation and difficulty in maintaining an open river mouth in the Tutaekuri River. An alternative scheme developed in 1959 saw the Ngaruroro and Tutaekuri rivers joined in the lower reaches to discharge from a single river mouth. The works effectively blocked off the existing course of the Ngaruroro River and modified the overflow channel to take the full design discharge.[167]

As a result of a stopbank failure at Twyford during the December 1980 flood, a further scheme was developed in 1987 that included the complete reconstruction of the stopbanks on the Ngaruroro from Fernhill to Chesterhope, and the raising and widening of stopbanks along the diversion channel of the Ngaruroro River as well as the Lower Tutaekuri River. Additional works were undertaken on the Tutaekuri River in the Dartmoor Valley due to floods in the 1980s and the community's desire to have protection like that afforded to the Moteo community directly opposite (where stopbanks had been constructed as part of the original 1930s scheme). These works were completed by 1995 and at this point the whole system of stopbanks met the 100-year design standard, which was for a flood of 2,100 m^3/s in the Tutaekuri River[168] and 3,500 m^3/s in the Ngaruroro River.[169]

The only change to the overall functioning and performance standard of the system from this time was the adoption of a proposed 500-year design level of service for the system. This standard was consulted on in the 2015 Long Term Plan, with the first project for implementation identified in the 2021/2031 Long Term Plan.[170] The only section of stopbank that had been upgraded prior to the 2023 flood event was on the left bank of the Tutaekuri River at Taradale.

The peak flows of the 2023 event have been estimated at 4,800 m^3/s for the Tutaekuri River and 6,000 m^3/s for the Ngaruroro River. These flows are approximately a 1,000-year return period event and, when considering the combined flows of greater than 10,000 m^3/s at the river mouth, most likely the second-largest[171] flood ever recorded in New Zealand. It overwhelmed the stopbanking system (see Appendix D, Figure D8), starting at the upstream end of the scheme then overflowing and breaching the left-bank stopbanks at Dartmoor and the right-bank stopbanks at Moteo. Further breakouts occurred at Waiohiki (see Figure 8.7) on the Tutaekuri River, with the newly upgraded stopbank directly opposite at Taradale overtopping by a small amount but

164 Williams G.J. (1987). The Ngaruroro River Scheme Investigations & Review. Hawke's Bay Catchment Board & Regional Water Board
165 The Soil Conservation & Rivers Control Council (1957). Floods in New Zealand 1920-53
166 Hawke's Bay Catchment Board (1959). Heretaunga Plains Flood Control Scheme
167 Hawke's Bay Catchment Board (1959). Heretaunga Plains Flood Control Scheme
168 At Puketapu Gauging Station
169 At Fernhill Gauging Station
170 HBRC (2021). Heretaunga Plains Flood Control Scheme Asset Management Plan 2021
171 Largest flood 12,700 m^3/s Buller River 1926. NIWA (2011). Flood modelling of the Buller River, Westport

not breaching. A number of breaches occurred on the Ngaruroro River, with the most significant overtopping being around Omahu, with floodwaters joining those spilling from Moteo and Waiohiki to fill up the "inside" of the stopbanks surrounding Pakowhai. Significant debris build-up at the railway bridge at Waitangi also likely contributed to the stopbank breach at Awatoto, which caused significant damage to the adjacent industrial area.

In terms of this assessment of the HBRC assets, systems and processes, the Heretaunga Plains are being considered as one area due to the interconnected nature of the Tutaekuri and Ngaruroro Rivers, especially once their floodwaters physically combined when the stopbank capacity of the two rivers was exceeded at a number of locations.

Figure 8.7 Tutaekuri River at Waiohiki[172]

8.5.1. River maintenance

Submitters questioned whether the river mouth's degree of opening affected the flooding that occurred, particularly in the lower reaches of the rivers. HBRC has confirmed[173] that the river mouth was inspected in the days leading up to the flood and managed in accordance with the "Lagoon & River Mouth Opening Instructions". HBRC also noted the significant erosion forces during the flood and that a new river mouth opening was carved out during the event (see Appendix E, Figure E6). The Panel considers that the river mouth opening was not a significant factor in the flooding that occurred and that the significant debris that built up on the Waitangi Railway Bridge was the most likely contributor to increased flood levels in this area. This is discussed further in the following section, which covers structural works.

As with most of the other rivers in the region, there was a perception among the community that both the Ngaruroro and Tutaekuri Rivers were filling up with gravel and that this contributed to

172 Source HBRC
173 HBRC response to Q12 from the Panel

the flooding that occurred. This was not the case for the Ngaruroro River, where gravel extraction of approximately 300,000 m³/year greatly exceeded the average historical natural gravel supply rate of 120,000 m³/year.[174] This has resulted in the riverbed level being lower than the 1999 baseline by up to 1 m in some places (see Figure 8.8).

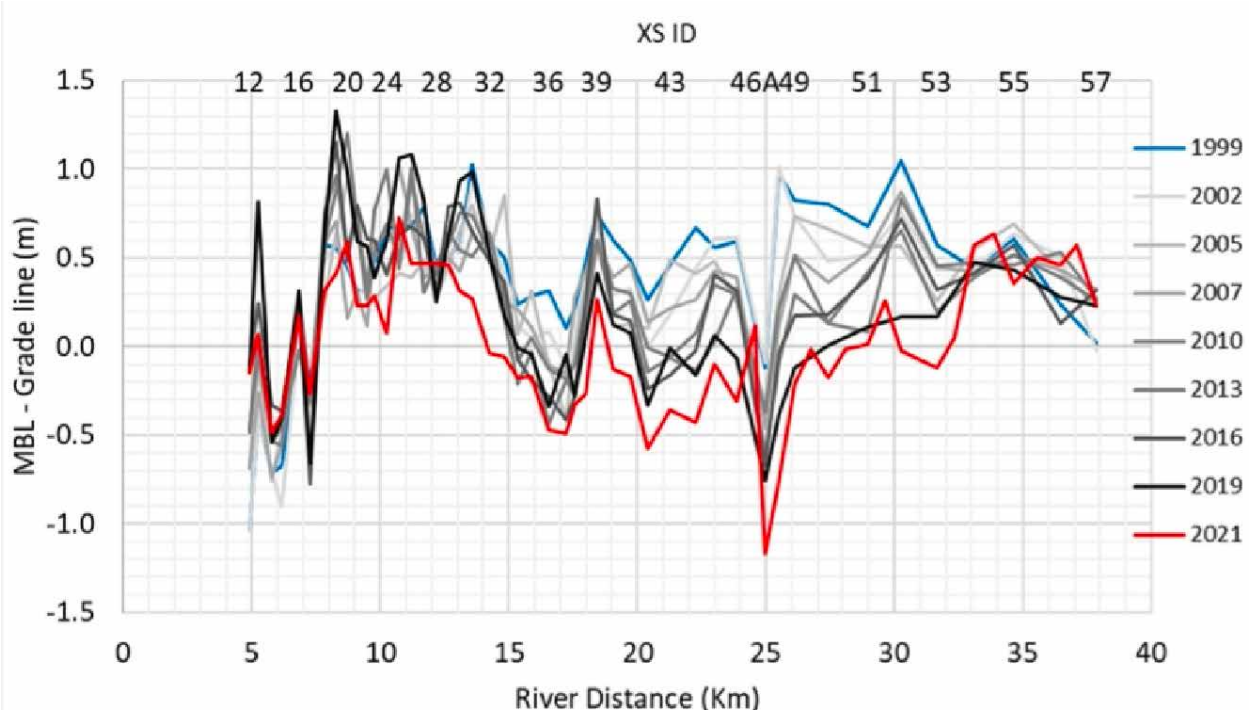


Figure 8.8 Ngaruroro riverbed levels[175]

The same is not true for the Tutaekuri River. Survey data from April 2021 shows 70,000 m³ of excess gravel above design grade upstream of the Motorway Bridge and 110,000 m³ of excess gravel upstream of the Puketapu Bridge. However, this excess gravel above design grade only equates to approximately a 300 mm increase in average riverbed levels (see Figure 8.9), which would have likely had negligible effects on flood levels and the stopbank failures that occurred.

174 HBRC (2023). Gravel Allocation 2023/2024. Asset Management Group Technical Report
175 HBRC (2023). Gravel Allocation 2023/2024. Asset Management Group Technical Report

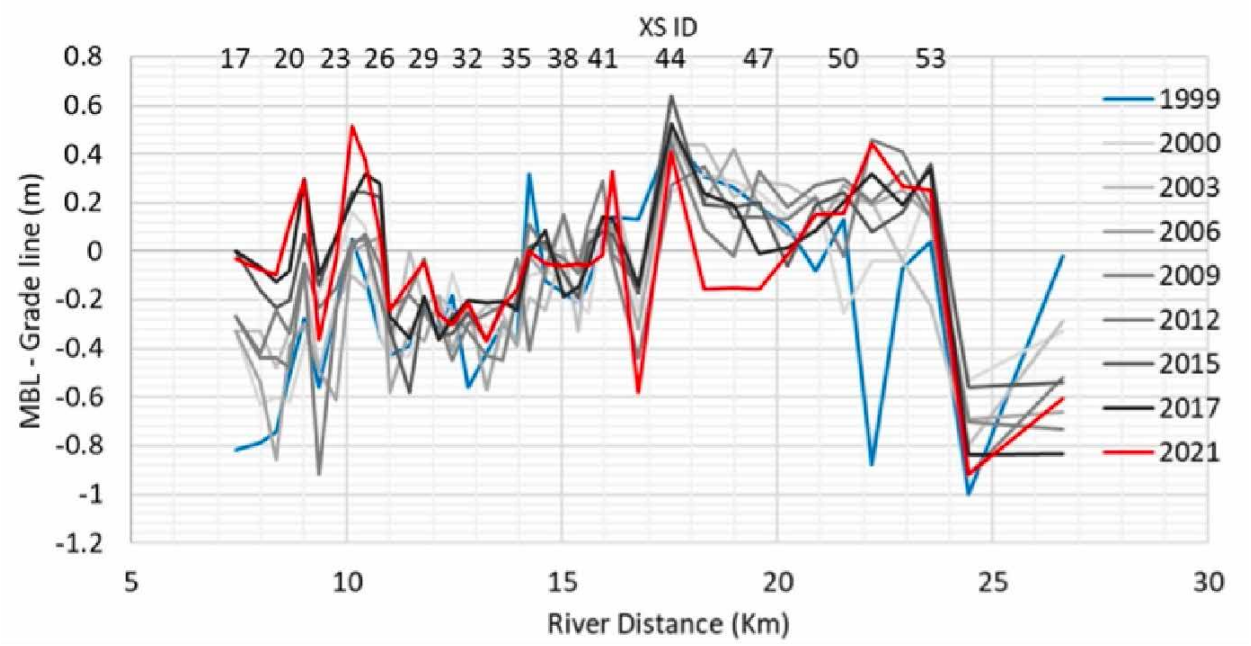


Figure 8.9 Tutaekuri riverbed levels[176]

In terms of keeping the main channel clear of vegetation and maintaining the edge protection, vegetation maintenance largely consists of willow plantings. An inspection of the aerial photographs prior to the 2023 flood event shows that the main channels of the Tutaekuri and Ngaruroro Rivers appear to be clear of vegetation and be in a condition in general accordance with the performance requirements of the Heretaunga Plains AMP. Likewise, the planted willow edge/ buffer protection was generally well established prior to the 2023 flood event and likely provided useful filtering and energy dissipation of floodwaters that reduced the amount of damage that occurred to stopbanks (see Appendix E, Figure E4, and E5).

Notwithstanding the well maintained channels and edge-protection/willow buffers, the 2023 event was of an order of magnitude greater than the overall design standard of the scheme. Therefore, the level of maintenance of the channel and buffers is not of great consequence when considering the widespread failures of the stopbank network that occurred. The stopbank failures are discussed in further detail in the following section.

8.5.2 Structural assets

All of the stopbanks on the Tutaekuri and Ngaruroro Rivers were designed to the 100-year flood standard, with the exception of the newly constructed Taradale stopbank, which was increased to a 500-year standard. The 2023 flood greatly exceeded the design standard, with the best estimate of the flood return period being approximately 1,000 years. With a flood of this size, the stopbanks are expected to be overtopped and they will do so from the upstream end of the system, as this is where the flood wave will arrive first.

As already described, most of the major breaches of the stopbank system were to the "inside" of the overall scheme, which prevented catastrophic flooding of Napier and Hastings but resulted

176 HBRC (2023). Gravel Allocation 2023/2024. Asset Management Group Technical Report

in significant inundation and damage within the Moteo, Waiohiki, Omahu and Pakowhai areas. Overflows did occur on the "outside" of the banks, causing vast damage and destruction from the Tutaekuri River at Dartmoor and taking out the Transpower Redclyffe substation further downstream. The Twyford area was also affected by overflows from the well-maintained right bank of the Ngaruroro River. The left bank stopbank of the Ngaruroro River breached at the combined river mouth, causing significant damage to the Awatoto industrial area through to the golf courses.

Despite the system not being designed to fail in this way, with all areas designed for the same 100-year standard with the exception of Taradale with the higher 500-year standard, the outcome was most probably the least damaging in terms of major overflows not inundating Taradale, Napier and Hastings and instead flooding the communities on the "inside" of the stopbank system, namely Moteo, Waiohiki, Omahu and Pakowhai. However, this highlights the key issue with a flood-protection scheme of this type, where one community is disproportionately affected for the benefit of another, particularly where the affected communities are disproportionately Māori. It also highlights the tension between the levels of protection afforded to rural and urban communities.

This is clearly a significant issue and not one that this review can answer specifically. What is important to highlight is that the performance of the system in flood events that exceed the design standard (Super Design events) must be understood, well communicated and planned for in advance. As noted in the AMP, "The Super Design event is a key residual risk to the scheme community that is uneconomic to eliminate completely".[177] The AMP goes on to state, "Management of residual risk focuses on good design practice, monitoring of asset status and development of contingency plans for response management should an extreme event occur. HBRC's plans for extreme flooding management are covered in the Flood Manual and Civil Defence Emergency Management Plans."[178]

However, an inspection of the HBRC Flood Manual and Civil Defence Emergency Management Plans reveals little or no contingency plan for a Super Design event on the Heretaunga Plains. The Panel specifically questioned HBRC on the Super Design contingency plan, which had appeared to be deferred as it was "particularly onerous, both in terms of financial cost and staff time, given the size and structure of HBRC's asset management team at the time."[179]

The Panel acknowledges that resource constraints will always be an issue, but for something as important as this, contingency planning for these extreme events should have been considered a high priority. An issue with developing a Super Design contingency plan for the Heretaunga Plains is the uncertainty in how the system would perform in events that exceeded the stopbank capacity. This issue is highlighted in the HBRC response to the Panel:

> *"The seemingly random nature of stopbank breaches results in planning with trigger levels as an impossible task, as the variables that cause the breaches are not known beforehand."*[180]

177 HBRC (2021). Heretaunga Plains Flood Control Scheme Asset Management Plan 2021
178 HBRC (2021). Heretaunga Plains Flood Control Scheme Asset Management Plan 2021
179 HBRC Response to Q15 from the Panel
180 HBRC response to Q33 from the Panel

With the stopbank system set up in the way it is, the only real certainty in terms of performance during Super Design events is that overtopping and failing will first occur at the upstream end and that Waiohiki will flood before Taradale because of the higher level of protection available at Taradale. The rest is largely left up to the site specific issues and event-specific outcomes that are not possible to predict other than through a large number of "worst case scenarios", which would include major breakouts into Taradale, Napier and Hastings. This is discussed further in the following section on event management, but taking a precautionary approach and evacuating the whole Heretaunga Plains (circa 100,000 people) is clearly not practical because the performance of the system in Super Design events is unknown.

This line of logic goes back to the fundamental design of the system, as its performance must be known during Super Design events. This creates the need for structural elements of flood management, including designated spillways in stopbanks, overflow channels, diversions, storage areas and differential stopbank standards. It creates a system with known performance for which achievable event management (including targeted evacuations) can be undertaken.

The complexity of this task is not to be underestimated, and it is again stressed that it involves trading-off flood risks for different areas to create a system that protects human life and minimises physical and economic damage. The fierce opposition and disagreement among the different communities that existed for more than three decades in the lead up to the original scheme going ahead in the 1930s will have to be revisited as HBRC, mana whenua and communities work together to develop a more resilient and effective scheme for the Heretaunga Plains.

In addition to the overarching strategic design of the Heretaunga Plains system described above, several site specific issues were raised by submitters that the Panel have questioned HBRC on and which are summarised below.

During site visits and hui at Waiohiki Marae, it was brought to the attention of the Panel that there appeared to be an opening in the high ground to the west of the marae. HBRC responded[181] to this with a flood map showing that the ground levels at the time of construction (1989-92) were adequate to contain the design 100-year flood. It is not clear whether this high ground had been unknowingly modified in the intervening years, but it does raise an issue about the awareness and protection of flood defences (such as stopbanks) that are not necessarily obvious.

Where natural high ground or other topographic features form a critical part of the flood management infrastructure, they need to be recognised and protected through legal mechanisms (designations or easements) as well as on-site physical barriers or information so that it is clear they cannot be modified. It is acknowledged that HBRC is working with the community on improvements to flood management in this area by realigning Upokohino Stream to accommodate a new stopbank.

The Omahu Marae, urupā and surrounding area were significantly affected by breaches from the Ngaruroro River as well as the floodwaters overflowing the Tutaekuri through Moteo (see Figure 8.10). It was noted by the community that the failure points on the Ngaruroro River were located at points where there were access ramps and guidebanks. HBRC's response to this was that the hydraulic effects of these features were accommodated within freeboard allowances within the design. It also referred to the Shared Learnings Report[182] from the River Managers' Special Interest Group, which provided specific recommendations around the alignment of access

181 HBRC Response to Q17 from the Panel

182 Westlake S., McCracken, S., Basheer, G., Heslop, I. & Carrol, G. (2023). Hawke's Bay Flooding Site Visit Heretaunga Plains Flood Control Scheme – Shared Learnings Report

ramps and a review of the use of deflection banks. The Panel acknowledges and supports these recommendations. The Panel also acknowledges the work of Piringa Hapū (Ngāti Hinemanu, Ngāi Te Upokoiri, Ngāti Honomōkai, Ngāti Mahuika) for the preparation of "Utaina – 10-year recovery plan".

The Panel encourages HBRC to work proactively in partnership with the mana whenua of Omahu, particularly in enabling the Pou Taiao of restoring and preserving a resilient natural environment.[183]

Figure 8.10 Ngaruroro River breach at Omahu[184]

The stopbank breach at Awatoto (see Figure 8.11) also caused significant damage and disruption within the industrial zone, with losses exceeding $300 million and ongoing issues with the discharge of partially treated wastewater from the Napier City Council wastewater treatment plant. The stopbank breach at this location was likely a combination of several factors, the key one being that this flood event was of an order of magnitude greater than the design standard of the stopbank at this location.

183 Piringa Hapū - Ngāti Hinemanu, Ngāi Te Upokoiri, Ngāti Honomōkia, Ngāti Mahuika, Utaina - 10 Year Recovery Plan, 23 April 2023 (copy provided to the Panel)

184 YouTube – Cyclone Gabrielle ...When Hell came to town https://www.youtube.com/watch?v=JuyWrDlV0Pk&t=300s

Figure 8.11 Breach at Awatoto[185]

In addition to this, localised increases in flood levels due to substantial blockage of the bridge openings with debris (See Figure 8.12) were the likely cause of the failure at this particular location. It was also noted[186] that a stormwater treatment pond was in close proximity to the landward toe of the stopbank and may have contributed to the failure. However, as already highlighted, this event was of an order of magnitude greater than the design standard of the stopbanks, so failure during this event was a certainty.

185 Source HBRC
186 Environment Canterbury (2023). Ngaruroro & Tutaekuri Rivers Cyclone Gabrielle Observations on Stopbank Performance and Damage

Figure 8.12 Debris at Waitangi Railway Bridge and road bridges immediately downstream of Awatoto stopbank breach[187]

8.5.3 Land use context

A design standard of 100-years appears to have been adopted across the Heretaunga Plains as the accepted minimum for insurance and subdivision requirements. Despite HBRC's consideration of residual risk emanating from potential stopbank breaches, there appear to be limited restrictions on development within the areas "protected" by the scheme stopbanks.

Significant subdivision and development has occurred across the plains in areas of residual risk, one notable location being Ohiti Road at Omahu. This land was subdivided through a Māori Land Court process, where HBRC was not given an opportunity to provide advice on the residual risk. This area has now been classified as Category 2C, requiring community-level flood management intervention to allow for the ongoing use of this land for residential purposes.[188]

In addition to this area of Category 2C land, a large area within Pakowhai and Dartmoor has been included in Category 3 (see Appendix D, Figure D11, and D12), with a wider area in Pakowhai being Category 2C.

187 Source HBRC
188 HBRC Response to Q43 from the Panel

8.5.4 Event management

The design of the Heretaunga Plains system does not provide for managing Super Design events. Perhaps, and as noted above, the only reasonably foreseeable elements of the system's operation once the design was exceeded were that the stopbanks at the upstream end of the system would begin overtopping first and that any overflows from Moteo would end up at Omahu and then fill up Pakowhai. Likewise, it could have been expected that the Waiohiki side would overtop prior to the Taradale side due to the differential level of protection. The major unknowns were significant breaches on the left bank downstream of Taradale for the Tutaekuri to take its old course through to Ahuriri and likewise on the right bank of the Ngaruroro to breach catastrophically and for the river to head towards Hastings.

Given the lack of consideration of Super Design events and the significant unknowns relating to the risks of inundation, particularly in the main urban centres, the HBRC response was in effect limited to providing advice on evacuations based on observations of stopbank overtopping, most notably at Taradale.

Nonetheless, the communications and forecast information provided by HBRC is provided below.

At 12:45pm on the 13th of February, the HBRC flood forecast was for a 50-year event for the Tutaekuri and Ngaruroro Rivers. Although a very significant flood, this would have been within the design parameters of the stopbank system.

At 7:52pm the Mangaone River, a major tributary of the Tutaekuri River, had passed the RED (20-year) flood level and was still rising very quickly, and by 9:42pm it had exceeded the 50-year level and was still rising. At 10.00pm a further forecast was made, which at that point observed rainfall had been 184 mm at Te Koau, but significant further rain was forecast, with intensities of 20-25 mm/hr from midnight to 4.00am. There was some commentary at the time that rainfall intensities had eased off and a suggestion that the worst had passed.

A further update at 11:30pm suggested that a 50-year event was expected, even though the Mangaone tributary was already above a 50-year event and significant further rainfall was predicted.

At approximately 12:30am, the major telemetry failure limited the data that was available, and at approximately 2:00am the water-level recorder on the Mangaone River at Rissington was washed away. At approximately 2:30am the water level recorded on the Tutaekuri River at Puketapu was washed away.

At daybreak, observations of stopbank overtopping and breaching were made and attention was drawn to the new Taradale stopbank, with river levels rising and approaching the crest. By 9:28am the Taradale stopbank was overtopping and advice from HBRC was to evacuate Taradale.[189] At 9:40am an attempt was made to send an EMA, which failed due to technical issues.

189 HBRC Response to Q35 from the Panel

At 10:16am a second EMA was successfully sent:

> *"Residents within the area of the Tutaekuri River are advised to evacuate. "Hawke's Bay Civil Defence advise residents of Taradale & those residents on the south side of the Tutaekuri River to evacuate to higher ground immediately. Flood protection systems on the Tutaekuri River are failing to contain water. Go immediately and take grab bags and animals and get to high ground asap. For further information refer to Civil Defence or local radio stations."*
>
> *Vodafone 15 / 2 Degrees 20 / Spark 63*

At 10:39am a third EMA was sent:

> *"Napier Police Evacuation Notice Taradale, Jervoistown and Meeanee "Hawke's Bay Civil Defence Emergency Management Group advise residents of Taradale, Jervoistown and Meeanee residing south of Anderson Park to evacuate to high ground. This also applies to residents on the south bank near Waiohiki and Omahu. Flood protection systems on the Tutaekuri River are failing to contain waters. Go immediately to your nearest hill and take grab bags and animals. Social media (Facebook) is the primary source of information due to comms outages. Please move now."*
>
> *Vodafone 39 / 2Degrees 48 / Spark 78*

By 3:42pm the river levels had dropped in the Tutaekuri, and the Taradale stopbank was inspected and declared safe, with people allowed to return home. The opposite was true for the Pakowhai area, which had been filling up due to a number of upstream breaches, and water was then some 4 m-plus deep with people stranded on roofs.

As with the Esk Valley, the accuracy of the flood forecast was reliant on the rainfall forecast provided by MetService. A comparison of forecast to actual rainfall is provided in Table 8.2.

Table 8.2 Forecast rainfall vs actual rainfall Tutaekuri & Ngaruroro catchments[190]

Tutaekuri/Ngaruroro Catchment Rainfall Stations	Forecast rainfall (mm)	Actual rainfall (mm)	% Difference
LK4 Ngaroto Tutaekuri	229	415	81%
Te Koau	266	369	39%
Ngahere HBRC	304	365	20%
Ngaruroro @ Kuripapango	314	328	4%
LK7 Poporangi	201	271	34%
Maraekakaho Stream D/S Tait Rd	143	224	57%

190 HBRC (2023). PowerPoint Presentation to Review Panel July 2023

Rainfall was clearly underestimated by the forecasts but, as already noted, if the forecasts had been more accurate there was still little or no planning available for implementing an emergency response. Given the configuration of the stopbank system, the opportunities for precautionary evacuations were very limited. This is reiterated in the response from HBRC to the Panel's question on this matter, in which it raises the issue that if rainfall forecasts had been more accurate or a more precautionary approach adopted, then the evacuation of approximately 100,000 people would have been required.[191]

8.6 Waipawa/Papanui

The Waipawa River had an estimated flood flow of 1,800 m^3/s during Cyclone Gabrielle, which, based on NIWA's assessment of systematic flow records back to 1987, suggested a recurrence interval in excess of 1,000 years. This flood exceeded the capacity of the system and overtopped stopbanks on the left bank upstream of Waipawa township, causing widespread flooding in residential and commercial premises (see Figure 8.13). It is noted that floodwater originating from Bush Drain in the northern areas of Waipawa also contributed to the inundation of properties.

Figure 8.13 Waipawa flooding due to stopbank breach[192]

In addition to the flooding of the urban area of Waipawa, a vast area of agricultural land was inundated due to the stopbank breaching at Walker Road. This allowed the Waipawa River to flow down an old tributary channel through Papanui Stream, severely damaging bridges and roads on its way through and inundating a vast area that had previously been Lake Roto-ā-Tara but since the late 1800s has been drained and used as agricultural land (see Figure 8.14).

191 HBRC response to Q33 from the Panel
192 Source: supplied to Panel

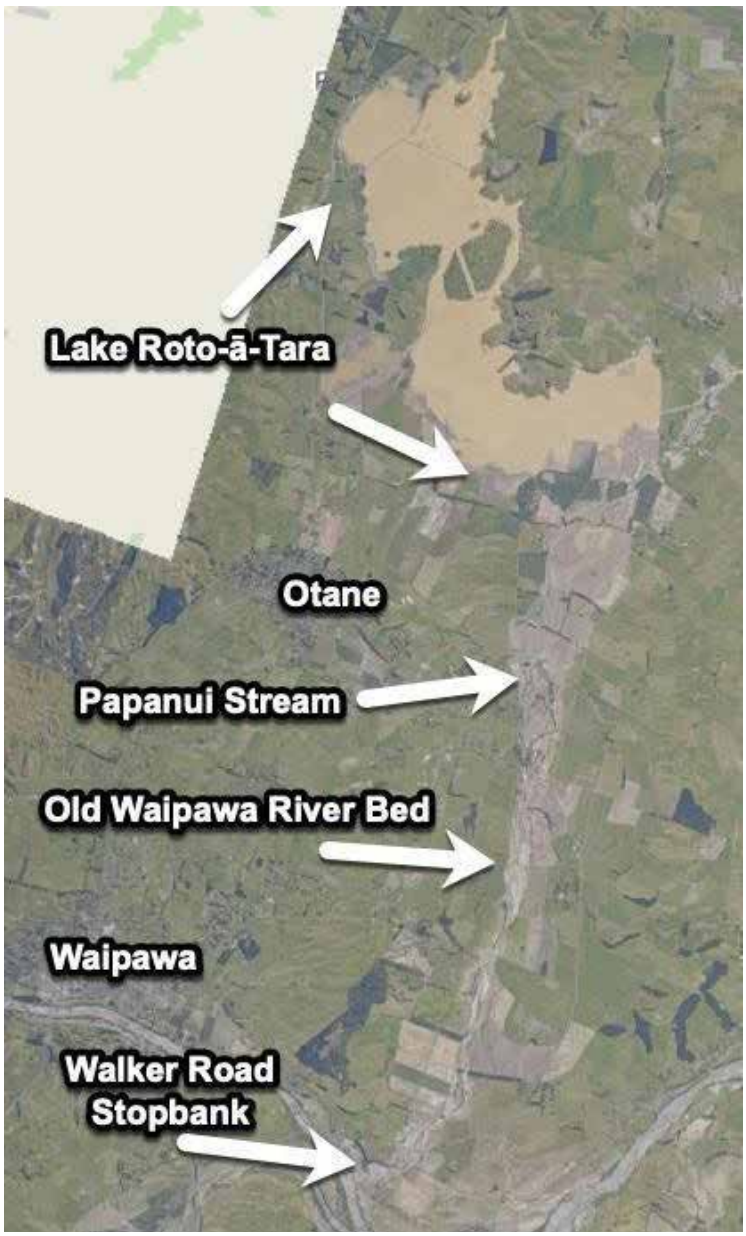


Figure 8.14 Inundation from Waipawa River stopbank breach at Walker Road[193]

The Panel completed a hikoi around the affected areas of Waipawa township and followed the path of the old river channel from the breach at Walker Road to the Lake Roto-ā-Tara area. Feedback from the community was largely concerned with the build-up of gravel within the Waipawa River and the degree to which this had affected the flooding of the township and the breach at Walker Road. In addition, some thought it would be desirable to allow for some controlled flow from the Waipawa River to be used to replenish Papanui Stream.

The overall assessment of HBRC's flood risk management for the Waipawa area is provided in the following sections.

193 Source LINZ 21 February 2023 Aerial Photo

8.6.1 River maintenance

The Waipawa River is part of the Upper Tukituki Flood Control Scheme, with objectives and agreed levels of service described in the AMP[194] for the scheme. The overall aim of the scheme is to reduce the risks of flood and erosion damage while maintaining a high-quality river environment with particular key outcomes, stated as the protection of life and communities and the sustainable management of river sediment.[195] The AMP specifically noted the need for future public consultation on the level of service provided by the scheme, with a particular focus on riverbed-level management.

As noted above, there was significant public feedback and concern regarding the aggradation (build-up) of gravel within the Waipawa River and how this may have contributed to the flood inundation that occurred. The Panel also noted the significant volume of gravel (circa 1.5 million m^3)[196] above the design grade line in the Waipawa River and the reduced flood capacity that this could cause. The Panel asked[197] HBRC to provide a detailed response on this matter.

In HBRC's response it highlighted that the reach of the river where most of the aggradation has occurred is upstream (see Appendix E, Figure E7) of where the stopbanks breached in Waipawa and at Walker Road (see Figure 8.15).

Figure 8.15 Long section of gravel volume above design grade for the Waipawa River[198]

The Panel concurs with the HBRC assessment in terms of the breach upstream of SH2 that affected the Waipawa township as the river bed appears relatively stable through this reach with little change and in fact slight degradation (bed lowering) occurring.

However, with regard to the breach at Walker Road the above bed level long section stops upstream of Walker Road and inspection of the Upper Tukituki cross sections is required to make any comment around the relative bed levels. As can be seen in the bed level analysis presented in Figure 8.16 below, there is significant aggradation in the reach immediately downstream of the Walker Road breach site and it is possible that this aggradation contributed to the failure of the

194 HBRC (2021). Upper Tukituki Flood Control Scheme Asset Management Plan. HBRC Publication No. 5472
195 HBRC (2021). Upper Tukituki Flood Control Scheme Asset Management Plan. HBRC Publication No. 5472
196 HBRC (2022). Gravel Allocation 2022-2023. HBRC Plan Number 5476
197 Q6 Panel Questions to HBRC
198 HBRC (2023). Gravel Allocation 2023/2024. Asset Management Group Technical Report

stopbank. A further, compounding factor regarding the failure of this stopbank regarding its alignment is discussed in the following section.

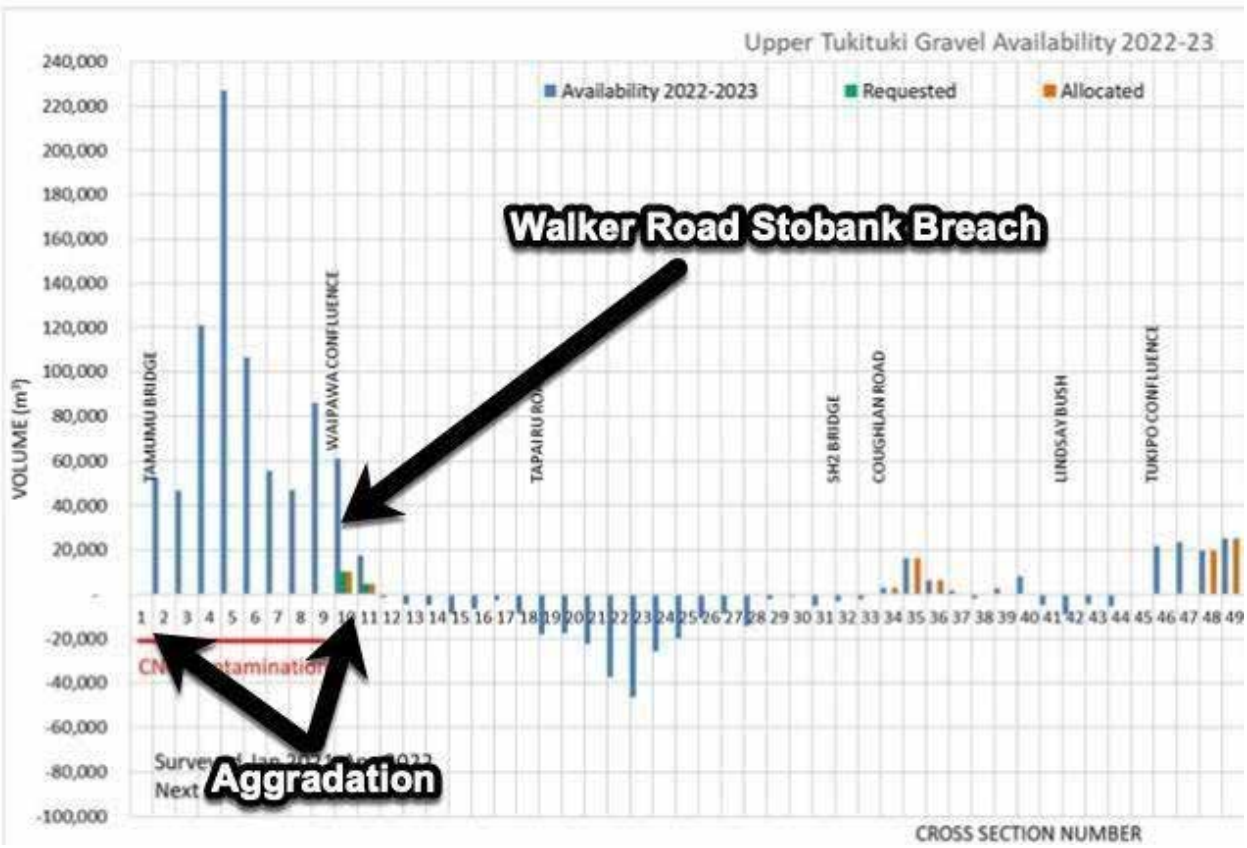


Figure 8.16 Long section of gravel volume above design grade for the Upper Tukituki River[199]

It is acknowledged that this area has been affected by Chilean Needle Grass in recent years (with gravel extraction being curtailed to prevent its spread) but the circa 800,000 m³ of gravel above the design grade line between cross sections 1 and 11 reflects a longer-term trend of aggradation that is unrelated to the disruption caused by Chilean Needle Grass. As noted in the HBRC 2022-2023 Gravel Allocation report, which cited work by NIWA:

> *"Deposition in the Upper Tukituki is increasing flood risk. The current deposition rate averages approximately 15 mm per year with a total increase in mean bed levels of 1.5 m predicted over the next 100 years. It is recommended that a long-term plan is developed for the management of aggradation induced increases to flood risk in the Upper Tukituki. As well as gravel extraction, this plan may need to explore options such as setting back defences to allow room for the river to aggrade."*[200]

The Panel supports this recommendation and acknowledges the works being undertaken by HBRC, assisted by Crown funding from the Infrastructure Reference Group (IRG), which to date has resulted in the extraction of approximately[201] 800,000 m³ of gravel from the Waipawa and Upper Tukituki Rivers.

199 HBRC (2023). Gravel Allocation 2023/2024. Asset Management Group Technical Report
200 Pg 29 HBRC Gravel Allocation Report
201 HBRC Response to Panel Question No 6

8.6.2 Structural assets

As already noted, the Waipawa River stopbanks breached in two key locations: upstream of SH2, causing inundation of the Waipawa township, and at Walker Road, causing inundation and damage to a vast area of rural/agricultural land. The key reason for both of these failures was the peak flood flow exceeding the design standard by more than 30%. The stopbanks were designed and maintained for a 100-year return period flood size of 1,350 m^3/s, while the size of this flood has been estimated at approximately 1,800 m^3/s.

The NIWA assessment of this flood suggests a return period of greater than 1,000 years based on the systematic records dating back to 1987, but this reduces to 120 years when this flood is included in the frequency analysis. It is also worth highlighting that there were many large floods prior to 1987 and that one of the original design schemes[202] had a design flow of 1,815 m^3/s, which was derived based on measured flows from the Tukituki River since 1923.[203] There were notable floods in 1931, when on the 24th to 25th of July the Waipawa River reached the roadway at the end of the High Street in the township,[204] and in 1975 when the stopbanks overtopped and breached.[205]

In addition to this event exceeding the stopbanks design standards, it is likely that channel aggradation and the stopbank alignment at Walker Road contributed to the failure at this location. As already noted, the reach from Walker Road downstream into the Tukituki River has experienced significant aggradation in the past decades, with over 800,000 m^3 of gravel being deposited above the design grade line. This deposition will likely have increased flood levels through this reach, which in this event may have caused the stopbank to overtop sooner than it would have otherwise, or increased the hydraulic load in terms of head differential, which may have changed the risks associated with a piping failure.

The elevated bed levels in the Waipawa/Tukituki River may also have slightly increased the volume of flow directed through the breach compared to a situation where the bed levels were at the design grade. However, the effects of aggradation are considered a somewhat moot point given that the flood size exceeded the agreed design standard of the stopbank and that any minor changes in the timing of the breach or the volume of flow through the breach would have been unlikely to change the outcome significantly.

A second potential contributing factor to the stopbank failure at Walker Road was the river channel alignment at the time of the flood. The Panel noted from Civil Defence briefings in the days leading up to the flood that there was concern about the channel alignment in the vicinity of the Walker Road stopbank. This was, at least in part, due to natural channel migration that occurred during Cyclone Hale in January 2023.

As highlighted in the HBRC response to the Panel's questions, this area had been inspected by HBRC river engineers, who noted that the "migrated river channel was not ideal."[206]

It is acknowledged and accepted that this alignment had only been evident for a matter of weeks after Cyclone Hale and prior to Cyclone Gabrielle, and that design and construction were required

202 Number One Scheme circa 1948
203 Williams G.E. (1985). Upper Tukituki Catchment Control Scheme – Investigations & Proposed Scheme
204 SCRCC (1957). Floods in New Zealand 1920-53. Pg 66
205 Williams G.E. (1985). Upper Tukituki Catchment Control Scheme – Investigations & Proposed Scheme
206 HBRC responses to Panel Question No. 22

before works could be executed to remedy it. It is also accepted that, once the flood was underway, doing any sort of emergency in-channel work was not feasible, safe or practical. Therefore, the channel alignment may have contributed to the failure of the Walker Road stopbank, but it was not reasonable to expect HBRC to have executed works prior to or during the flood to lessen the impacts.

A third potential contributing factor to the failure of the Walker Road stopbank is related to its alignment. As shown in Appendix E, Figure E8, the stopbank is aligned in an unusual way that protrudes at a 90-degree angle to the direction of river flow. Significant turbulence and erosive forces would have been generated during the flood around the 90-degree apex of this stopbank, so it is not surprising that this was the point of failure (see Appendix E, Figure, E9). Presumably it was a landownership constraint that resulted in this adverse stopbank alignment; it is something that HBRC was aware of and was actively working towards resolving.

It could be suggested that the heightened awareness of the risks associated with the river alignment noted above was directly linked to the risks associated with this stopbank's alignment with and proximity to the river channel. Nonetheless, it is concluded that the alignment of this stopbank would likely have contributed to this being the point of failure of this system and the river flowing down its old path to Papanui Stream and refilling Lake Roto-ā-Tara, significantly affecting a vast area of agricultural land as well as public and private assets along the way.

Even though there are three potential mechanisms (aggradation, channel alignment and stopbank alignment) that have interacted to possibly contribute to this being the point of failure, the overarching cause of the failure is the flood size being significantly greater than the design standard. Even if HBRC had addressed the downstream channel aggradation, immediate channel alignment and stopbank alignment prior to the flood, it is still possible that the stopbank would have failed at this location. It is reasonable to assume that in this circumstance it may have been less likely to fail or may have failed later in the event, but due to the size of the flood it was still likely to fail, particularly given that this was where the river used to flow before engineering intervention in the late 1800s.

8.6.3 Land use context

The Waipawa and Upper Tukituki Rivers are subject to extensive flood management schemes, including stopbanks and gravel management. These have enabled land use and development in and around Waipawa and Waipukurau. As noted above, the construction of Walker's stopbank and drainage works in the 1800s enabled agricultural land use over the old bed and a vast area that was previously Lake Roto-ā-Tara.

While land in the Waipawa/Papanui catchment is not subject to land categorisation as a result of Cyclone Gabrielle, there are areas in the Waipawa township and Papanui Stream towards Lake Roto-ā-Tara that remain subject to flood and residual risks as a result of stopbank breaches.

The Panel notes that there is a strong desire among the community to progress restoration plans for Papanui Stream. We note the work[207] progressed by HBRC and the Papanui Catchment focus group as a positive starting point for this restoration. The Panel encourages HBRC to continue

207 HBRC/Papanui Catchment Focus Group (2015). Improving the Water Quality in the Papanui Catchment. A community initiated integrated catchment management strategy

exploring opportunities to work with the local community and mana whenua to progress these plans. It is acknowledged in HBRC's response[208] to questions from the Panel that the scenario of controlled overflows into Papanui Stream is being considered as part of the Upper Tukituki scheme review.

8.6.4 Event management

As with the Heretaunga Plains rivers, there was recognition of the residual risk of stopbanks failing due to a flood exceeding the capacity of the system, but no definitive plans were in place for such an event. There was an early awareness of the potential for this event to be a significant one in the Waipawa River, and at 11am on the 13th of February HBRC circulated hazard maps for a breach at Walker Road to the local and regional Civil Defence Controllers.

At 12:45pm an email from HBRC advised that this event was likely to be a greater-than-50-year flood event and to consider observations of erosion on the Waipawa River at Walker Road. This was in part due to an adverse river alignment at this location following the flood in January 2023.

In the afternoon and at 4:55pm, a prediction of a 50-year-flood peak at approximately 6:00am the following morning was communicated. Flood hazard maps were circulated (see Appendix D, Figure D13) showing inundation extents assuming all assets performed and the flood did not exceed forecasts, together with dam break analysis maps (see Appendix D, Figure D14) showing a more extensive area of inundation, which was referred to as being extremely unlikely to occur. There was also a protocol of actions in terms of communications and updates that depended on whether or not the river rose above the RED warning level. This ad-hoc planning during the event was similar to planning evident across the rest of the region.

By 11:04pm the advice provided to Central Hawke's Bay District Council and Civil Defence began with "The situation on the Waipawa is looking rather ominous, if all the forecast rain eventuates." At this point the advice appeared to be based on "hoping for the best" rather than "preparing for the worst", although the prediction was still for a 50-year flood level for the Waipawa River through the township, which in theory would have been contained within the stopbanks. This again, highlights a lack of clarity and decisiveness around flood risk communications from HBRC to those responsible for issuing warnings and actioning evacuations.

There were further communications from HBRC through the night, but by dawn it was realised that there had been a major telemetry failure and that the Waipawa River level needed to be checked manually. At 8:49am the Waipawa flood map was re-sent to Central Hawke's Bay District Council, and by midday the District Council was reporting that 400-500 homes had been evacuated in lower Waipawa along with Pōrangahau Village.

8.7 Pōrangahau

The coastal settlement of Pōrangahau has flooded a number of times historically, with the 1941, 1953 and 2004 floods all inundating the township and damage to property. A brief summary of these historical floods in comparison to Cyclone Gabrielle is provided below.

208 HBRC response to Q24 from the Panel

On the 4th of May 1941, 400 mm of rain fell in 24 hours, causing the Pōrangahau River to rise 14 metres and flow onto its floodplain, with houses at the pā experiencing floodwater up to the roofs and flooding through the township up to 1.2 metres deep.[209] Again, on the 28th of January 1953, there was a significant flood, with the river rising 13 metres above normal and an estimated discharge of 2,300 m^3/s.

In 2004, there was a notable flood (see Figure 8.17), with river levels rising 10 metres and an estimated discharge of 550 m^3/s. This resulted in flooding through the town (see Appendix D, Figure D16), probably to a lesser extent than that of the 1941 and 1953 floods.

Figure 8.17 Pōrangahau during 2004 flood[210]

NIWA has estimated the peak flood flow of the Pōrangahau River during the 2023 flood as 1,590 m^3/s. This can only be considered an estimate, as the river level monitoring gauge was destroyed during the event and the flood flow was estimated using a numerical model[211] to replicate the observed inundation.

209 SCRC (1957). Floods in New Zealand 1920-53
210 Source HBRC
211 Block-adaptive graphics processing unit flood model

Figure 8.18 Pōrangahau during 2023 flood[212]

Based on this flow estimate and observations of the 30 houses, urupā and marae buildings inundated, it is highly likely that the 2023 event was worse than the 2004 event, but of a comparable size to the larger historical floods of 1941 and 1953. NIWA has assessed the return period[213] of the 2023 flood as >1,000 years, but this does not include the 1941 and 1953 events so is possibly less than this. If 2023 were the second-largest flood since 1941, it would have a return period of approximately[214] 50 years.

It is with the above context of known flood risk that the assessment of HBRC's flood risk management for Pōrangahau is set out below.

8.7.1 River maintenance

The AMP[215] for the Pōrangahau Flood Control Scheme describes the maintenance level of service required for the 90 km of river and stream channels covered by the scheme. The objective of the scheme is to "reduce the probability of closure of Pōrangahau Road (within the boundaries of the Pōrangahau River Flood Control Scheme) due to flooding". This very limited objective is to be achieved with a routine maintenance of vegetation, mainly willows, to keep channels clear, along

212 Source: supplied by resident
213 Including the estimated Cyclone Gabrielle peak flow
214 Based on Gringorten plotting position
215 HBRC (2021). Pōrangahau Flood Control Scheme. Asset Management Plan 2021. Publication No. 5547_11

with the removal of blockages within the channel. In the past decade, the average yearly cost of undertaking this maintenance work has been $50,000.

An inspection of the 2021-2022 aerial photographs (see Appendix E, Figure E10), shows that the river channel adjacent to the Pōrangahau settlement appears to be reasonably clear of blockages and vegetation. It is also acknowledged that the level of service discussed in the AMP refers to the annual flood event; Cyclone Gabrielle was clearly much larger than that.

Of note was feedback from local residents on a perceived build-up of riverbed levels over time, prior to the event. The Panel has been unable to verify this, as it appears the bed levels are not monitored by HBRC. Understanding the variability of riverbed levels will be a key part of any future management of flood risk for Pōrangahau and it is recommended that HBRC add riverbed monitoring for key reaches to the scope of the AMP.

8.7.2 Structural assets

No structural assets such as stopbanks and pump stations are included in the scheme, but a significant river diversion, known as Sidwill's Cut, was undertaken in the 1950s to cut off a large meander bend immediately downstream of the Pōrangahau settlement. A local community group is now working to improve the habitat and planting within the residual oxbow.

Sidwill's Cut most likely provided some benefits for the Pōrangahau settlement during Cyclone Gabrielle, by reducing the extent and duration of the flooding. However, a more comprehensive plan will be needed in the future to prevent the flooding of houses, marae, urupā and businesses. The Panel has received a copy of a HBRC presentation to the community outlining possible stopbanking options, along with alternatives including elevating structures.

It was clear to the Panel that community trust in HBRC is generally lacking, and we consider it essential that HBRC works with the community, mana whenua and central government to develop solutions for reducing flood vulnerability for Pōrangahau.

8.7.3 Land use context

Despite a history of flood events inundating the township, coastal settlement has continued to persist at Pōrangahau and Te Paerahi.

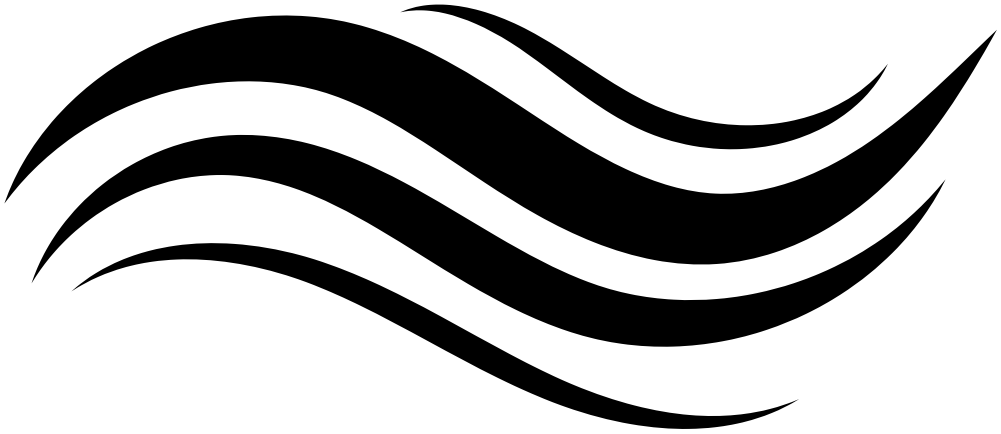
As of September 2023, the Pōrangahau settlement, which includes a marae, urupā and kaumātua housing on the south side of the river, is within Category 2A. As noted above, further work is needed to understand whether community-level or property-level interventions can be developed to adequately manage the flood risk within this community.

8.7.4 Event management

No specific flood forecasting advice was provided for Pōrangahau during this event. From the Panel's community hui and feedback it is understood that evacuations were initiated by the community based on observations of the river overtopping its banks and starting to flow through

the village. The first mention of Pōrangahau specifically in the HBRC communication logs was at midday on the 14th of February, with Central Hawke's Bay District Council advising that Pōrangahau village had been evacuated and at 1pm that the evacuation centre at Pōrangahau was unusable and evacuees had relocated to the rugby club.

Within the context of what was happening in Wairoa, the Esk Valley, the Heretaunga Plains and Waipawa, it is possible that Pōrangahau was overlooked by HBRC staff, who were clearly struggling to deal with the region-wide disaster that was occurring. It is for this reason that better planning, systems, procedures and community awareness are needed to ensure that even when systems are stretched, the appropriate information reaches the right people in time for them to do something about it.



CHAPTER 9:
Adequacy of the Regional Planning Framework

This chapter provides a qualitative assessment of the adequacy of the regional planning framework in directing flood hazard risk management across the region. As noted in Chapter 7, the Regional Policy Statement is a key mechanism through which the Regional Council can direct the control of land use for the purposes of avoiding and mitigating flood hazard risk.

Commentary is first provided on the provisions of the RPS and the Regional Resource Management Plan (RRMP), and the identification of flood hazards through the HBRC Hazard Portal. Then the extent to which the RPS informs provisions of relevant regional and district plans is assessed by identifying relevant flood hazard management provisions within each plan and how these reflect the RPS.

The Panel's overall observations of and opinion on the effectiveness and adequacy of the RPS are provided at the end of this chapter.

The Panel is aware that HBRC is in the process of revising the RPS and note that we would expect it to give effect to our recommendations.

The Panel is also aware that HBRC, together with Napier City and Hastings District Councils, are developing a Future Development Strategy for the Napier and Hastings urban areas, and that release of a draft document is imminent. The Panel expects that, once finalised, it would give effect to our recommendations.

9.1 The Hawke's Bay Regional Resource Management Plan

The Hawke's Bay RRMP is a combined RPS and regional plan. The RPS sections of the RRMP set out regional policy direction, including natural hazard provisions that must be given effect through regional and district plans. The regional plan sections include rules enabling HBRC to undertake river management works, and to ensure other activities do not exacerbate flood hazards.

The RRMP became operational in 2006. A number of amendments and changes have been made to the RRMP, predominantly related to freshwater, air quality and urban development matters.

Set out below are the relevant objectives, policies and methods of the RPS, followed by the regional plan provisions relating to natural hazards, river management and flooding, and hill country erosion.

9.1.1 Overview of the RPS

Chapter 3 of the RMMP contains the "Regionally Significant Issues, Objectives and Policies" of the RPS. Chapters 3.1A, 3.1B and 3.2–3.13 identify the following as being "Regionally Significant Issues", with those highlighted in **bold text** being those that to some extent relate to the management of flood-related risks and the effects of flooding:

- Integrated Land Use and Freshwater Management;
- **Managing the Built Environment;**
- **The Sustainable Management of Coastal Resources;**
- **Loss and Degradation of Soil;**
- Scarcity of Indigenous Vegetation and Wetlands;
- Effects of Conflicting Land Use Activities;

- Agrichemical Use;
- Management of Organic Material;
- Groundwater Quality;
- Groundwater Quantity;
- Surface Water Resources;
- **River Bed Gravel Extraction;**
- **Natural Hazards;**
- Maintenance and Enhancement of Physical Infrastructure;
- **Recognition of Matters of Significance to Iwi/Hapu**

The most relevant objectives and policies within those topics are set out below.

9.1.1.1 Chapter 3.1B – Managing the Built Environment

This chapter was introduced by Plan Change 4, which was made operative in 2014. The provisions provide guidance and direction to Hawke's Bay's local authorities when making decisions on urban activities, infrastructure and associated effects, and have a particular focus on the Heretaunga Plains sub-region.

The key objective relating to managing flood hazards in the built environment is [emphasis added]:

URBAN FORM (REGION)	
OBJ UD1	Establish compact, and strongly connected urban form throughout the Region, that: a) **achieves quality built environments that: ....** iii. **retain** heritage values and **values important to tangata whenua,** iv. are healthy, environmentally sustainable, functionally efficient, and economically and socially resilient, and .... e) **avoids or mitigates increasing the frequency or severity of risk to people and property from natural hazards.**

This objective is very broad and leaves much of the heavy lifting to subsequent policies to articulate how urban activities are to be managed. The approach of allowing either the avoidance **or** mitigation of hazard risks is not considered appropriate because it provides insufficient direction that some urban activities will be inappropriate in high flood risk areas and therefore MUST be avoided. Much of the direction provided on how flood risk is to be avoided or mitigated relates to the design of stormwater infrastructure, rather than river flooding caused by heavy rainfall. For example, Policies UD2, UD4.2 and UD 6.1 apply to the development of business activities, residential growth and papakāinga and marae-based development respectively, and all require that it [emphasis added]:

… avoids or mitigates … stormwater infrastructure that is unable to mitigate identified flood risk [and] flood control and drainage schemes that are at or over capacity…

Appropriate greenfield growth areas, albeit subject to further assessment, are identified in Policy UD4.3 (residential) and Policy UD4.5 (industrial). Indicative areas are mapped in Schedule XIVa, some according to lot boundaries and others indicated only by a circle. These locations are indicative until formalised by a plan change.

On the other hand, Policy UD4.4 identifies "inappropriate" residential greenfield growth areas. These areas are not mapped but are described as follows [emphasis added]:

INAPPROPRIATE RESIDENTIAL GREENFIELD GROWTH AREAS (HERETAUNGA PLAINS SUBREGION)	
POL UD4.4	Within the Heretaunga Plains sub-region, areas where future residential greenfield growth has been determined as inappropriate, beyond existing settlements are: a) Waipatiki Beach b) Tangoio c) Whirinaki d) Puketapu e) Jervoistown and Meeanee f) Clive g) East Clive h) Clifton i) Ocean Beach – apart from the potential for appropriate growth of the existing Waipuka bach settlement on Māori land inland of areas at risk of coastal hazards **j) Natural detention areas (50-year flood ponding areas)** k) Haumoana (north of East Road)

The appropriateness or inappropriateness of these locations appears to be driven by a desire to achieve a compact urban settlement pattern. When considering flood risk, the identification of "appropriate" and "inappropriate" areas in these policies is inconsistent. While Policy UD4.4 indicates that "50-year flood ponding areas" are inappropriate for residential greenfield growth, Policies UD4.3 and UD4.5 indicate that areas with known flood risk are appropriate for residential growth provided hazards are avoided or mitigated through structure planning. For example, the map excerpts in Figure 9.1 below show that Te Awa is identified as appropriate for residential growth (purple area) and Awatoto is appropriate for industrial growth (orange circle). When overlaid with the Hazard Portal flood maps, and as recent events also make clear, both these areas are subject to demonstrable flood risk.

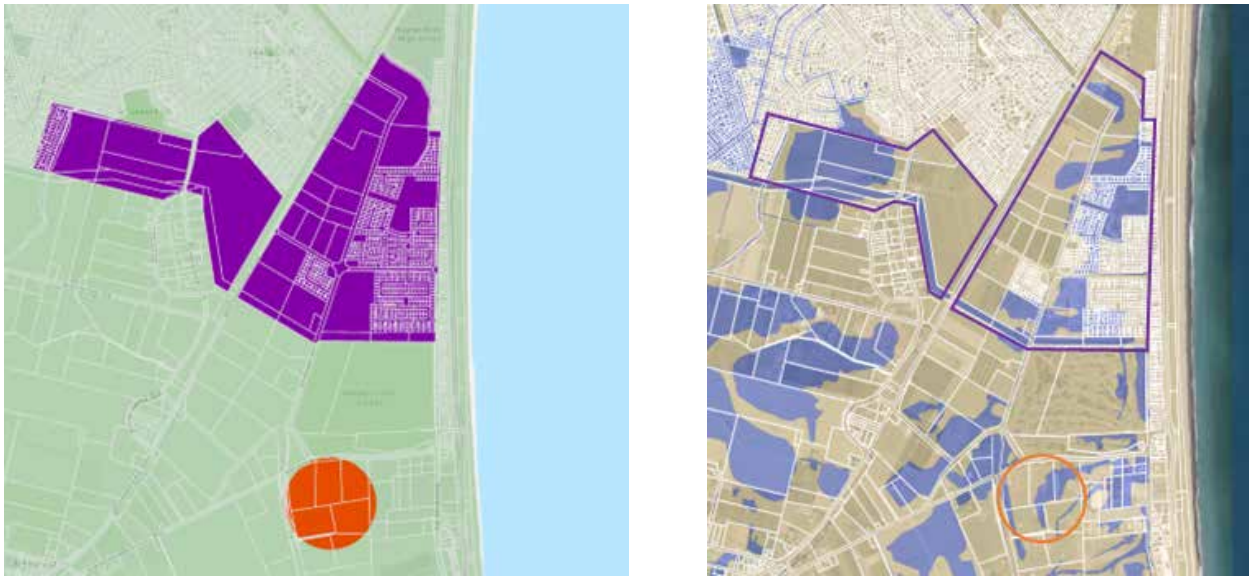


Figure 9.1 Excerpt of RRMP planning maps showing "appropriate" locations for greenfield residential development at Te Awa (purple)[216] and greenfield industrial growth at Awatoto (orange circle),[217] compared to those areas on the Hazard Portal flood map.

Development within "appropriate" greenfield growth areas is subject to further assessment in accordance with Policies UD10.1, UD10.3, UD10.4 and UD12. This further assessment largely consists of a requirement to undertake comprehensive structure planning. The only direction specific to the consideration of flood risk management, or natural hazards more generally, is provided by Policies UD10.4 and UD 12 [emphasis added]:

POL UD10.4	Notwithstanding Policy UD10.1, in developing structure plans for any area in the Region, supporting documentation should address: … g) **how any natural hazards will be avoided or mitigated.**

POL UD12	In preparing or assessing any rezoning, structure plans, or other provisions for the urban development of land within the Region, territorial authorities shall have regard to: … h) **Provision for the maintenance and enhancement of water in waterbodies, including appropriate stormwater management facilities to avoid downstream flooding and to maintain or enhance water quality;…**

Again, the consideration of flooding is centred around the avoidance or mitigation of flood risk and the performance of stormwater systems. The policies do not provide any guidance on what return periods should inform flood risk assessments or the extent to which mitigations are appropriate in these contexts.

216 RRMP - Schedule XIVa Indicative Residential Greenfield Growth Areas
217 RRMP - Schedule XIVb Indicative Industrial Growth Areas

Method UD1 requires HBRC to:
Ensure natural hazard mitigation and promote awareness of natural hazard risk, particularly risks associated with coastal erosion and inundation.

Method UD5 requires HBRC to:
Continue to monitor, research and map natural hazards, and review hazard and risk information, and provide information and guidance to territorial authorities on natural hazards and natural hazard risk.

These methods highlight HBRC's non-regulatory roles. While the Panel acknowledges the importance of developing and sharing information on flood risk, there is no clarity, urgency or ownership of ensuring that information translates into sensible planning decisions.

Anticipated Environmental Result UD 12 is that [emphasis added]:
Urban development be avoided in areas identified as being at unacceptable risk from natural hazards (flooding, coastal inundation, coastal erosion, liquefaction, land instability).

In the Panel's assessment, Chapter 3.1B does not provide sufficient strength or clarity to enable Anticipated Environmental Result UD12 to be achieved. The chapter does not define what is considered to be "unacceptable risk" and does not include any objective or policy that identifies where such risk is to be avoided rather than mitigated.

9.1.1.2 Chapter 3.2 The Sustainable Management of Coastal Resources

The key coastal management objectives in Chapter 3.2 that relate to hazard management state [emphasis added]:

OBJ 7	The promotion of **the protection of coastal characteristics of special significance to iwi**, including waahi tapu, tauranga waka, taonga raranga, mahinga kai and mahinga mataitai.

OBJ 8	**The avoidance of further permanent development in areas prone to coastal erosion or inundation**, taking into account the risk associated with global sea level rise and any protection afforded by natural coastal features.

The scope of Objective 8 is limited to permanent development and the direction of Objective 7 is weakened by only "promoting" protection of coastal characteristics of significance to Māori, rather than directing that they must be protected.

9.1.1.3 Chapter 3.3 Loss and Degradation of Soil

The objectives and policies in Chapter 3.3 focus on a reduction of hill country erosion. The primary focus of this chapter is on protecting soil health from inappropriate land uses and vegetation clearance. In particular, Policy 1 sets out the role of the HBRC in providing financial incentives and promoting self-regulation as the primary response to addressing the loss and degradation of soil in the region, and Policy 3 relates to vegetation removal from highly erodible land.

The Panel supports the intent of these provisions because managing land use to minimise erosion can also minimise disruption to infrastructure and the risk of erosion exacerbating flood risks.

9.1.1.4 Chapter 3.11 River Bed Gravel Extraction

The objectives of Chapter 3.11 state: [emphasis added]

OBJECTIVES	
OBJ 28	**The avoidance of any gravel extraction at a rate which exceeds the rate of natural supply, except** in areas where there are stored reserves which may be removed in a controlled manner such that **flood protection and river control assets are not compromised.**
OBJ 29	**The facilitation of gravel extraction from areas where it is desirable to extract excess gravel for river management purposes and the minimisation of flood risk, or to maintain or protect the functional integrity of existing structures**, whilst ensuring that any adverse effects of gravel extraction activities are avoided, remedied or mitigated.
OBJ 30	The maintenance of the use and values of the beds of rivers and the avoidance of any significant adverse effects on the river bed resulting from the extraction of gravel.

Policies 50-52 relate to the allocation of gravel resources to ensure extraction is undertaken at levels consistent with the design profile, while Policy 53 sets out the decision-making criteria for resource consent applications for gravel extraction. A decision-maker is required to have regard to "the avoidance of any adverse effect on flood control assets or river protection works" and "the avoidance of any activity that would cause flood control measures or river protection works to be required".

These provisions provide a strong enabling mandate for HBRC to undertake river management and control gravel extraction for flood hazard management purposes. This clear direction is supported by Policy 55 of Chapter 3.12 (discussed below) and has translated into an enabling rule framework through regional and district plans.

As evidenced in the Waipawa / Tukituki Rivers, aggradation of gravel in the river bed contributes to flood risk. It is noted in recent years that gravel extraction in these rivers has been disrupted due to the presence of Chilean Needle Grass. HBRC has been managing conflicting responsibilities for managing a biosecurity risk and flood hazard mitigation. As noted in Chapter 8, the Panel supports HBRC's work in removing gravel built up material from these rivers.

9.1.1.5 Chapter 3.12 Natural Hazards

Chapter 3.12 is of fundamental importance because it is the topic-specific section of the RPS that deals with flooding hazards. The relevant provisions of the chapter are set out in full below [emphasis added].

OBJECTIVES	
OBJ 31	**The avoidance or mitigation of the adverse effects of natural hazards** on people's safety, property, and economic livelihood.

Explanation and Reasons

3.12.2 Flooding and droughts are the most recurrent natural hazards in Hawke's Bay, but the region also has a history of earthquakes, volcanic ash falls and tsunami. Each of these is briefly discussed below.

Flooding

3.12.3 Within Hawke's Bay, there is widespread potential for flooding. Individual rainfall events causing flooding that can range from localised downpours affecting particular catchments, to cyclonic storms causing general flooding over large parts of the region. Considerable flood protection works have been carried out in the region, particularly on the Heretaunga and Ruataniwha Plains. These works have significantly reduced the risk from most flood events. However, very large events exceeding flood protection design standards can be devastating to normally protected areas. Indeed, measures taken to reduce the flood risk, such as river control works and post-disaster relief, can actually increase the catastrophic potential of large floods because they enable an increased occupancy and level of development within flood plains. To be truly effective flood protection works must be undertaken in conjunction with better land use planning, and adequate and timely flood forecasting. ….

Chapter 3.12's singular objective provides for adverse effects of natural hazards to be "avoided or mitigated". The problems associated with not specifying the circumstances where hazards need to be avoided, and where mitigation is not appropriate, nor allowed, has been covered when discussing Chapter 3.1B, above and is not repeated here. It suffices to say that the ability to "avoid or mitigate" the effects of flood hazards provides a pathway for enabling land use development provided some form of mitigation is proposed, rather than specifying that development in specified areas must not occur because of unacceptable flood risk.

Despite the "Explanation and Reasons" for Objective 31 clearly stating the significant risk from flood events which can exceed the design standards and recognising the need to manage flood risk through good land use planning, the policies and methods do not require such an approach to be established.

POLICIES	
POL 55	**ROLE OF NON-REGULATORY METHODS**

Explanation and Reasons

3.12.10 To use non-regulatory methods set out in Chapter 4, as the principal means of addressing hazard avoidance and mitigation, in particular:

(a) Liaison with territorial authorities - To provide information on natural hazard risk to territorial authorities, and advocate that future development is managed in such a way that the risk of exposure to natural hazards is avoided, remedied or mitigated.

(b) Works and services - To provide hazard mitigation measures, in particular flood mitigation measures, where the benefits can be shown to outweigh the costs and the identified beneficiaries can meet the costs.

(c) Natural hazard priorities - To focus both hazard avoidance and mitigation on areas of high human population density as a first priority.

Policy 55, is focused on HBRC's actions and provides no directive guidance nor direction to councils, consent applicants, or decision-makers when they are preparing or implementing objectives, policies and rules relating to flood hazard risks.

The outcomes of relying on the provision of hazard information and advocacy can vary greatly. An example of relative success is the adoption of flood hazard areas as requested by HBRC through a submission on the Central Hawke's Bay Proposed District Plan Review in 2021.

A contrary example is the 2008 Private Plan Change which enabled residential development within the Te Nagrue floodplain. The submissions made by HBRC are acknowledged and summarised by the following excerpt from HBRC's evidence:

> *"It is my (HBRC Technical Expert) opinion, based on the historical flooding (and the disastrous consequences of these previous events) and the study carried out, that mitigation is not a practicable option for the Te Ngaru flood plain. Development and settlement of the floodplain is strongly discouraged due to the risks to life, infrastructure and property damage. It is recommended that for the high risk Te Ngarue floodplain, development should be avoided. Therefore the plan change request should be declined."*[218]

Even with this technical advice to the contrary, the rezoning and subsequent subdivision consent was approved by Hastings District Council with mitigation in the form of minimum floor levels of 15.7 mRL. However, the entire Te Ngarue floodplain, including several completed and partly-constructed residential dwellings enabled by the 2008 Private Plan Change, is now within the Category 3 area (see Appendix D, Figure D4).

218 Clode. G., (2008). Statement of Evidence Tangoio Beach Development - Private Plan Change 31

The Anticipated Environmental Result for Chapter 3.12 are:

Anticipated Environmental Result	Indicator	Data Source
Natural hazard mitigation measures in place to minimise the risk to human safety and the environment from natural hazards	Loss of life and property in a natural hazard event	Emergency services records

These anticipate that natural hazard mitigation measures **minimise** risk to human safety and the environment. This sets a very low bar and one that was not achieved during Cyclone Gabrielle.

9.1.1.6. Chapter 3.14 – Recognition of Matters of Significance to Iwi/Hapu

The objectives and policies in Chapter 3.14 relevant to flood hazard management are as follows [emphasis added]:

OBJECTIVE	
OBJ 34	**To recognise tikanga Māori values and the contribution they make to sustainable development and the fulfilment of HBRC's role as guardians, as established under the RMA, and tangata whenua roles as kaitiaki, in keeping with Māori culture and traditions.**

POLICIES	
POL 57	Where policy is being developed for the management of natural and physical resources the following matters shall be had regard to: (a) Where the effects of an activity have minimal or no measurable impact on the state of mauri, the life sustaining capacity of a resource – no or minimal regulation (noa). (b) Where the actual or potential effects of an activity on the state of mauri are significant – the activity shall be dealt with on a case-by-case basis according to those effects (rahui). (c) Where the impacts of an activity have a severe and irreversible impact upon the state of mauri that activity shall be prohibited (tapu).
POL 58	**To share information on matters of resource management significance to Māori and on processes to address them.**

OBJECTIVE	
OBJ 35	**To consult with Māori in a manner that creates effective resource management outcomes.**

POLICIES	
POL 59	**Consultation with tangata whenua should be undertaken in a manner that acknowledges Māori values, with the fundamental approach in consultation being "kanohi ki te kanohi" (face to face) or personal contact.** Other matters necessary to be exercised are: (a) consideration of a consent application not yet finally decided upon (b) listening to what others have to say (c) considering their responses (d) deciding what will be done (e) appropriate timing).
POL 60	To encourage hapu to develop resource management plans, and to use the plan, when recognised by an iwi authority, to assess the incorporation of Māori values in the planning process
POL 61	Resource management decisions made subsequent to consultation shall show regard for that consultation.
POL 62	The following is the recommended approach for consultation with tangata whenua: (a) Where the issue is at a macro, region-wide level consultation be with iwi. (b) Where the issue is localised, yet non site-specific, consultation be with hapu. (c) Where the issue is site-specific consultation be with whānau.
POL 63	**Consultation involving iwi or hapu is expected generally to be undertaken on a marae. The place of consultation should be determined as a result of agreement between both parties.**

OBJECTIVES	
OBJ 36	**To protect and where necessary aid the preservation of waahi tapu (sacred places), and tauranga waka (landings for waka).**
OBJ 37	**To protect and where necessary aid the preservation of mahinga kai (food cultivation areas), mahinga mataitai (sea-food gathering places), taonga raranga (plants used for weaving and resources used for traditional crafts) and taonga rongoa (medicinal plants, herbs and resource).**

POLICIES	
POL 64	**Activities should not have any significant adverse effects on waahi tapu, or tauranga waka.**
POL 65	**Activities should not have any significant adverse effects on taonga raranga, mahinga kai or mahinga mataitai.**
POL 66	**The importance of coastal, lake, wetlands and river environments and their associated resources to Māori should be recognised in the management of those resources.**

This chapter establishes a significant obligation on HBRC to engage meaningfully with Māori, and acknowledge and protect locations of significance to Māori. The feedback from mana whenua provided to the Panel is that virtually none of the outcomes sought by this chapter have been realised. If anything, many areas of significance to Māori (often the only lands remaining in whānau, hapū or iwi ownership) are highly susceptible to flood hazard and lack sufficient or any physical protection. This is also evidenced by the many urupā and marae damaged by the February 2023 flood. Feedback also consistently stated that protection of these areas did not satisfy HBRC's conventional "cost-benefit" requirements and so no progress had been made on improving resilience in those areas.

9.1.2 Regional plan provisions of the RRMP

The objectives, policies and rules comprising the regional plan portion of the RRMP relating to natural hazards cover matters relating to stormwater management, water management, wetlands and activities such as vegetation clearance, and soil disturbance.

Policy 79 includes environmental guidelines to manage the effects of activities on the beds of rivers and lakes including no reduction in the ability of the channel to convey flood flows, or no significant impedance to the passage of floating debris.

A range of rules related to discharges, diversions, structures, damming, planting and other disturbances of river and lake beds are subject to conditions such as:

- The activity shall not cause or contribute to the flooding of any property, unless written approval is obtained from the affected property owner;
- The activity shall not cause any permanent reduction of the ability of the receiving channel to convey flood flows or impedance to the passage of floating debris;
- There shall be no damage or destruction to flood control or river protection works.

Rule 70 of the RRMP enables activities related to flood control and drainage undertaken by local authorities as a permitted activity, subject to conditions. This rule is pivotal in the implementation of AMPs, as it provides for the majority of HBRC's river management activities to occur without the need for resource consent. Rule 71 requires any other party undertaking activities that may affect a river control and drainage scheme to seek resource consent as a discretionary activity.

Proposed Plan Change 9 (TANK) contains a number of new provisions relating to the management of water quality, allocation and use of water within the Tutaekuri, Ahuriri, Ngaruroro and Karamu (TANK) catchments.

The key objectives and policies seek that land and freshwater in the TANK catchments is sustainably managed as integrated natural resources, and that mauri enhancement and ecosystem health outcomes are achieved. Specific objectives and policies also seek that riparian margins are protected or improved to reduce river and stream bank erosion.[219] Similar to the RRMP rules, the TANK rules also include conditions to ensure that activities do not cause or contribute to flooding, and identify areas at risk to flooding.

The regional plan sections of the RRMP primarily serve to enable flood protection works and prevent activities that exacerbate flooding. As such, the regional planning sections of the RMMP are only tangentially relevant to flood hazard management.

The Panel acknowledges that Section 8.4.4.5 in the "Administrative Matters" chapter of the RRMP sets out the respective functions of the HBRC and the territorial authorities in respect of natural hazards under section 62(1) of the RMA, but it provides little material direction as to outcomes. It is not discussed further.

One area that, in the Panel's assessment, warrants further consideration is to provide greater clarity that the primary function of the Region's flood protection stopbanks is to contain floodwater within the river channel, and to actively discourage incompatible activities which may cumulatively undermine the structural integrity of flood protection structures, such as providing vehicle access to the river and or for motorised recreational activities. It is also recommended that where natural high ground or other topographic features form a critical part of the flood management infrastructure they need to be recognised and protected through planning mechanisms.

Another planning related matter raised with the Panel relates to the operation of the Waikaremoana Hydropower Scheme owned and operated by Genesis Energy. Submissions questioned whether the scheme operated in accordance with its resource consent during Cyclone Gabrielle and whether/the extent to which the scheme contributed to downstream flooding. The Panel has been provided with a report from SLR Consulting[220] which concludes that outflows from the hydropower operation along with reservoir level limits were such that the power scheme had a negligible effect on downstream flooding around Wairoa. The Panel's review confirms the conclusions in that assessment.

The Panel suggests that HBRC should also review resource consents for other activities that may pose a risk to flood management. The need for a review of this nature is highlighted by discussion in Chapter 8. One example cited relates to a hard fill site established near the mouth of the Esk River which may influence the width and capacity of the river at that location.

9.2 The Hawke's Bay Hazard Portal

While the maps included in the Hazard Portal do not have an explicit statutory purpose, they provide a regional overview of natural hazards affecting Hawke's Bay, including defining flood risk

219 Objective 5 and Policies 5, 12, 21, 23 & 24
220 SLR Consulting (2023). Waikaremoana Power Scheme Hydrological Audit

areas. The Hazard Portal is accessed through the HBRC's website (and those of other agencies) and is a useful resource for residents, although accessing the information relies on individuals being aware of its existence.

Flood hazard maps have been produced for select areas of the region, showing "flood risk areas" and "low flood risk areas", using both a contour-based approach and flood modelling. Flood modelling is based on 100-year return period events (1% annual exceedance probability) for river flood risk areas, and 50-year return period events (2% annual exceedance probability) for floodplain flood risk areas. The scale of modelling is not property specific, and each area is assumed to include a 5–50 m buffer. The effects of climate change have not been included in the flood modelling.

Flood hazard modelling has not been undertaken for much of the Hawke's Bay region and some areas identified for greenfield residential growth in the RPS, such as Haumoana and Te Awanga, which were excluded from the study area.

While the mapping identifies general areas exposed to flood hazard, it does not (nor does it purport to) provide detail regarding the potential consequences of a flood event in these areas. The mapping is not sufficiently detailed nor accurate to determine flood risk at a property level. Therefore it is difficult to understand how this information should inform the management of land-use activities in areas exposed to flood risk.

The Hazard Portal is not linked to the RPS or RRMP and the selection of model parameters was not informed by the RPS or RRMP. However, some of the district plans require consideration of these maps.

The Panel has concluded that the usefulness of the Flood Hazard Portal in informing RMA processes, and decisions in respect of individual proposals, is limited. The Panel considers that the RPS should, as a minimum, identify the return period or AEP that should be adopted for undertaking flood risk assessments and determining where development is, and importantly, is not, appropriate. Additionally, flood hazard maps should be developed for flood scenarios in circumstances where the level of service provided by stopbanks and other flood management assets is exceeded.

9.3 District plans

9.3.1 Introduction

As noted above, district plans must give effect to RPSs. It is beyond the scope of our Terms of Reference to address district planning matters, as those functions rest with the territorial authorities. However, we provide an overview of the relevant district plans below, to demonstrate how effective the RPS is / has been in directing how the use of land should be managed by territorial authorities in response to natural hazard risk.

We further note that even absent any policy directive to do so, a territorial authority may refuse a subdivision consent, or impose conditions, if there are significant risks from natural hazards.[221]

221 Section 106(1)(a) RMA

There are four territorial local authorities located solely in the Hawke's Bay region: Wairoa District Council, Napier City Council, Hastings District Council, and Central Hawke's Bay District Council. In addition, the Taupō and Rangitikei Districts each have a small area within the Hawke's Bay region, but those areas have not been considered in this review and are not discussed further.

9.3.2. Wairoa District Plan

The Operative Wairoa District Plan includes provisions relating to natural hazard management, as follows:

- To minimise the vulnerability of the community to the effects of natural hazards on people, property, community services and infrastructure;[222]
- To adequately inform the community of potential risks;[223]
- To ensure land use, development and subdivision does not increase the risk from natural hazard events on communities and the environment.[224]

The associated policies include:

- Preventing activities in areas where the adverse effects of natural hazards cannot be avoided, remedied or mitigated;[225]
- Ensuring the potential effects of natural hazards are taken into account when considering resource consents and require measures to mitigate any risks;[226]
- Recognising the limits of attempts to control natural processes by physical work;[227]
- Avoidance of inundation hazards as the appropriate means of implementing inundation hazard management for new subdivisions. Mitigation is only appropriate where avoidance is not practicable.[228]

The majority of zones provide for any activity (i.e. new dwellings) as a permitted activity (regardless of if it is located within a natural hazard area or not), subject to compliance with standards and conditions for permitted activities. The rules within various zones require any structures or buildings in flood-prone areas to be constructed with a freeboard of not less than 300 mm above the 50-year flood level. If there is any non-compliance with a permitted activity standard or condition, resource consent is either a controlled or discretionary activity. It appears that Wairoa District Council relies on HBRC mapping to identify flood-prone areas despite the text of the Wairoa District Plan indicating that flood hazard areas are identified on planning maps.

All subdivision on land identified on Council records as being subject to natural hazards requires resource consent for a discretionary activity. Each application for a new lot is required to identify whether the land is subject to known natural hazards and whether the development is likely to increase the danger arising from the occurrence of natural hazards. Each new lot created and the

222 Objective 8.4.2
223 Objective 8.4.3
224 Objective 8.4.4
225 Policy 8.5.1
226 Policy 8.5.2
227 Policy 8.5.5
228 Policy 8.5.7

subsequent use of the property following subdivision should not be likely to cause, accelerate, worsen or result in material damage to the land, or adjoining land.

Aerial photographs from the 1980s until the present day indicate that there has been limited additional development within identified flood-prone areas such that there has been very little increase in exposure to flood risk. Although market forces may also have played a role, it would appear that the flood hazard has been acknowledged and regulated appropriately in the circumstances. Notwithstanding this positive comment, existing development in these areas includes residential, commercial and mana whenua assets.

As of the 12th of April 2024, the North Clyde area as well as the low terrace on the right bank upstream of the town bridge is provisionally classified as Category 2C. Further development of the flood protection options is required to move these areas to confirmed Category 2C and eventually to Category 1 upon completion of the works. The same applies to locations in Frasertown.

It is essential that the future development of flood management infrastructure does not enable subdivision and development in areas of high residual flood risk. The risks and downfalls from the construction of stopbanks resulting in intensive development of floodplains has been thoroughly examined within New Zealand and is documented in the seminal publication of Neil Eriksen – Creating Flood Disasters.[229] Wairoa District Council, HBRC, iwi entities, PSGEs such as Tātau Tātau O Te Wairoa and the Wairoa community should consider residual risks and scenarios where flood defence Levels of Service are exceeded to ensure appropriate planning controls are in place which prevent development in the highest risk areas.

9.3.3 Hastings District Plan (operative in part)

The Hastings District Plan contains various provisions relating to the management of subdivision and land use development within areas prone to natural hazards and includes a bespoke "Natural Hazards" chapter (Chapter 15).

Chapter 15 contains objectives that refer to, amongst other things:

- Minimising the effects of natural hazards on the community and the built environment;
- Avoiding increasing the risk to people, property, infrastructure and the environment from the effects of natural hazards.

Policies NHP2, NHP3, NHP4 and NHP5 are particularly apposite. They state:

229 N.J. Ericksen (1986). Creating Flood Disasters? New Zealand's need for a new approach to urban flood hazard. Water & Soil Miscellaneous Publication No. 77

POLICY NHP2	Manage land use activities in identified natural hazard areas where communities and resources are potentially at risk. **Explanation…** **Flooding** Consists of areas of concentrated populations or assets, or localities of high risk identified as being prone to flooding. The Hawke's Bay Regional Council will from time to time produce flood extent maps based on the computer modelling of a range of return period design rainfall events (i.e. 50 to 100-year floods). The individual flood-prone areas identified in the District are: *Clive / East Clive* This identifies properties in the Clive township and properties on the landward side of Muddy Creek at East Clive. *Karamu* This area is based on a computer modelled 50-year flood level in the Karamu catchment but does not include urban areas of Hastings City. *Southland* This area is based on a computer modelled 50-year flood level along the Southland Drain. *Te Awanga* Flood protection works on the true left side of the Maraetotara River, the Leyland and Haggerty drains and the Te Awanga Stream were completed by the Hastings District Council in 2008. A large majority of the urban part of Te Awanga is therefore now protected from a 1 in 50-year river flood event, however a small amount of the township near to and including the Te Awanga motor camp remains at risk of flooding from the Maraetotara River in a 1 in 50-year event. *Haumoana* Computer modelling analysis of likely flooding scenarios for the Tukituki River indicate that, in the event of flooding during a high tide or storm surge, water may back up at the river mouth and spill into the residential area of Haumoana. Flooding is an effect than can and will be mitigated through the use of Building Act regulations where minimum levels for floor height are required. The extent and location of potentially floodable areas of the District, as described above, can be found in Council's GIS system. **River Flooding** Consists of rivers and streams in parts of the District beyond the Heretaunga Plains, which do not have a high degree of flood protection (i.e. stopbanks) and have a history of occasional, severe flash flooding. When this natural hazard occurs, not only is the area covered with water but silt and gravel is often deposited by the floodwaters.

	Fast moving and fast rising floodwaters carrying debris can also pose a threat to human life and properties. Avoidance is therefore the most appropriate approach in relation to this hazard where possible. The valley floor, fans and flood plain of the Esk River Valley are subject to periodic inundation and fast rising flood waters during intense rainfall events. When this natural hazard occurs flooding of properties and land causing damage and temporary loss of use can also occur, posing a risk to life. For new land uses and development, avoidance of the hazard is considered the best approach. The District Plan requires any permanent buildings, structures and habitable buildings within the River Hazard Overlay in the Esk Valley to obtain consent as a Non-Complying activity, thus promoting the avoidance of this hazard. *Te Ngaru Stream (Tangoio)* The Te Ngaru Stream Catchment is located about 20 km north of Napier in the Tangoio area. The catchment area is relatively steep but ends in a flat floodplain at the coast. The floodplain has been inundated many times from flash flooding due to the extremely volatile nature of the runoff in the catchment. There is a risk to public safety and there is generally very little warning time for flooding in this area. However, an area of the floodplain is zoned Coastal Residential. Residential activities and visitor accommodation within the Coastal Settlement Zone at Tangoio is provided for where the floor levels of habitable rooms are equal to, or greater than, the reference level of RL 15.7 (5.7m above mean sea level (MSL)) to mitigate the effects of flooding. Site specific investigations into the localised flood levels in the Te Ngaru catchment and specifically at the Coastal Settlements Zone at Tangoio were undertaken in 2008 as part of a Private Plan change request. The recommended reference level of RL 15.7 is expected to provide protection from a 1 in 100-year flood level plus 500 mm freeboard. *Waipatiki* The Waipatiki Catchment is located about 25 km north of Napier. The catchment is in an area that is known for short duration flash flooding. The settlement of Waipatiki is located on the floodplain near the coast. Safety is of great concern in this valley during flood events since there is almost no warning time for evacuation. Avoidance of the flood-prone areas is preferable where possible and practicable to prevent loss of life and property, however there are properties zoned Coastal Residential where it is not possible nor practicable to avoid the flood hazard. In these instances the recommended freeboard to be used in conjunction with flood levels is a minimum 0.5m to mitigate the effects of flooding.

POLICY NHP3	Adopt and promote the best practicable options (including mitigation or the 'do nothing' option) in the management of areas of existing development actually or potentially at risk from natural hazards. **Explanation** Council, in assessing land use activities and subdivisions in hazard prone areas, will promote and attempt to adopt the 'best practicable option' for each situation but recognises there may be situations where the hazard has a demonstrable negligible effect or where mitigation is suitable to reduce the risks to acceptable levels. There will also be situations where historical development in hazard prone areas (liquefaction and flood hazard areas for example) dictates that avoidance is not possible so mitigation needs to be relied upon to reduce hazard risk.

POLICY NHP4	Adopt and promote an avoidance approach to development located within areas of significant natural hazard risk, rather than mitigation or remedial measures. **Explanation** Primarily, Council will attempt to take an avoidance approach to new and increased development within hazard prone areas where a significant degree of risk may be present. A significant degree of risk is defined as a hazard that has a possible to almost certain likelihood of occurring and major to severe consequences if or when it does occur – as defined in the GNS Science Report 2010/06 June 2010 – *Hazard & Risk in the Hawke's Bay.*

POLICY NHP5	Restrict the establishment of activities which have the potential to increase the extent to which natural hazards have, or may have, an effect on human life or the natural and built environment. **Explanation** Through the District Plan or other legislative methods Council will control or prevent activities where there is the potential for the effects of natural hazards on human life or the natural and built environment to be exacerbated.

The objective and policy framework of Chapter 15 fills many gaps left by the RPS. Of note, these policies provide direction to applicants and decision-makers on how to manage risk in different scenarios. The Explanation of Policy NHP2 provides some certainty regarding where flood hazard risks must be managed by describing areas of the District where flood hazards are known. The Explanation indicates that these are available in "Council's GIS system" but there is no link or information on how to access the GIS system provided. The Explanation of Policy NHP4 defines a "significant degree of risk" which must be avoided for new development.

Chapter 15 includes a number of rules enabling and controlling activities within the River Hazard Overlay. Of note, permanent buildings, structures and habitable[230] buildings within the River Hazard Overlay (except sites zoned Coastal Settlement Zone at Tangoio and Waipatiki) are non-complying activities.[231]

The River Hazard Overlay is included in the planning maps, however, this area is generally confined to a narrow strip along river corridors, including the bed and banks of the river, and potential flood risks for land adjacent to existing stopbanks is not identified. A notable exception is the lower Esk River Valley, where a wider zone of up to 500 m is identified – and which includes a number of existing residential dwellings.

One of the assessment criteria for activities within a known natural hazard area, relates to public safety and is [emphasis added]:

15.1.6.1D	The effects of the occurrence of the identified natural hazard and the consequences of the natural hazard on the proposed activity will need to be assessed. In making this risk assessment the following factors will need to be considered: a. **The extent to which public safety can be achieved**. In assessing the proposal, **regard will be had to methods of ensuring public safety such as early warning systems, emergency management contingency plans, escape routes and any other mitigation techniques.**

Chapter 30, which controls subdivision and land development, seeks to prevent subdivision in localities where there is a significant risk of material damage from natural hazards.[232] Policy SLDP4 is of particular relevance and states:

POLICY SLDP4	Ensure that land being subdivided, including any potential structure on that land, is not subject to material damage by the effects of natural hazards. **Explanation** Some areas within the Hastings District are unsuitable for development, or require specific measures to be undertaken to avoid the effects of natural hazards, these can include flooding, inundation, erosion, subsidence or slippage and earthquake faults (see Section 15.1 of the District Plan on Natural Hazards). Section 106 of the Resource Management Act requires that Council may refuse consent to any subdivision in these areas, or any adjacent or nearby areas that may be affected by the activities that could take place once the subdivision has been approved, unless adequate measures are available to overcome or reduce the risk of the hazard.

230 Habitable buildings means *"any building or part thereof which provides overnight accommodation for people, whether or not it is self-contained..."* Examples of habitable buildings includes dwellings, sleep-outs and visitor accommodation
231 Rule NH12
232 Objective SLDO3

Natural Hazards are included within the general assessment criteria listed in Chapter 30 for controlled, restricted discretionary and discretionary activities. These assessment matters include:

i. Whether the land, or any potential structure on that land, will be subject to material damage by erosion, falling debris, subsidence, slippage or inundation from any source.

ii. Whether there are any methods/measures available to overcome or reduce the risk of any hazard(s), and whether these methods/measures may have any significant adverse effects on the environment.

In assessing the above matters, the Council will have regard to the following:

a. Any information held on the Council's Natural Hazard Database and the Natural Hazards Historical Database

b. The Objectives, Policies and Methods of the Natural Hazards Section of the District Plan (See Section 15.1)

c. Information by suitably qualified professionals whose investigations are supplied with the subdivision consent applications.

While the overall approach seeks to ensure exposure to and the consequences of flood hazards are not increased, most land use activities are controlled by zone-specific rules which enable urban development and subdivision in locations subject to flood risk, provided that this risk is mitigated.

The Rural and Plains Production Zones do not include conditions or standards specific to flood hazard risks and residential activities can generally occur as permitted activities.[233] Urban areas subject to known flood risk and activities which are potentially sensitive to flood hazard risks, such as education centres, places of assembly and visitor accommodation, require resource consent as restricted discretionary activities and require flood risk to be mitigated through minimum floor levels and cross-reference Chapter 15.[234]

Urban development at Tangoio and Waipatiki is managed through the provisions of the Coastal Settlement Zone. Intensification in areas most at risk from erosion and inundation is to be avoided.[235] Flood hazard risks appear to be primarily managed through minimum floor levels and controls on intensification.[236] (The 2008 Private Plan Change in Tangoio is commented on above in relation to Chapter 3.12 of the RPS, and is not repeated here.)

Consideration of natural hazards in relation to Papakāinga activities across the district (Chapter 21) defers to Policy UD6.1 of the RPS.[237] Development plans prepared for papakāinga are to include detail on identifying, and avoiding or mitigating the locational constraints of natural hazards.[238]

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233 For example, Rules PP2, PP3, RZ2, RZ3, CR1, CR2
234 For example, Performance Standards 10.2.5N and 10.2.8B in the Clive-Whakatu Residential Zone, Assessment Criteria 11.2.8B – G in the Haumoana-Te Awanga Residential Zone
235 Objectives CSZO3 and Policy CSZP8
236 For example, Rule CSZ11 and General Performance Standard 12.2.5A
237 Explanation of Policy PKP3
238 Assessment Criteria 21.1.8A

The Hastings District Plan provides some certainty regarding where flood hazard risks are present and what level of risk is unacceptable, however there is significant difference in the extent of flood hazard identified in the District Plan's Flood Hazard Overlay, compared to the Hawke's Bay Hazard Portal.

Areas protected by the Heretaunga Plains Scheme's stopbanks to a 100-year standard are generally not identified as flood risk areas. Despite a level of protection being provided, the residual risk to those areas was highlighted in a 1987 scheme review, as follows:

> *"the whole of the Heretaunga Plains is potentially floodable whatever flood protection works are constructed."*

This was further quantified through residual flood risk mapping (See Appendix D, Figures D9, and D10) of 21 stopbank breach scenarios completed as part of the Heretaunga Plains Flood Risk Assessment.[239]

The need to consider residual risk has not translated into an RPS directive nor land use controls in the Hastings District Plan and subdivisions and development have occurred in flood risk areas across the Heretaunga Plains. For example, following Cyclone Gabrielle, a large area within Pakowhai and Dartmoor has been included in Category 3 with a wider area in Pakowhai being Category 2C. These land classifications go some way towards recognising residual risk and the Panel recognises the challenges associated with restricting land uses in areas where flood risk is managed up to the 100-year event.

The RPS could provide a greater level of confidence in Hastings District Council's flood risk management approach, if the RPS ensured that district plans were required to map flood hazards and consider residual risk when defining unacceptable risk exposure and consequences.

Another notable example of development within an area of residual risk is Ohiti Road at Omahu. This land was subdivided through a Māori Land Court process where, we were advised, HBRC was not provided an opportunity to provide advice on the residual risk. This area is now Classified as Category 2C requiring community level flood management intervention to allow for ongoing use of this land for residential purposes.[240] The relationship between the RMA, and the role of the RPS in informing land use decisions controlled by other legislation is a matter that should be considered further.

9.3.4 Napier City District Plan

Napier City Council has recently notified its Proposed District Plan. It is in the very early stages of the process and, as a consequence of Cyclone Gabrielle, Napier City Council decided that provisions relating to natural hazards should be publicly notified at a later date.

The Operative District Plan contains a topic-specific chapter on Natural Hazards (Chapter 62) which describes flooding hazards in the district:

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239 Hawke's Bay Catchment Board and Regional Water Board (1989). Heretaunga Plains Flood Risk Assessment
240 HBRC Response to Q43 from the Panel

Flooding Hazard Area

The Heretaunga Plains are alluvial and there are a number of rivers that traverse this area. Within the Napier City boundary there are two major rivers – the Esk and the Tutaekuri. Considerable flood protection works have been undertaken, especially on the Tutaekuri. However, very large rainfall events could exceed the design standards for these works and the potential for flooding exists. The Heretaunga Plains Flood Hazard Study 1999 was carried out by the Hawke's Bay Regional Council on the flood risk from a breach of stop banks along the Tutaekuri River. Major breach scenarios at Taradale and Brookfields indicate that most of the Napier urban area (excluding the Hill areas) would become inundated.

Flood paths and ponding areas have been identified and this information has been used in considering Napier's urban growth options and for the provision of suitable pumping systems to ensure that ponding will not have a significant impact.

This type of flooding is an effect that can and will be mitigated through the use of the building regulations where minimum levels for floor height are required.

River Hazard Area

The effects of rising river levels cannot be as easily managed as ponding-style flooding covered by the Flooding Hazard Area. Areas identified within the River Hazard Area will be subjected to fast moving floodwaters during extreme weather events. With River flooding there is a high risk of loss of life if effects are not mitigated effectively. Due to the magnitude of the risk involved, the properties within the 'River Hazard Area' will be subject to more stringent controls than areas within the 'Flooding Hazard Area'.

Local authorities exercising their statutory powers will be permitted to undertake natural hazard mitigation activities where they follow the provisions of the relevant statute and they have expertise in this field, as and where required.

River Hazard Areas along the Esk Valley and the Tutaekuri River are mapped in the District Plan. These areas are generally within the bounds of existing stopbanks and are therefore limited in spatial extent. The Flooding Hazard Areas are not publicly available and it is assumed those maps are used to set floor levels through the Building Act.

The objectives seek to manage the effects of natural hazards on land uses and control the effects of land uses and development on areas subject to natural hazards.[241] Policies to achieve these objectives include:

- Identifying natural hazards, collecting information and monitoring the state of and effects of natural hazards;[242]
- Controlling the subdivision, use and development of land to ensure that risks to the community are avoided, remedied, or mitigated;[243]
- Ensuring that practical protection methods are considered;[244]
- Directing development away from areas known to be subject to natural hazards;[245]
- Controlling existing development in areas subject to natural hazards.[246]

241 Objectives 62.3 and 62.4
242 Policies 62.3.1-3 and 62.4.3
243 Policy 62.3.4
244 Policy 62.3.5
245 Policy 62.4.1
246 Policy 62.4.2

Local authorities exercising their statutory powers are permitted to undertake natural hazard mitigation activities in the River Hazard Areas, subject to conditions.[247] Any other activities which are not associated with network utility operations require resource consent as a discretionary activity.[248]

Volume 2 of the Operative District Plan comprises the Code of Practice for Subdivision and Land Development. It includes provisions directing the consideration of natural hazards in relation to land development, including:

5.1.5 Objective 5

The maintenance of acceptable levels of risks posed by natural hazards and the effects of climate change to the environment and inhabitants of Napier City.

The avoidance or mitigation of the risks posed by natural hazards on the inhabitants and the environment of Napier is an important element of sustainable management, in that natural hazards can inhibit the opportunities for people and the community to provide for their health, safety and wellbeing. This matter should be addressed prior to the development and use of land, particularly at the subdivision stage.

5.2.6 Policy 6

To identify natural hazard-prone areas and, where appropriate, to control the use and development of land (including subdivisions) to avoid, remedy or mitigate the effects on the natural hazard or the effects of the natural hazard on the developments.

Explanation: Napier is at risk from a variety of natural hazards due to its low lying topography, coastal location, proximity to earthquake fault lines and the erosion potential of parts of the district. Identification and imposition of special controls will be an on-going process.

6.1 Controlled Activities

6.1.1. Any land development (including any subdivision) is a controlled activity, where it is stated as a controlled activity under the specific rules contained within Volume I of the City of Napier District Plan (including the Ahuriri Section).

…

The matters over which the Council shall exercise its control shall be the following:

c. all engineering work shall take into consideration any hazard mapping prepared by Hawke's Bay Regional Council or Napier City Council.

Most zones within Volume 1 of the District Plan provide for land development (including subdivision) as a controlled activity and other urban land uses, such as Residential Activities, are permitted or restricted discretionary. Permitted conditions refer to compliance with the relevant provisions of the Natural Hazards Chapter (Chapter 62). There is limited scope for consideration of flood hazard management through subsequent applications to change or intensify land use in ways which might increase risk.

247 Rule 62.10
248 Rule 62.13(c)

While the Operative District Plan acknowledges flood hazards are present, it is not transparent about the location of flood hazards and seeks to primarily manage flood hazards at the time specific land development proposals are being considered. Given the entire Esk Valley floodplain was inundated to significant depth in 1938 and was classified as a flood hazard zone by HBRC (see Appendix D, Figure D6) it is somewhat surprising to see the limited extent of flood hazard mapping included in the Operative Napier District Plan. Hence our recommendations elsewhere about strengthening the RPS.

It is highlighted that the land categorisation process only covers property affected by Cyclone Gabrielle and it is likely that there are other properties exposed to the same level of flood risk (but which did not materialise given the specific conditions during Gabrielle). It is recommended that HBRC review and strengthen the provisions of the RPS so that areas of flood risk are consistently identified and included in district planning maps, and provisions are included which ensure building and development in areas subject to high levels of flood risk is prevented.

9.3.5 Proposed Central Hawke's Bay District Plan – Appeals Version

The Proposed Central Hawke's Bay District Plan – Appeals Version ("Proposed District Plan") includes a topic-specific Natural Hazards chapter.

The Natural Hazards chapter includes objectives that seek to increase the awareness and understanding of natural hazard risks in the district, that significant risks from natural hazards and the effects of climate change on the community are minimised and that any increase in risk to people, property, infrastructure and the environment from the effects of natural hazards are avoided, remedied or mitigated. Relevant policies include:

- Having up-to-date natural hazard information available, in conjunction with HBRC;
- Adopting the best practicable option for managing both existing and new activities in areas at risk from natural hazards;
- Requiring climate change effects to be built into natural hazard risk assessments;
- Preference for subdivision, land use activities or other new development to be located and designed so that natural hazard mitigation activities are not required;
- The adoption and promotion of an avoidance approach to the establishment of new vulnerable activities and Building Importance Category 4 structures with post-disaster functions located within areas at significant risk from natural hazards;
- Enabling activities that reduce the risk of adverse effects from natural hazards (including relocation of structures within areas at significant risk of adverse effects from natural hazards);
- Allowing public authorities to carry out natural hazard mitigation activities.

The Proposed District Plan maps identify natural hazard areas, including Flood Hazard Areas. Zone 1 includes very high risk areas such as the main channel of a major river as well as high risk areas adjacent to main rivers, in an overland flow path, or where there is a risk of flooding due to stopbank failure. Zone 2 includes areas adjacent to Zone 1, where the flood risk is considered low.

Land use rules control new structures in Flood Hazard Areas according to "Building Importance Category". In Flood Hazard Area Zone 1, only structures presenting a low degree of hazard to life and other property – such as farm buildings or temporary buildings – are permitted, while residential activities are classified as restricted discretionary. Residential activities of a certain scale and form are permitted in Zone 2. Assessment Matter NH-AM4 requires the effects and the consequences of natural hazards to be assessed, and specifies that the following matters need to be considered:

a. The extent to which public safety can be achieved. In assessing the proposal, regard will be had to methods of ensuring public safety such as early warning systems, emergency management contingency plans, escape routes and any other mitigation techniques;

b. Assessment of the probability, magnitude and consequences of the cumulative natural hazards that affect the proposal;

c. The type, scale, and distribution of any potential effects from the cumulative natural hazards that affect the proposal;

d. The extent to which verifiable new information from a suitably qualified professional demonstrates that any land within an area identified on the District Planning Maps or held in Central Hawke's Bay District Council or HBRC databases (i.e. GIS or web-based portal) as potentially subject to a natural hazard is not under threat from the hazard concerned or that the hazard is negligible;

e. The potential risk to life, and economic and built environment risk associated with the proposed activity;

f. The health and safety of potential property owners and/or occupants of the building(s);

g. The effects on the community including physical, economic, and cumulative effects;

h. The nature and type of land use activity proposed and its potential maximum occupancy;

i. Whether the proposal will result in consequences to other properties or infrastructure as a result of the natural hazard occurring.

In addition, the Proposed District Plan's subdivision rules include conditions relating to whether the land being subdivided within a Natural Hazard area identified on the Planning Maps. If land is within a Natural Hazard area the subdivision is classified as restricted discretionary. Assessment criteria relate to:

- Whether the land will be subject to material damage from a natural hazard;
- Whether there are methods or measures to overcome or reduce the risk;
- Access during and after a natural hazard event.

When assessing the above, regard must be had to information on the District Council's hazard register or the Hawke's Bay Hazard Portal, investigations supplied with subdivision applications, and the objectives, policies and methods of the Natural Hazards chapter.

While the Panel generally supports the Proposed District Plan's approach to identifying and managing flood hazard risks, we acknowledge that it has not been driven by the RPS. The provisions in Chapter 3.1B of the RPS, regarding urban development, overwhelmingly relate to the Heretaunga Plains subregion and which clearly are not applicable to Central Hawke's Bay, and as discussed above, even region-wide policies provide little to no direction on how flood hazard risks should be addressed.

The RPS's approach whereby mitigation is always an available option is evidenced through the Proposed District Plan's objectives, restricted discretionary status for activities in areas subject to flood hazard risks, and associated assessment matters. For example, a subdivision application must demonstrate that flood hazard risks can be "overcome" or "reduced". There is no direction regarding the level of risk reduction that is required to be achieved.

This is a case in point of why we have recommended that the RPS be amended to provide greater guidance to district plans and decision-makers under the RMA regarding where mitigation of flood risk will be appropriate, and where it must be avoided.

The flood hazard mapping for Central Hawke's Bay (see Appendix D, Figure D13) produced by HBRC in 2021 provides a sound basis for decision making relating to avoiding development in high risk areas. It is noted that HBRC sought these flood hazard areas to be adopted through their submission on the Proposed District Plan and they have subsequently been adopted alongside rules controlling land use within the identified flood hazard areas.

In particular, the Panel supports the identification of areas around Bush Drain and Papanui Stream towards Lake Roto-ā-Tara as high risks (see Appendix D, Figure D15). Flooding experienced in these areas during Cyclone Gabrielle demonstrates the importance of identifying and planning for residual risk and the failure of stopbank assets. HBRC is encouraged to work with Central Hawke's Bay District Council to ensure these residual risks are appropriately managed and any applications for development in these areas are carefully assessed.

The flood mapping (see Appendix D, Figure D17) incorporated into the Proposed District Plan for Pōrangahau is not dissimilar to that which occurred around the settlement in February 2023. As of September 2023, the Pōrangahau settlement including the marae, urupā and kaumātua housing on the south side of the river are provisionally identified as Category 2A. Further work is needed to understand whether community level or property level interventions can be developed to adequately manage the flood risk within this community.

As with other areas of known flood risk in Central Hawke's Bay, future development in Pōrangahau will be subject to the controls included in the Proposed District Plan. It is recommended that HBRC takes a precautionary approach and works with Central Hawke's Bay District Council to ensure that further development in high flood risk areas does not occur and ensure mitigation is not available to progress inappropriate development in high risk areas.

9.4 Summary comment on the effectiveness of the RPS

The RPS must take a region-wide perspective and needs to be more directive regarding the management of flood hazard risks, and natural hazards more generally. In the Panel's opinion the RPS requires a significant overhaul.

Key policies for flood hazard management are inwardly focused, and do not provide definitive direction to territorial authorities on how their district plans should identify and manage flood hazard risks.

Currently, the RPS requires the "avoidance or mitigation of the adverse effects of natural hazards",[249] and identifies non-regulatory methods as the principal means of natural hazard avoidance and/or mitigation rather than providing clear and directive policies which seek the avoidance of development in high risk flood hazard areas.

While HBRC's role in non-regulatory advocacy and provision of information are important, these functions need to be adequately resourced to ensure their effectiveness, and need to be supported by a strengthened regulatory approach.

Key areas which in the Panel's view, require better direction and guidance through the RPS are:

A consistent approach to identifying flood hazard areas

While the Hawke's Bay Hazard Portal provides a high-level indication of risk exposure for those who know of its existence, the usefulness of its flood hazard maps in informing RMA decisions is limited. Without direction from the RPS, the approach across District Councils has been varied but identification of flood hazard areas is relatively limited and does not identify areas at risk if the level of service provided by an existing flood management scheme is exceeded.

In addition to the matters set out below, the RPS should identify the return period or AEP that should be adopted for assessing flood risk at specific locations. Flood hazard maps should also be developed for flood scenarios exceeding the levels of service provided by stopbanks and other flood management assets.

In assessing flood frequency, HBRC should include the 2023 flood event as well as other notable historic floods to ensure the underestimation of flood risk in Pōrangahau and the Esk Valley is not repeated there or elsewhere in the Region.

Consideration of the effects of climate change on flood hazards

The consequences of climate change, such as more frequent and more severe weather events, need to be taken into consideration when identifying and assessing flood hazard risks. Where urban centres are located near river mouths or low-lying coastal areas, river flood and ponding hazards may also be affected by sea level rise. These effects of climate change will have significant impacts on the return period or AEP of flood events in future, and the level of service provided by flood management schemes. The RPS should indicate what timeframe over which climate change effects should be assessed to ensure a consistent approach across the region. A 100-year timeframe would be consistent with the NZCPS, noting that absent any structural intervention, the current levels of service will decline over time in response to climate change.

Identifying unacceptable risk

Defining unacceptable risk needs to include consideration of both exposure to and consequences of flood hazards. Some activities can tolerate a higher exposure to risk than others because the consequences may be lower. The RPS should provide explicit direction on locations that are exposed to intolerable levels of risk and activities that may result in unacceptable consequences.

249 Objective 31 of the RPS

Explicit direction that unacceptable risks must be avoided

As currently drafted, the RPS provides for the mitigation of flood hazard risks, regardless of the scale or consequence of the risk. A clear and directive set of objectives and policies would direct decision-makers when to decline application for inappropriate activities in locations which are considered to have unacceptable levels of risk. The term "avoid" could also usefully be associated with prohibited activity status rules, so that it is clear that applications cannot be made for certain activities in particular locations. The RPS should not allow district plans to provide pathways for inappropriate activities in areas where the risks are unacceptable through the provision of mitigation measures.

Identifying types of mitigation that are acceptable

Where it is not necessary to avoid risk, **the levels of** exposure to and consequences of the risk needs to be determined and mitigated. As the RPS does not identify what types of mitigation is appropriate for managing flood hazards, discretion is left to district councils to determine – either in their district plans or on a case by case basis. Some forms of "mitigation", such as provision of evacuation routes or warning sirens, depend on the reliability of physical infrastructure, systems, and processes. The numerous failures observed during Cyclone Gabrielle in relation to rainfall projections, flood modelling, repeaters, generators and batteries indicates the significant consequences when too much trust is placed on mitigations for protecting human life and property. The RPS should, therefore, provide more directive guidance on this matter.

Identify and manage residual risk

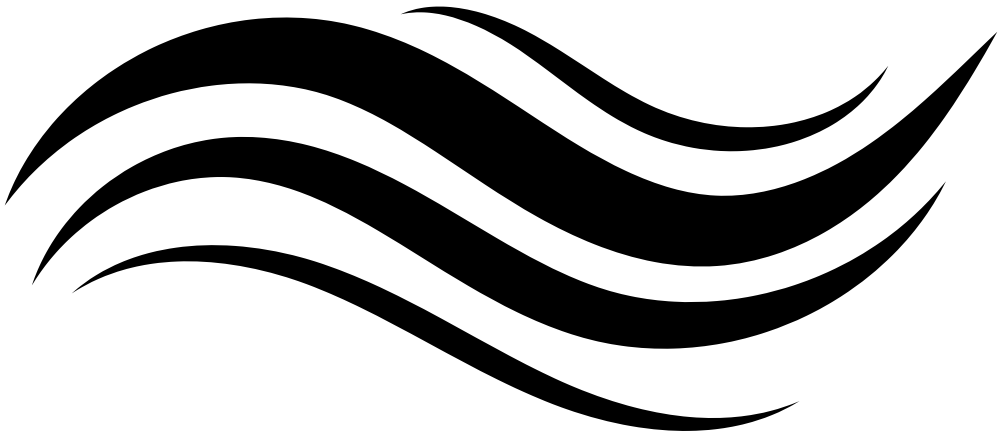
History in Hawke's Bay and elsewhere is that as land becomes better protected from flooding, the pressures to further develop that land and intensify activities on it increases. The Panel considers that HBRC should remain vigilant to the residual risk associated with ponding and overtopping of stopbanks, pump failures and the like, and ensure that residual risk is managed through robust land use controls. The Panel notes that flood mapping adopted into the Proposed Central Hawke's Bay District Plan goes some way in this regard and we highlight the Kāpiti Coast District Plan as another example of identifying and managing residual flood risk through land use planning.

Identify areas where managed retreat from areas with high flood hazard risk is required

There may be areas unaffected by Cyclone Gabrielle that are within a high flood risk area. HBRC needs to identify these areas and determine whether the activities in those areas are appropriate, or whether managed retreat is to be explored with that community.

Address inconsistencies between Chapter 3.14 and other RPS chapters, particularly Chapter 3.12

The Panel observes that the land currently occupied by Māori communities is typically the remnant of much larger holdings they held prior to the arrival of pākehā. These areas are often subject to high flood risk and Chapter 3.12 does not appropriately acknowledge HBRC's obligations, including those in the RPS to protect these locations.



CHAPTER 10:
Conclusions and recommendations

The approach taken by the Panel has been to gather information, data and perspectives from a wide range of sources including first-hand accounts of the flooding, detailed technical reports from HBRC, kōrero from mana whenua, thorough analysis of the flood event size from NIWA as well as insights from the wider community. This information has provided the basis for understanding what happened during this flood event and assessing the performance of the HBRC systems and processes from the perspective of overall statutory compliance and alignment with accepted good practice for flood risk management in New Zealand.

One of the key challenges in completing this assessment has been the extraordinary scale and magnitude of this event, with the whole region affected and the most densely populated Heretaunga Plains experiencing an unprecedented 1000-year flood event. The event largely overwhelmed any structural flood defences in its way and rivers spilled onto floodplains that they hadn't occupied for a great number of years.

But in a number of places this wasn't the first time in living memory that extensive floodplain inundation had occurred. The Esk Valley, in particular, was an example of history repeating itself; reflecting the 1938 flood event which was of similar magnitude to the 2023 flood. Given what was known of the 1938 flood, the key question is: was there adequate planning, preparation and management for another flood of similar magnitude? A summary of the answers to this question and the recommendations arising is provided below.

The key overarching issue is the limited capacity of the region's river and social systems to manage increased flood size and frequency as we move towards a future defined by climate change and ever increasing asset values. The legacy flood management infrastructure developed through the past century is, in many places, no longer fit for purpose and needs to be substantially upgraded and re-imagined to provide a safe, healthy and resilient river, floodplain and overall catchment system.

The key strategic arrangement of the catchment system needs to be based around the evolving global best practice of "Making Room for the River" and "Natural/Nature Based Solutions". This type of design is a step-change from current practices and involves a far higher level of sophistication in the conceptual arrangement of the system. Fundamental to this is designing the system so that its performance in super design events is known, not left to chance – which is a feature of many of the current systems.

Within the overarching frameworks of "Making Room for the River" and "Natural/Nature Based Solutions" the fundamental and accepted best practice tools of floodplain management planning still apply, namely:

- River maintenance (gravel extraction, channel clearing, riparian management);
- Structural works (stopbanks, overflow channels, diversions, spillways, storage);
- Planning controls (prohibiting development in high risk areas);
- Event management (accurate flood forecasting to enable precautionary evacuations of manageable areas).

Equally important as these technical matters is recognising our unique place as Aotearoa/New Zealand and how we apply these technical principles working in partnership with mana whenua and other communities. Creating our own unique interpretation of "Making Room for the River"

and "Natural/Nature Based Solutions" based on blending mātauranga Māori with western science and engineering provides the key to opening the gateway on our path to more effective flood risk management.

Fundamental in the development and implementation of improvements to the flood risk management systems is active involvement, collaboration and partnership with mana whenua, communities and stakeholders. Only through genuine involvement in this process will it be possible for truly effective long-term solutions to be developed and implemented. Through this process, the disproportionate impact on mana whenua needs to be fairly and equitably addressed whilst prioritising the cultural significance of particular parts of the whenua.

Equally important and constraining the scope of how far flood risk management infrastructure can be taken is the question of funding and affordability. A shift back to the central government partially funding these works is likely needed to achieve effective long-term solutions, as well as a greater weighting to regional rather than local rating contributions to budgets. This would mean a return to the practices of the past century when most of these large schemes were constructed using up to a 70% subsidy from the central government with the rest made up from regional funding through rates.

It is noted that the 2024 Government Budget includes $200 million in grants and loans to co-fund flood resilience projects requested by regional councils in Before the Deluge 2.0.[250] Further ongoing investment will be needed to upgrade, improve and maintain the legacy systems around the country.

As well as this broader-scale funding for capital and maintenance works, HBRC needs to consider the resourcing of its flood risk management function so it can effectively deliver day-to-day activities including key planning and advisory functions; as well as managing physical maintenance and construction works and having sufficient contingency and back-up for fulfilling flood event management responsibilities.

Further discussion is provided below under the four key categories of flood risk management tools as well as mana whenua/mātauranga Māori, community and resourcing/funding.

10.1 Structural works

This flood event clearly demonstrated the fundamental issue with the primary type of structural works used in flood risk management, namely stopbanks. They can only contain floods up to a certain size before they begin overtopping and failing. In itself, this is not the only issue, it is also understanding what happens when the design is exceeded and having effective systems and processes in place for managing the residual risk. In particular, planning controls are needed to restrict intensive residential development so there aren't more people and assets put at risk, and achievable emergency management provisions for evacuation from defined and known areas are essential.

This clearly illustrates the interconnected nature of flood risk management tools and how all of them need to be considered and to work cohesively to achieve an effective system. Noting that

250 Te Uru Kahika (2023). Before the Deluge 2.0 Updated case for co-investment in flood management infrastructure following Cyclones Hale and Gabrielle

only some of the major rivers across the region currently have stopbank systems, this is important to highlight along with the likelihood of more stopbanking, particularly where communities consider options for moving out of the Category 2C designation.

The functioning of the Heretaunga Plains stopbank system of the Tutaekuri and Ngaruroro Rivers clearly demonstrated these principles, with significant uncertainty around how they would perform in overdesign events. This led to a completely impractical evacuation scenario where 100,000 people would have potentially had to be moved.

On the flip side, in areas where there were no flood management structures (for example, Wairoa, Tangoio, Esk, Pōrangahau) the communities are completely reliant on Planning Controls and Emergency Management to manage flood risk. As a result of the 2023 flood, many of these communities are now in the process of developing stopbanking options and this process must take heed of the lessons learnt from the Heretaunga Plains system during this event.

Specifically related to the design of these works, taking a "Making Room for the River" and "Natural/Nature Based Solutions" approach is the evolving global best practice for flood and erosion risk management. The New Zealand River Managers Special Interest Group recently released guidelines[251] on the application of these concepts to New Zealand Rivers and Streams including reference to international guidelines[252,253] promoting the use of "Natural/Nature Based" solutions.

In general terms these solutions can include retreating stopbanks and erosion protection infrastructure to allow more natural river functioning through meandering and lateral erosion; as well as allowing floodwaters to spill, flow and be stored in a controlled manner through secondary systems capable of conveying very large floods. The overarching objective is to safely convey very large floods from the upstream end of floodplains to the sea.

This naturally leads to the question: how big should the flood be that is designed for? This has two elements, firstly assessing and understanding the flood frequency of a particular catchment which, most importantly, incorporates large floods from the historic record. This is particularly highlighted in the Esk Catchment where the largest flood ever recorded in 1938 was not accounted for in the flood frequency analysis that informed the flood mapping and risk assessment for the Esk Valley Floodplain. With two floods of around 2,200 m^3/s in the past 100-years, a flood of this size cannot be considered an outlier and should be incorporated into design, planning and flood event management with the addition of reasonable allowance for further increases due to climate change.

Secondly, once the flood frequency is understood, a design standard should be evaluated in terms of the value of damage that can be avoided from that investment. This type of analysis[254] which will provide the most economically efficient solution where overall costs are minimised, should be considered as part of the options consideration process. Other factors include minimum standards to meet Building Act 2004 requirements (50-year), as well as subdivision and insurance requirements (100-year).

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251 Christensen K.J. (2023). Application of Room for the River for NZ Rivers & Streams. NZ River Managers Guidelines

252 Ciria (2022). The Natural Flood Management Manual. CIRIA C802

253 Bridges, T. S., J. K. King, J. D. Simm, M. W. Beck, G. Collins, Q. Lodder, and R. K. Mohan, eds. 2021. International Guidelines on Natural and Nature-Based Features for Flood Risk Management. Vicksburg, MS: U.S. Army Engineer Research and Development Center

254 See Kind J.M. (2014). Economically Efficient Flood Protection Standards for the Netherlands. Journal of Flood Risk Management 7(2014) 103-117

In light of the above and our analysis, the Panel recommends:

1. HBRC should prioritise the objective of safely conveying large floods from the mountains to the sea in order to minimise and prevent damage from floods and erosion.

2. HBRC should ensure that the residual risks associated with floods that exceed the design capacity of stopbank systems are identified, assessed and actively managed. This could be through a combination of planning controls, changes to stopbank systems (e.g. spillways) and event management (e.g. proactive evacuations).

3. When designing new flood management works or improvements to existing systems, HBRC should consider the evolving best practice of "Making Room for the River" in terms of lateral erosion and floodwaters. For example, secondary systems including spillways, diversions and storage areas should be considered with the objective of directing floodwater to identified areas with the lowest consequences to the communities of Hawke's Bay. In addition, these solutions should have known performance in super design events that enables effective event management including precautionary evacuations where appropriate.

4. HBRC should collaborate with mana whenua and other communities in developing fair and equitable flood management solutions. These solutions should recognise and compensate appropriately those properties that are adversely affected in order to achieve an overall community benefit.

5. HBRC should determine the design standard of improved flood management systems based on robust economic analysis to determine the minimum net cost accounting for the investment required for the flood mitigation works and the value of flood damages avoided due to those works. The widely applied 100-year, including climate change, should be considered the minimum standard and not the default standard. This will necessitate a consideration of the flood management standards and long-term budgets, an example being the 500-year flood standard for the entire Heretaunga Plains Scheme within the current Long Term Plan.

6. When designing flood management works or assessing the adequacy of existing works, HBRC should include historic floods that have not been measured as part of the systematic record in the analysis. For example, the inclusion of the 1938 flood flow estimate for the Esk Valley significantly affects the assigned frequency of the 2023 event. Similarly, for Pōrangahau the inclusion of the 1941 and 1953 flood events significantly changes the assessment of the 2023 flood frequency and the basis for what is a reasonable design standard for the future.

7. When assessing and designing flood management systems near river mouths, HBRC should incorporate scenarios that consider partial blockage situations, as well as a range of sea-level and storm-surge conditions. By way of example, at the Esk River mouth the interaction with the adverse coastal conditions in addition to significant debris loading is likely to have increased flood levels in the lower reach of the river.

8. When assessing and designing flood management systems near bridges, HBRC should incorporate scenarios that consider partial blockage situations and account for these in the design. The breaching of stopbanks immediately upstream of bridges was a notable feature of this event, with the breach at Awatoto being a clear example.

9. HBRC should ensure that where natural high ground forms part of the flood management system, it is identified and protected appropriately so that it maintains its functionality over time. For example, it was unclear whether the high ground upstream of Waiohiki marae was at the same level during the flood as it was when surveyed and assessed to be up to the 100-year design standard.

10. HBRC should undertake a review of activities allowed on river floodway berms and stopbanks to ensure that the flood management infrastructure is protected from damage and or ongoing maintenance requirements that would otherwise not be required. For example, the use of motorbikes and 4WD vehicles on the Waipawa and Ngaruroro Rivers.

11. HBRC should review the efficacy of deflection banks on stopbanks to ascertain their benefits and the risks of isolated turbulence that can contribute to increased flood levels and or erosive failures of stopbanks. This is particularly relevant on the Ngaruroro River, where stopbank breaches occurred where these features were located.

12. HBRC should review the alignment of access tracks over the crests of stopbanks, with a preference for their starting from the downstream end and heading up the stopbank to reduce turbulence that may affect stopbank performance.

13. HBRC should undertake regular monitoring and topping up of the stopbank crests around access tracks to ensure crest levels are maintained. The most notable example of this was the access track immediately upstream of the bridge across the Ngaruroro River at Omahu, where a breach occurred.

14. HBRC should complete a risk assessment of adverse stopbank alignments, including sharp bends and locations where stopbanks are in very close proximity to river channels. The risk assessment should include prioritised mitigation measures to manage these risks. One notable example is the Walker Road stopbank on the Waipawa River, which is perpendicular to the direction of river flow and very close to the active river channel.

10.2 Flood event management

The magnitude of this flood significantly exceeded the capacity of stopbank systems, causing significant inundation of the unprotected floodplains; meaning the key issues experienced around the event's management provide valuable learning points for future improvements.

Firstly, as noted earlier, the design of the stopbank system directly relates to how and where it is going to fail during a super design event. If super design events haven't been incorporated into the design with spillways, overflows, known failure points, then you cannot readily determine where floodwaters will go during an overdesign event. This might be ok for relatively small, sparsely occupied areas (e.g. North Clyde, Tangoio, the Esk Valley, Pōrangahau) where you can evacuate the whole floodplain as a precautionary measure. But it doesn't work for densely populated areas like the Heretaunga Floodplain where you would potentially have to move in excess of 100,000 people in a short period of time.

The fact that there was no event management plan for the Heretaunga Plains was a result of there being no way of predicting where overflows would go and no practical way of evacuating all the people possibly affected from the entire area. It may have been foreseeable that the upstream areas would fail first, as this is where the floodwave arrives first, and that any overflows from Moteo would affect Omahu and Pakowhai. Likewise, Waiohiki would always flood before Taradale, due to the different levels of protection on the stopbanks on each side of the river (500-year Taradale vs 100-year Waiohiki).

Considering areas where there was no stopbanks, and known flood risk (North Clyde, Tangoio, the Esk Valley and Pōrangahau) the level of pre-event planning was very limited, as evidenced by the HBRC Flood Manuals, and advice through the event appeared ad-hoc with a lack of clarity on what was actually being predicted. The accuracy of the advice was also significantly hindered by under-forecasting, as well as a repeater failure and the loss of some rainfall collection sites, affecting the ability of HBRC's flood forecasters to rely on measured rainfall.

As already highlighted for the Esk and Pōrangahau floodplains, the significant flood events of the past 100 years were not included in the flood frequency and flood risk mapping and as such the understanding of the depth and extent of possible flood inundation was likely underestimated. Having accurate flood risk information which includes large historic floods is essential for effective flood event management planning, including understanding trigger levels and likely extents and depths of inundation.

Notwithstanding the above limitations it is acknowledged that HBRC did circulate flood maps that it had on hand, generally of the 100-year flood extents, at least 24 hours prior to the flood peaks occurring. In some instances this information was contextualised as "worst case scenario" and the language used in communications to CDEM was not as clear and decisive as it could have been. This may have affected the decision making of territorial authorities and Civil Defence in terms of issuing warnings and initiating evacuations of at risk areas. A more precautionary approach which reflected the uncertainty in the forecasting predictions as well as the consequences of underpredicting the event using clear and decisive language could have provided a better outcome.

It is clear that improvements in the monitoring, telemetry and repeater network are needed, along with improved rainfall forecasting, to ensure accurate information can be provided to those who need it during events. Communication needs to be clear around expected areas of inundation with pre-prepared maps of a range of flood inundation scenarios that everyone can understand. A precautionary approach should be adopted.

In light of the above and our analysis the Panel recommends:

15. HBRC should actively communicate and educate communities on the levels of flood risk to which they are exposed and assist them in improving their resilience to flooding, including, but not confined to, improving and updating the HBRC online Hazard Portal.

16. HBRC should ensure that flood risks are accurately quantified and that flood frequency assessments include significant past flood events.

17. HBRC should improve its systems and technology for monitoring and modelling rainfall in real time in order to provide more accurate and timely forecasts of river flows and associated flood inundation across the region. For example, communication stations should have adequate back-up power supplies to ensure continual operating when needed, and it should be clear when data is not being gathered or transmitted. Inundation maps for a range of events should also be readily available.

18. HBRC should identify specific trigger levels for alerts and recommended evacuations for known flood risk areas, document them in its Flood Manual[255] and communicate them to those who are affected.

19. HBRC should ensure that robust systems are in place to alert the community when trigger levels are being approached or exceeded and ensure Civil Defence has all the information it needs to undertake its functions. This could include providing greater public access to HBRC river flood forecast information.

20. HBRC should take a precautionary approach when providing forecast flood inundation information to Civil Defence. The use of "worst case scenario" terminology should be avoided as it may convey a potentially inaccurate and overly optimistic assessment of what may actually occur. All communications regarding potential flood inundation should be as clear and decisive as possible.

21. The Panel endorses the recommendations of the Hawke's Bay Regional Council Cyclone Recovery Committee Telemetry Review (August 2023), the Report of the Independent External Review for Hawke's Bay Civil Defence and Emergency Management Group (March 2024) and the Report of the Government Enquiry into the Response to the North Island Severe Weather Events (March 2024).

255 A document that describes key processes and activities for Regional Council staff and contractors in the lead up to and during flood events

10.3 Planning controls

The concept of controlling land use to manage development in areas where there is a high degree of flood risk is simple. However, residential developments have been allowed to occur in locations such as Esk Valley and Tangoio despite a well-documented history of significant flooding. Such areas are considered unsafe for residential use and are now within the Category 3 Classification. Similar declarations were made by the relevant authorities at the time following the 1938 Esk Valley Flood and the 1963 Tangoio Flood. Weak and insufficient planning direction has enabled poor planning decisions and shows just how short society's memory is when it comes to matters of flood hazard management.

This highlights the fundamental importance of including large historic floods in the flood frequency analysis and the delineation of flood hazard areas. Historic floods cannot be ignored or written off as outliers when assessing flood risk for the purpose of controlling land use.

Among HBRC's responsibilities under the RMA is the responsibility to prepare, implement and review an RPS. Large parts of the RPS, including the Natural Hazards chapter, have not been reviewed since the RRMP was made operative in 2006. These provisions are now almost 20 years old and are in dire need of a review to reflect more modern approaches to flood risk management and address significant gaps in the RPS.

The RPS is also largely inwardly focused, predominantly directing HBRC their own non-regulatory functions, rather than directing the development of District Plans to enable an integrated approach to flood hazard management.

While this non-regulatory approach appears to have been successful in ensuring the district plans include rules which enable HBRC to undertake river management works, the limitations on relying on advocacy are demonstrated by the 2008 Private Plan Change at Tangoio. Despite technical evidence strongly opposed to the subdivision, the proposal went ahead and the land developed. These lots are now all classified as Category 3, a situation that really should not have been allowed to happen.

Key policies for flood hazard management in the RPS are weak and too vague, leaving wide-ranging discretion for land use management in the various District Plans. The RPS indicates that avoidance and mitigation are equally appropriate responses to flood hazard risk, and seeks only that "Natural hazard mitigation measures are in places to minimise the risk to human safety".

In lieu of sufficiently detailed direction from the RPS, the region's territorial authorities have identified flood hazard areas and created regulatory frameworks to manage flood hazard risk which vary greatly. For example, some district plans only map flood risk within the stopbanks of a river and do not identify areas at risk when the LOS of a stopbank is exceeded. Although the district plans all include objectives and policies requiring the avoidance, remediation, and/or mitigation of natural hazard risk, they also provide consenting pathways for activities in inappropriate locations where they are exposed to unacceptable flood hazard risk and where mitigation should not be countenanced. Some district plans indicate types of development that are inappropriate in a flood hazard area through a non-complying activity status. However, in those circumstances, heavy reliance is placed on mitigation measures such as minimum floor levels, and there is very little to inform when and where mitigation is appropriate, or whether the risk is too great and must be avoided altogether.

In addition, HBRC should appropriately monitor and enforce third party resource consents that affect flood risk. Activities on river berms in close proximity to critical locations in terms of flood conveyance should be very restricted and tightly controlled. This has already been noted in terms of recreational impacts on stopbanks above, but extends to other activities on berms including the clean fill operation at the mouth of the Esk River.

In light of the above and our analysis, the Panel supports:

→ The Category 3 classification to those areas that experienced extreme flood hazard conditions during Cyclone Gabrielle and that residential habitation does not occur in these areas;

→ The equitable buy-out of properties from the Category 3 classification and acknowledges the need for Central Government Funding to support this.

The Panel's specific recommendations are as follows:

22. HBRC should urgently review the Regional Policy Statement so that it includes clear and directive objectives and policies regarding land use management in flood hazard areas.

23. HBRC should update and include the 2023 flood event as well as other notable historic floods in the assessment of flood frequency for use in identifying flood hazard areas. The underestimation of flood risk in the Esk Valley and Pōrangahau are examples of significant historic floods not being accounted for.

24. HBRC should ensure that Regional Policy Statement provisions:

    a. Identify and map areas subject to flood hazard risks, including scenarios that exceed the levels of service provided by flood management assets;

    b. Direct how the effects of climate change are to be taken into consideration when identifying flood hazard areas and assessing subdivision and land use applications;

    c. Define unacceptable flood hazard risk;

    d. Direct that district plans avoid unacceptable flood hazard risks, including, for example, through the use of prohibited activity rules;

    e. Define when mitigation measures to manage flood hazard risks are appropriate and the types of mitigation that are appropriate;

    f. Identify areas of high flood hazard risk where managed retreat is required.

25. The review of the Regional Policy Statement should ensure that new and intensified residential development and subdivision is prohibited in areas subject to unacceptable flood hazard.

26. The review of the Regional Policy Statement should ensure that direction is provided for the identification and management of residual flood risks resulting from ponding, stopbank breaches and overflow. The Panel recommends that the approach to residual risk adopted by Kāpiti Coast District Council is taken as best practice.

27. HBRC should urgently review the provisions of the Regional Resource Management Plan to ensure that the design of new structures, particularly bridges, minimises to the extent practicable the extent to which they constrict flood flows and act as debris barriers during floods. An example would be to explore options not involving/minimising the use of piles and raising bridge deck levels well above extreme flood levels.

28. HBRC should ensure it has sufficient financial and people resources to allow it to provide effective advocacy and technical input to planning processes and resource consent applications, to ensure that development does not occur in areas subject to unacceptable flood hazard risks.

29. HBRC should review current resource consents relating to the risks to flood management activities and assets and ensure there are appropriate consent conditions in place and that they are being complied with so that effects are appropriately managed. For example, the clean fill operation at the mouth of the Esk River should be reviewed.

10.4 River channel maintenance

The level of maintenance undertaken on the river and stream channels was a key issue raised by many people the Panel met with, and in many written submissions received. The Panel noted a number of areas where there could have been more maintenance undertaken in terms of willow clearing and gravel extraction, but due to the extreme nature of this flood event the Panel concludes that the level of maintenance would have likely had a limited impact on the consequences of the flood event.

Notwithstanding, the Panel provides recommendations relating to river channel and stream maintenance for the purpose of HBRC achieving an acceptable and consistent level of service across the region's waterways.

It must be highlighted that the river and stream channels have been hugely affected by this event with areas of scour and vast volumes of silt deposition, particularly on berms. Surveying and analysing the post flood event river channel capacity will be essential for understanding the current level of service and prioritising where works are needed to reinstate to the levels agreed in the respective AMPs.

In light of the above and our analysis the Panel recommends:

30. HBRC should re-survey all river and stream channels within current scheme boundaries to assess whether they meet the currently agreed levels of service in the respective Asset Management Plans. From this work, a prioritised work programme should be developed to demonstrate how systems will be returned to their agreed service levels.

31. It is acknowledged that there will likely be a period of increased spending on river-channel maintenance to undertake the repairs/reinstatement required by the above, but when considering longer-term budgets, HBRC should review the annual maintenance budget and funding model in terms of regional versus local share to ensure that adequate levels of service are achieved and funding is affordable.

32. HBRC should be more proactive in managing gravel build-up where it is above design grade lines, and either extract it to maintain the agreed level of service or develop and implement alternative options. These should include but not be limited to being more directive regarding gravel extraction and removing contractors' ability to pick and choose locations based on convenience. Noting that the 2023 flood event will have likely changed river bed levels considerably; the Upper Tukituki system and the Tutaekuri River and lower Esk River were noted as locations where specific assessments and actions are needed.

33. HBRC should investigate options for more permanent river mouth openings using techniques such as constructing heavy guide banks/moles at locations where they are critical for flood conveyance and increased flood levels cannot be accommodated by upstream flood management works. During Cyclone Gabrielle the Esk River mouth was at least partially impeded and may have contributed to the extent of upstream flooding.

34. HBRC should evaluate the need to add maintenance of the Wairoa River channel to the scope of the existing Asset Management Plan for the area. This evaluation should include consideration of riparian vegetation management as well river-bed-level monitoring in line with the typical survey frequency (five-yearly) of the region's other main rivers.

35. Using the survey data noted above, HBRC should complete a geomorphic assessment of the bed-level trajectory for the lower Wairoa River for the purpose of assisting with the assessment of flood management infrastructure options for this area.

10.5 Mana whenua

There are several examples throughout the region of marae, papakāinga and urupā being located on marginal floodplain land in close proximity to rivers that were catastrophically inundated during the flood. The typical pattern the Panel observed was that the land currently occupied by Māori communities is the remnant of much larger holdings they held prior to pākehā occupation. In many places there was known flood risk at these floodplain locations and no structural flood defences or planning to provide management of that flood risk.

The Panel considers that mana whenua were disproportionately impacted by the flood. Despite that impact, many marae stood up as emergency support hubs for the wider community as well as their own people and provided accommodation, kai and other support in some cases for many months after the flood, for example, at Omahu Marae.

The Panel received feedback of a disconnect between some mana whenua groups and HBRC and a perception that HBRC does not protect mana whenua communities in the same way that other Hawke's Bay communities are protected against flood risk (for example, the Waiohiki papakāinga that was flooded, while Taradale was largely protected due to its high stopbank).

Some mana whenua groups also told the Panel that the land categorisation process is, in effect, another form of raupatu (confiscation) of their last remaining land holdings and for that reason they do not want to leave those areas despite the risks of staying.

The Panel acknowledges that HBRC works with various committees that have mana whenua representation and its Māori partnerships group provides advice on how to engage with mana whenua. However, the Panel considers more needs to be done to work with mana whenua at a governance level; that inequities between mana whenua and other Hawke's Bay communities need to be acknowledged by HBRC; and that a new flood management model needs to be developed with mana whenua for a safe and sustainable future.

In light of the above and our analysis the Panel recommends:

36. HBRC should engage kanohi ki te kanohi (face to face) and at a rangatira ki te rangatira (leadership to leadership) level with mana whenua groups in the region, in addition to relying on existing advisory committees and groups.

37. HBRC should acknowledge the inequity whereby Māori land and communities have been marginalised by decisions and actions of central and local government for many decades and are often located on low-lying, flood-prone land (for example, Tangoio, Waiohiki and Omahu).

38. HBRC should recognise and provide for Māori communities and low-socio-economic areas that are disproportionately exposed to flood risk because flood protection in those areas does not satisfy HBRC's traditional cost/benefit approaches. HBRC should develop a new flood management model with mana whenua.

39. HBRC should engage urgently with communities on Category 3 land such as Petane Marae and Tangoio Marae, and, with the Crown and territorial authorities, provide funding and assistance for the planning, consultation, purchase and potential rebuild of these marae and papakāinga on other land.

40. Where marae and papakāinga are unprotected in terms of flood protection works (two examples being Pōrangahau and Wairoa), HBRC needs to partner with mana whenua groups at those places in looking at all options to render those communities safe and sustainable into the future. Options may include raising the floor levels of marae or moving communities to higher ground. HBRC needs to engage urgently with these communities and with the Crown provide funding and assistance for planning, consultation, purchasing and other measures necessary to manage flood risk effectively in these marae and papakāinga.

41. The Panel encourages HBRC to work proactively and in partnership with mana whenua in the development of recovery plans such as "Utaina: 10 Year Recovery Plan", which was developed by Piringa Hapū (Ngāti Hinemanu, Ngāi Te Upokoiri, Ngāti Honomōkai, Ngāti Mahuika) to restore and preserve a resilient natural environment.

10.6 Community

During the course of the Review the Panel was continually amazed by the stories shared with us. Not only was the information instructive, but the selfless actions of individuals, whānau and whole communities during and after the flood impressed us in ways that words cannot do justice to, and which will stay with us.

Community-led actions involved individuals, whānau, neighbours and marae, as well as people from further afield, with many risking their own lives to rescue people during the event. In some instances, community groups were formed in the midst of the flood recovery (for example, the Cyclone Impacted Communities umbrella group which included community members from Puketapu, Pakowhai and Dartmoor). In the aftermath of the flood there was considerable momentum and coordination by communities, especially those cut off from the rest of the region to support and look after each other through the recovery process.

The Panel met with several community and other stakeholder groups during the Review and it was apparent that there was a range of perspectives on the extent to which and how HBRC works with communities in relation to flood management, planning and recovery. One persistent theme was the lack of meaningful engagement and that local knowledge and perspectives were not seen by HBRC as being useful. People observed that site-specific local knowledge is ignored because "that is not what our (mathematical) models say". The Panel considers that as HBRC leads the region's response to Cyclone Gabrielle and makes it more resilient to future floods, it needs to augment its toolbox to make more and better use of the networks and knowledge that exist within communities.

Looking towards the future, particularly given the need for new and significant upgrades to existing flood management infrastructure, the Panel considers it essential that HBRC treats the region's communities as project partners rather than consulting and seeking feedback once much of the scoping and critical thinking has already occurred. As highlighted in the NZ Standard for Managing Flood Risk (NZS9401), optimum flood risk management outcomes require close collaboration and communication with all stakeholders taking a partnership approach.

In particular as HBRC engage with communities and stakeholders the following principles and outcomes from NZS9401 are important to consider:

a. Communities and stakeholders are involved in formulating flood risk management solutions;

b. Decisions are a shared responsibility of all relevant interests;

c. Individual responsibility for managing personal risk is enhanced;

d. Public and private interests are balanced;

e. The roles and responsibilities of all stakeholders are clear and agreed;

f. A comprehensive risk communications strategy is in place and actively managed.

Community and stakeholder participation is fundamental to managing flood risk, as is recognising that flood risks will affect many people and can include transferring risk from one community to another.

Community understanding of risk and consequence has been heightened by their on-the-ground experiences during this flood event. The community is also mobilised, organised and motivated to progress improvements in flood risk management infrastructure and processes. HBRC and the community should make the most of this, learning the lessons from this event to progress and implement effective new and improved flood risk management solutions for the many areas in the region that will be forever subject to flood risk.

In light of the above and our analysis the Panel recommends:

42. HBRC should communicate and collaborate effectively with communities, mana whenua and stakeholders in the development and implementation of flood risk management solutions for areas subject to flood risk.

43. HBRC should make more and better use of the local networks and knowledge that exist within communities as it leads the process of developing comprehensive flood risk management solutions and implements the physical works needed to improve flood resilience in Hawke's Bay.

44. HBRC should develop a collaborative process for developing flood scheme design involving the regional and district councils, mana whenua and the wider community.

10.7 Funding and resourcing

The resourcing and funding of day-to-day river and flood management activities is considered to be inadequate in many areas. This was exacerbated during Cyclone Gabrielle with significant issues across the whole region occurring simultaneously, meaning that HBRC staff were stretched far beyond their capacity. Of course, and we acknowledge, in addition to dealing with the enormity of this flood event, Council staff were also concerned for the safety of their own families and homes.

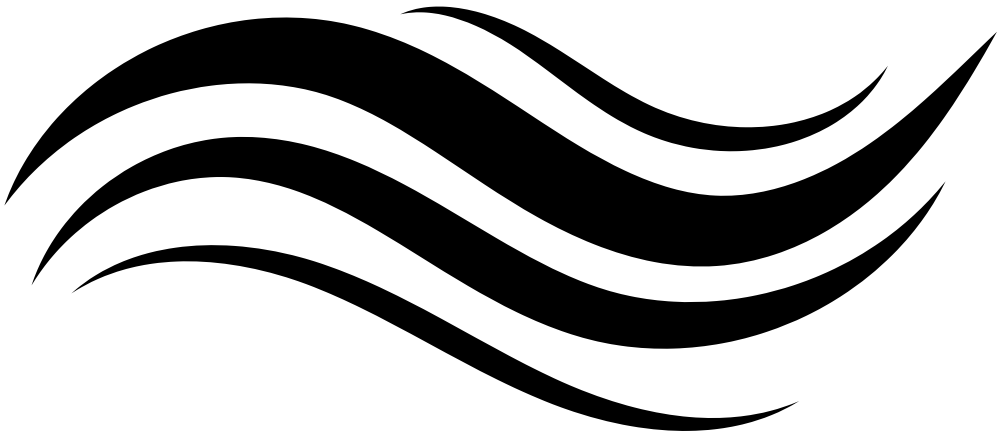
In addition to improved funding for HBRC staff resources, the funding of large scale capital improvements and future maintenance needs to be addressed. The current model where most of the funding is derived from targeted local rates will not be sufficient to effectively fund long-term solutions. This is a significant issue for smaller rural communities, and especially Māori communities, where the value of land that has been marginalised over decades, is considered insufficient to cover the costs of its protection. The need for central government funding along with a greater regional contribution is likely to be needed to achieve an affordable and equitable funding regime.

In light of the above and our analysis the Panel recommends:

45. HBRC should review the resourcing of its flood risk management activities to ensure it is sufficient to deliver the agreed level of service for day-to-day operations and has sufficient back-up and contingency plans to meet its flood event management responsibilities.

46. HBRC should continue to be proactive in working in partnership with central government to provide an affordable funding mechanism for new capital works and ongoing maintenance activities.

47. HBRC should review the funding of current and future river-management schemes so that the targeted and regional rates contributions enable affordable and equitable outcomes.



APPENDIX A:
Terms of reference

Terms of Reference for the Review into the performance of Hawke's Bay Regional Council's (HBRC) Flood Scheme Assets and River Management programmes in response to Cyclone Gabrielle

Purpose of the Review

The purpose of this Review is to:

1. understand the circumstances and contributing factors that led to flooding in the Hawke's Bay region during Cyclone Gabrielle
2. report on the performance of HBRC's flood scheme assets and river management programmes during the Cyclone Gabrielle event, and
3. review decision-making regarding catchments where flood scheme assets and river management programmes exist and whether these remain viable.

Audience for the Terms of Reference

The Hawke's Bay Regional Council (HBRC) wishes to record its intentions in relation to the Review.

The Terms of Reference is a public document intended to explain the Review to the Hawke's Bay community, its stakeholders, iwi and the public generally as well as relevant Government ministers.

The Terms of Reference sets out the scope of the Review.

The Review Panel

HBRC has initiated and commissioned the Review. HBRC is the approver of the Terms of Reference.

The Review will be conducted by the following panel of experts **(Review Panel):**

1. Phil Mitchell, Partner at Mitchell Daysh
2. Kyle Christensen, Christensen Consulting Ltd
3. Bernadette Arapere, Barrister

The Review Panel will be led by Phil Mitchell as Chairperson.

The Review Panel is independent to HBRC and impartial. The Review Panel will provide an arms-length assessment of HBRC infrastructure, assets and activities as defined by the Terms of Reference.

The Review Panel may request advice from an independent Legal Advisor and other subject matter experts during the course of the review.

The Review Scope

The scope of the Review will have two interlinked parts:

1. To review the performance of all HBRC-owned and operated flood protection, control and drainage schemes, including associated telemetry and stream monitoring assets, and river management programmes during the Cyclone Gabrielle event, specifically considering:
    1.1. The origin and purpose of each scheme and programme, including intended levels of service (LOS)
    1.2. The severity of the Cyclone Gabrielle event and any other contributing factors relative to scheme purpose/ LOS and the event itself, and
    1.3. Scheme maintenance and operation before, during and in the immediate aftermath of the event.

2. To consider and recommend a wider range of total catchment options using a long-term and holistic vision and having regard to increasing climate change risks.

The Review Panel will report its findings on the circumstances that led to the breaches and will make recommendations it considers fit on matters within the Review scope, including recommendations relating to future actions that HBRC might take.

Exclusions

The Review has been commissioned by the HBRC to cover matters it is responsible for. It is not intended to cover district or city council roles and responsibilities during Cyclone Gabrielle, including but not limited to:

- The effectiveness of the local or Group Civil Defence Emergency Management responses, including the timing and notification of evacuations,
- The establishment and implementation of the recovery phase of the flood event.

Also outside the scope of the Review is the HBRC and Hawke's Bay Civil Defence Emergency Management Group wider operational responses to the event.

The Review Panel may, as it deems appropriate, draw information from any review already taking place, in totality or in part, for this Review.

Public opportunity to provide information, input and feedback

The Review Panel will ensure that all members of the community affected by, and all iwi and stakeholders with an interest in, the flood event from Cyclone Gabrielle are given the reasonable opportunity to provide information, input and feedback. The Review Panel shall accept written input and feedback and will also provide an opportunity for verbal input and feedback to be provided. It will initiate meetings with the Hawke's Bay community, iwi and stakeholder groups that it identifies as well as groups identified by HBRC to the Review Panel.

HBRC will provide full disclosure to the Review Panel of all the relevant information it holds. It will also provide the Review Panel with full access to any relevant staff. In order to be effective, it is expected that the Review Panel will also receive information and hear from organisations outside of HBRC.

Timeframes

The Review Panel should provide its final report to HBRC by or on 31 January 2024.

Reporting Sequence

Prior to its publication, the Review Panel must provide a draft report to the HBRC Chief Executive for a factual check only. The Review Panel shall allow ten working days to undertake this factual check, giving a minimum of five working days' notice of the delivery date of the draft report. An extension may be granted at the discretion of the Review Panel.

The Review Panel is to provide its final report, including its findings and recommendations, to HBRC in writing no later than the date specified in this Terms of Reference. Any delays in meeting this date are to be agreed with the Chief Executive of HBRC.

The Review Panel's report will be made public. HBRC may receive and consider the outputs of the Review in confidence, prior to their public release, to enable it to prepare and provide an initial response to the Review Panel's findings and recommendations.

Enquiries

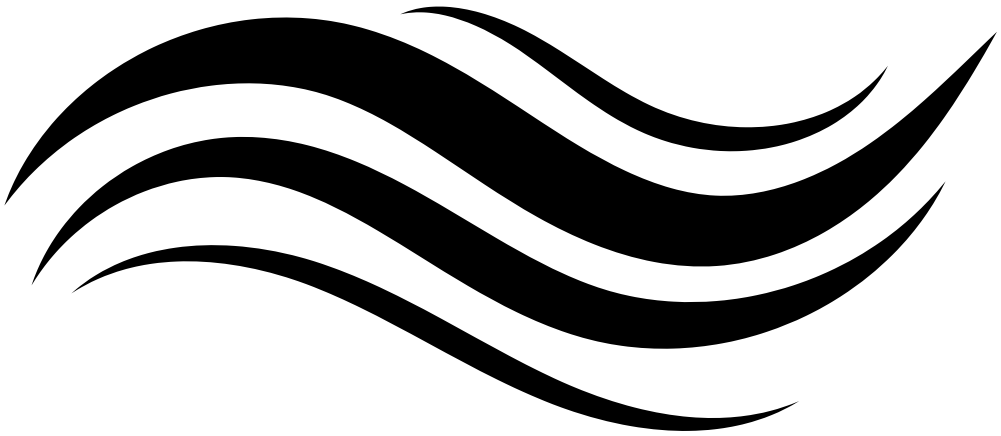
Any enquires to HBRC should be directed to the Chief Executive, by phone 06 835 9200 or email info@hbrc.govt.nz

Approval

This Terms of Reference was approved by resolution of the Hawke's Bay Regional Council on 26 April 2023, subject to confirmation delegated to the HBRC Chief Executive.

This Terms of Reference were finalised by the HBRC Chief Executive on 5 July 2023.

This Terms of Reference was accepted by the Review Panel on 19 July 2023.



APPENDIX B:
About the panel

A panel of three independent reviewers have led the Hawke's Bay Independent Flood Review – Pae Matawai Parawhenua.

Dr Phil Mitchell – Chair

Phil is an environmental planner with more than 40 years' experience, specialising in resource management and consenting processes for significant development projects, advising clients from across the public and private sectors.

He has an in-depth knowledge of New Zealand's environmental legislation and its implementation and is an experienced expert witness particularly in water-related matters. He has acted as a hearings commissioner and chair on more than 100 occasions.

Phil is a member of the New Zealand Planning Institute, Past President and Founding Executive Committee Member of the Resource Management Law Association and is a recipient of the NZ Planning Institute Distinguished Service Award. Phil has been a member of two of the Government's Resource Management Act Technical Advisory Groups, the most recent of which was to recommend amendments to sections 6 and 7 of the Resource Management Act 1991.

Phil is co-founder and Partner at Mitchell Daysh – an environmental planning practice.

Phil lives in Auckland.

Bernadette Roka Arapere

He uri tēnei o Ngāti Raukawa te au ki te Tonga, o Ngāti Tūwharetoa, o Ngāti Maniapoto hoki.

Bernadette is a barrister specialising in public and administrative law litigation and Māori legal issues. She has been senior counsel in the courts at all levels including the Supreme Court, in judicial review proceedings, appeals and other general litigation including Waitangi Tribunal proceedings.

Bernadette is a Deputy Chair of the Teachers' Disciplinary Tribunal, a Trustee of the NZ Law Foundation and Raukawa ki te Tonga Trust, a Commissioner of the Transport Accident Investigation Commission, and an active member of Te Hunga Rōia Māori o Aotearoa (the Māori Law Society).

Prior to joining the independent bar, Bernadette was Crown Counsel at the Crown Law Office in Wellington and a Director of Wackrow Williams & Davies Ltd in Auckland.

Bernadette is a co-founder of Kōkiri Chambers – a kaupapa Māori, virtual barristers' chambers.

Bernadette lives in Whanganui.

Kyle Christensen

Kyle is an engineer specialising in river engineering and floodplain management. As an independent consultant with 25 years' experience Kyle regularly provides expert evidence and advice on a range of river and flood risk management issues.

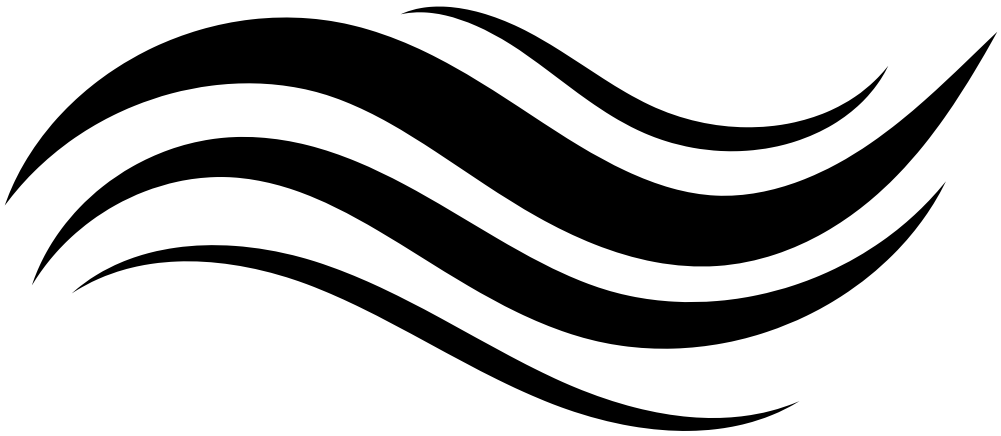
Specialist areas include review of hydrological and hydraulic models, design review and failure diagnosis of flood and erosion protection works, and expert advice for complex river and floodplain management related issues.

Kyle was a member of the Rangitāiki River Scheme Review panel which investigated the failure of the Rangitāiki River floodwall that caused significant flood damage to Edgecumbe in 2017 and was the technical expert for the 2018 Independent Review of the Ngongotahā Flood Event which investigated significant flooding which occurred in Ngongotahā, Rotorua.

Kyle is a practice area assessor for Engineering NZ and is past Chair of the Engineering NZ/Water NZ Rivers Group. He has recently authored best practice guidelines on the future direction of river management in New Zealand.

Kyle is the Director of Christensen Consulting – a flooding and erosion advisory consultancy.

Kyle lives in Wellington.



APPENDIX C:
Information received

HBRC document inventory

List of documents supplied by HBRC to the Hawke's Bay Independent Flood Review.

All documents were published on the Hawke's Bay Independent Flood Review website, with the exception of several documents that were withheld at the request of HBRC.

Documents that were withheld have been marked with an asterisk.

Documents relating to structural assets

Asset Management Plans

- 01. 2020 Small Schemes Summary and Context AMP
- 02. 2020 Small Schemes Makara AMP (note there is no 2021 version)
- 03. 2020 Upper Tukituki Flood Control Scheme AMP (note there is no 2021 version)
- 04. 2021 AMP Executive Summaries
- 05. 2021 Heretaunga Plains Flood Control Scheme AMP
- 06. 2021 Small Schemes Kopuawhara AMP
- 07. 2021 Small Schemes Opoho AMP
- 08. 2021 Small Schemes Paeroa AMP
- 09. 2021 Small Schemes Ohuia AMP
- 10. 2021 Small Schemes Northern Minor Works AMP
- 11. 2021 Small Schemes Te Ngarue AMP
- 12. 2021 Small Schemes Esk River and Whirinaki AMP
- 13. 2021 Small Schemes Te Awanga AMP
- 14. 2021 Small Schemes Poukawa AMP
- 15. 2021 Small Schemes Pōrangahau AMP

Annual Reports

- 2012-2013 Annual Report Land Drainage and River Control
- 2013-2014 Annual Report Land Drainage and River Control
- 2014-2015 Annual Report Land Drainage and River Control
- 2015-2016 Annual Report Land Drainage and River Control
- 2016-2017 Annual Report Land Drainage and River Control
- 2017-2018 Annual Report Land Drainage and River Control
- 2018-2019 Annual Report Land Drainage and River Control
- 2019-2020 Annual Report Land Drainage and River Control
- 2020-2021 Annual Report Land Drainage and River Control
- 2021-2022 Annual Report Land Drainage and River Control

Long Term Plan and Infrastructure Strategy

- HBRC 2021-2031 Long Term Plan
- HBRC 2021-2051 30 Year Infrastructure Strategy

HPFCS Pump Stations

- 2021 NormOlsen PumpStation Review subfolder (41 docs)
- Annual Electrical Inspections subfolder (multiple subfolders and docs)
- Gantry Reports subfolder (4 docs)
- Scanned Drawings subfolder (3 subfolders and multiple docs)
- Structural Reports subfolder (17 docs)

Stopbank Levels of Service

- Phase 1 Tech Briefs subfolder (5 docs)
- Phase 2 Tech Briefs subfolder (7 docs)
- Taradale PUR with mark up
- IRG Level of Service 2021 Taradale Stopbank Upgrade 14.09.2021 Draft drawings
- AM22-688 Asset Maintenance Contract 2022-2023 pdf *

Documents related to channel management

Bed level monitoring documents

- Allocation Table Central subfolder (17 docs)
- Allocation Table Northern subfolder (13 docs)
- Allocation Table Silt subfolder (8 docs)
- Allocation Table Southern subfolder (16 docs)
- Comments subfolder (10 docs)
- Historic Graphs subfolder (6 docs)
- Volumes subfolder (9 docs)
- Allocations all rivers 2003-2010 excel spreadsheet
- Allocations Final GC rivers 2023-2024 excel spreadsheet
- Extraction all rivers (accurate as of 17 Aug 2023) excel spreadsheet

Gravel Extraction related documents

- Annual Gravel Allocation Reports:
    1. 2018-2019 (2 docs)
    2. 2019-2020 (6 docs)
    3. 2020-2021 (5 docs)
    4. 2021-2022 (5 docs)
    5. 2022-2023 (6 docs)
    6. 2023-2024 (2 docs)*
    7. Recommendations for improvements

Global Consent Decision 5 July 2022 *

Annual Maintenance Plans

a. Contract Information 22-23 subfolder (5 docs). Pages 1 – 3 and 16 – 49 only.
b. OPAL 3 Reporting 22-23 Financial Year LOSM subfolder (6 docs)*
c. 2022-23 monthly accounts Tech 1 subfolder (8 docs)*

Documents related to hazard identification

- Advice Esk Valley Residential Developments subfolder (13 docs) (excluding councillor emails *

20210806 Flood Hazard Mapping for Central Hawke's Bay

- Asset Management Group Technical Report – Wairoa River Flood Hazard Survey
- Wairoa River Flood Hazard Survey - Accompanying Flood Hazard Maps
- Heretaunga Plains Flood Hazard Study 1999 (which also covers all possible evacuation zones)
- Hazard Portal link from HBRC

Documents related to emergency management

- HydroTel Alarm Config Summary 20230829
- HBRC Flood Manual 2015
- HBRC Flood Manual 2000

Related LGOIMA Responses

a. LGOIMA OIR-23-018 subfolder
b. LGOIMA OIR-23-084 subfolder
c. LGOIMA OIR-23-102 subfolder
d. LGOIMA OIR-23-030 Redacted
e. LGOIMA OIR-23-073 Redacted
f. LGOIMA OIR-23-107 Redacted*

- Media pack related to CDEM response *

Maps

a. Ngaruroro Maps (4)
b. Tukituki Maps (12)
c. Tutaekuri Maps (4)
d. Waipawa (1)

Related reports

- HBRC Cyclone Recovery Committee Telemetry Review Paper 16 Aug 2023
- HBRC Kak report*

- Pete Davis Telemetry Overview Presentation 16 Aug Cyclone Recovery Committee Meeting
- Telemetry Review Paper 1 16 Aug Cyclone Recovery Committee
- Telemetry Review Paper 2 16 Aug Cyclone Recovery Committee
- Draft Shared Learnings Report, Hawke's Bay Flooding Site Visit (Heretaunga Plains Flood Control Scheme) *
- 1987 Ngaruroro River Scheme Investigation and Review
- 1989 Heretaunga Plains Flood Risk Assessment Report (2 pdfs) which was a post Cyclone Bola (1988) report and resulted in significant works in the 1989-1993 period
- Ngaruroro – Tutaekuri River Mouths Feasibility Study 1989
- Ngaruroro – Tutaekuri River Mouths Study Addendum 1989
- Ngaruroro – Tutaekuri River Mouths Study Addendum Supplements 1989
- Tutaekuri River – Puketapu to Hakowhai Flood Management Review 1989
- Tutaekuri River Review – Supplementary Material 1
- Tutaekuri River Review – Supplementary Material 2

Documents provided later (after original batch was supplied)

- Gabrielle Flood Extents V1 *
- 3979_AM0717_Esk_Flood_Risk_Assessment *
- Tonkin and Taylor Report – KiwiRail *
- TREC Esk Model Build Memo Jan2024 *
- TREC Esk Model Build Memo May2024 *
- Q12. Lagoon and River Mouth Instructions Redacted 5 April 2024

Photos and videos*

- G43 Brookfields Bridge Failure video
- G146 Puketapu Vicarage Road Bridge Video 14.2.23 0430
- G148-39 Vicarage Road Puketapu Video 14.2.23 0730
- G23-154 Moteo Pa Road Video 1 14.2.23 0647
- G464 Ngaruroro at Awatoto Video 14.2.23 1000
- G470 Brookfields Bridget Video 14.2.23 0630
- G441 Vicarage Road Bridget 14.2.23 0800
- G473 Stopbank at Omahu Video 14.2.23 0800
- IMG 3257 NG Left Bank Near 69 Taihape Road video
- 230215_U_TC Gabrielle Catastrophic Damage Imagery
- Images and videos captured 16 Feb 2023
- Images and videos captured 17 Feb 2023
- 2023-02-25 Screen grab of Sentinel Hub – Awatoto breach taken 19 Feb 23
- 2023-02-25 Screen grab of Sentinel Hub – Dartmoor Rd breach taken 19 Feb 23
- Awatoto Drone Footage from David Okros
- Dartmoor Rd Tutakekuri breach 2
- Dartmoor Rd Tutaekuri breach

- Omaranui Rd stopbank blowout
- Original mp4
- Siisons Rd Site 1 Ngaruroro Stopbank
- Stopbank blowout east end Blk D Allen Rd nursery
- Waitangi Drone footage from David Okros
- Subfolder of 85 photos from SharePoint site that HBRC staff had gathered at the time

Detailed timeline of the flood event *

Note that some items redacted as previously provided to media as information pack for LGOIMA requests.

- CDEM Situation Reports and action plans subfolder (19 docs)
- HBRC Comms subfolder (13 docs)
- HBRC Situation Reports subfolder (21 docs)
- Estimated time, location of stopbank breaches and bridge failures
- MetService Weather Updates 09 Feb to 21 Feb

Reports from other agencies

MetService

- **Interagency briefings:** copies of presentations used by MetService in the NEMA and Council/CDEM briefings during 4 - 17 February 2023.
- **Rainfall Summary Map:** Observed: map of the observed rainfall via MetService Quantitative Precipitation Estimate product for the 7 days (168 hours) ending midnight Friday 17 February 2023.
- **Severe Weather Outlooks Watches Warnings:** documents with the products issued as stated. The "raw format" file contains an archive extract of the warnings/watches with only the situation statement and technical part of the warning/watch relevant to Hawke's Bay, with all other regions/areas in that issue of the warnings/watches omitted for clarity.
- **Support Forecasts:** copies of the first support forecasts issued to Hawke's Bay on 17 February 2023. Special forecasts to support the recovery period continued throughout February and most of March (to the 24th) with changes in content/area as requested by Council/CDEM.
- **Weather Model Rain Accumulation Plots:** summary plots of the forecast model rainfall data that was sent to/available to council that cover the key period of the event.
- **Weather Radar Imagery:** Web page viewers for Mahia radar and for North Island imagery. Covers the period from 1am Monday 13 February to 2:45pm Tuesday 14 February 2023.
- **Weather Station Observations:** excel spreadsheet containing hourly rainfall values from the core MetService observing sites in Hawke's Bay.
- High Level Report on the performance of MetService Warning System for the Auckland and Gabrielle events.

NIWA

- Flood frequency in the Hawke's Bay Region following Cyclone Gabrielle – prepared by NIWA for HBRC April - 2024

Genesis Energy

- Genesis Energy information submission to the Hawke's Bay Independent Flood Review
- Waikaremoana Cyclone Gabrielle Operations PowerPoint presentation document
- Waikaremoana Power Scheme Hydrology Audit

Unison Networks

- Unison (and Centralines) submission on the Emergency Management Bill
- Link to Unison presentation – Cyclone Gabrielle – Innovation in an Emergency: https://prezi.com/view/7Noz2gLRzH5l4hSmTbeW/
- Unison and Centralines' submission to the Department of Prime Minister and Cabinet's consultation on Critical Infrastructure Resilience in 2023 about better planning integration between critical infrastructure providers: https://consultation.dpmc.govt.nz/national-security-group/critical-infrastucture-phase-1-public-consultation/results/unisonnetworksandcentralines.pdf

Groups and sites visited

The Hawke's Bay Independent Flood Review Panel held a series of hui, meeting and site visits with flood affected marae, infrastructure service providers, industry and community representative groups during the information gathering process.

Organisations engaged with are listed below.

In addition to this list, the Panel met with many individuals and whānau who provided valuable insights, but have not been listed here to protect their privacy.

Mana whenua

- Mana Ahuriri Trust
- Ngāti Kahungunu Iwi Inc
- Tamatea Pōkai Whenua
- Ngāti Kere Authority
- Te Taiwhenua o Tamatea – Tamatea/Kahungunu
- Tamatea Ōtane
- Te Taiwhenua o Te Whanganui ā Orotu
- Rongomaraeroa Marae
- Waiohiki Marae
- Omahu Marae
- Tangoio Marae
- Petane Marae
- Moteo Marae

- Timi Kara Marae
- Mataweka Marae
- Te Whatuiāpiti Marae – Otane
- Te Tapairu Marae – Waipawa
- Rākautātahi Marae – Takapau
- Tatau Tatau o Te Wairoa and Wairoa mana whenua
- Maungaharuru Tangitu Trust

Infrastructure Service Providers

- Transpower
- Genesis Energy
- Contact Energy
- Unison Networks (including Centralines)
- Waka Kotahi New Zealand Transport Agency
- KiwiRail
- Awatoto Business Cyclone Recovery Group
- Whirinaki Business Cyclone Recovery Group
- Hawke's Bay Horticulture Advisory Group
- Hawke's Bay Rural Advisory Group

Community

- Cyclone Impacted Communities Groups
- Pakowhai, Puketapu, Dartmoor area representatives
- Whirinaki, Esk Valley, Bay View area representatives

Questions for Hawke's Bay Regional Council

The Panel reviewed a range of technical information and reports provided by HBRC and information provided by those who directly experienced the impacts of the cyclone flooding. On 16 February 2024 the Panel raised a number of follow-up questions with HBRC, in line with the Review process. HBRC responded to those questions on the 5th of April. These responses are below.

Maintenance issues

A common theme of feedback the Panel has received from the community concerns a perceived lack of maintenance in and around rivers and the Council's drainage network across the Region.

1. Please comment in general terms on the levels of maintenance across the Region's rivers and drainage network and provide Council's assessment of the contribution the levels of maintenance made to the magnitude and duration of flooding during Cyclone Gabrielle.

In terms of river maintenance, which involves activities such as edge protection (trees, rope-and-rail, groynes, etc.) stop bank integrity, etc. the state of the system was in good shape, and any minor difference in state of maintenance would have had very minor difference in the resulting damage from Cyclone Gabrielle. In general, the scale and magnitude of Cyclone Gabrielle in most locations was extremely large and widespread, which eclipsed the design standards of the scheme. HBRC conducts many inspections every year, with clear documentation and photos. Any deficiencies are followed up with and corrected within reasonable timeframes. There were no outstanding maintenance issues that were lacking just prior to Cyclone Gabrielle.

On the other hand, the drainage network only serves local surrounding land, and does not cater for river flows, in particular overflows from the rivers to the drainage network. Since very little rain fell on the drainage areas, there were no specific issues that the state of the maintenance regime would have changed to make any difference to the outcome of the deluge – they were ultimately overwhelmed by flood waters of a magnitude that they were not designed to handle. For example, some pump stations failed to operate when they were overwhelmed and submerged by flood waters from rivers overtopping and breaching stopbanks, rather than being overwhelmed by the pooling water that they were designed to handle.

2. Please provide details of how the Council's annual budget for river maintenance is determined.

Budgets for all Council activities are initially set in the Long Term Plan approved every three years. In the intervening years Annual Plans update those budgets for any changes that have occurred. This can be for a variety of factors including; current state of the rivers, outcomes of annual inspections and future work programmes, as defined by the relevant Asset Management Plan.

The annual budget for planned maintenance activities is reviewed annually and adjusted in the Work Group contract and other contracts to reflect changing needs of the schemes. There is no specific calculation or allocated percentages of total values. Rather, needs are assessed annually. Changes to maintenance budgets are reflected in the Long Term and Annual Plans.

Additionally, all HBRC budgets are increased annually based on inflation factors provided by Taituarā and BERL. Where significant changes to an activity are proposed these are consulted on with the ratepayers before being included in plans.

Capital for new and renewal activities are provided for in the Asset Management Plans (AMPs), which are then used to build the Long Term Plan. Reviews of asset conditions are undertaken annually and help inform the renewals programme.

3. Please provide details of how the Council prioritises river maintenance activities across the Region.

Maintenance activities are organised through several planned maintenance programmes, which have been in existence for a number of years. Regular asset inspections are undertaken, and defects are noted, which drive a programme of reactive work. Prioritisation of reactive work is based on several factors, with consequence of the defect being the dispositive factor, as determined by the Engineering Officer.

There is no material deficit in maintenance tasks noted within the organisation. In 2021, HBRC initiated deployment of a new enterprise asset management system (TechOne), which represents a step change in maintenance management and go live of the first components is forecast for September 2024.

HBRC uses a multi-criteria analysis method to prioritise capital upgrades. A sample is shown below at Figure 3.1.

Criteria			Project Number	1	2	3	4
Description	Range	Weighting	Site	Taradale	Moteo	Omarunui	Haumoana
			Chainage	17-22-L	43b-47-R	23-41-R	1-4-R
Consequence of Failure (Overtopping)		15	River	Tutaekuri	Tutaekuri	Tutaekuri	Lower Tukituki
Value of Buildings & Property within 100m	10 - more than $10m0 - less than $100,000	3		0 0	0 0	0 0	0 0
Value of Economic Impact	10 - High 0 - Low	2		0 0	0 0	0 0	0 0
Number of People to be evacuated	10 - more than 1000 - less than 10	4		0 0	0 0	0 0	0 0
Time for community to largely recover	10 - more than 2 year0 - less than 1 month	3		0 0	0 0	0 0	0 0
Reputational Damage to HBRC	10 - High profile site, will receive extensive coverage and enquir	1		0 0	0 0	0 0	0 0
Impact on Insurability	10 - If investigated and found to be sub-LOS insurers would defir	1		0 0	0 0	0 0	0 0
Archeological/Cultural/Recreational damag	10 - Areas of significant value likely to sustain irreparable damag	1		0 0	0 0	0 0	0 0
Consequence of Failure (Structural Breach		45					
Value of Property Impacted	10 - more than $500m0 - less than $1,000,000	8		0 0	0 0	0 0	0 0
Value of Economic Return Impacted	10 - High0 - Low	5		0 0	0 0	0 0	0 0
Damage to Key Infrastructure	10 - Inevitable loss of roads, bridges, bulk water/wastewater0 - I	5		0 0	0 0	0 0	0 0
Lives put at risk (people in the immediate b	10 - more than 1000 - less than 1	10		0 0	0 0	0 0	0 0
Time required to recover incl psychological	10 - more than 5 years0 - less than 1 year	4		0 0	0 0	0 0	0 0

Figure 3.1 – Sample multi-criteria analysis for asset maintenance prioritisation

The method is well-documented in literature, and HBRC uses a team of in-house staff and industry experts from consulting firms to develop the analysis and assign scores to the various criteria.

4. Please advise what plans the Council has /intends in order to quantify and fund additional river maintenance arising as a result of climate change?

HBRC is undertaking a programme of full reviews of all 25 of its river management and drainage schemes. This programme was funded through the 2021 Long Term Plan and is expected to be completed by late 2027. A list indicating the status of these reviews is shown at figure 4.1 below. The criteria for these reviews consider population growth and the effects of climate change on weather patterns and sea level rise, through to 2100.

As an example, Napier/Meeanee scheme review has been completed, and an additional $50 m of capital upgrades have been incorporated into the draft 2024 Long Term Plan.[1] As scheme reviews are completed, the recommendations will be incorporated into Asset Management Plans and ultimately Long Term Plans. Councillors have been advised that material increases in scheme investment will be required as this work programme is completed.

HBRC has also secured additional funding to accelerate scheme reviews – prioritising the Heretaunga Plains Flood Control, Upper Tukituki Flood Control, Awatoto/ Brookfield Drainage and Pakowhai Drainage schemes as part of the North Island Severe Weather Funding Agreement with the Crown.

Any recommendations from the HBIFR will also be used as a justification to seek additional funding for climate change adaption in our river management and drainage schemes, as appropriate.

Reviews completed	Reviews underway	Reviews to be started
• Napier/Meeanee • HPFC Brookfields/Awatoto • HPFC Pakowhai	• Heretaunga Plains Flood Control • Upper Tukituki • Opoho • Ohuia/Whakaki • Wairoa Rivers and Streams/Nuhaka • HPFC Karamu and HPFC Raupare/Twyford*	• Upper Makara • Porangahau • Esk and Whirinaki* • HPFC Haumoana and Te Awanga - Maraetotara* • HPFC Muddy Creek • Paeroa • HPFC Puninga • Te Ngarue • Kairakau • Poukawa • Kopuawhara • Central and Southern • HPFC Tutaekuri Waimate/Moteo
* Two schemes addressed together in a combined review.		

Figure 4.1 – Status of HBRC Scheme Reviews

1 HBRC is currently drafting the 2024 Long Term Plan for consultation. It is anticipated that it will be adopted later in the year.

5. Please provide details of any changes to maintenance plans that have been made, or are proposed, in direct response to Cyclone Gabrielle.

HBRC is committed to taking a deliberate, well-considered and evidence-based approach to its response to Cyclone Gabrielle. Accordingly, changes to maintenance plans for existing infrastructure as a direct result of Cyclone Gabrielle have been limited to reactive activities to remediate damage or address other effects of the event. Outside of these necessary reactive changes, our independent scheme reviews will inform any substantive changes to our maintenance plans. We also look forward to the recommendations from the HBIFR, which will inform these changes.

In terms of the changes that have been made in this respect, there has been some short-term reduction in maintenance to eliminate duplication with activities undertaken during response and recovery work. For example, the following activities were undertaken in direct response to the event and have therefore been unnecessary to subsequently attend to in accordance with our maintenance plan:

- drain desilting,
- edge protection work where edge protection was destroyed,
- floodgate maintenance, and
- pump reconditioning.

However, river and waterway channels are being resurveyed and assessed for inclusion in the annual channel excavation programme, following the initial silt clearing response, with priority work undertaken in the Wairoa and Northern Schemes. Upgrades have also occurred at Makara dams #1 and #4 and an associated desiltation programme is also being undertaken as a response to the Cyclone Gabrielle event.

Another common theme of feedback received from the community relates to a perceived lack of gravel extraction across the large gravel bed rivers of the Region. From the Panel's evaluation of available information (HBRC 2022-23 Gravel Allocation Report) the Waipawa River stood out as having a significant volume (1,452,000 m^3) of excess gravel above the design grade line.

6. Please comment and provide all relevant data on the extent to which this excess gravel build-up in the Waipawa River contributed to the flooding that occurred through Waipawa during Cyclone Gabrielle.

Anecdotal observations about gravel build-up causing higher river levels are not easily substantiated, since any build-up would likely be mobilised in the extreme events. It should be noted that river models used for forecasting and to analyse levels of service are all referred to as 'fixed bed models'. During the simulation runs, there is no mechanism to alter the bed levels in the computer models, therefore the predicted levels will always have an element of variation which cannot be resolved.

To examine the difference that may occur as a result of gravel build-up (or extraction), a computer simulation was done using a variation in the bed level assuming 50,000 m^3 of gravel was extracted over a length of approximately 2.5 km. Results showed a decrease in water level of approximately 180 mm at the greatest point, tapering to 0 mm difference at distances away from the bed lowered section. An approximate average of 100 mm decrease could be concluded to result from the removal of 50,000 m^3 of gravel. Results could vary depending on the details of the other parameters which affect river control, being slope, meander, bed material, roughness, depth and width, as are shown the following Figure 6.1.

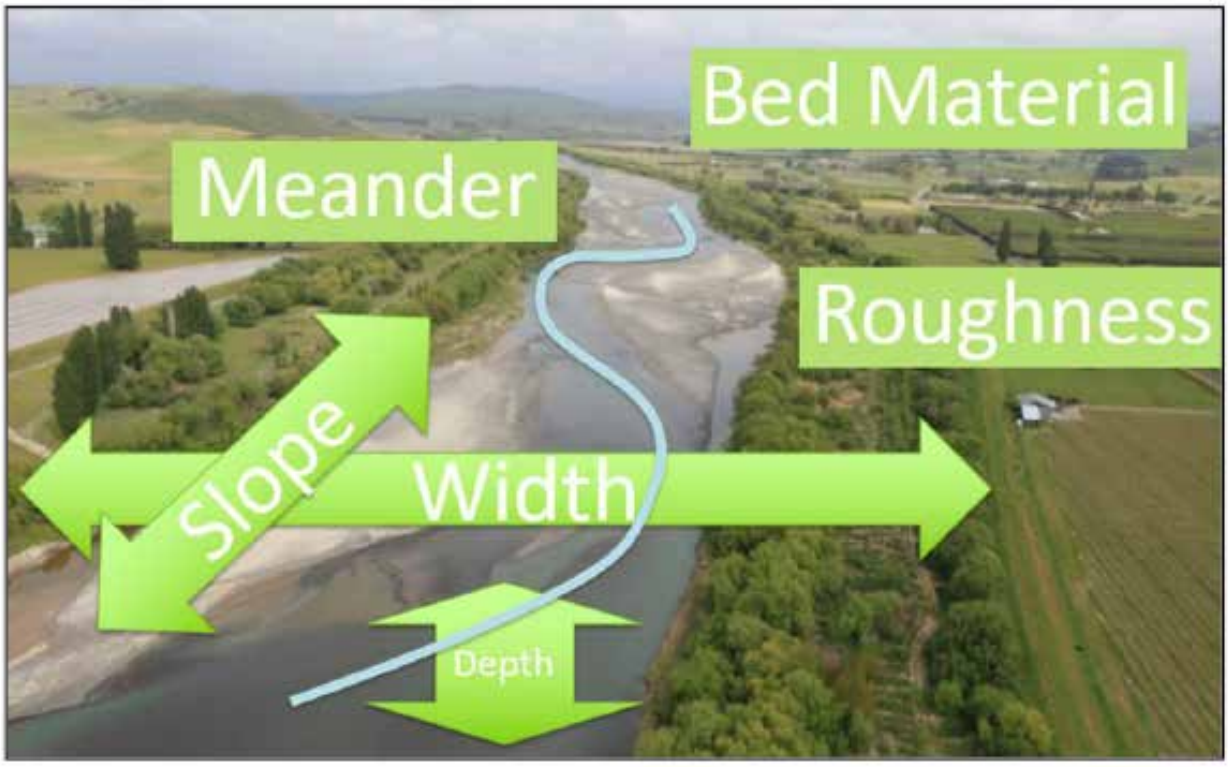


Figure 6.1 – Illustration showing the key variables affecting river control

The anecdotal observation of gravel build-up is also difficult to reconcile with a river in full flood. Consider, for example a deposit of gravel in the bed increasing the bed by 200 mm over a 40 m wide river. When the river is in flood, the top water width increases to around 300 m, so the effect of the gravel becomes less significant as the river depth increases. At lower flow conditions, a small build-up of gravel may have a large effect. However, this is not an issue since the increase in water level is still within the main channel.

HBRC monitors riverbed gravel and provide the mechanism for extraction, in areas where environmental conditions allow.

Based on our observations and analysis, the increase in gravel in the rivers was generally not in the locations where stopbank overflows or breaches occurred, such that a correlation could be drawn between increased gravel levels and the key mechanisms causing flooding (i.e. stop bank overtopping and breaching) during Cyclone Gabrielle.

HBRC staff presented to a Council gravel workshop on 7 Jun 2023 the following data on Waipawa River. Staff concluded that there was not a significant volume above grade from the section adjacent to the Waipawa township (where flooding occurred), as demonstrated in Figures 6.2 below to 6.4 below.

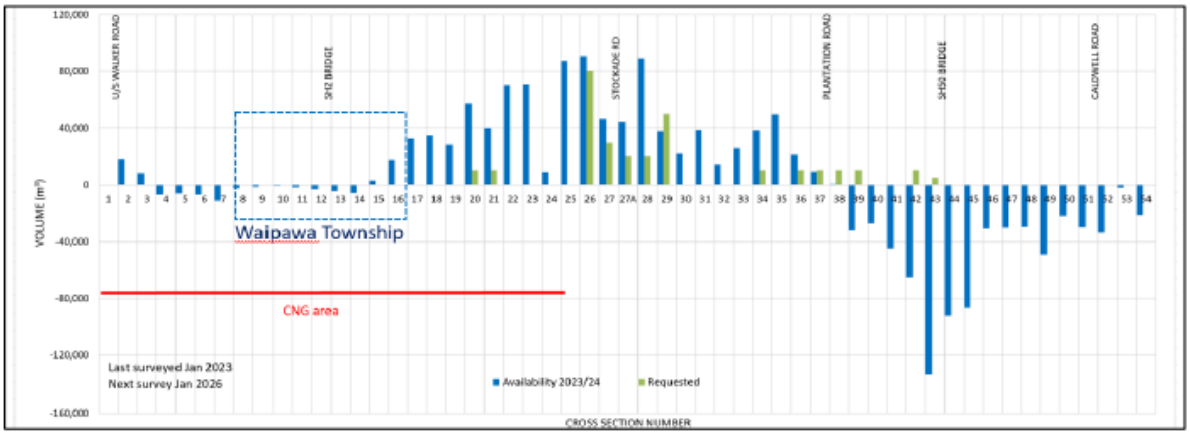


Figure 6.2 – Waipawa River Gravel Availability 2023-24

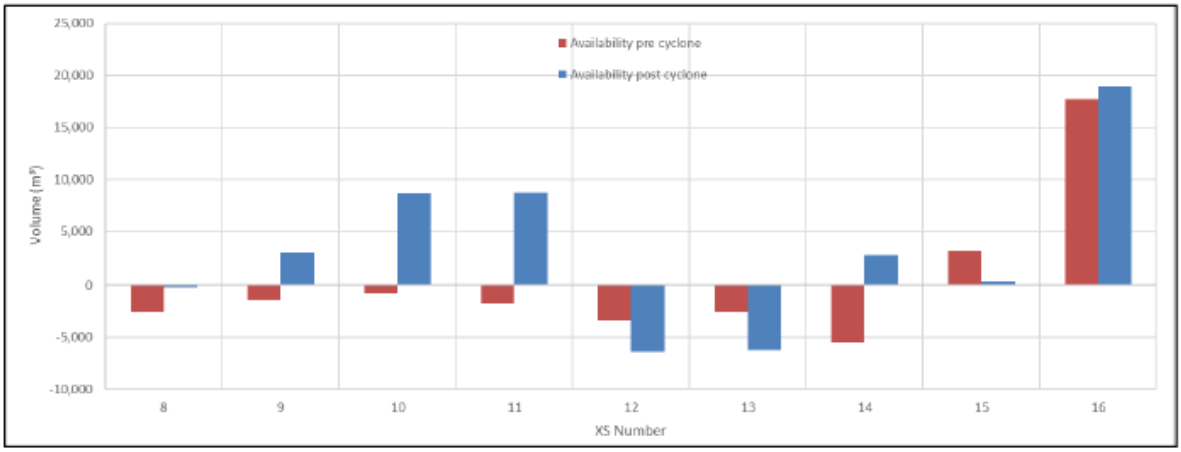


Figure 6.3 – Waipawa River gravel availability at Waipawa pre-cyclone vs post-cyclone

Note: While this graph shows the total movement in gravel (in m^3) upstream and downstream of the SH2 bridge (Bench mark 12) - the total change in grade was 150 mm.

It should be noted that, while in some sections gravel is above the current grade line, in other sections it is below the grade line.

It should also be noted, as was mentioned above, that any areas of gravel aggradation are many kilometres from the Waipawa township, were overtopping of stopbanks occurred. The width of Waipawa river diminishes significantly, from an average width of 160 m to around 100 m, just downstream of the township. This is more likely to have been a factor in containment of flood flows.

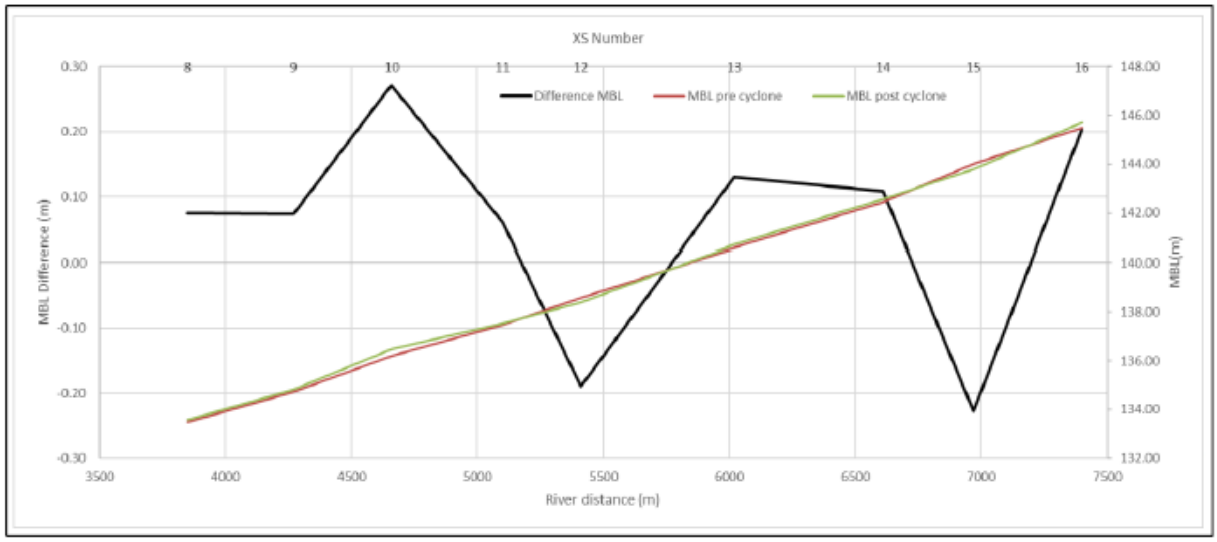


Figure 6.4 – Waipawa River - Mean Bed Level (MBL) at Waipawa; Comparison and Difference pre-cyclone vs post cyclone

Gravel extraction activities are undertaken by private contractors at no cost to the scheme. In fact, the scheme charges contractors \$0.8/m^3 to extract gravel within the Waipawa River. The general cost of gravel extraction is between \$5–\$10/m, depending on beach size, location to hard standing, and length of extraction site.

The Upper Tukituki is dependent on private gravel extractors to extract gravel at their own cost. Given that the operating budget of the scheme is around \$700k per annum, the scheme would not be able to afford to pay extractors to extract gravel, without significant increases to the target rate.

Most of the areas of aggradation are in reaches of the rivers that are not attractive to private gravel extractors – in that the cost of extraction and cartage of gravel from these reaches isn't commercially viable.

If HBRC were to pay for the removal of the aggraded material in the Waipawa, the scheme would need to spend between \$5–\$10 m as a one-off cost and then around \$300k pa, which isn't viable for the scheme at its current revenue.

To address this issue, in 2021 HBRC developed a Crown-supported[2] programme for gravel extraction in the Upper Tukituki scheme. This involved a 64% contribution from the Crown, with a total value of \$8m over 3 years. This programme has enabled HBRC to directly contract gravel extractors and to pay them for extraction of gravel from non-commercially viable aggradation areas.

The graph at figure 6.6 below demonstrates the success of this programme through to the end of 2022. 800,000 m^3 has been removed so far under this programme. By the end of 2024 we anticipate that over 1 million m^3 of gravel will have been extracted from the Waipawa and Tukituki rivers, with the majority extracted from the Waipawa.

If HBRC were to pay for the removal of the aggraded material in the Waipawa, the scheme would need to spend between \$5–\$10 m as a one-off cost and then around \$300k pa, which isn't viable for the scheme at its current revenue.

2 Through Infrastructure Reference Group (IRG) funding

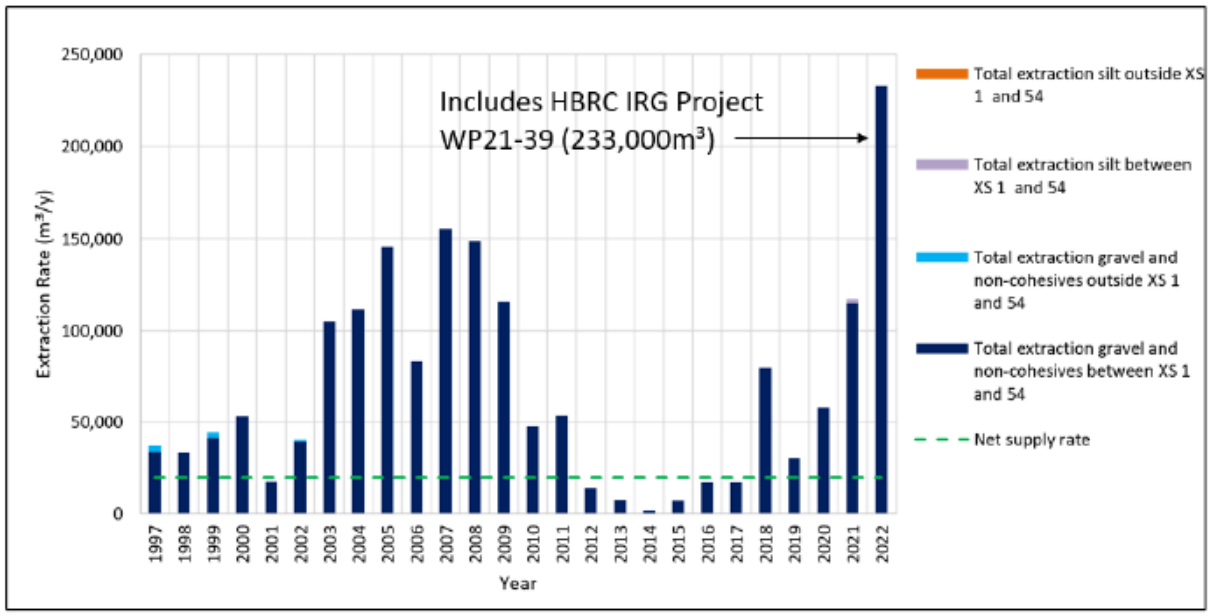


Figure 6.6 - Waipawa River Extraction History – 1997-2022

The programme was delayed for over a year due to the effects of Cyclone Gabrielle and the reprioritisation of resources. However, the programme restarted in 2024 and will continue into 2025.

7. What, if any, future initiatives are planned for managing excess gravel build-up in the Waipawa River?

As noted in the above question, HBRC has a partially Crown-funded programme for gravel removal which is targeting the removal of aggraded gravel in the Upper Tukituki scheme. This has recommenced in 2024 after delays resulting from Cyclone Gabrielle, and is due to continue into 2025.

Further, the River Managers' Special Interest Group, as part of Te Uhu Kahika, has been working with the Crown to extend the Crown-funded programmes across the sector. HBRC, in its submission, has requested a further 3 years of additional subsidised gravel extraction with the Upper Tukituki scheme.

The scheme review for the Upper Tukituki scheme, being undertaken by Tonkin + Taylor, has a provision for review of gravel management including a review of the current mean bed level. The outcome of this review may suggest a change in bed level, which may encourage further extraction.

With regard to gravel extraction within the Upper Tukituki scheme outside of the IRG programme, the extraction fee is discounted when compared to the rivers in the Heretaunga Plains.

We also note that the Controlled Area Notice (CAN) relating to Chilean needle grass that was in effect over areas of the Waipawa river, including in the vicinity of Waipawa, expired on 31 March 2024. This CAN placed conditions on the extraction of gravel, and we expect that its expiry will enable a greater level of gravel extraction from the Waipawa River for local use such as farm tracks.

8. What, if any, future initiatives are planned for managing excess gravel build-up in other rivers across the Region?

Gravel build-up requiring active management is primarily a feature of river systems with flood control schemes. This is a result of the confinement of the river channel focusing the deposit of sediment within the confines of the scheme, raising the mean bed level of the river. This effect may result in the lowering of the level of service of the scheme if the gravel level is not actively managed. Accordingly, initiatives to manage excess gravel build up are primarily focused on the controlled major rivers, namely the Tukituki, Ngaruroro and Tutaekuri rivers.

HBRC has a process for managing gravel thought our global consents for gravel extraction, which proves to be an effective approach to gravel management for the Ngaruroro and Tutaekuri Rivers. This requires regular surveying, the determination of sustainable gravel extraction volumes and the targeting of extraction of gravel from areas where gravel has aggraded.

However, for rivers in the Heretaunga Plains Flood Control Scheme, there has a been an historic process of overextraction. In many reaches, gravel levels are below the design bed level. As such, gravel extraction from these rivers is likely to decrease in coming years.

9. How does the Council respond to resource consent applications for gravel quarries outside of the active river channels and how does this affect Regional gravel supply?

Consent 'triggers' for quarrying gravel outside of riverbed (i.e. land-based quarrying) are in accordance with national regulations and/or regional rules (being discharge permits, water permits and occasional land use consent). Such quarries typically fall to territorial local authorities as the principal (land use) consent authority. HBRC may be involved in relation to impacts on groundwater, removal of vegetation (if in proximity of a waterway) and stormwater controls.

For land use consent applications that are publicly notified by territorial local authorities, HBRC has the opportunity to make submissions like any other person. Occasionally, HBRC might be considered to be an affected person in relation to a land use consent application. The TLA holds discretion as to who it considers to be an affected party for the particular circumstances of each resource consent application.

In HBRC's statutory advisory activities, HBRC often promotes/refers to HBRC Waterway Guidelines.

Land-based quarries are a way of managing gravel availability by contractors etc. HBRC doesn't get directly involved in supply and demand considerations. They have been established to ensure continuity of supply and will be used in combination with river sourced gravel to match demand.

10. To what extent has the Council considered non-market mechanisms to address the locations at which gravel is extracted and the amounts to be removed at each and will non-market mechanisms be part of any future initiatives to manage excess gravel build-up in rivers across the Region?

HBRC considers that the market alone is an insufficient mechanism for managing gravel availability. Accordingly, we undertake market interventions such as the IRG-supported programme outlined in the answer to Question 6 above.

HBRC has also considered further non-market mechanisms for managing gravel at key locations. These include maintenance operations such as channel shaping, spraying and beach raking and ripping. There remains a cost to the scheme (recovered through targeted rates) in undertaking these activities.

Market-based gravel extraction, with appropriate intervention, is still considered the most cost-effective tool for gravel management. HBRC has been mindful that the traditional policy of removing gravel at no cost to the ratepayer has been of overall benefit to the ratepayer.

HBRC has also considered designing reaches to become transition zones. However, HBRC has not been confident that this will be effective. We note that this method was the primary form of gravel management in the upper reaches of the north stream of the Ashburton River and proved to be ineffective in the 2021 floods.

The following performance measure is included in the 2022-2023 Asset Management Contract:

B.7.3 Maintenance of Streams, Waterways and Channels

Streams, Waterways and channels shall be maintained such that:

e. Channel siltation does not occur to a depth of more than 150 mm above the design invert or a straight line between the inverts of the nearest culverts upstream and downstream from

11. Please provide any information that explains how the extent to which this performance standard is being achieved is determined - using the Northern Schemes Assets as an example

Whether this performance standard is being achieved is determined through a programme of regular inspections and surveys. Drains are re-surveyed as required and the new bed levels measured against baseline inverts.

The Northern scheme drains (Paeroa, Ohuia-Whakaki, Opoho, Kopuawhara and Northern Streams) are currently going through the process of resurveying and drain clearing. It is expected that this process will be completed by 2026.

Another common theme of feedback received from the community was that river mouths were partially blocked and consequently river flows impeded during Cyclone Gabrielle. The Panel notes that river mouth openings are not included in the scope of the Esk/Whirinaki Scheme nor the Northern Scheme that includes the Wairoa River.

12. Please provide details of river mouth opening practices generally across the Region, with a particular emphasis on the Esk River, Wairoa River and Te Ngarue Stream and whether any works had been undertaken on these river mouths in the days leading up to Cyclone Gabrielle.

The Operative Regional Coastal Environment Plan applies to the opening (and closing) of a river mouth, lagoon or estuary by Councils. This is a permitted activity as per Rules 54 and 133, subject to compliance with five conditions. There is no direction in the rule on when a river mouth should be opened. This would be guided by operational considerations.

Operationally, river mouth openings are managed in accordance with the HBRC Lagoon and River Mouth Instructions 2021. We have included these instructions in the HBRC/HBIFR Share site for the Panel's consideration.

Assessment of whether an opening is required is based on operator observations of staff gauges at key locations in the relevant mouths. In some locations remote sensors (Waterwatch) are used to monitor the height of water in the mouths.

HBRC has provisioned through the draft 2024 Long Term Plan to install cameras at key locations to monitor and record the state of the river mouth.

The mouths of all key rivers and streams were assessed in the days leading up to Cyclone Gabrielle, with the Esk being assessed and photographed at around 5pm before the event. It is standard practice for operational teams to assess each key river mouth when there is a risk of flooding.

It was noted, that the Esk River was full, and the mouth was open. Blockage of the mouth likely occurred during the flood event itself with a strong easterly swell and accumulated woody debris.

It is also worth noting that during high intensity flooding events, flood conditions rapidly scour out river mouths for effective discharge. This was seen at the Wairoa River mouth and the Ngaruroro, Tutaekuri and Clive River mouths – particularly where the Tutaekuri created a new river mouth. Figures 12.1 and 12.2 below show those river mouths in the immediate aftermath of Cyclone Gabrielle.

Figure 12.1 – Wairoa River Mouth – 16 February 2023

Figure 12.3 – Tutaekuri and Ngaruroro/Clive River mouths – 16 February 2023

13. Please provide Council's assessment of what effect more open river mouths would have had on the flooding that occurred in the lower reaches of the Wairoa and Esk Rivers and the Te Ngarue Stream during Cyclone Gabrielle.

River mouth inspections were undertaken in preparation for Cyclone Gabrielle. All, including Wairoa and Esk Rivers and the Te Ngarue were functioning well and the high flows over the previous months associated with Cyclone Hale and other rain events had assisted to maintain open mouths.

Operator observations demonstrated that the Esk mouth was fully open prior to the Gabrielle event. Blockages of the mouth occurred during the event itself, and given the forces involved (river flows and swell) were impossible to safely clear. Evidence from this location is that the quantity of trees and woody debris was significant (see Figure 13.1 below), which caused a massive block to the water escaping the lower reaches.

Water levels were likely increased by at least 1 m higher than what might be expected without the debris. Our engineering team have assessed that be extremely difficult to maintain an open river mouth at the Esk which would have prevented that amount of debris seen in Cyclone Gabrielle from causing a blockage.

Storm surge at least 0.6 m during the event was significant, and gravel movement which blocks the mouth is a constant issue that cannot be overcome within the budgets that would be expected for such a catchment. There is consented concrete dump site near the river mouth on private land that would likely influence or prevent a permanent wide opening to cater for the amount of debris during the event.

Figure 13.1 - Woody Debris build-up near Esk River mouth.

Evidence from the Wairoa River is that the condition of the river mouth had very little influence on the flooding in North Clyde. At the location where the overflow occurs in North Clyde, the ground elevations are approximately 10 m above mean sea level. The variation in water levels at the coast range up to about 3m above mean sea level. This results in about 7m of elevation head of water at the North Clyde overflow point above the high point at the coast. This amount of elevation head is significant and will overwhelm the variation at the coast. As a corollary, blocking the mouth completely would not result in causing an overflow at North Clyde.

14. Please advise what, if any, future initiatives the Council has planned for managing river mouth opening practices/procedures to prevent impediment to river flows.

As noted in question 12 above, HBRC has provisioned budget for the addition of cameras to each of the key river mouths in the 2021 LTP over a ten-year period. Automated IOT sensors (Waterwatch) are being installed at key river mouths to monitor water levels.

A new SCADA system is currently being installed and these sensors will feed back to the Telemetry system. This will allow trending and alarming of river levels upstream of river mouths and will enable timely responses for mouth openings, where required. This is an acceleration of the planned 2021-2031 programme.

Structural Assets

Stop Banks

The following questions relate to planning for a flood event larger than the design standard of the current stopbanks.

A Super Design Contingency Plan is referred to in the Heretaunga Plains Flood Control Scheme 2021 Asset Management Plan (HP-AMP) - "Review and development of contingency plans for super design events within the main river systems is to be undertaken as part of the super design flood review, following recommendations made in the report Super Design Flood Event (Beca 2000)" Pg 64 "Develop a Super Design Contingency Plan in accordance with the actions set out in the 2008 proposal" Pg 195. It was also noted on Pg 195 that the development of this plan was taken out of the improvement plan.

15. Please explain the rationale for the Super Design Contingency Plan for the Heretaunga Plains being taken out of the improvement plan.

The recommendation to plan for super design events from the 2000 Beca report was developed into a proposed programme in 2008 (the super design flood review). That programme was included in the Asset Management Plan as part of the improvement plan in 2015. However, it was removed from the improvement plan in 2017. This did not necessarily reflect a decision by HBRC to not pursue super design contingency planning, only that it would not be pursued and funded as part of the asset management improvement plan.

We can find no record of the specific reasons for the decision to remove the programme from the improvement plan. However, there are records that show that the development of this plan would be particularly onerous, both in terms of financial cost and staff time, given the size and structure of HBRC's asset management team the time. Figure 15.1 below demonstrates that the programme was anticipated to consume the equivalent of 148 weeks of staff time. We think that it is likely that this project did not meet the threshold for funding in the LTP and consequently was removed from the AMP improvement plan, to be addressed by other means. However, we have subsequently restructured and grown the asset management team and contracted out key technical workstreams in order to achieve this required work programme. These changes commenced in 2018.

We note that the ongoing technical scheme reviews for the Heretaunga Plains and Upper Tukituki schemes will develop plans for managing super design events, demonstrating HBRC's commitment to super design contingency planning outside of the previous super design flood review.

Table 1 Super Design Flood Contingency Planning - Programme summary

Tasks	Staff Time (weeks)
Computer modelling and flow depth, velocity plots	82
Population and asset value maps for each scenario, risk and liability assessment	11
Identify preferred breach scenarios, re-entry points, model, and design	22
Pre-event planning options, hazard plans, designations, buildings, and land use criteria. Options for land shaping, private land controls	11
Cost / benefit assessments, activation protocol for controlled breaching. CDEM communications protocol	11
Public consultation, communications plan, flood manual updates and CD alert level	11
TOTAL	**148**

June 2008.

Figure 15.1 – Programme Summary of Super Design Flood Contingency Planning

16. Please advise what plans/systems the Council had in place for events that exceeded the capacity of the Heretaunga Plains stopbank system.

HBRC has produced flood extent maps (1999) with approximately 21 scenarios to account for events that exceed the capacity of the system. At the time of publication of that map series, Civil Defence was a more integrated part of HBRC, and the teams worked together to develop strategies associated with the exceedance scenarios. This was a period prior to widespread internet use, and approximately 100 sets of hard copy maps were produced and distributed to all agencies involved.

In more recent years, with the current Civil Defence structure centralised in the Hawkes Bay Civil Defence Emergency Management Group Office, the systems in place for dealing with such events involve HBRC working with Civil Defence agencies (local council Emergency Operations Centres (EOCs) and/or the Group Emergency Coordination Centre (GECC)) to advise on appropriate actions in accordance with those flood extent maps. As discussed in further detail below, this is broadly what occurred with respect to the overtopping of the true left stop bank of the Tutaekuri in the vicinity of Taradale on the morning of 14 February.

We also note that the scale and magnitude of Cyclone Gabrielle was such that it exceeded the capacity of the system by a significant margin. Plans for exceedance events had been discussed for many years, and responders would generally use the available resources to manage the events. It is also important to understand that an important aspect of the Heretaunga Plains Flood Control Scheme was that all areas had equal flood protection (of 1%AEP) such that no single area would be disadvantaged if a super design event eventuated. Despite this concept, the reality is that when the capacity was exceeded by such a large margin, including above the freeboard (safety margin of stopbank height above the 1%AEP), certain areas were more vulnerable to the overflows. The concept of equal protection for all areas may be reviewed, such that a dedicated overflow or spillway area may be implemented, which may affect some areas more than others. Prior to any such action taken, public consultation will be required.

It was noted during the Panel's site visits and hui at Waiohiki marae that the Tutaekuri stopbank on the right bank upstream of Waiohiki Bridge stops at or about benchmark BM24R with no obvious high ground to the north of Victoria, Pentar or Ngati Hinewera Lanes. It appeared that this area was the source of significant flooding in this area.

17. Please confirm the factual situation as to the extent of flood protection provided in this area.

This portion of the scheme was constructed in 1989-92, and the design flood levels indicate that at all cross-section locations and all interpolated locations in this area, the 100-year flood level was below the high ground level (i.e. this location was adequately protected up to the 1%AEP event). This is shown in the following figure 17.1. The blue shaded area shows the extent of the 100-year flood level. Contours shown use NZVD16 datum.

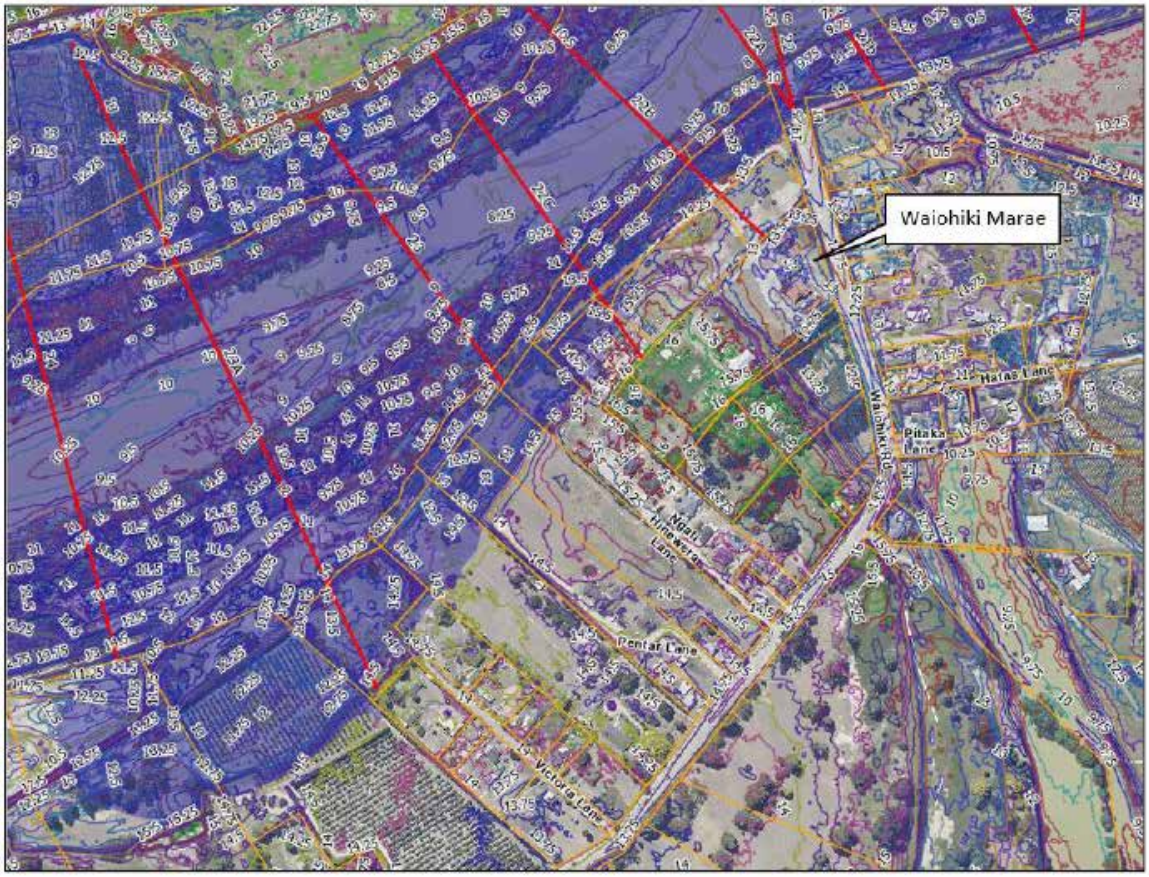


Figure 17.1 – 1:100-year flood extent in vicinity of Waiohiki

This area was subject to flooding during Cyclone Gabrielle. Two main causes for this flooding were that the flooding significantly exceeded the 1:100-year level and that debris at the Redclyffe Bridge created a damming effect, forcing water into the referenced area.

18. Subject to the response to 17. above, would the flooding experienced around the Waiohiki marae have been any different if flood protection up to the 1% AEP protection referenced in the HP-AMP had been in place prior to Cyclone Gabrielle?

As illustrated in Figure 17.1 above, this area was already protected to the 1%AEP. Based on the original analysis for the stopbank design, the referenced area was above the 1%AEP flood levels.

19. Subject to the response to 17. above, what plans are in place for addressing the gap in the stopbanks at Waiohiki?

Notwithstanding the fact that the referenced area is above the modelled 1:100-year flood levels, Cyclone Gabrielle demonstrated that this area is a relative weak point in the Heretaunga Plains Flood Control Scheme. This is due to its proximity to the bridge and because the high ground, while above the 1:100-year flood levels, appears to provide less freeboard above those levels than areas protected by stop banking. HBRC has therefore identified the need for better resilience at this location.

Accordingly, HBRC's negotiated funding agreement with the Crown for a programme of flood resilience works across the Hawke's Bay includes a co-funded sum of $10 m, which is dedicated to works at Waiohiki.

Planned works at Waiohiki include a new stop bank from Redclyffe Bridge to the rear of Napier Golf Course and realignment of Upokohino Stream to accommodate the new stopbank. A schematic of the proposed works is provided at Figure 19.1 below. This project is presently in planning phase with site investigations complete and preliminary design underway. We anticipate that this project will benefit from the streamlined consenting pathway presented by the proposed Order in Council for Hawke's Bay Flood Works under the Severe Weather Emergency Recovery Legislation Act 2023.

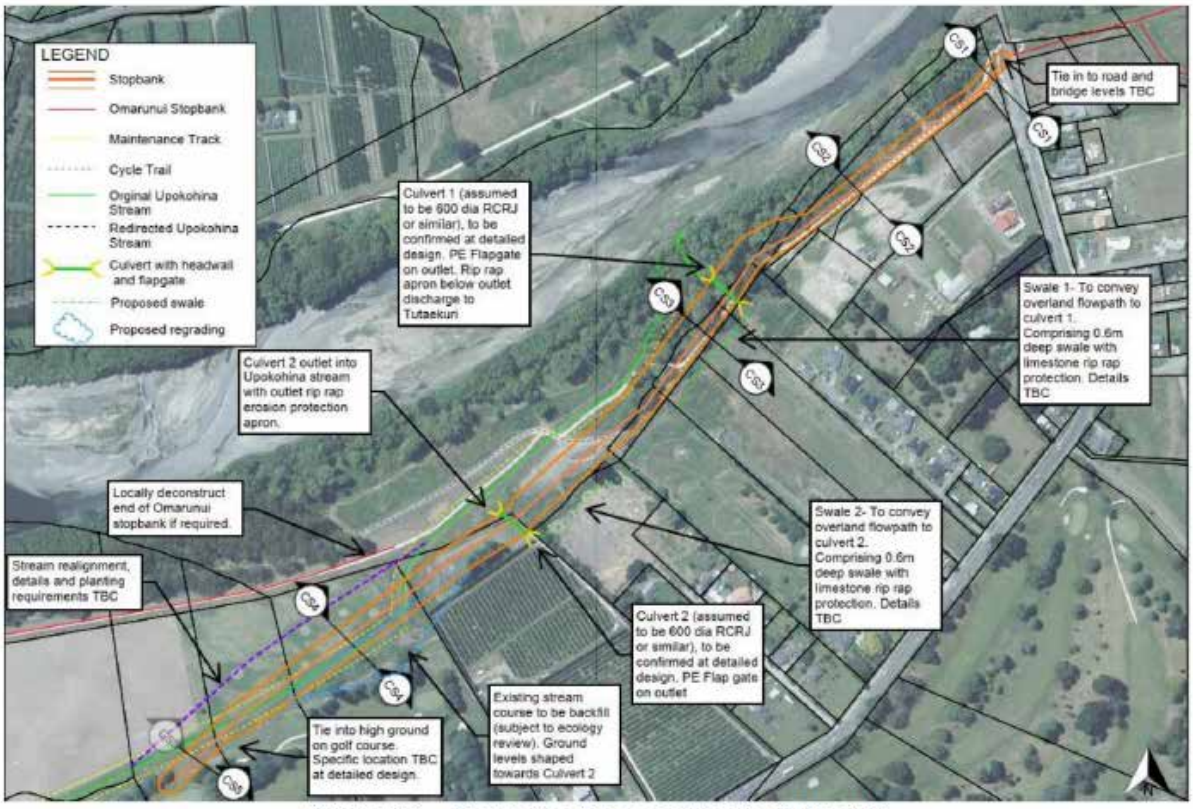


Figure 19.1 – Schematic of proposed works at Waiohiki

Another common theme of feedback from the community was that several stopbank breaches occurred on the Ngaruroro River where guide banks/access tracks were located on stopbanks.

20. Please provide Council's assessment of whether and to what extent guidebanks/access tracks contributed to the failure of stopbanks on the Ngaruroro River, including details of the condition rating from last asset inspection of the Ngaruroro River stopbanks.

The fact that elements of the stopbank system such as access tracks and guidebanks result in increased water levels on the upstream side of the tracks, is known and accounted for in the design of the system. Freeboard is included to account for such variations. However, in key locations, flooding during Cyclone Gabrielle exceeded the design levels and the freeboard by a significant margin.

We note that Ian Heslop's contribution to the shared learnings report of the River Managers' Special Interest Group[3] made some observations and recommendations on this point. Recommendations for future design consideration included that access track ramps should go from downstream upwards and not the other way around, that stopbanks could be offset to allow for access ramps and that the use of deflection banks should be reviewed. These recommendations, combined with others from the HBIFR and scheme reviews will be taken into consideration in future maintenance and design work.

The draft information provided to date by NIWA suggests that Cyclone Gabrielle was around a 200-year flood in the Esk River. The Esk River & Whirinaki Drainage Scheme AMP states a 500+ year flood as the level of service for the Pan Pac/Contact Energy/Transpower site which was significantly flooded during the event.

21. Please provide Council's assessment of why the Whirinaki Drainage Scheme failed below its agreed level of service.

Our assessment, based on the revised NIWA data, is that the flooding at this location exceeded the level of service of this scheme

The analysis in the Esk Asset Management Plan was derived in 2013 (prior to 2018 and 2023 events) and showed the 500-year return period using a Gumbel Distribution for the Extreme Value Analysis was determined to be 1,340 m^3/s. The estimated peak flow at Waipunga Bridge during Cyclone Gabrielle was 2,175 m^3/s. Note this value was estimated from peak levels during the event and includes silt and debris.

The current NIWA analysis presents an update using the additional data from 2013 to 2023, which include the 2018 and 2023 events, both extreme events. This new analysis updated the Extreme Value Analysis with new data to now show the 500-year event is considered to be 3,970 m^3/s using a Generalised Extreme Value distribution (i.e. a different distribution than that which was used in 2013 and prior).

3 A yet-to-be published report, made available to the HBIFR panel

However, we note that there is a very large margin of error on this present analysis from NIWA. We also note the significant upward curvature of NIWA's estimated flood frequency curve (as demonstrated in figure 21.1 below). We consider the present estimate in the NIWA report requires additional analysis before a direct comparison to the agreed level of service with this drainage scheme can be drawn. That work will be undertaken as part of the planned resilience works for the Whirinaki Drainage Scheme.

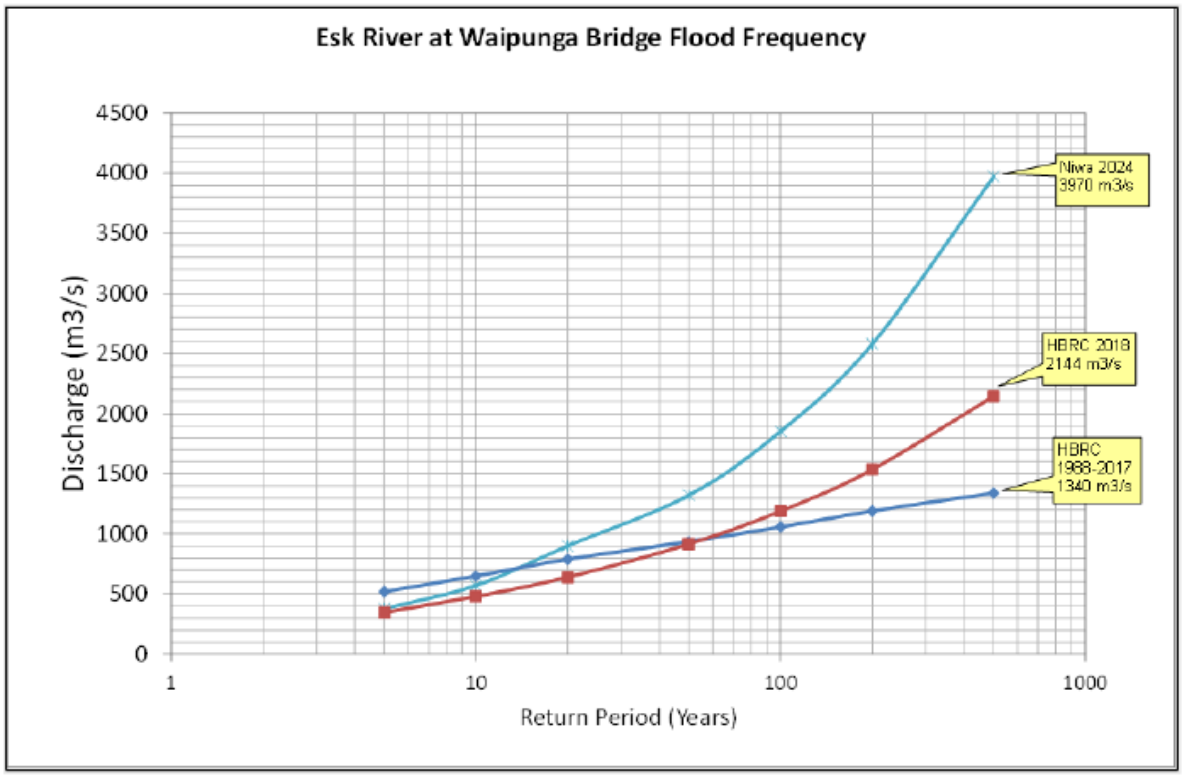


Figure 21.1 - Comparison of flood frequency curves

We also note that there was significant backwatering around the Whirinaki stopbank due to debris blockage of the Esk river at the mouth. Unlike many other stopbanks, the Whirinaki stopbank suffered very little

damage from overtopping. The primary damage to the stopbank was caused by the property owners breaching the stopbank to allow floodwaters back into the Whirinaki drain. This suggests the flow's velocities were exceptionally low and suggests the significant effect of backwatering. It is therefore impossible to draw a definitive conclusion about the return period of the flood event at this specific location as compared to the level of service of the stop bank, as many other factors were at play. A definitive conclusion in this regard would need to control for the effects of damming at the SH2 bridge and river mouth, the heavy easterly swell, significant ponding and backwatering in the lower catchment.

Civil Defence briefings reviewed by the Panel indicate that the Waipawa River stopbank at Walker Road was not at design standard prior to Cyclone Gabrielle. From information received from the community and the Panel's site visits, a significant breakout occurred at this location, resulting in water flowing down the old course of the river (Papanui Stream).

22. Please clarify how long this stopbank had been below the design standard and the reasons why reinstatement/repairs had not been completed.

The inference taken from the Civil Defence briefings indicating the stopbank at Walker Road was not at design standard is not accurate. Rather, the comment was in relation to the river channel near the stopbank, not the stopbank itself. As with all rivers, the main channel migrates side to side during a flood. The occurrence of Cyclone Hale in January 2023 resulted in the main channel of the Waipawa River migrating towards the Walker Road stopbank. This was inspected by HBRC river engineers in January 2023, and it was determined that under normal conditions, the migrated river channel was not ideal. However, attempting to alter the migrated channel at the location would require considerable investment into the design and construction.

We understand the evidence collected after Cyclone Gabrielle indicates the failure of the Walker Road stopbank was likely due to seepage and erosion at the stopbank, as opposed to the migration of the river channel.

Further, analysis of the flood frequency on the Waipawa River in the NIWA report indicates the frequency of discharge in the Waipawa was in the order of greater than 1000 years, which was much greater than the design standard of 100 years (1%AEP). Based on these details, it is unlikely that any correction to the migrated river channel would have had any effect on whether the stopbank failed.

23. If this stopbank had been up to full design standard, would this breakout have occurred and what would the effects on the main river channel have been?

The stopbank was up to the design standard of 100 years (1%AEP). The pre-cyclone return period of the event was calculated in the NIWA report to be approximately 1100 years. This far exceeded the capacity of the system, and we conclude that the breakout would have occurred regardless of the state of the system.

Feedback from the community suggests that it would be desirable to provide a controlled overflow (or low flow) provision into the Papanui Stream.

24. Please provide the Council's response to that suggestion and if it has any plans in that regard.

Providing a controlled overflow provision from the Tukituki system to the Papanui would require careful examination and comparison between the expected damage saved in the Lower Tukituki system versus the potential damage in the Papanui system.

This scenario is being reviewed as part of the Upper Tukituki scheme review, and a more definitive answer on the effectiveness of this approach will be addressed in the review.

Bridges

Debris loadings on bridges has been highlighted as a significant issue across the Region during Cyclone Gabrielle and appears to have contributed to stopbank breaches, particularly at Awatoto.

25. Please provide details of how the Council works with bridge asset owners to manage debris build-up removal and any information available on the state of debris at the railway bridge at Awatoto prior to Cyclone Gabrielle.

Observations during the cyclone indicate large debris build-up on bridges, and failures of assets upstream of these locations. Computer modelling of the river system with and without particular bridge blockages confirmed this.

It is custom and practice within the sector for the owner of an asset in a river to be responsible for its maintenance. As such, the maintenance of bridges, including the removal of debris from bridge piers, lies with the owner – whether a private landowner, NZTA, KiwiRail or the relevant TA.

Under law, HBRC is not able to operate within 15m of a KiwiRail bridge.

There is an expectation that the asset owner will undertake sufficient inspections to ensure that their assets are operating effectively. Where significant debris have accumulated over time on a bridge pier, and the relevant asset owner has not undertaken any maintenance, HBRC will contact the owner regarding the condition of their assets.

With regards to the rail bridge at Awatoto, HBRC are not aware of there being a build-up of debris on this bridge pre-Gabrielle.

26. Please provide performance standards from any recent bridge resource consent applications and comment on how these may change in response to Cyclone Gabrielle.

The erection and placement of structures such as a bridge is a discretionary activity under Rule 69 of the Regional Resource Management Plan. The Plan provides broad discretion over the matters that can be considered and covered in conditions. We don't have any specific design performance standards in the Plan or any specific referenced best practice design documents.

Applications are required to be submitted with the associated design calculations and design plans and levels. The assessment is expected to address the effects of the proposed structure, such as on river dynamics, bed or bank scour/erosion, flooding, and passage of flood flows and debris. Recent examples of consented bridges can be provided if required. In these examples the proposed bridge levels exceeded the estimated 1 in 100 yr event flow level. These designs were reviewed as part of the consent process by HBRC engineers or consultant engineers. Other aspects of design are also considered, including the width and orientation of the proposed bridge and need for erosion and scour protection.

Consent applicants will need to have regard to changes in design flows and levels post-Cyclone Gabrielle. For example, we are currently considering an application by Hastings District Council for the replacement bridge at Puketapu. The design is currently being reviewed by HBRC engineers but is based on modelling that takes into account Cyclone Gabrielle flows and levels. The new bridge will be significantly higher than the old bridge, and higher than the reported Cyclone Gabrielle flood levels. The design also considers the need to pass debris under the bridge.

Capital works on flood management assets

27. Please provide details of how the overall capital works budget for flood management assets is determined.

The Capital delivery programme starts with the 30-year infrastructure strategy, where focus has been on meeting the needs of growth, changing land use, adapting to climate change, and anticipating any new standards or policy direction from Government.

The capital programme is built within the relevant AMPs, which reference the infrastructure strategy and look at provisioning for capital development to meet level of service requirements within the scheme.

Scheme reviews are performed at regular intervals to assess the level of service that the scheme is performing to and make recommendations for change to scheme assets to better meet the needs of the community. This flows into the AMP which further flows into the LTP.

Prior to Cyclone Gabrielle as part of the 2021-31 LTP, HBRC initiated a full review of all schemes over a 6-year period. The expectation is that this will be completed by 2027. The full list and status of these reviews is shown below at Figure 27.1 below (which is the same as Figure 4.1 above)

Renewal works for each are defined and phased by the relevant AMP and are scheduled into the relevant LTP, for delivery.

Reviews completed	Reviews underway	Reviews to be started
• Napier/Meeanee • HPFC Brookfields/Awatoto • HPFC Pakowhai	• Heretaunga Plains Flood Control • Upper Tukituki • Opoho • Ohuia/Whakaki • Wairoa Rivers and Streams/Nuhaka • HPFC Karamu and HPFC Raupare/Twyford*	• Upper Makara • Porangahau • Esk and Whirinaki* • HPFC Haumoana and Te Awanga - Maraetotara* • HPFC Muddy Creek • Paeroa • HPFC Puninga • Te Ngarue • Kairakau • Poukawa • Kopuawhara • Central and Southern • HPFC Tutaekuri Waimate/Moteo
* Two schemes addressed together in a combined review.		

Figure 4.1 – Status of HBRC Scheme Reviews

28. Please provide details of any changes to capital works budgets that have been made, or are proposed across the Region in direct response to Cyclone Gabrielle.

Capital budgets have changed significantly since Cyclone Gabrielle. The land categorisation work has required HBRC to create a capital programme to improve flood resilience in 7 new communities. Furthermore, additional capital is required in the Awatoto and Pakowhai drainage schemes to upgrade and improve the resilience of 3 pumpstations. The total budget for this work has been costed to $250 m.

As noted above, scheme reviews are being undertaken on all schemes and it is highly likely that there will be recommendations for new capital investment to improve resilience and meet the changes in service performance (i.e. overdesign event management). The exact details will be seen in the recommendations from the reviews.

Provision has also been made to renew assets which fall below the post Gabrielle 1%AEP level of service criteria. The details of this renewal programme will be worked on over the coming months.

Council officers have signalled to councillors that significant increases are likely over the next 30 years to respond to Cyclone Gabrielle and Climate Change. These will be progressively included in Asset Management Plans and future Long Term Plans.

29. What additional capital budget does the Council have/intend to enable capital works to address the effects of climate change?

The effects of climate change and our response to them are being assessed through HBRC's programme of scheme reviews. The expectation is that a recommended Capital delivery plan will be produced as part of the reports which will identify works required to mitigate against the effects of climate change.

As an example, prior to Cyclone Gabrielle, HBRC commissioned the Napier/Meeanee scheme review, which reviewed how the Napier/Meeanee scheme would meet a 1%AEP level of service in 2050 and 2100, considering climate change (primarily sea level rise) and population growth. This review recommended a $50 m capital investment programme over the next 10 years. This has been incorporated into the draft 24-27 Long Term Plan.

Flood Response

The performance and accuracy of the Council flood forecasting model is a key part of informing and prioritising flood response activities. Feedback received from the community indicates that the months leading up to Cyclone Gabrielle had been particularly wet (not least due to Cyclone Hale in late January 2023) and it is likely the groundwater levels and base flows in rivers were elevated above "normal" levels.

30. Please provide further details on the Council's flood forecasting model including specifically how antecedent conditions are incorporated into the model's inputs and outputs.

The forecasting models incorporate antecedent conditions by using previous rainfall values continuously. The model stores a value for soil moisture in a field called the 'Lower Root Zone'. Water is added to this field from rainfall and is converted to discharge in the river as a function of the amount of water in the lower root zone. Wet antecedent conditions will result in a high value in the lower root zone variable and will result in higher runoff.

The forecasting system also has a component referred to as 'Data Assimilation', whereby the forecast river level values are updated with actual levels, such that the model predictions are improved during an event since the state of the river is known to the model (albeit with a 1 hour delay, as that is the time it takes for the data to be transferred from the sites through the telemetry system and for the models to be run). The data assimilation assists with the forecasts in the upcoming 3-8 hours, but the accuracy degrades significantly over longer times.

We note that during Cyclone Gabrielle, many critical instruments for the forecasting system were either destroyed or rendered offline due to technical outages. This had a major impact on the flood forecasting system, and use of the flood forecasting system was halted on the night of the cyclone. Manual observations were sought where possible and safe to do so.

31. Could you please clarify how the Council utilises MetService forecasts for decision-making and the role it plays in location-specific (e.g. Esk Valley) risk-based approaches?

The MetService forecasts are critical to the HBRC's flood response. HBRC receive a gridded forecast (which predicts rainfall for the coming 84 hours) for every rainfall site. This data is downloaded automatically from MetService and is available to view in the software Council uses (Hydrotel). A sample is included in the following Figure 31.1, showing rainfall at a variety of sites in Wairoa.

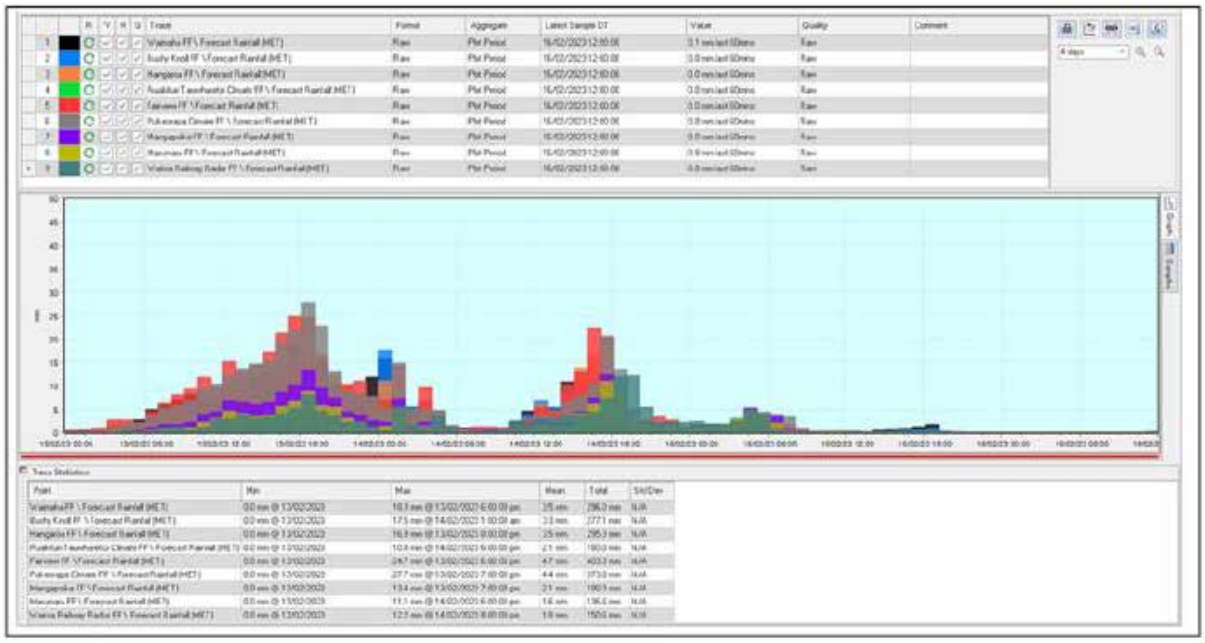


Figure 31.1 – Example Hydrotel entry showing Wairoa rainfall sites

The data from the rainfall forecast is input into the river level forecast models. At the time of Cyclone Gabrielle, HBRC was in the process of upgrading the forecasting system. Wairoa was complete in the new system, while Ngaruroro, Tutaekuri and Tukituki (Upper to Lower) were still available in the existing system. Rainfall is input to the Wairoa model automatically, while the older system required manual input of forecast rainfall.

HBRC also receives textual forecasts from MetService, an example of which is shown at Figure 31.2 below.

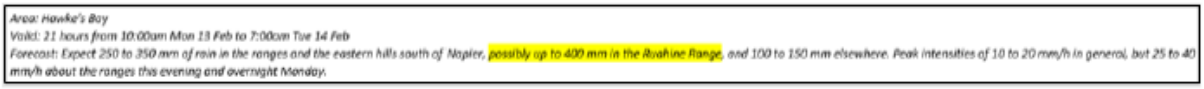

Area: Hawke's Bay
Valid: 21 hours from 10:00am Mon 13 Feb to 7:00am Tue 14 Feb
Forecast: Expect 250 to 350 mm of rain in the ranges and the eastern hills south of Napier, possibly up to 400 mm in the Ruahine Range, and 100 to 150 mm elsewhere. Peak intensities of 10 to 20 mm/h in general, but 25 to 40 mm/h about the ranges this evening and overnight Monday.

Figure 31.2 – Example MetService textual forecast

This forecast is examined in comparison to rainfall return periods to determine how significant the rainfall is likely to be, and how widespread the coverage area may be.

HBRC also use a subscription service called MetConnect, a service from MetService which provides a variety of additional weather-related forecasting products. One specific product is the Modelled Forecast Fields, an example of which is shown in Figure 31.3 below.

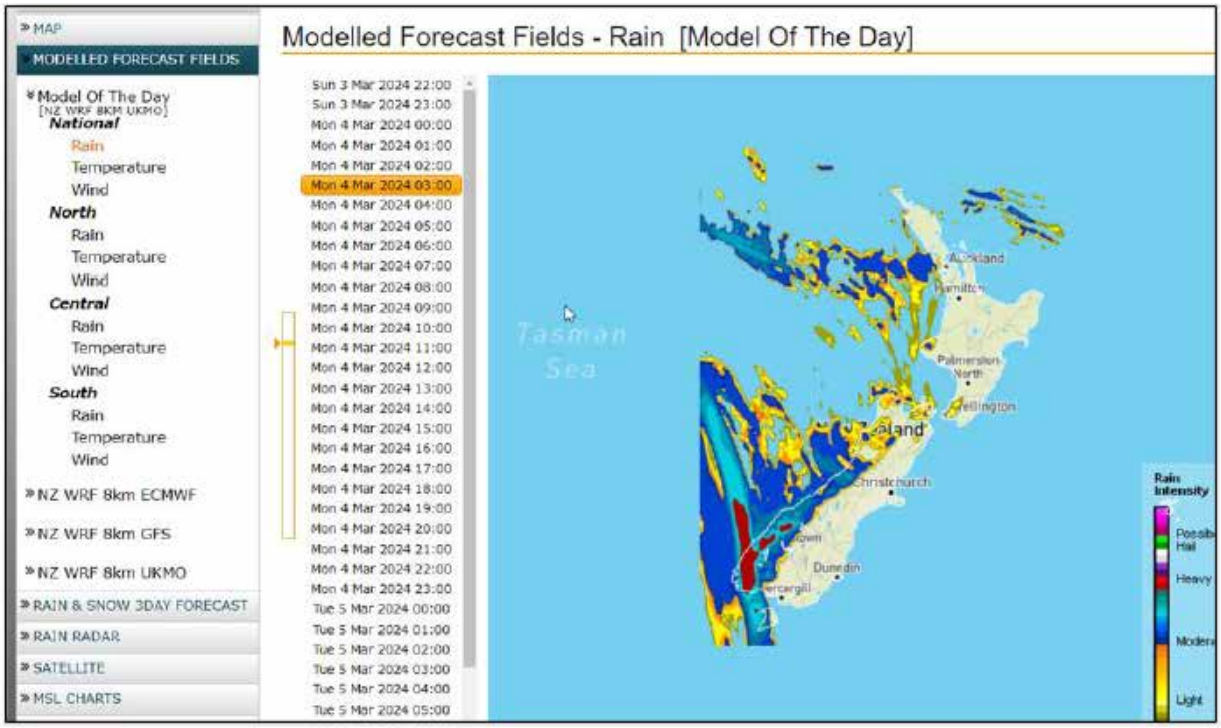


Figure 31.3 – Example of MetService Modelled Forecast Fields product

This product provides hourly forecasts from 3 different MetService products. MetService provide their advice by identifying the 'Model of the Day' which they consider to be the most accurate forecast. HBRC flood forecasters examine all three models, however, we always have in the past used the Model of the day forecasts based on MetService advice.

Regarding the Esk catchment, the forecast for the Esk appeared to be underestimated in part of the mid and lower catchment, and well estimated in the upper portion. We note there can be, and was, a difference in the textual forecast as compared to the gridded forecast. The example provided below shows the warning as issued at 3:15pm Monday February 13, indicating 250-350 mm rainfall in the hills south of Napier (Esk is north of Napier), and 100-150 mm elsewhere (which includes the Esk).

> *SEVERE WEATHER WARNING*
>
> *Issued by MetService at 3:15 pm Monday 13-Feb-2023 {MEDIA} Cyclone Gabrielle to bring widespread significant severe weather to northern and central parts of New Zealand.*
>
> *==========*
>
> *HEAVY RAIN WARNING - RED*
>
> *==========*
>
> *Area: Hawke's Bay*
>
> *Valid: 21 hours from 10:00 am Monday to 7:00 am Tuesday*
>
> *Forecast: Expect 250 to 350 mm of rain in the ranges and the eastern hills south of Napier, possibly up to 400 mm in the Ruahine Range, and 100 to 150 mm elsewhere. Peak intensities of 10 to 20 mm/h in general, but 25 to 40 mm/h about the ranges this evening and overnight Monday.*

The gridded forecast provided for approximately 280 to 300 mm of rain in the Esk Catchment over the 21-hour period. Actual rainfall turned out to be approximately 520 mm in the Esk Catchment. HBRC flood forecasters were reacting to the larger gridded rainfall forecast amounts in the Esk (i.e., working on what was considered the worst case scenario), noting that 300 mm rainfall in 21 hours is approximately a 50-60 year event. This was considered to be a significant event, and preparation was already taking place for evacuations of the vulnerable areas. The 100-year flood hazard area map was transmitted to CDEM to show the potentially vulnerable areas, again to account for what was considered to be a worst case scenario. The final result of over 500 mm rainfall had a return period far in excess of 100 years, and together with the silt and debris in the water far exceeded any forecast flood extents.

32. If the MetService forecasted rainfall had been exactly what actually occurred, to what extent would the Council's flood forecasting model results have changed?

HBRC maintains three separate models for flood forecasting, covering:

1. The Wairoa River and its tributaries,
2. The Ngaruroro, Tutaekuri and Mangaone rivers, and
3. The Tukituki (Upper, Middle and Lower) and its tributaries in the Upper Tukituki Flood Control Scheme.

In many parts of these catchments, the MetService forecast rainfall was very close to actual rainfall and the model results were similar to observations.

However, where significantly more rain fell than forecast, if the forecast rainfall was exactly as occurred, a much different forecast model would have resulted (bearing in mind, that the models also include assumptions dealing with the amount of runoff derived from the rainfall). For example, a major portion of non-forecast rainfall occurred on the Okawa catchment, leading to the Ngaruroro River above Fernhill. Forecast river levels on the Ngaruroro would have been much higher if this rainfall was input to the model.

These river forecast models are not 2-dimensional floodplain models that show flood extents over large areas. Rather, the models are single-channel river models that predict levels in the river, assuming no breaches or overtopping. Once simulated water is in the river model, it will travel down the system and exit at the sea. This will not account for the losses that occurred due to overtopping or breaches, and thus result in higher values in the lower reaches than would have occurred.

Despite that limitation, the models are also self-correcting at the water level gauges, once the observed levels are assimilated back in the model (i.e. the forecast improves as the flow is moving down the system). It should be noted that there is still a large margin of error associated with modelling very high flows, due to the inherent non-linearity of the rainfall to runoff process. River levels forecast several days in advance which are based solely on forecast rainfall will have a large margin of error. The accuracy of the forecasts increases greatly when some rain has fallen in the upper catchments, and the actual water level measurement are combined with the forecast rain to produce forecast water levels in the lower parts of the catchments. This is valid for short time periods, in the range of around 3 to 8 hours depending on the length of the catchment and time of concentration.

We also note that if HBRC received a rainfall forecast of the exact rain that did fall, a significantly different level of escalation would have occurred in the CDEM response preparation. The return periods for some major catchments have been calculated as being between 500 to 1000 years, and this event involved almost every catchment in Hawke's Bay. If such knowledge had been available, river forecasting models would have been only a small component of the response, since the knowledge of 500-to-1000-year return periods would already indicate extreme river levels will ensue, and a much higher level of escalation would have taken place.

33. To what extent would the Council's flood management responses have been different if the flood forecast two days prior to Cyclone Gabrielle had been more aligned with what actually occurred?

We have to assume, for the purposes of this counterfactual, that we did not know the actual location of overflows or breaches on rivers with flood control schemes. The seemingly random nature of stopbank breaches results in planning with trigger levels as an impossible task, as the variables that cause the breaches are not known beforehand.

If the knowledge had been available that significant high river flows were to be occurring based solely on a forecast, the flood forecasts would likely have warranted a recommendation to evacuate all areas such as Flaxmere, Clive, Twyford, Pakowhai, Taradale, Napier, Awatoto, Brookfields, Waiohiki, Puketapu, Moteo, Dartmoor, Rissington, Esk, Te Ngarue, Waipatiki, Aropaoanui, Wairoa, North Clyde, Ohuia, Nuhaka, Opoutama, Mahanga, Kaiwatau Road, Waipawa, Waipukurau, Pōrangahau (and likely other locations).

This would potentially have captured upwards of 100,000 people.

Actioning evacuations is the responsibility of Civil Defence Emergency Management agencies, in coordination with other agencies such as FENZ and New Zealand Police. However, the input from the HBRC Flood Forecasters would be required to identify areas that were unlikely to flood, as well as safe access and egress routes. The scale of such an undertaking would be well beyond the resources that HBRC had to be able to provide answers within a short time.

If we had advance knowledge that such an event was to occur, there would need to have been a request for significant assistance from external resources. There would be no possible way that the current resources of flood management response would be able to cope with such an event, and we think it is unlikely that additional resources would have been available within the timeframe to significantly have changed the approach to the response on this occasion, particularly noting that many other regional councils and unitary authorities were also significantly impacted by the event.

We note that evacuation plans generally follow an initial procedure of 'be prepared'. We believe HBRC was sending many signals that this event was likely to be very large. As it happened, the event was still significantly larger than we had foreseen.

Feedback from the community is critical of the Council for not having an accessible flood warning system available to the public.

34. What, if any, future initiatives are planned in this regard?

We note that the responsibility to provide, maintain, control, and operate warning systems sits with the Hawke's Bay Civil Defence Emergency Management Group in accordance with section 18(2) of the Civil Defence Emergency Management Act 2002. HBRC inputs, particularly our telemetry systems and flood forecasting products, would plainly be critical to any such system. However, it is unlikely that HBRC itself would lead any such initiatives that result in warnings of hazards being pushed to the public.

There is significant planning at present, including working with the National Flood Warning Steering Group, to enable common platform flood warning alert systems to be developed and installed at all participating councils. MetService has also expressed an interest in being involved in this project.

A critical component of the improved service is that it should be enabled such that resources from neighbouring councils could be made available during large scale events. We note that flood forecasting is a specialist task for which councils generally struggle to recruit and maintain suitable staff. Councils generally have only a couple of people who fulfil these roles, which makes implementation and continued improvement difficult.

However, HBRC is reviewing our approach to the provision of public-facing information to ensure that it is of maximum use to the users. We note that feedback we receive from users of a public system, i.e., river levels shown on our website, are that just seeing some number on a chart does not mean much to most people. The users need a context of the severity of the forecast, and the implications to different areas. This is only achieved by careful interpretation of the river level forecasts from the specialist staff who are familiar with various ground levels in relation to river levels. However, we note that other Councils' public facing rivel level information (for example Horizons Regional Council) have a greater ability for the public to subscribe to receive alerts directly via text message or email. HBRC is looking at whether such an ability may be appropriate to roll out for Hawke's Bay.

We finally reiterate that power and equipment outages during the night of Cyclone Gabrielle did render our telemetry system ineffective, and HBRC resorted to manual observations relayed back to others to make informed decisions. This would also have affected a publicly available alerting system.

It is noted that the Council's Flood Response Manual (2015) has no information on evacuation trigger levels for any of the rivers within the Region. From reviewing the timeline and communications logs evacuation warnings appeared to be fairly ad-hoc during Cyclone Gabrielle.

35. Please provide details of what evacuation trigger levels were used to inform and advise Civil Defence on evacuation requirements during Cyclone Gabrielle and what planning and analysis were used as the basis for this information

HBRC has historically taken the approach of providing bespoke advice on flood extents and recommendations for evacuations catered for the event in question. Rather than trigger points being pre-set, the trigger for providing evacuation advice has been the expert assessment of HBRC's flood forecasters. That assessment is based on flood modelling, MetService forecasts, antecedent conditions, the observed levels of rivers, etc. An explanation of how evacuation advice was developed during Cyclone Gabrielle is provided below.

We note that this approach is consistent with that taken by most other regional councils and unitary authorities. Most approaches, as ours, appear to rely on using available data and resources at the time to make provide appropriate advice.

While they would not necessarily have made a difference to the approach taken during Cyclone Gabrielle, HBRC acknowledges that having more formalised trigger points included in our Flood Manuals would be an additional tool to assist in the tendering of timely evacuation advice to Civil Defence agencies. We will consider this improvement as part of our overall response from the recommendations of the Government Inquiry and independent review into the cyclone response and anything to this end included in the HBIFR's recommendations.

We note that there is always a need to consider the best course of action before a warning or evacuation notice is given, rather than triggers automatically prompting evacuation. Accordingly, HBRC input to Civil Defence is always in the nature of advice, and the best course of action will not necessarily be issuing an evacuation order or warning. Evacuations undertaken at the wrong time can result in people increasing their chance of harm if they move from relative safety into more dangerous situations. Our advice is for Civil Defence agencies and emergency services, who can consider the advice in context and make fully-informed decisions with regard to evacuations and warnings

Approach during Cyclone Gabrielle

In areas where there are flood protection schemes, particularly stop banks, evacuation advice was based on any concerns about the integrity of the relevant infrastructure or in the anticipation that the level of service of the scheme would be exceeded. Notably, it was not anticipated by HBRC's flood forecasters that the level of service of the schemes would be exceeded. So, advice was informed by observed river levels and observations of the performance of the infrastructure. For example, during Cyclone Gabrielle, the advice to evacuate Taradale was given when it was observed that water was just flowing over the stopbank near EIT. That became the natural trigger point, decided upon at the time using available resources and knowledge. Forecasting of the flood extent for that scenario was produced in the 1999 Super Design flood strategy report, which informed the advice to Civil Defence agencies.

Given that it is not possible to predict in advance where and how schemes will fail in super design events, applying a formalised trigger point would necessarily result in evacuation advice being given before levels of service are exceeded and capture various breach scenarios. During Cyclone Gabrielle, this may have resulted in unworkable advice to evacuate swathes of the Heretaunga Plains, highlighting the need for the advice to be filtered through Civil Defence agencies before being formalised into evacuation orders and warnings.

Where no flood protection exists, such as in Esk, Rissington and Te Ngarue, evacuation recommendations are initially based on weather and HBRC flood forecasting. The most at-risk areas such as low-lying areas of Esk Valley, were identified well in advance. Advice on forecast flood extents, including the need for evacuations at places like Shaw Rd, Hukarere Girls School and the Eskdale Holiday Park, was given to Civil Defence agencies in the days leading up to the event.

This approach was constantly monitored, and updates were provided using river level warnings. Such an update occurred during Cyclone Gabrielle when it became evident that rainfall was exceeding MetService forecasts and therefore also exceeding HBRC's flood forecasts. When the Mangaone at Rissington reached the 20-year (red) level, with further rainfall expected, Civil Defence agencies were advised of the need to evacuate that area. Similarly, when the Esk River reached levels beyond forecast the advice was updated and eventually it was determined that it would be "best to consider that any house in the Esk Valley may be at risk".

For Wairoa, HBRC had previously produced a series of flood maps which provide the details relating to the water level recorder at the Railway Bridge in relation to the flood extents that may occur in North Clyde, i.e. trigger levels that would indicate the need for evacuation. Each map contains a hydrograph with a line indicating the current state of the water level at the Railway Bridge, as well as the modelled flood extents which shows the depth of flooding according to the legend. Two examples are shown at Figure 35.1 below, with the left-hand image showing no flooding occurring in North Clyde when the level at the Railway Bridge has just reached the RED warning level. The right-hand image shows flood extents associated with the level at the Railway Bridge above the RED level.

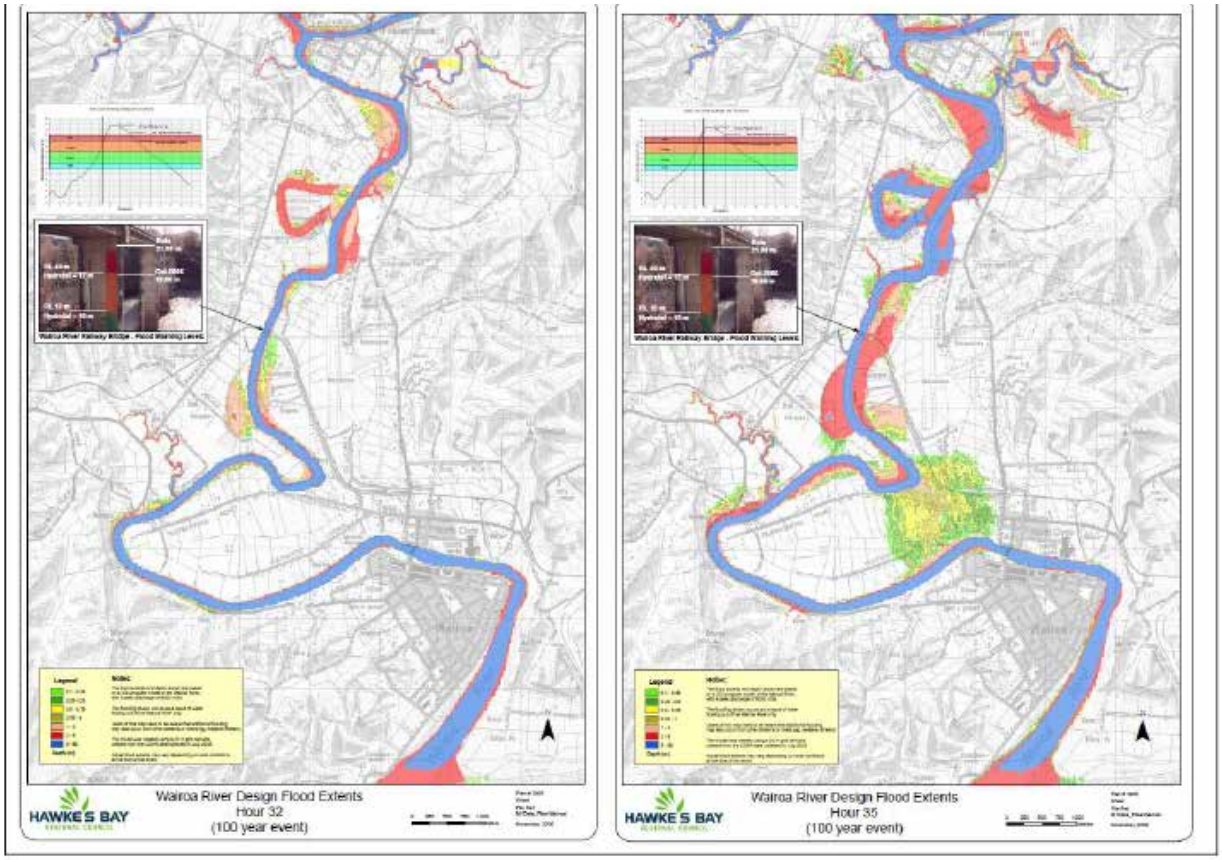


Figure 35.1 – Example Wairoa Flood Maps

Shortly after HBRC produced these maps, presentations were made to Wairoa District Council staff, Councillors, and CDEM staff. Many booklets of the maps were made and distributed to appropriate staff. The intended use involved referencing anticipated flood levels from the forecasting system and conveying that

Information to appropriate staff such that, for example, the expected flooding could be stated as being similar to the map showing Hour 35. This would enable CDEM agencies or other staff to make decisions on appropriate evacuations.

We note that during Cyclone Gabrielle, three distinct issues arose which hampered the use of this system, or otherwise made the system not become as effective as it may have been. Firstly, in the eastern catchment of Wairoa, significantly more rain fell than was forecast by MetService. For example, at Fairview, the MetService forecast was for 235 mm of rain, and the measured rainfall was 449 mm. Pukeorapa was similar with a forecast of 230 mm, and observed rainfall of 381 mm. The forecast river levels using the MetService forecast rainfall resulted in lower river levels than what was observed, and the out of channel flow through North Clyde was not forecast by HBRC flood forecasters. Secondly, at a critical time, communications with Wairoa were either completely cut off or severely hampered such that no updated data was available, and no discussion could be had with on-site observations from staff in Wairoa, and therefore no updates could be readily provided to assist with updated forecasts. Thirdly, due to extremely high workload on HBRC flood forecasters staff during Gabrielle, resources were allocated to catchments such as Esk, Mangaone, Tutaekuri and Ngaruroro, where high river levels and stopbank breaches were becoming life-threatening. Since forecast rainfall was not indicating any significant flooding in Wairoa, the forecasting team anticipated that area would be unlikely to have significant immediate life-threatening issues.

A consistent theme from the community's feedback was that the performance of pump stations during Cyclone Gabrielle was clearly affected by the widespread power outage and in some cases complete inundation of the stations occurred – one example, of many, being at Haumoana.

36. Please provide details of the current back-up systems in general for pump stations in the case of power outages and any plans the Council has to improve them.

HBRC owns two mobile generators (150kva and 400kva) and has an agreement with Napier City Council with regard to provision of up to 8 mobile generators within the Napier/Meeanee scheme.

HBRC further owns 6 tractor mounted pumps of various sizes (300 – 750l/s) and 2 skid mounted 6'' diesel pumps which can be used to temporarily augment or overpump from pumpstations. HBRC's Works Group maintains the pumps and is trained and experienced in their provisioning and operation.

HBRC also has commercial relationships with a generator services company and a mobile pump supplier to provide pumps and generators, on a hire basis, rapidly in response to an event.

Finally, agreements are in place with large local farming enterprises to use tractors and pumps in rural catchments in the case of pump failure.

HBRC is reviewing its provisioning of back-up systems and is taking a holistic view, where new pumpstations (such as the 3 new pumpstations in Pakowhai and Awatoto) will be resilient to power or pump failure through redundancy and dedicated generation.

37. Please provide details of funding and investment in pump stations arising as a result of climate change.

This has been answered in question 29, particularly with regard to the Napier/Meeanee scheme and the pumpstations associated with this scheme. Further, as addressed in question 4, all schemes are undergoing a programme of scheme reviews which will assess the current level of service of the scheme, which will include consideration of funding and investment in pump stations. This will take into account population growth and the effects of climate change and will develop a series of capital programmes to allow the schemes to meet their level of service into the future.

It is expected that the pumpstations associated with these scheme reviews will feature in these capital programmes, where they will need to be upgraded to maintain a level of service with regard to climate change and population growth or change.

The three pumpstations that form part of the HBRC Flood Resilience Programme, Pakowhai, Brookfields and Mission, had already been part of a review and assessment against an enhanced level of service which takes into account the effects of climate change. The enhanced level of service will see them move from a rural drainage level of service (32mm/ha/d) to an urban stormwater level of service (2% AEP).

A number of eye-witness accounts suggested sudden "waves" of flood water occurred where levels rapidly rose and then subsided.

38. Please comment on any observations to support the theory of the formation and failure of landslide dams in upper catchment areas and the extent to which/if this may have contributed to flood waves propagating downstream.

We have no specific evidence of this occurring. While it is difficult to comment with any certainty as to this occurring during Cyclone Gabrielle without commissioning specific investigation or analysis, we agree that the failure of landslide dams is a valid theory to explain this observed phenomenon.

39. Please comment on any observations of maximum head build up at bridges that subsequently failed and the extent to which/if this may have contributed to flood waves propagating downstream.

There is ample evidence showing debris build-up on bridges contributed to increased water levels on the upstream sides. As the bridges failed, the flood wave travelling downstream would then release the additional water and cause further water level increases downstream.

The Panel has been told about a "spillway" on the right bank of the Tutaekuri River and that there had been some intention of mechanically breaching it during Cyclone Gabrielle.

40. Please provide details of any designated breach points on the Tutaekuri River stopbank system and whether instructions were issued to activate any of them during the Cyclone Gabrielle.

No controlled breaching of stopbanks occurred during Cyclone Gabrielle.

Details of the only designated breach point in the Heretaunga Plains Flood Control Scheme are available on Pages 110 and 111 of the Heretaunga Plains Asset Management Plan, as snipped at figure 40.1 below. Figure 40.2 shows the approximate location.

The Tutaekuri River has one section of cement stabilised stopbank at Cross Section right bank 19 + 300, located in a position which is able to provide a controlled overflow to the Tutaekuri-Waimate area.

This may be activated at times when there is a risk of a breach on the left bank which may flood Taradale and Napier.

Figure 2-7: Tutaekuri Section 19+300 – cement stabilised detail

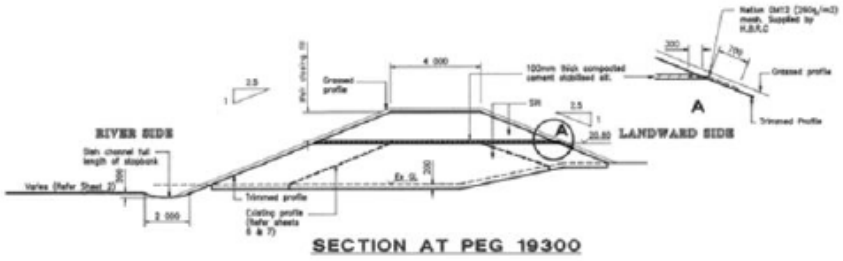


Figure 40.1 – Extract of Heretaunga Plains Asset Management Plan detailing a designated breach point

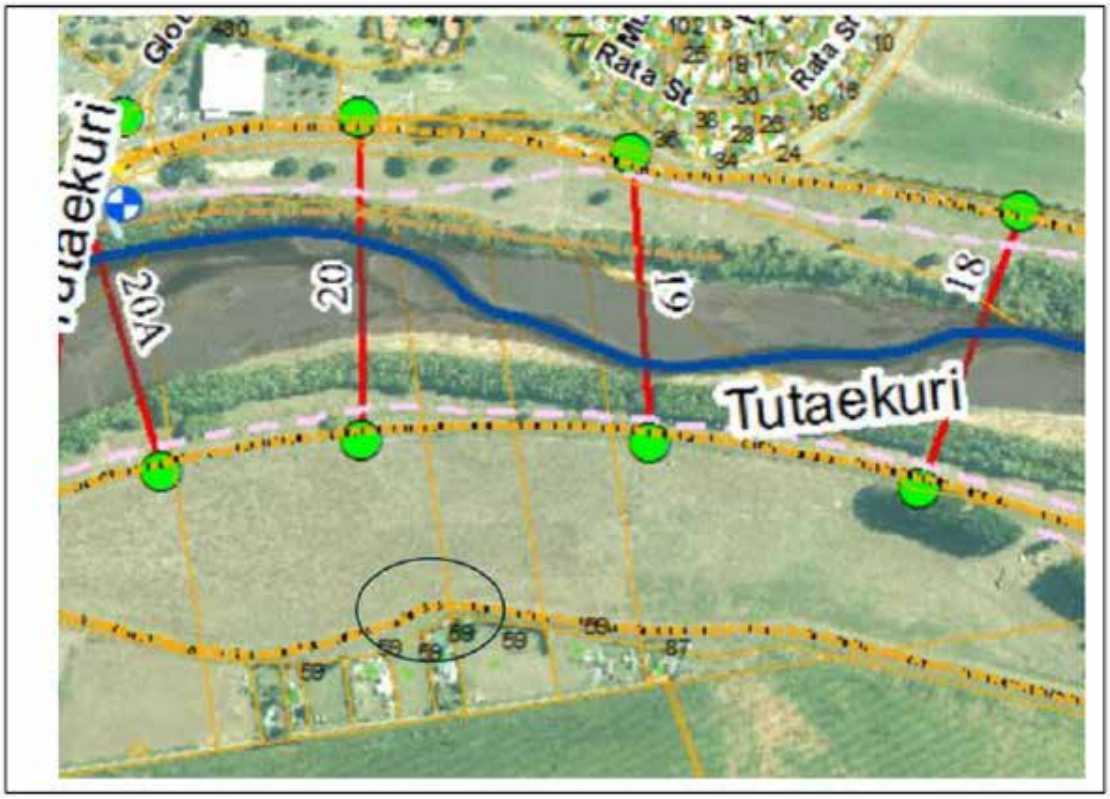


Figure 40.2 – Approximate location of the designated breach point

During Cyclone Gabrielle, when it became evident that there existed a significant threat to Taradale, an excavator was instructed to mobilise to this location, with the intention for HBRC to provide further instruction on whether to enable the controlled breach to occur. Due to accessibility constraints, the excavator and operator did not reach the site.

We note that if a breach were to have been enabled, the effect in Pakowhai would have been minimal, accounting for only a very small proportion of the flooding that actually occurred. An estimate is that the overflow rate from the controlled breach would have been in the order of 20 – 40 m^3/s for a short time, causing ponding in the lowest parts of Pakowhai of about 300 mm, whereas the flooding to depths of 6 m in Pakowhai was the result of perhaps 1000-2000 m^3/s of river flow from multiple uncontrolled breach locations for many hours.

Indeed, post event analysis has shown that water which escaped the right bank of the Tutaekuri at Waiohiki was actually flowing back into the river near the location of the designated breach site, as shown in the following figure 40.3.

Figure 40.3 – Photos showing water flowing back into the Tutaekuri river at the approximate location of the designated breach site

While HBRC confirms that there was an intention to move plant to the location during Cyclone Gabrielle to enable the option of a controlled breach at the designated breach site, we note that it is unlikely that a decision to undertake a controlled breach would have been actioned. This is because since the designated breach point was installed, residential development has been undertaken adjacent to the applicable section of stop bank.

The appropriateness of this option continuing to feature in the asset management plan will be reviewed by HBRC in light of the findings of this review.

Planning controls

41. As a result of Cyclone Gabrielle, what, if any, consideration has the Council given to updating the Regional Policy Statement to provide a more directive framework that would avoid or limit residential/urban development in flood-prone/high hazard areas?

Prior to Cyclone Gabrielle, HBRC had commenced a review of the Regional Policy Statement and its regional plans. Our work programme was configured to prepare a combined document branded as the "Kotahi Plan". RPS and plan preparation had commenced pre-Cyclone. However, as a result of the priority of cyclone recovery work and various other factors, HBRC is now progressing RPS preparation ahead of regional plan content. The RPS focuses on identification of key issues and options.

Modernising the RPS provisions for natural hazards was already a priority for HBRC. One option under consideration for the RPS is indeed a more directive approach for control of land use activities to avoid or mitigate significant risks of some types of hazards. No decisions on preferred options have been made yet. We would welcome the HBIFR's recommendations in this respect.

National direction in the form of Government Policy Statements or National Policy Statements (other than the New Zealand Coastal Policy Statement) are notably absent. NPSs for flood management and natural hazard decision-making have been attempted over past decade or so, but none are in effect. A 'Climate Adaptation Act' has also been hailed as delivering some assistance; but such a Bill is still yet to emerge.

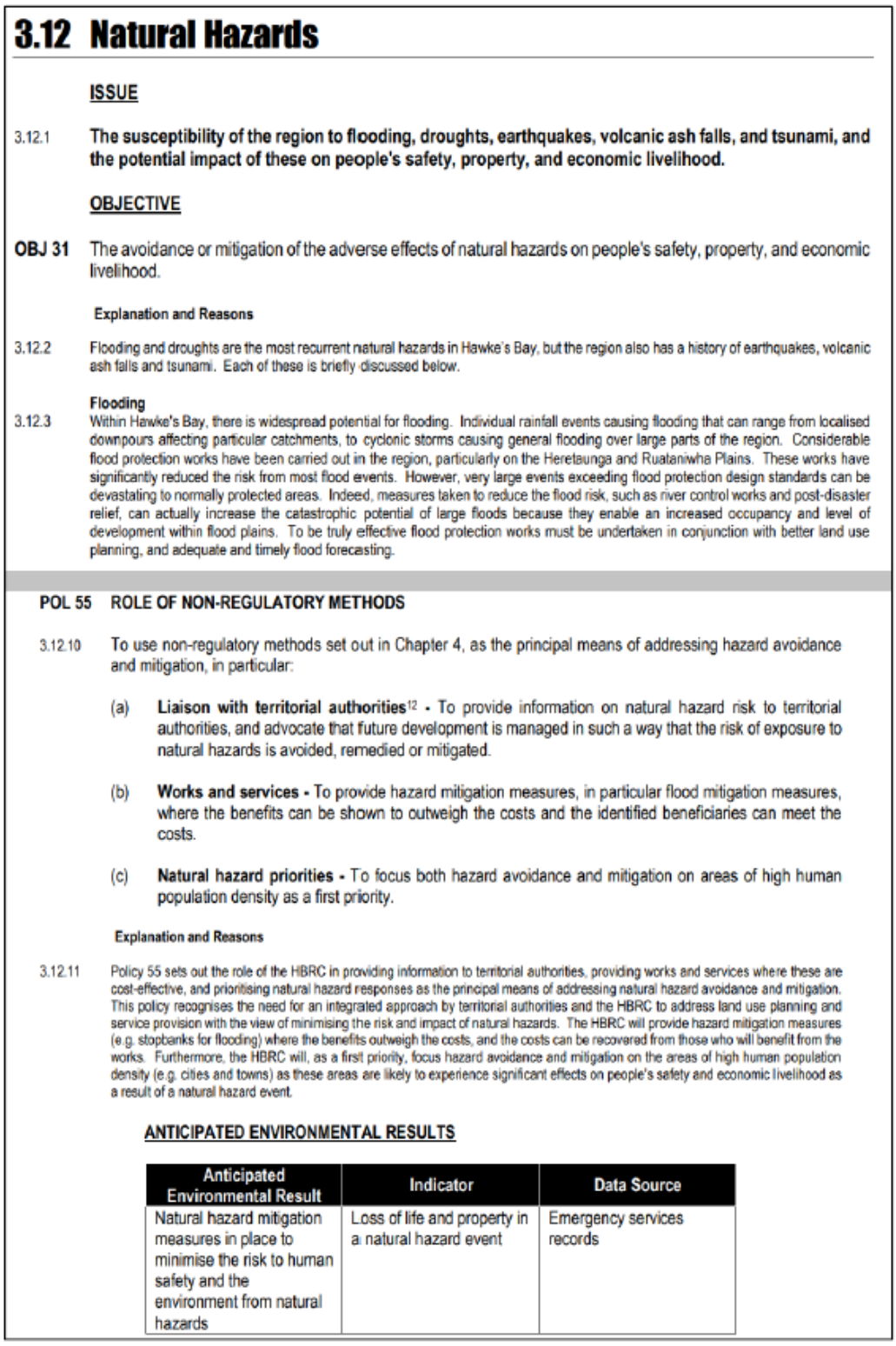
The Hawke's Bay Regional Coastal Environment Plan (RCEP) already identifies coastal hazard zones (erosion and storm surge inundation) with associated Coastal Hazard Zones and land use controls. Accordingly, something similar for flooding hazards would not be entirely precedent setting.

However, the RPS is not the regulatory instrument per se. It would set an intention for the organisation to take a more directive approach. That approach would need to be given effect in regional plans and district plans. We note that Regional Plans cannot control subdivision, pursuant to sections 30-31 of RMA. Accordingly, HBRC's ability to take truly directive approach to determining where residential/urban development takes place is ultimately limited by our statutory role.

Meanwhile work continues on preparing the Napier-Hastings Future Development Strategy ('FDS') as per the National Policy Statement for Urban Development. HBRC is jointly responsible for preparing that FDS with Napier City Council and Hastings District Council. The FDS is building on earlier urban growth strategies for the Heretaunga Plains. All of these successive growth strategies have used best available information on natural hazard-related constraints to inform preferred settlement patterns for residential and urban development. Change 4 to the operative RPS was notified in December 2011 and took effect in January 2014. Notably, Change 4 inserted Chapter 3.1B into the RPS. That chapter features policies that identify locations considered suitable and unsuitable for future greenfield residential developments. Those locations arose from the 2010 Heretaunga Plains Urban Development Strategy prepared jointly by NCC, HDC and HBRC.

42. In relation to flood-prone/high hazard areas, what involvement has Hawkes Bay Regional Council taken when the Region's District Councils have notified their respective district plans?

HBRC takes an active approach to our involvement in the development, notification, and amendment of district plans, by providing advice and information to the territorial authorities. This occasionally involves HBRC making submissions on proposed plans/plan changes. This 'active advocacy' is consistent with Policy 55 of the HB Regional Resource Management Plan, the relevant extracts (relating to flooding, in particular) of which are provided below at Figure 42.1.



3.12 Natural Hazards

ISSUE

3.12.1 **The susceptibility of the region to flooding, droughts, earthquakes, volcanic ash falls, and tsunami, and the potential impact of these on people's safety, property, and economic livelihood.**

OBJECTIVE

OBJ 31 The avoidance or mitigation of the adverse effects of natural hazards on people's safety, property, and economic livelihood.

Explanation and Reasons

3.12.2 Flooding and droughts are the most recurrent natural hazards in Hawke's Bay, but the region also has a history of earthquakes, volcanic ash falls and tsunami. Each of these is briefly discussed below.

Flooding

3.12.3 Within Hawke's Bay, there is widespread potential for flooding. Individual rainfall events causing flooding that can range from localised downpours affecting particular catchments, to cyclonic storms causing general flooding over large parts of the region. Considerable flood protection works have been carried out in the region, particularly on the Heretaunga and Ruataniwha Plains. These works have significantly reduced the risk from most flood events. However, very large events exceeding flood protection design standards can be devastating to normally protected areas. Indeed, measures taken to reduce the flood risk, such as river control works and post-disaster relief, can actually increase the catastrophic potential of large floods because they enable an increased occupancy and level of development within flood plains. To be truly effective flood protection works must be undertaken in conjunction with better land use planning, and adequate and timely flood forecasting.

POL 55 ROLE OF NON-REGULATORY METHODS

3.12.10 To use non-regulatory methods set out in Chapter 4, as the principal means of addressing hazard avoidance and mitigation, in particular:

(a) **Liaison with territorial authorities**[12] - To provide information on natural hazard risk to territorial authorities, and advocate that future development is managed in such a way that the risk of exposure to natural hazards is avoided, remedied or mitigated.

(b) **Works and services** - To provide hazard mitigation measures, in particular flood mitigation measures, where the benefits can be shown to outweigh the costs and the identified beneficiaries can meet the costs.

(c) **Natural hazard priorities** - To focus both hazard avoidance and mitigation on areas of high human population density as a first priority.

Explanation and Reasons

3.12.11 Policy 55 sets out the role of the HBRC in providing information to territorial authorities, providing works and services where these are cost-effective, and prioritising natural hazard responses as the principal means of addressing natural hazard avoidance and mitigation. This policy recognises the need for an integrated approach by territorial authorities and the HBRC to address land use planning and service provision with the view of minimising the risk and impact of natural hazards. The HBRC will provide hazard mitigation measures (e.g. stopbanks for flooding) where the benefits outweigh the costs, and the costs can be recovered from those who will benefit from the works. Furthermore, the HBRC will, as a first priority, focus hazard avoidance and mitigation on the areas of high human population density (e.g. cities and towns) as these areas are likely to experience significant effects on people's safety and economic livelihood as a result of a natural hazard event.

ANTICIPATED ENVIRONMENTAL RESULTS

Anticipated Environmental Result	Indicator	Data Source
Natural hazard mitigation measures in place to minimise the risk to human safety and the environment from natural hazards	Loss of life and property in a natural hazard event	Emergency services records

Figure 42.1 – Extracts of Regional Resource Management Plan

A notable example of such advice was that in 2013 HBRC presented a flood hazard map of the Esk Valley to HDC and NCC. The map was a worst-case scenario, showing flood extents from an event beyond the 50- or 100-year return period events. This map is shown below as Figure 42.1, and it is noted that it matches almost exactly the extents of flooding during Cyclone Gabrielle (apart from the area near Pohutukawa Drive that flooded during the event, but which we believe was exacerbated by the debris and logs which blocked the river mouth).

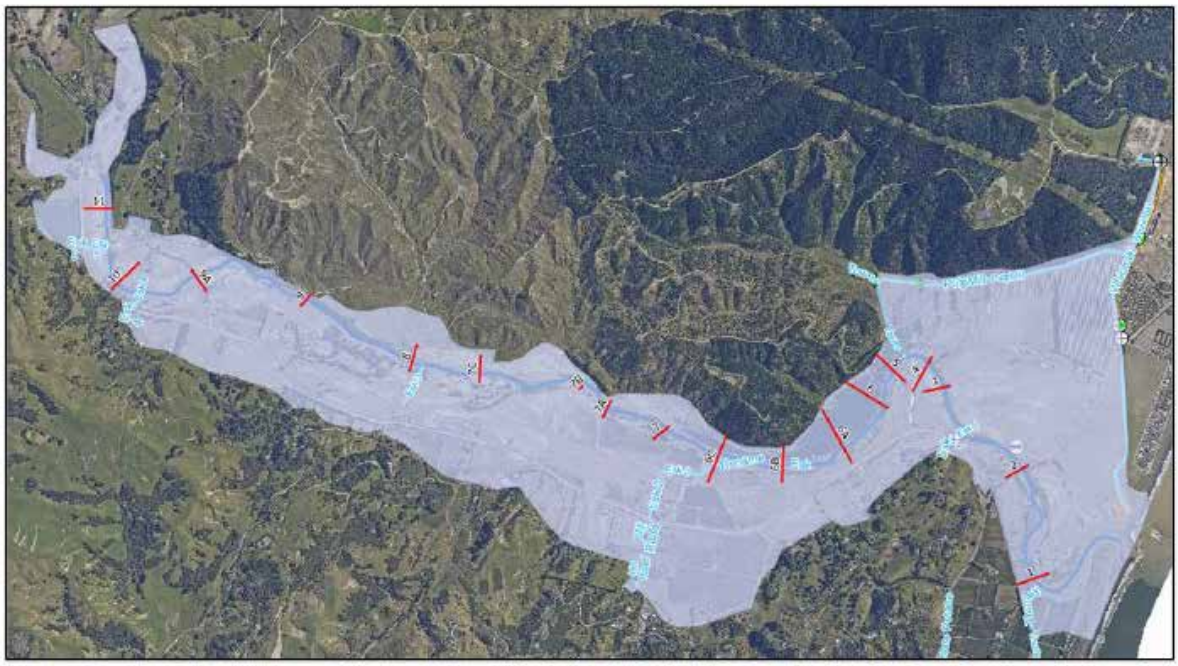


Figure 42.1 – 2013 HBRC flood hazard map for Esk Valley

The proposed hazard map was rejected from being included in the two district plans with the following reason given by one of the councils:

> *Our rules regarding land uses within the River Hazard Overlay are fairly restrictive however, and applying these rules / standards to a new wider area modelled on 'a worst case scenario' or extreme events with return periods greater than 100 years may not sit so easily with those land owners.*

HBRC also published the book of super design flood scenarios in 1999, the results of which were also not included in any district plan.

In August 2021, HBRC submitted on the proposed Central Hawke's Bay District Plan, particularly on the [then] proposed plan's provisions for flood hazard areas and associated land use controls. HBRC appeared at the hearing. Many of HBRC's submission points relating to flood hazard areas were accommodated by the CHBDC's Hearing Panel's decisions (issued 25 May 2023).

We intend on continuing our involvement and input into the natural hazards chapter of the proposed Napier District Plan. Napier City Council intends publicly notifying a district plan Variation later in 2024 to include provisions for management of natural hazards in Napier City.

43. Citing as many examples as possible, to what extent does the Hawkes Bay Regional Council become involved in land use and subdivision consent applications involving flood-prone/high hazard areas?

HBRC takes an active approach to our involvement in land use and subdivision consent applications to the extent where there is an opportunity to be involved.

We often provide information and advice to developers who ask us, prior to them formally lodging applications with the city and district councils. Once an application is made to the relevant TLA, there are very limited opportunities for HBRC's involvement, unless the TLA determines that the application is notified. Public notification of consent applications presents an opportunity for HBRC to assess the application and make a submission if deemed appropriate. We also note that approvals advanced through Māori Land Court approval pathways for subdivision appear to proceed without the opportunity for HBRC to provide advice.

We have provided advice on many subdivision consent applications in this way, including the subdivisions at Iona Triangle, Riverbend Road, Jervoistown, Flaxmere, Te Awa, Parklands, Brookvale, Arataki, Ongaonga (x 3), Mt. Herbert Road, SH2 Waipawa, Waipawa near Bush Drain, Te Awanga, School Road Clive, Pohutukawa Drive. There are likely to be many others.

A common theme with these applications is that the developers tend to just reach the minimum standard to satisfy the 50-year (for building code compliance) or 100-year (for subdivisions) return period flood control, and rarely if ever take into account design events which exceed these levels.

We provide a couple of specific examples, relevant to areas affected by flooding during Cyclone Gabrielle.

One of the more notable examples was a private plan change request in 2007/08 to rezone approximately 4ha of land at Beach Road, Tangoio from Rural to Coastal Residential. The purpose of this change was to develop approximately 30 residential lots in the subdivision. HBRC submitted on that rezoning request opposing the application and seeking that the rezoning request be declined. In relation to flooding risk issues, HBRC's submission, in part, stated:

> *"The site is located on the highly volatile Te Ngaru Stream flood plain. The Regional Council considers residential development on the floodplain to be unacceptable due to the area's history of extreme flood events and the threat of coastal inundation. In a flood event, the area will be inundated with high velocity waters capable of causing significant damage to property. There is a substantial risk to public safety and health, and any permanent structures in this environment will be at risk. In the Council's opinion, residential occupation of the floodplain is not sustainable."*

The plan change and subsequent residential development was nonetheless approved. The Beach Road development was severely impacted by flooding during Cyclone Gabrielle and has been classified as Category 3 land.

Another notable case, where the subject land was impacted by Cyclone Gabrielle flooding was a subdivision at Ohiti Road, Omahu. We understand this subdivision was advanced via a pathway through the Māori Land Court, rather than the typical pathway where the TLA is the consent authority. To the best of our knowledge, HBRC was not given any opportunity to be involved in proceedings for that subdivision proposal. That development has been classified as Category 2C land post Cyclone Gabrielle, meaning that community-level interventions need to be implemented in order for the risk to life to be mitigated. HBRC and the Crown have committed $10 m for those flood protections to be developed.

The Panel has received a significant amount of feedback on how land uses in the upper reaches of the Region's rivers affect erodibility of the land and flood potential in the lower catchments - in particular, the relative contributions resulting from pastoral farming vs plantation forestry vs the retention/regeneration of native vegetation.

44. Does the Council have access to any technical information that compares the erodibility of steep country in the Region's upper catchments and the respective downstream flood risks associated with pastoral farming, plantation forestry, and the retention/regeneration of native vegetation?

HBRC has extensive technical literature, and monitoring and investigation projects that aim to inform our understanding of erosion processes, soil loss, landslide susceptibility, efficacy of mitigation techniques and effects on downstream receiving environments. These projects do not currently assess the flood risks associated with land use or erosion processes.

HBRC has current funding to investigate the feasibility of nature-based solutions for reducing flood peak flows in two catchments, which is a work programme through to June 2025.

45. Please explain the existing controls available to Hawkes Bay Regional Council for managing agriculture and forestry activities in the Region, particularly in head water catchments and/or upper catchments, and the approach taken when such activities are proposed at scale.

The 2017 National Environmental Standards for Plantation Forestry (NES-PF)[4] applied and was administered by HBRC across the region including in upper catchments. This sets conditions for afforestation and forest harvesting. On steeper slopes, resource consents are required. These are generally issued with conditions that are consistent with the Permitted Activity standards of the NES. Conditions include control of sediment, slash, protection of wetlands and indigenous vegetation. There were limited circumstances where rules in the regional or district plans could be more stringent than the NES-PF.

4 In 2023, the NES was amended and renamed to apply to "commercial forestry"

There are Rules in the Regional Resource Management Plan (RRMP) addressing vegetation clearance and soil disturbance. It is a Permitted Activity to clear vegetation and disturb soil (e.g. through earthworks) subject to conditions preventing transportation or deposition of disturbed matter into any water body, and site rehabilitation. Similar rules apply under the Regional Coastal Environment Plan in relation to the landward parts of the coastal environment above mean high-water springs. Rules do not address favouring one land use over another.

In May 2020, HBRC publicly notified proposed Plan Change 9 (PC9) to the RRMP. PC9 is a package of amendments relating to land and freshwater management in the Tutaekuri, Ahuriri, Ngaruroro and Karamu river catchments - the 'TANK' catchments. Decisions on PC9 submissions were issued in September 2022. Provisions in PC9 featured clearer policy direction, rules, non-regulatory methods etc to achieve freshwater limits over time. These included limits for sediment.

PC9 is currently subject to sixteen appeals filed in the Environment Court where appeal proceedings are ongoing.

Like other parts of New Zealand, the following national regulations also apply (or soon will apply) to forestry and agricultural activities in HB:

- Resource Management (National Environmental Standards for Freshwater) Regulations 2020
- Resource Management (National Environmental Standards for Commercial Forestry) Regulations 2023
- Resource Management (Stock Exclusion) Regulations 2020[5]
- Resource Management (Freshwater Farm Plans) Regulations 2023[6]

46. Please advise any intended changes to existing controls for managing agriculture and forestry activity in the Region, particularly in head water catchments and/or upper catchments, to address the effects of climate change?

The NES-PF has been amended to become the NES-CF since Cyclone Gabrielle. This includes more specific provisions for slash control that will be administered by the Regions. They also allow for rules in regional or district plans for afforestation to be more stringent.

These rules could be used to determine the appropriateness of, respectively, afforestation, agriculture and indigenous revegetation in certain locations. This provision was not available pre-cyclone and may now be considered by HBRC in the preparation of future regional plans.

5 In 2023, an Order in Council was passed granting an extension to some of the stock exclusion regulation requirements. The Order in Council was passed under the Severe Weather Emergency Recovery Legislation Act 2023

6 These Regulations are not yet in force in the Hawke's Bay region, but are likely to come into effect in 2025 (unless the Government makes further amendments to farm planning and freshwater farm plan requirements).

Mana whenua

47. Using representative examples, please provide details of the formal and informal relationships the Council has with mana whenua organisations, at both the governance and operational levels.

HBRC has a myriad of formal and informal relationships with Mana whenua organisations which support, shape and enhance our work. Such relationships pervade both the governance and operational levels of HBRC.

At the governance level, HBRC has been privileged since 2022 to be a local authority with Māori representation enabled through the provision of Māori constituencies. There are two Māori constituencies, Māui ki te Raki and Māui ki te Tonga, each with one member representing Māori who live in the northern and southern areas of Hawke's Bay. Additionally, the Chairs of both the Regional Planning Committee and Māori Committee of Council (both external appointees representing Mana Whenua organisations) sit in on meetings of Council in a non-voting capacity.

The Regional Planning Committee (RPC), a Council Committee established pursuant to the Hawke's Bay Regional Planning Committee Act 2015, is established to oversee the review and development of the Regional Policy Statement and regional plans for the Hawke's Bay region, as required under the Resource Management Act 1991 (RMA). This committee is the co-governance group for the management of natural resources in Hawke's Bay, with an equal number of Regional Councillors and Post Settlement Governance Entity (PSGE) appointees.

All RPC members have full speaking and voting rights.

This committee considers and recommends strategies, policies, rules and other methods for inclusion into the Regional Resource Management and Regional Coastal Environment Plans to Council. The committee will also make recommendations to Council to ensure the effective implementation of plans, processes, research, monitoring and enforcement to satisfy the requirements of the RMA, National Policy Statements, National Environmental Standards and relevant associated legislation.

Many of HBRC's standing committees have Mana Whenua representation. Representative examples include:

- the Māori Committee, which includes 13 representatives nominated by the Tangata Whenua, appointed at the first meeting of the Māori Committee each triennium; plus one alternate representative nominated to attend in an appointee's absence[7] and
- the Corporate and Strategic Committee, which includes one (non-council) member of the Māori Committee, and one tāngata whenua representative from the Regional Planning Committee.

7 Notably, the Māori Committee has been a standing committee of HBRC since the early 1990s

Further, many of the Joint Committees that HBRC administers (or is involved in) have appointees from Mana Whenua organisations. Again, as representative examples:

- The Clifton to Tangoio Coastal Hazards Strategy Joint Committee includes "Tangata Whenua Members" appointed by:
  - The trustees of the Maungaharuru-Tangitū Trust, on behalf of the Maungaharuru-Tangitū Hapū,
  - Mana Ahuriri Incorporated, on behalf of Mana Ahuriri Hapū, and
  - Tamatea Pokai Whenua,[8] on behalf of the hapū of Heretaunga and Tamatea.
- The Climate Action Joint Committee includes:
  - One member (and one alternate) from each Post-Settlement Governance Entity within the region, and
  - Two members (and one alternate) appointed to represent the Ngāti Kahungunu Taiwhenua and Board representatives on the HBRC Māori Committee.
- The Hawkes Bay Civil Defence Emergency Management Group Joint Committee includes advisory, non-voting members[9] representing:
  - Mana Ahuriri,
  - Maungaharuru-Tangitu Trust,
  - Tatau Tatau o Te Wairoa, and
  - Ngati Kahungunu Iwi Incorporated

At the operational level HBRC's Māori Partnerships group provides organisation-wide leadership, guidance and representation and will help staff and councillors engage more effectively with Tāngata Whenua. This includes leading HBRC's tailored engagements with Mana Whenua organisations. Some representative examples are demonstrated in Figure 47.1 below. These examples list various projects being undertaken by HBRC and the mana whenua organisations that are engaged as part of that mahi.

8 Formerly the Heretaunga Tamatea Settlement Trust

9 Under the extant Civil Defence Emergency Management Act 2002, non-elected members cannot be full members of a Civil Defence Group. HBRC supports the change proposed in the Emergency Management Bill that will allow for Mana Whenua organisations to sit as full members of Civil Defence Groups

Kaupapa/Project	Marae/ Hāpū/ Group
Hawea Historical Park development	Waipatu, Ruahapea, Waiohiki, Matahiwi, Kohupatiki.
Karewarewa Paritua Restoration Karamu Catchment Review	Marae: Mangaroa, Taraia, Mihiroa, Houngarea
HBRC and external Science Monitor Agencies. Mana Taiao Hub	Tamatea Pokaiwhenua Heretaunga Taiwhenua Kahungunu Inc Tamatea Taiwhenua
Coastal Waste Management. Te Ikatiere reserve Te Angiangi Marine reserve, Rahui	Coastal Hapū Collective MACA – Rangitane, Papauma, Ngati Kere Authority, Kairākau Land Trust.
Recovery/ Land Cat 2	Nga Piringa hapu, Omahu Marae. Tihei Tamatea
Lake Poukawa Lake Runanga Between Two Rivers Stop Bank upgrade CIA work	Kahuranaki Marae Te Runanga Marae Awhina Marae
Whirinaki Resilience Project	Petane Marae Mana Ahuriri
Waiohiki Stop Banks	Ngati Paarau Trust

Figure 47.1 – Examples of HBRC activities and engaged Mana Whenua organisations

48. Please provide details of if/the extent to which Council engages with mana whenua when planning and implementing flood protection and flood management activities.

HBRC's Māori Partnerships group offer guidance to the Asset Management Group regarding best practices for engaging with mana whenua concerning flood management activities. They provide advice on tikanga to ensure that meetings between HBRC representatives and mana whenua are conducted respectfully and productively. In many cases, Māori partnerships facilitate connections between asset management and mana whenua, and sometimes participate in hui to provide cultural guidance, fostering meaningful connections.

Management plans received by HBRC that have been prepared by iwi authorities and/or hapu groups are also used to inform various asset management operations, to the extent that they are relevant at place. Management plans received by HBRC are routinely made publicly available via HBRC's 'Pataka' interactive mapping portal. For example, these management plans have been used to inform preparation and review of various HBRC documents such as various recent editions of the Code of Practice for Flood Control and drainage works, river mouth opening protocols, Scheme asset management plans and HBRC's waterway design guidelines.

In close collaboration between HBRC's Asset Management Group and the Māori partnerships team, the integration of tangata whenua values into asset management practices unfolds through a structured process. Scoping and planning sessions are held with mana whenua representatives to determine the objectives of Cultural Values Assessments (CVAs) and Cultural Impact Assessments (CIAs), focusing on key assets and projects. Led by mana whenua expertise, CVAs delve into the significance of cultural values associated with specific assets, while subsequent CIAs evaluate potential impacts of proposed actions on tangata whenua values and customary practices. Findings from these assessments are integrated into HBRC's decision-making frameworks, ensuring that infrastructure projects and maintenance activities align with tangata whenua aspirations and respect their cultural heritage.

Post cyclone, HBRC has engaged Mana Ahuriri and various hapu along the Tutaekurī in order to ascertain their cultural values as they relate to the river. These assessments will give HBRC an understanding of what is of cultural importance to the mana whenua of the river. We have also contracted marae and hapu along the river to carry out Cultural Impact Assessments. These assessments will inform our stop bank designs and highlight how different designs will impact upon various cultural values.

49. Where Māori land was compulsorily acquired for flood protection purposes (for example at Waiohiki) to what extent did the subsequent works adequately protect Māori land and communities during Cyclone Gabrielle?

We have no evidence to suggest that any flood protection infrastructure failed below its nameplate level of service, which for the major schemes is a 1% AEP flood level. We address the specific issues with regard to Waiohiki at questions 17-19 above. In this respect we consider that no communities within the flood schemes were inadequately protected by them as a matter of design.

If the suggestion here is that some Māori land was compulsorily acquired, but that despite the compulsory acquisition the relevant community and/or its land was not subsequently protected by the scheme, then we can confirm that we are aware of no specific instances of this occurring. Indeed, with respect to Waiohiki we reiterate that the design of the scheme saw the community there protected to the same level of service as other parts of the scheme.

50. Feedback from Māori and the community is that Māori land and less prosperous communities are disproportionately underserviced in terms of flood protection and flood management activities. The Council is invited to respond to this criticism, including addressing the question of how the quantum of Council's investment in flood management activities is linked to rating policies.

Historically, river management and flood protection schemes evolved from The Soil Conservation and River Controls Act 1941. This enabled the formation of a scheme and allowed the controlling authority (most often a Catchment Board) to set a fee to pay for the scheme from those who would benefit from the scheme.

This essentially set a 'user pays' process for financing of schemes. As befits the time in which they were created - schemes were often set up to protect urban environments and to increase the amount of productive land available for farming.

At the time that most schemes were created, regrettably little thought was given to the protection of isolated, predominantly Māori communities, and little thought was given to the protection of cultural values.

In 1989, local government was reformed with the Regional Councils brought into existence. Catchment Boards were disbanded and the flood control schemes were moved under the remit of the Regional Councils. The bulk of financing for flood control schemes still sat with the targeted ratepayers, who enjoyed the greatest benefits of the scheme.

Events like Cyclone Bola had dramatic effects on Hawke's Bay, and particularly on Māori communities such as Nuhaka and Wairoa. At the time, there were proposals to create flood control schemes in these areas – particularly in Wairoa. However, the cost of the scheme – from capital investment to ongoing operations - would need to be met by the community under the extant rating models. The proposal was assessed as unaffordable for the community, the proposal was not adopted and therefore no operating flood control scheme exists today.

Post Cyclone Gabrielle, there is greater recognition given to the limitation of a targeted rating approach on the ability of smaller, less prosperous local communities to enjoy the protection of a flood control scheme. As such, the Crown ensured that all capital funding for a flood control scheme in Wairoa is 100% funded by the Government.

HBRC itself have also looked at how schemes could be made more affordable for smaller, less prosperous communities and have enacted a revised Revenue and Financing Policy. This allows for a greater proportion of general rates to be used to finance scheme activities. It essentially removes the burden of targeted rates from small rivers and streams schemes, as follows:

- 30% general rate and 70% targeted rate (with 9 rating factors) based on capital value (CV) for the 4 flood protection and control schemes
- 10% general rate and 90% targeted rate (with 19 rating factors) based on CV for all drainage and pumping (except for Raupare Enhancement and Opoho schemes which are to remain based on area and fixed charge respectively).
- Rivers and stream maintenance moves to the general rate (25 rating factors).

Flood Protection	Drainage	Rivers and stream maintenance
Heretaunga Plains	Brookfields/Awatoto	Central/Southern
Maraetotara	Clive and Muddy Creek	Esk
Upper Makara	Haumoana and Te Awanga	Kairakau
Upper Tukituki	Karamū Drainage and Tributaries	Kopuawhara
	Karamū Enhancement	Pōrangahau
	Napier/Meeanee/ Puketapu	Te Ngarue
	Ohuia Whakakī	Wairoa
	Opoho	Whirinaki
	Paeroa	
	Pākōwhai	
	Poukawa	
	Puninga	
	Raupare and Twyford	
	Raupare Enhancement	
	Tūtaekurī/Waimate/Moteo	

Figure 50.1 – HBRC's Flood Protection, Drainage and River and Stream Maintenance Schemes

The new policy also increases the proportion of general rate into Flood Control and Drainage schemes, making them more affordable for those who are directly affected.

For areas like Nuhaka and Whakaki, who have previously had to pay targeted rates for drain clearance under the Wairoa and Northern Streams schemes, and for the residents of Kopuawhara, all scheme fees will now be met from the general rate.

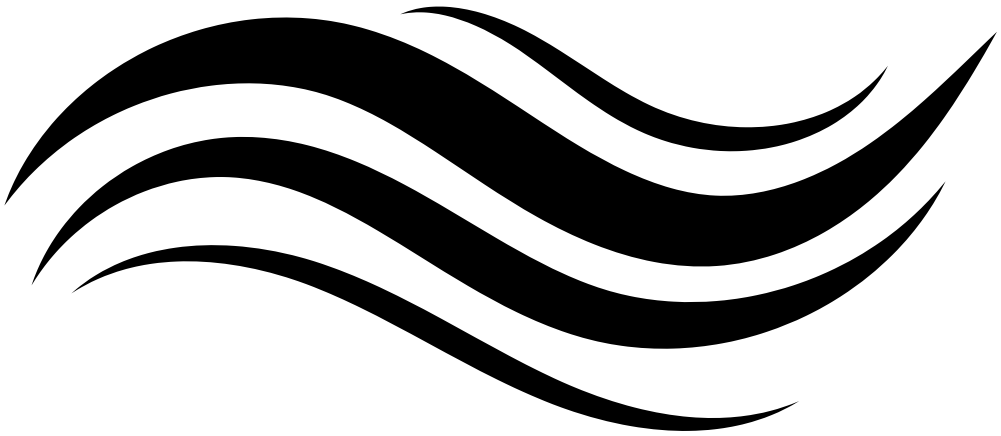
51. Could the Council please explain if/the extent to which its flood management activities are influenced by the presence of wāhi tapu, mahinga kai, wai Māori and whenua Māori alongside and within rivers it manages?

Flood management activities are becoming far more attuned to the cultural impact of physical works carried out in the natural environment. With reference to question 47 and 48, HBRC engages and participates heavily in discussion with mana whenua in regard to undertaking new capital works and, increasingly, operational and maintenance activities.

In the case of new consents that HBRC has gained to undertake flood management activities (Westshore Tidal Gates and the Global Gravel Extraction consents), significant effect is given to ensuring that culturally significant places, spaces and features are protected. There are requirements for undertaking cultural value and cultural impact assessments and a greater requirement for partnering. An example of this working successfully in practice is the effort and investment that HBRC has committed to the Hawea Historical Park as part of the Karamu Stream enhancement works.

When undertaking new capital delivery (such as for the IRG-funded Tukituki gravel extraction programme or Flood Resilience Programme (Category 2) works), significant time is taken working with mana whenua groups to understand the cultural impacts of the proposed works and in all cases, works are modified, changed or off-set, to ensure that culturally significant items, spaces, or places are protected.

This will especially be the case in areas where flood protection activities have not been undertaken previously, such as Wairoa and Pōrangahau.



APPENDIX D:
Flood risk maps

Wairoa

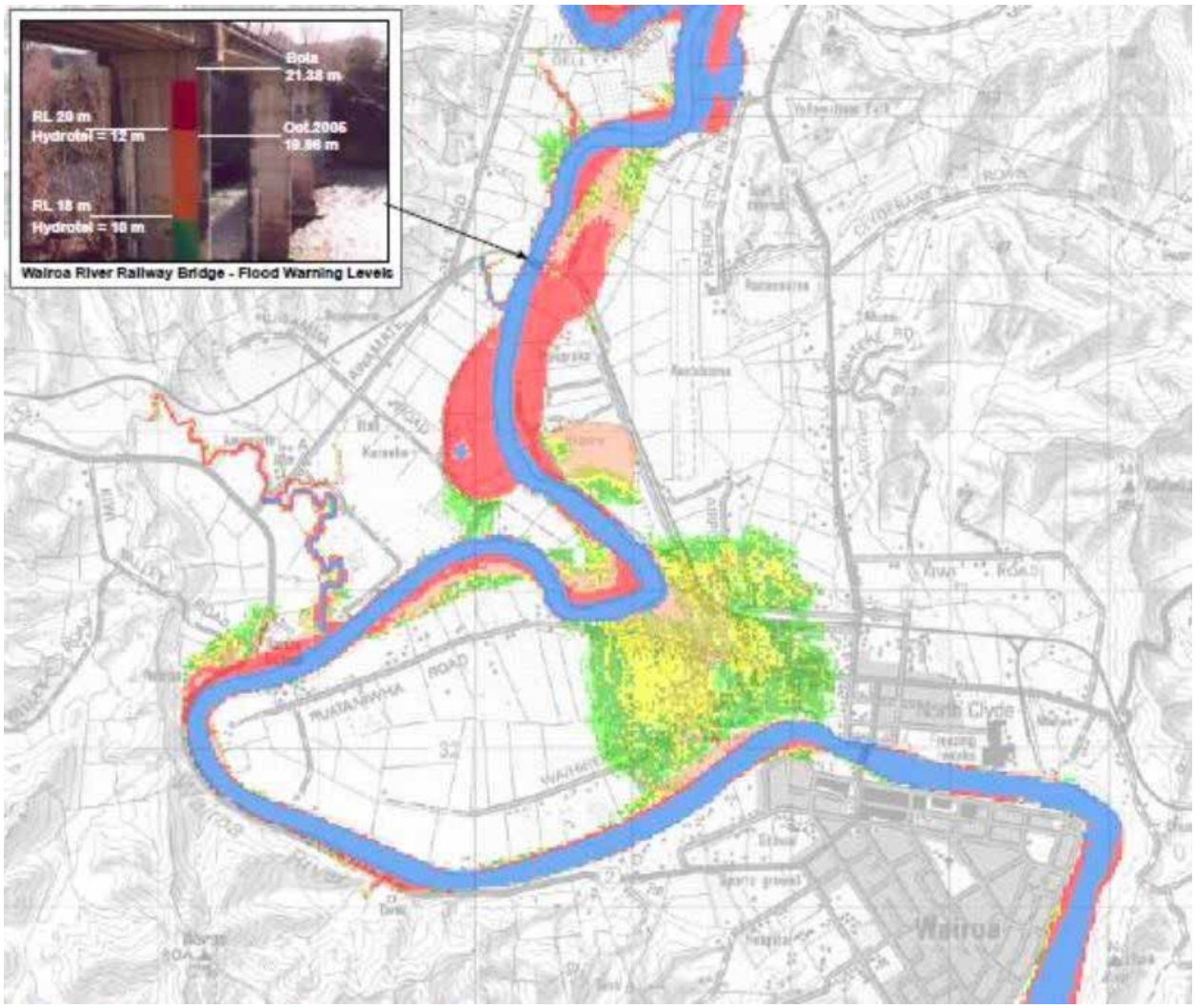


Figure D1 Wairoa Floodwaters Spilling once RED warning level is exceeded

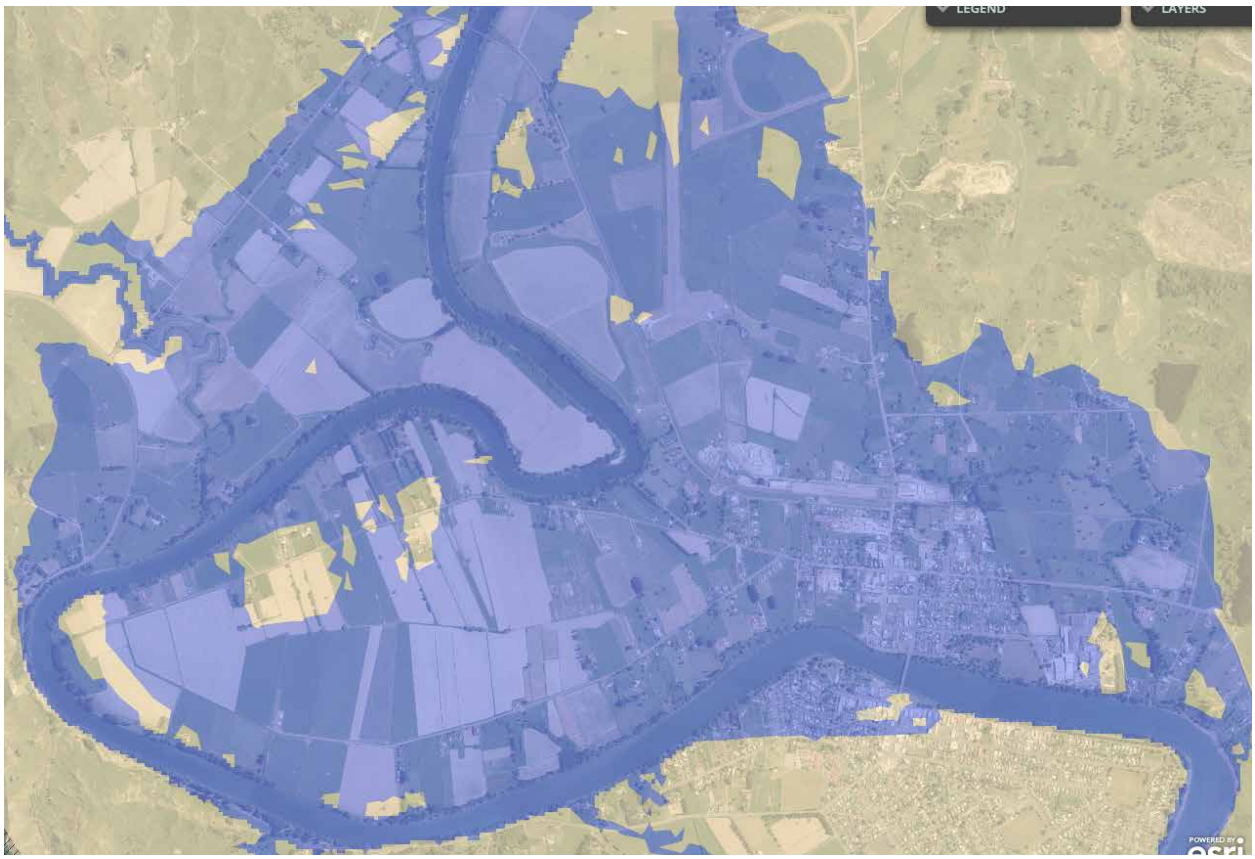


Figure D2 Wairoa Flood Hazard Map

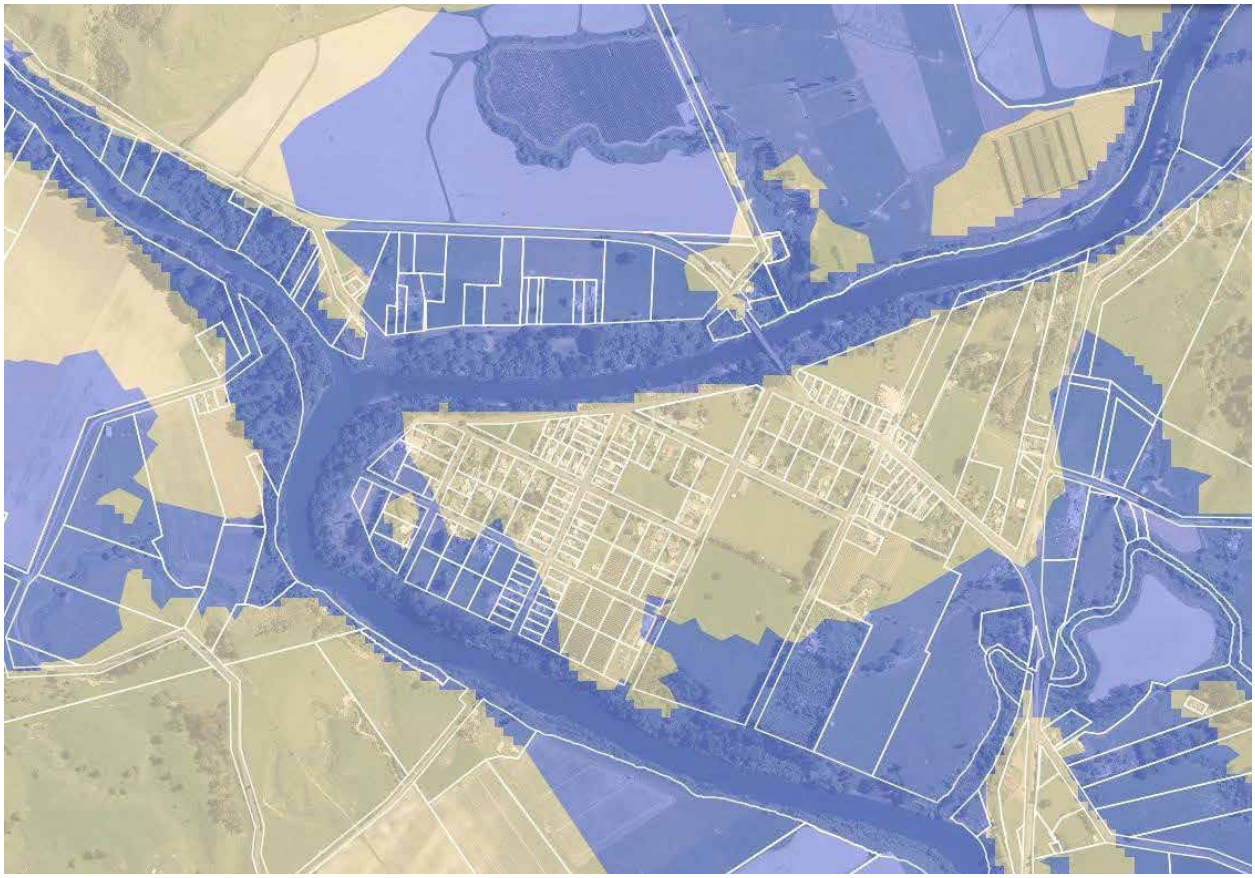


Figure D3 Frasertown Flood Hazard Map

Tangoio – Te Ngarue Stream

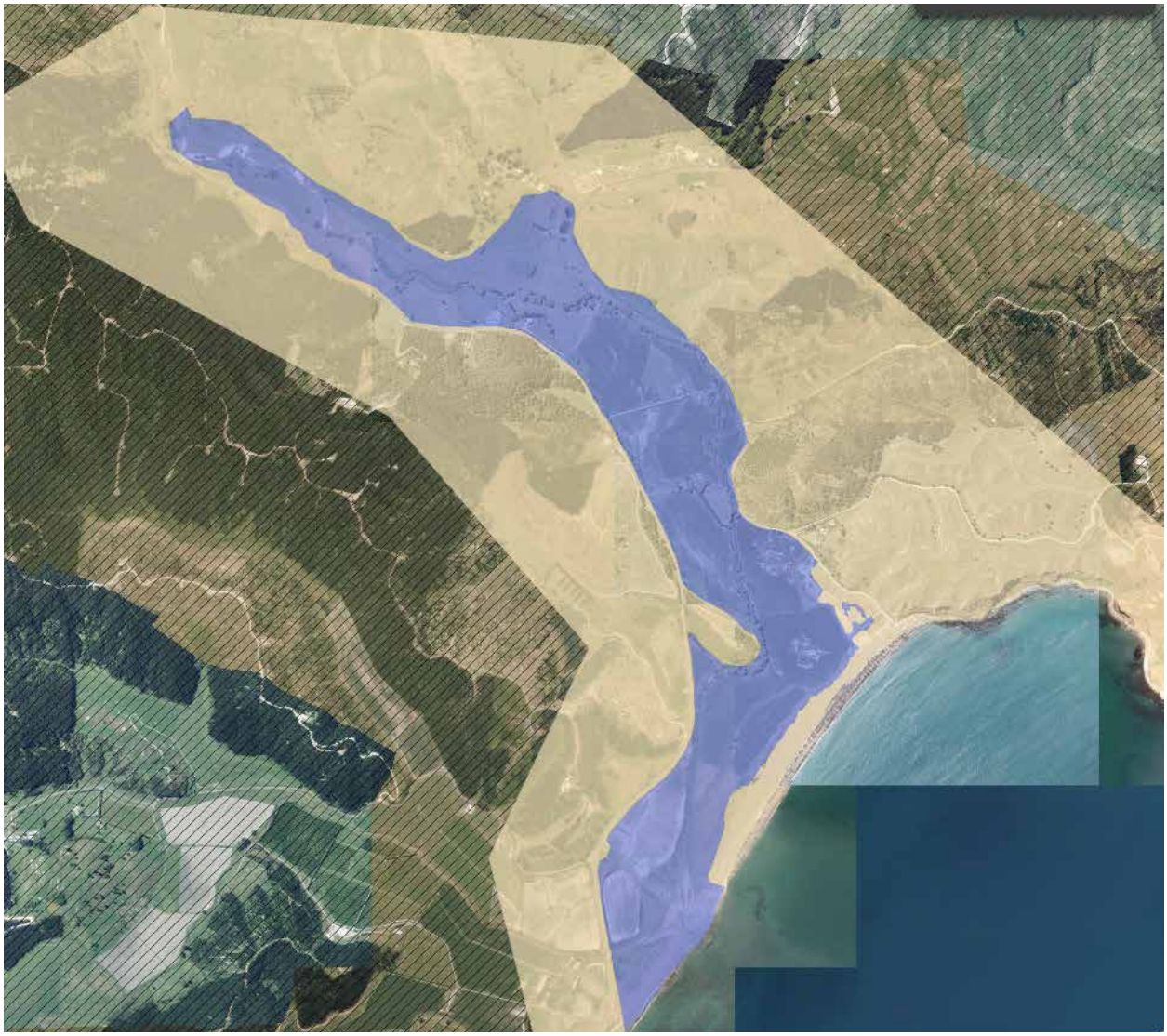


Figure D4 Tangoio - Te Ngarue Stream

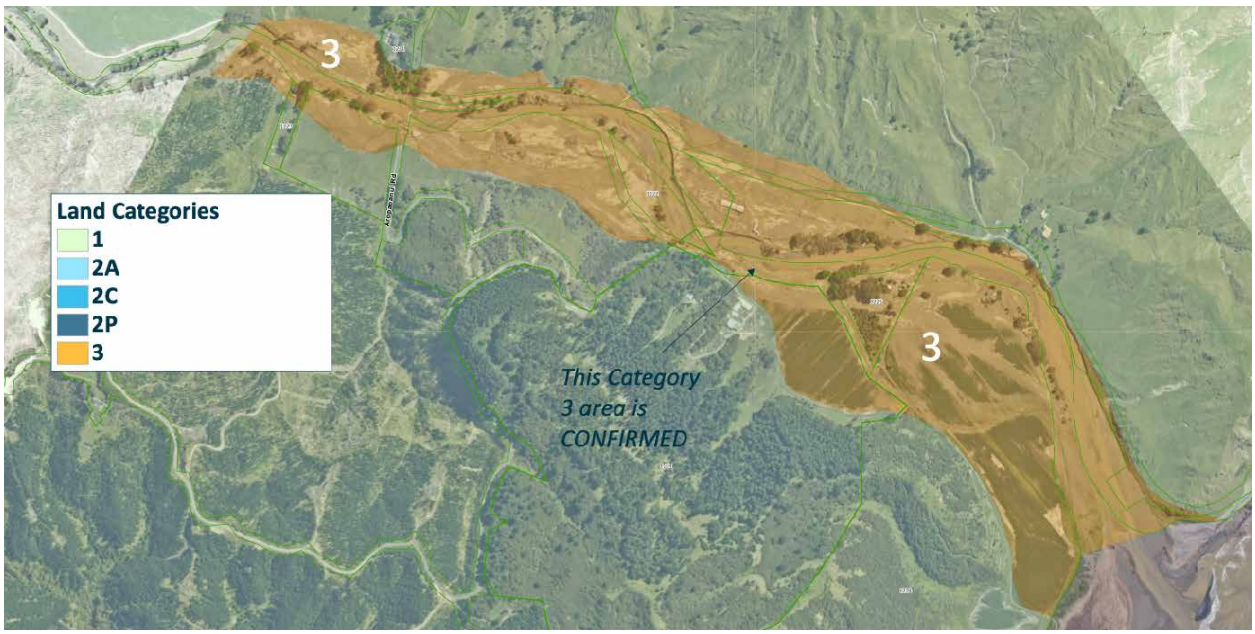


Figure D5 Aropaoanui Land Categorisation

Esk Valley

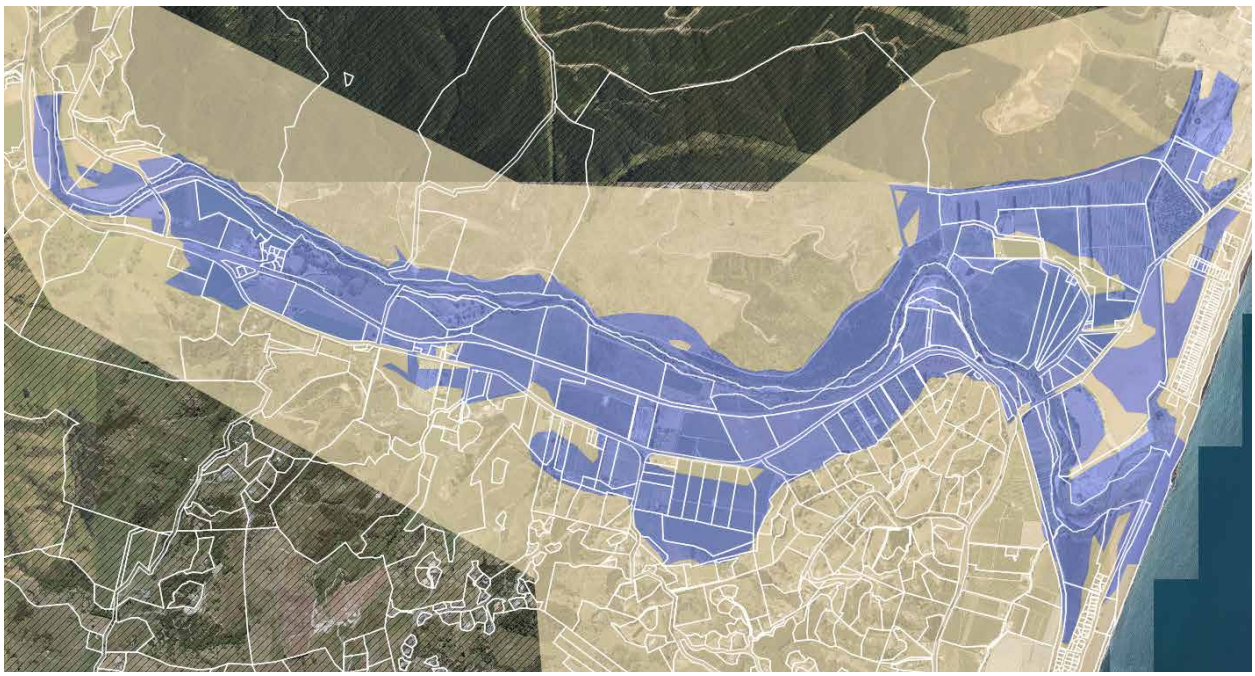


Figure D6 Esk Valley & Whirinaki Flood Hazard Map

Heretaunga Plains

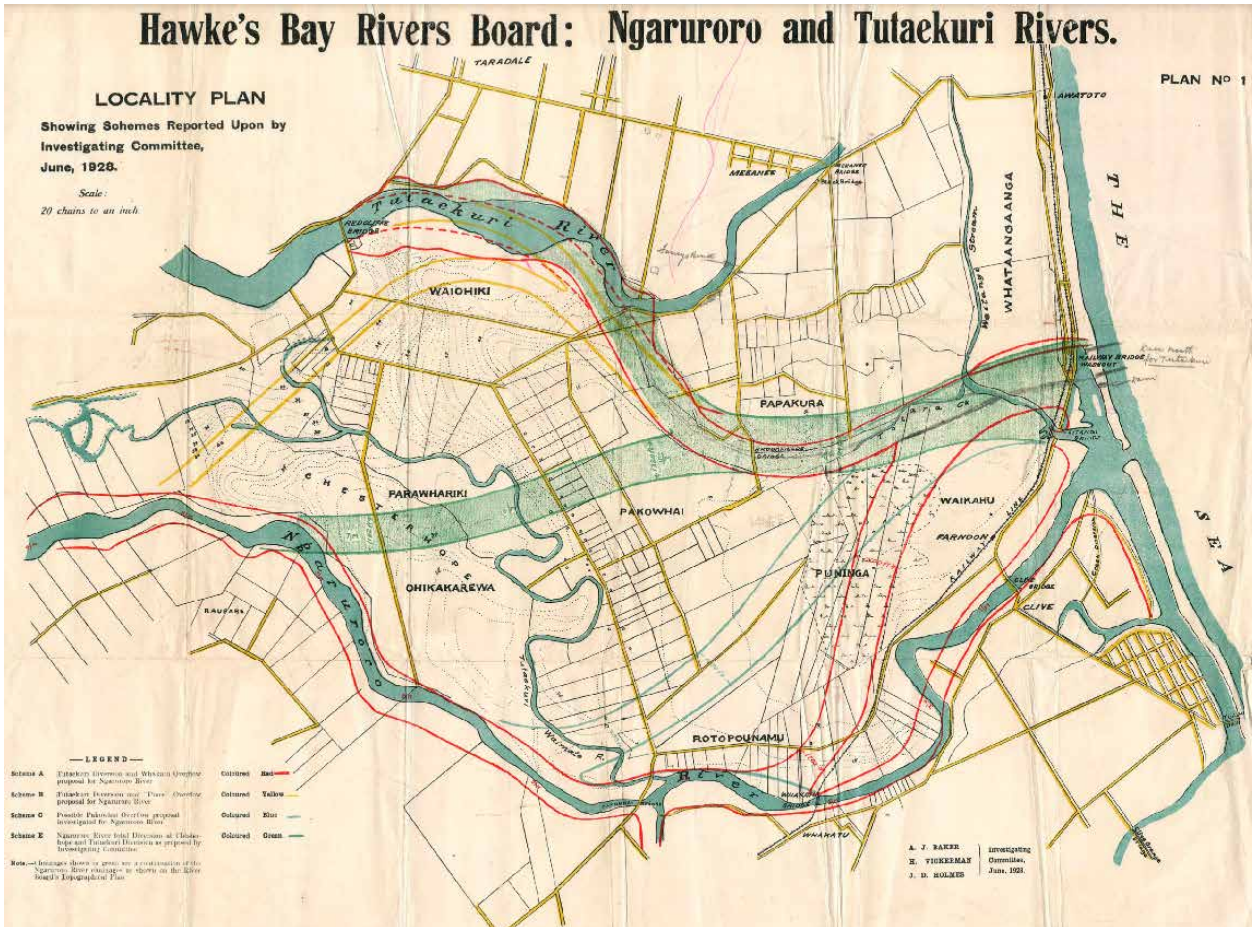


Figure D7 Heretaunga Plains Scheme 1928

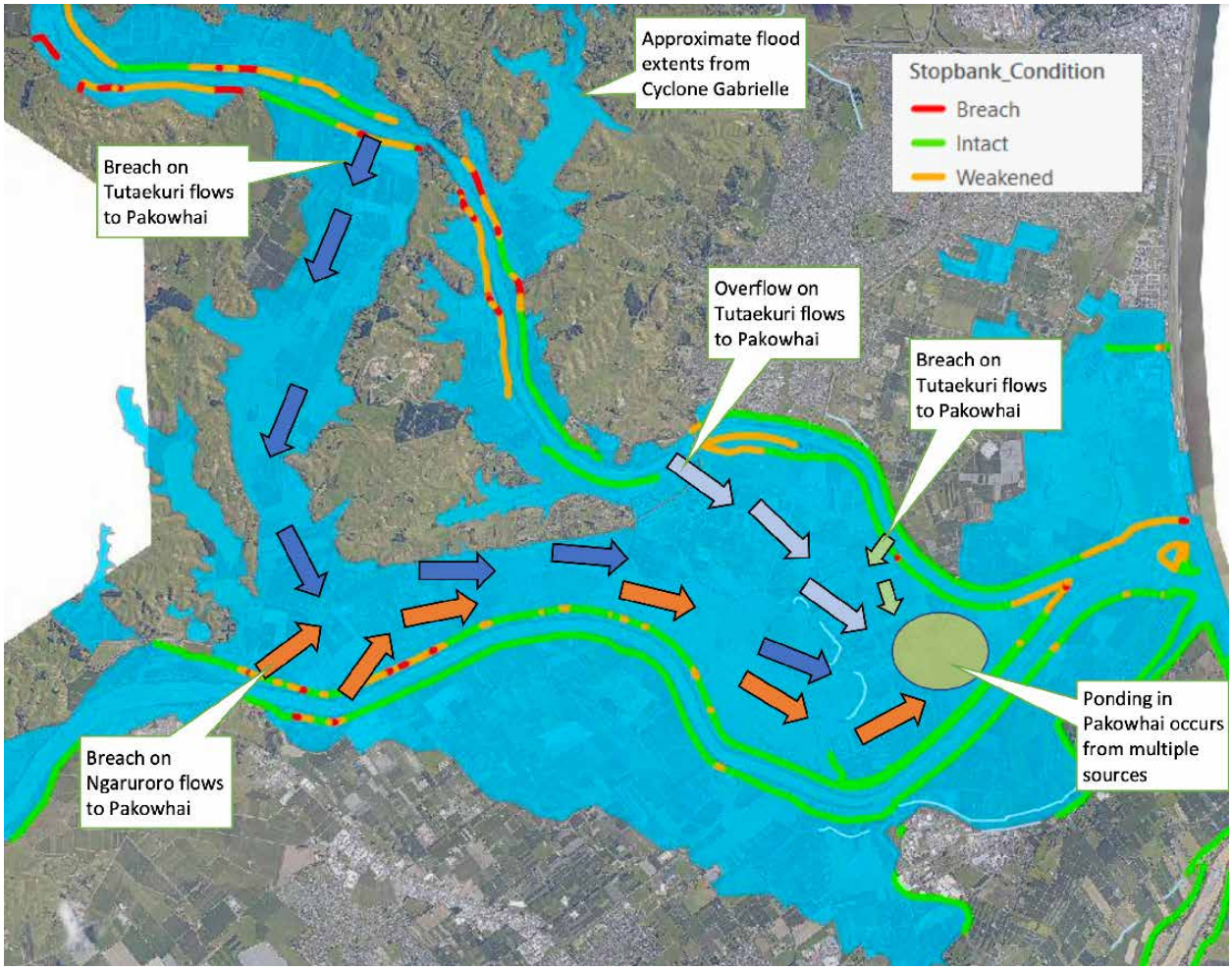


Figure D8 Breaches/Overflows Inundation Heretaunga Plains

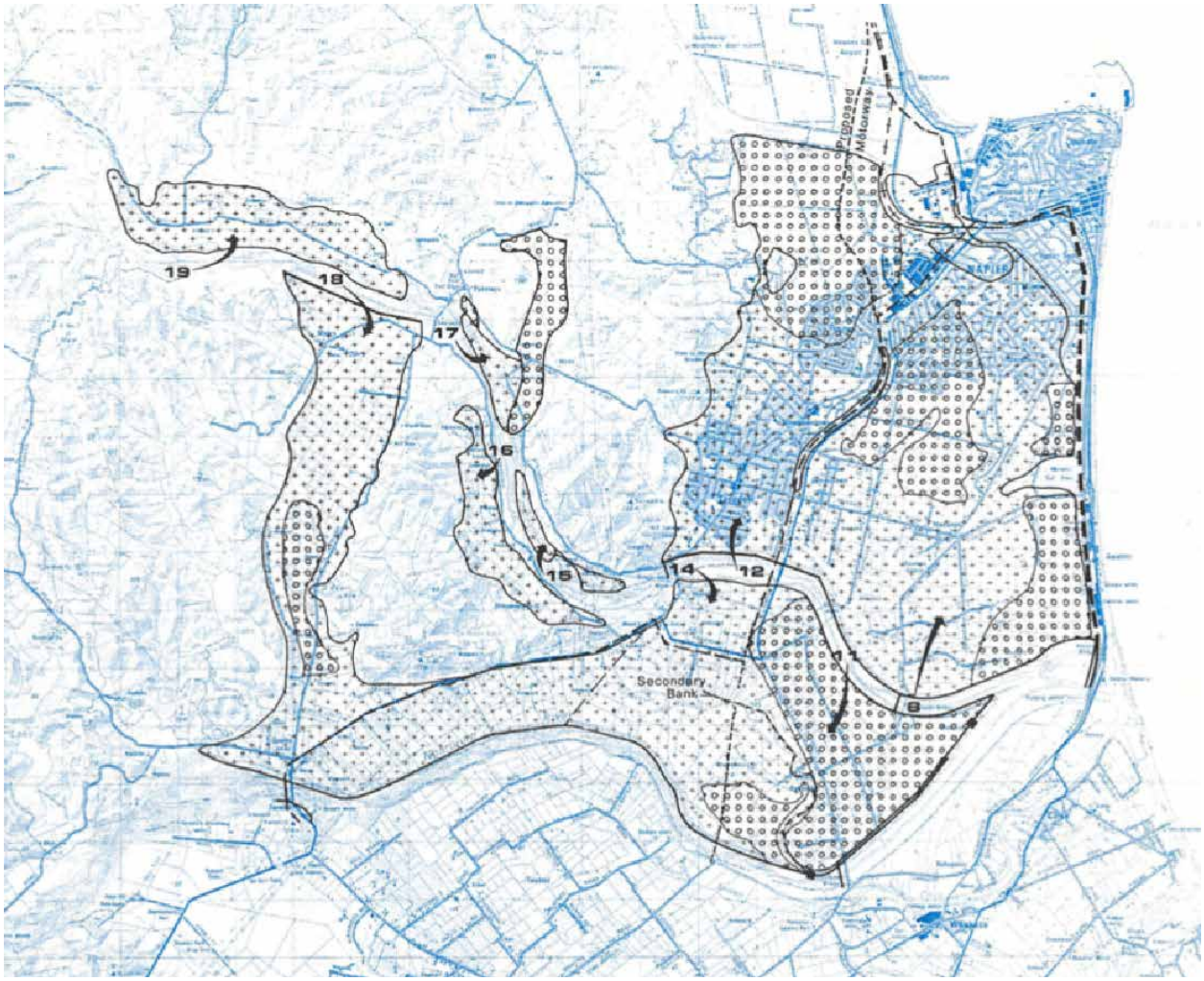


Figure D9 Residual Flood Risk from Tutaekuri River

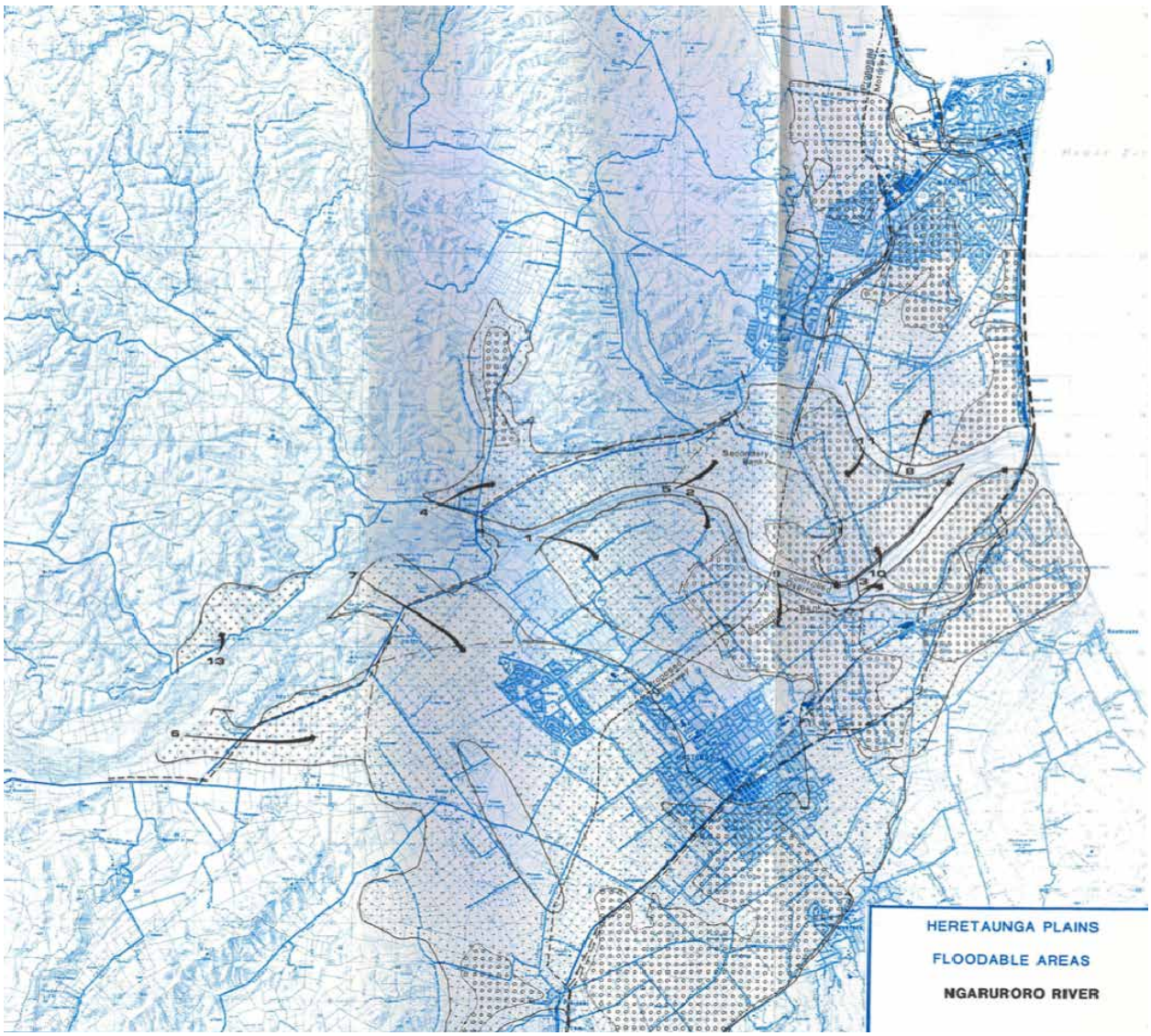


Figure D10 Residual Flood Risk from Ngaruroro River

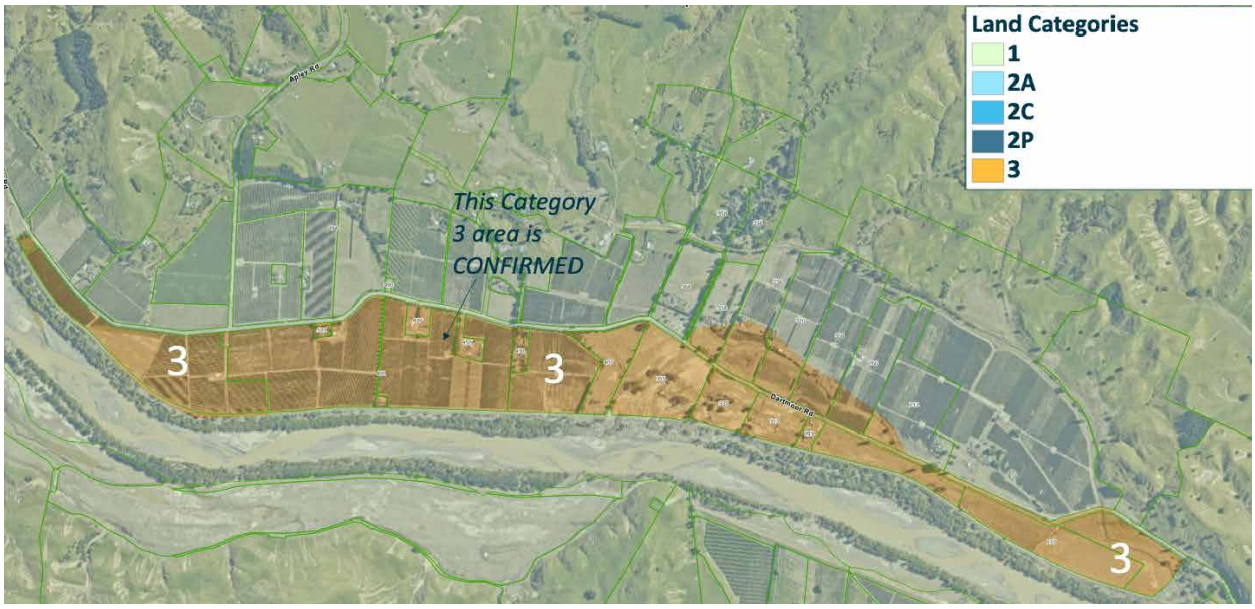


Figure D11 Dartmoor Category 3 Area

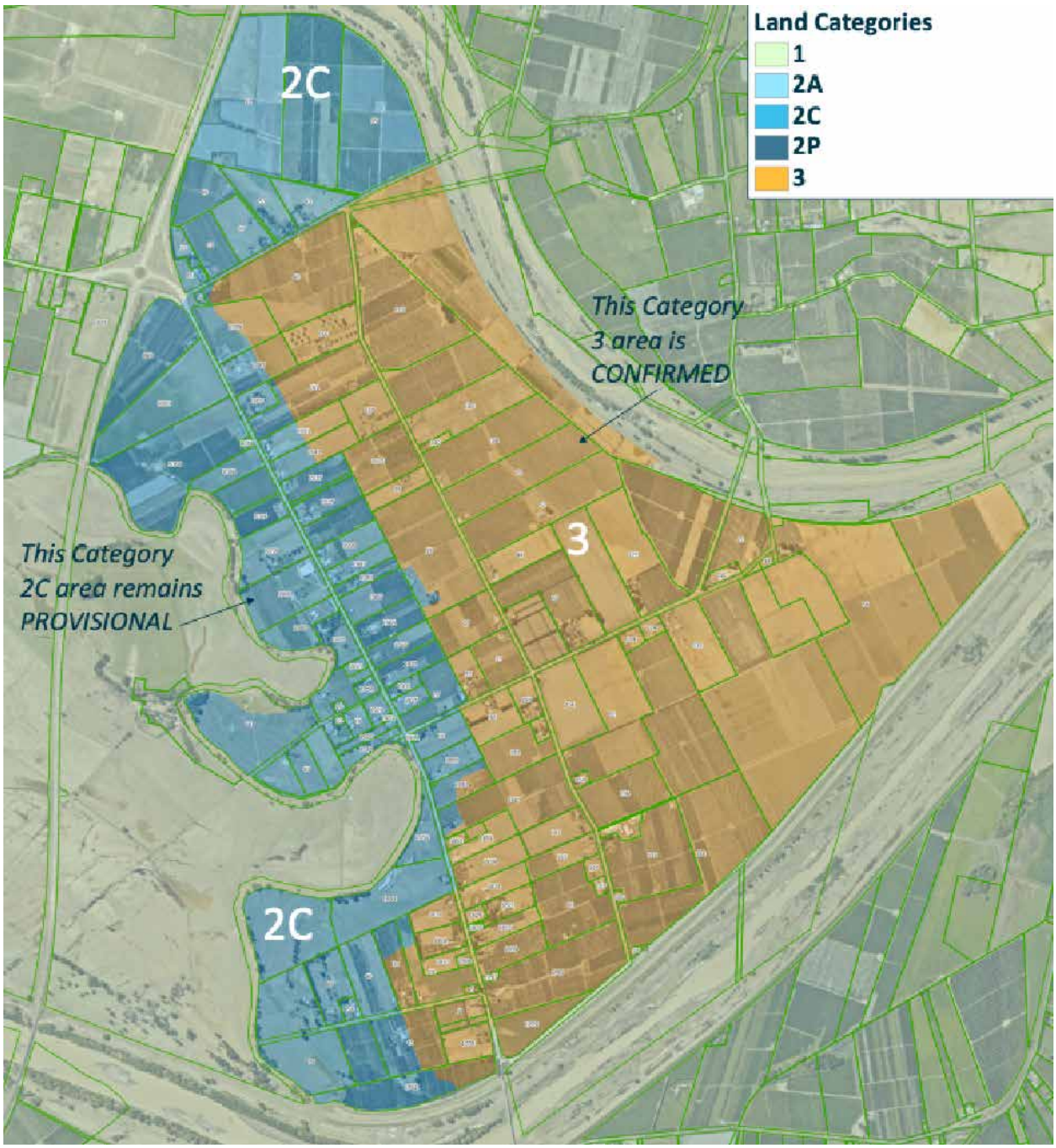


Figure D12 Pakowhai Category 3 & 2C Areas

Waipawa

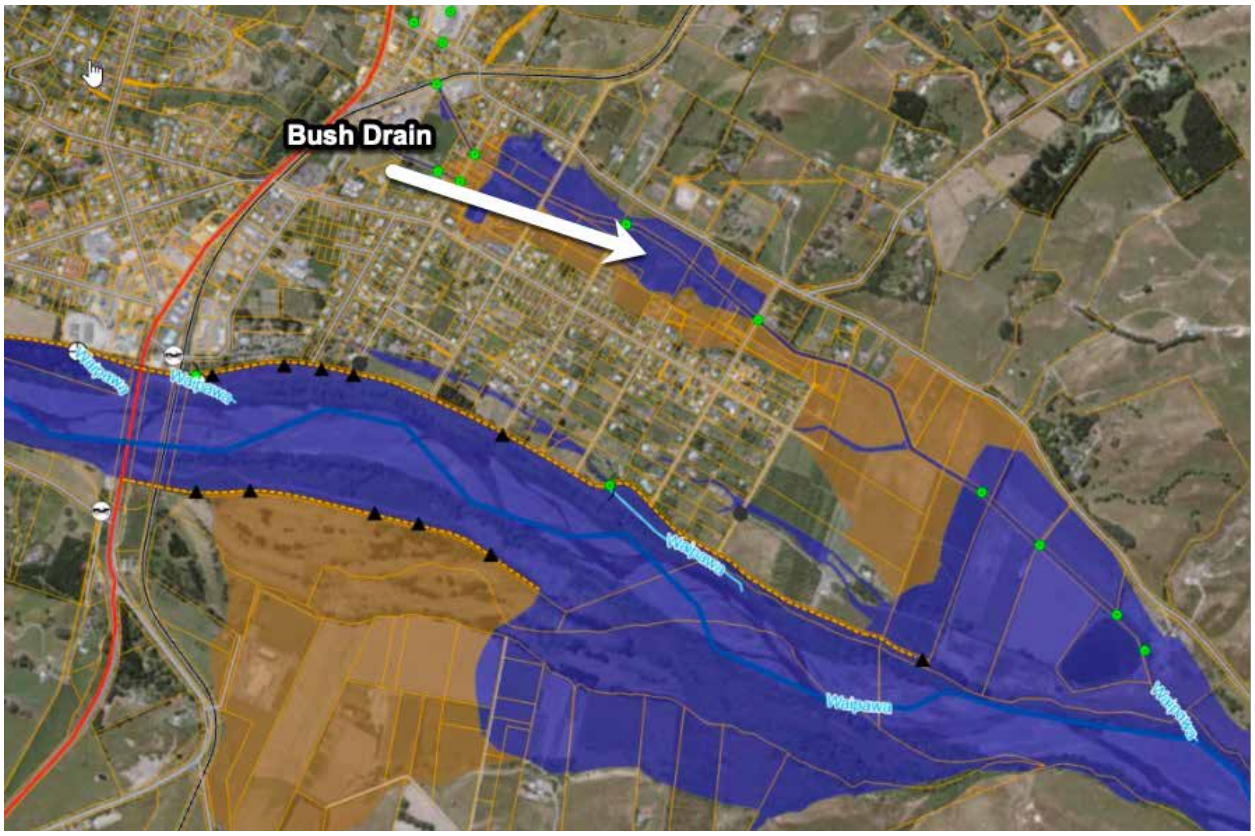


Figure D13 Flood Hazard Mapping for Waipawa

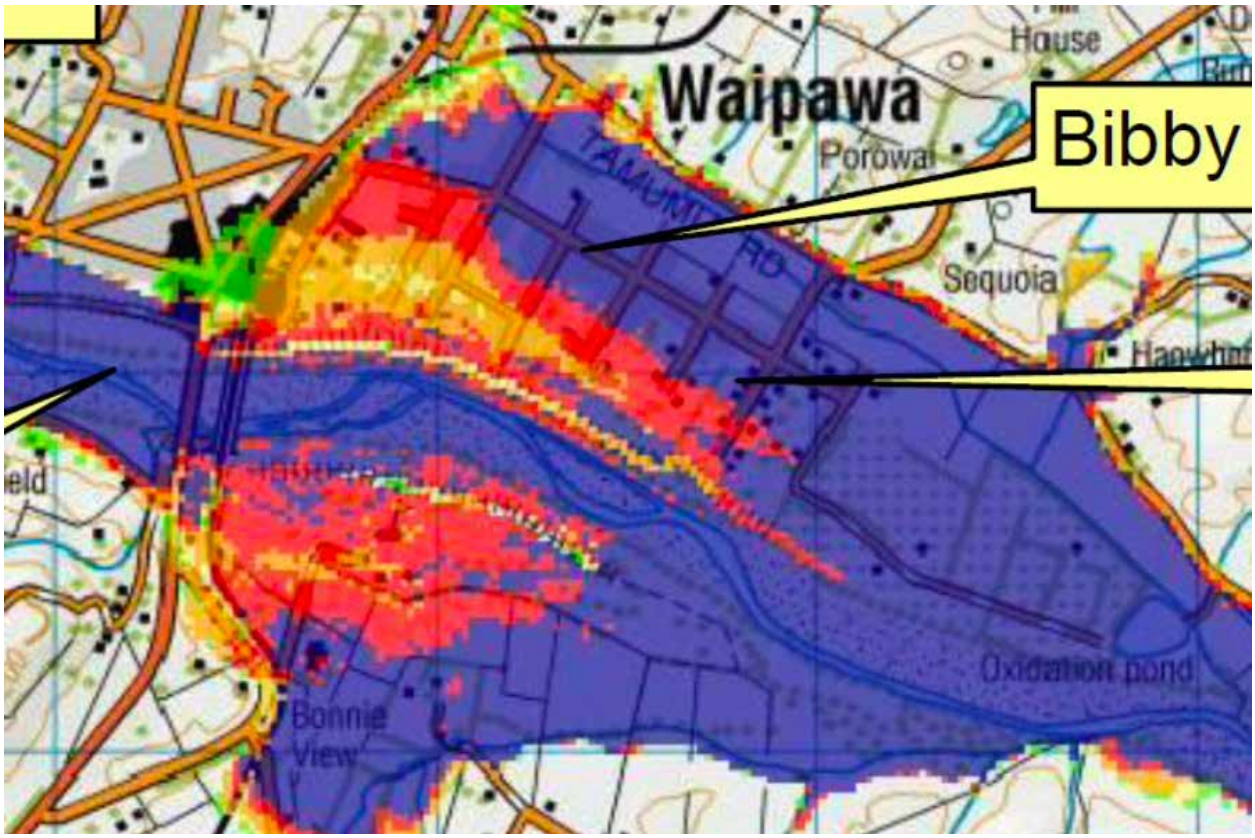


Figure D14 Dam Break Flood Hazard Mapping for Waipawa

Awanui/Papanui Stream

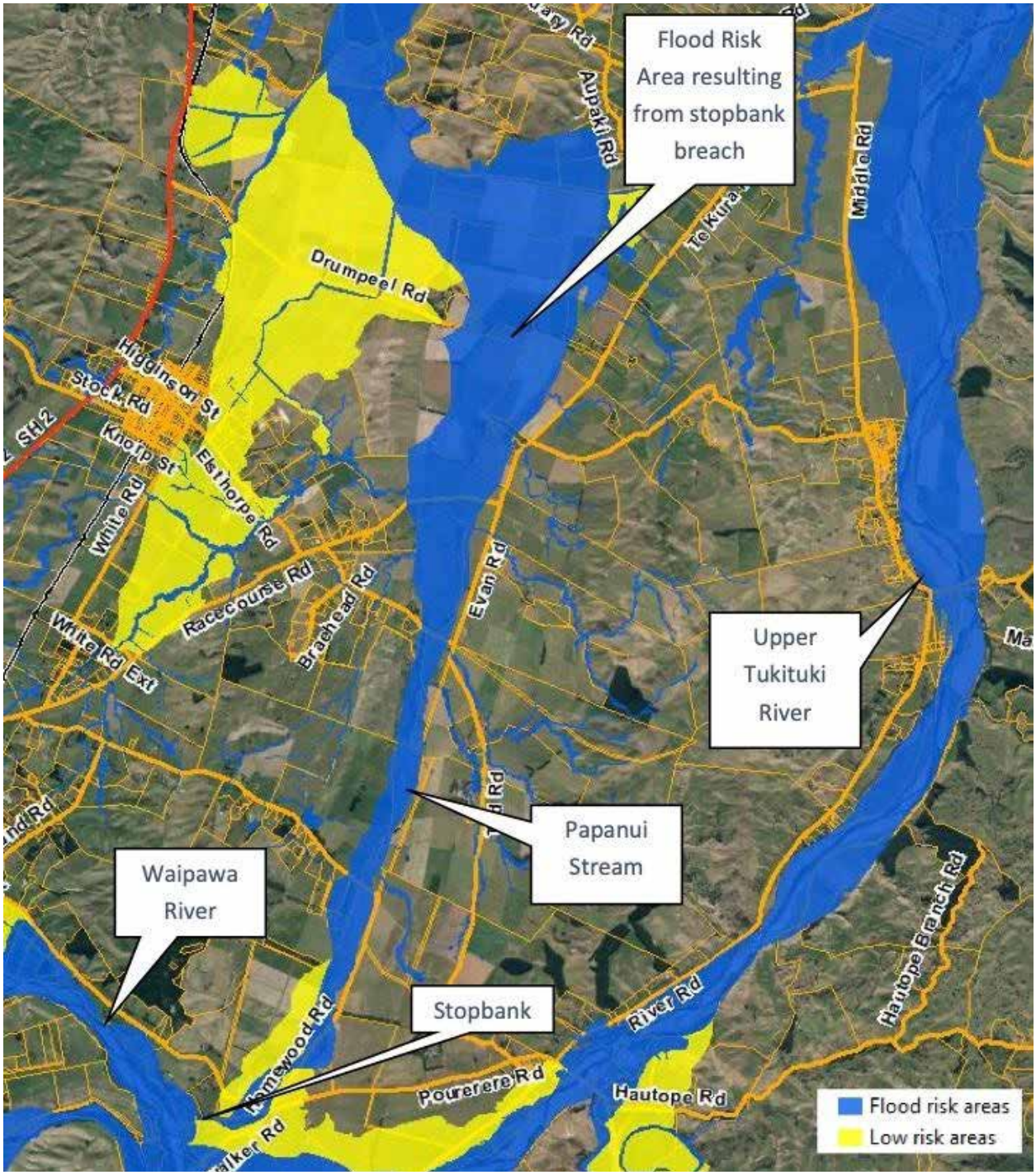


Figure D15 Flood Hazard Mapping for Walker Road Breach into Papanui Stream

Pōrangahau

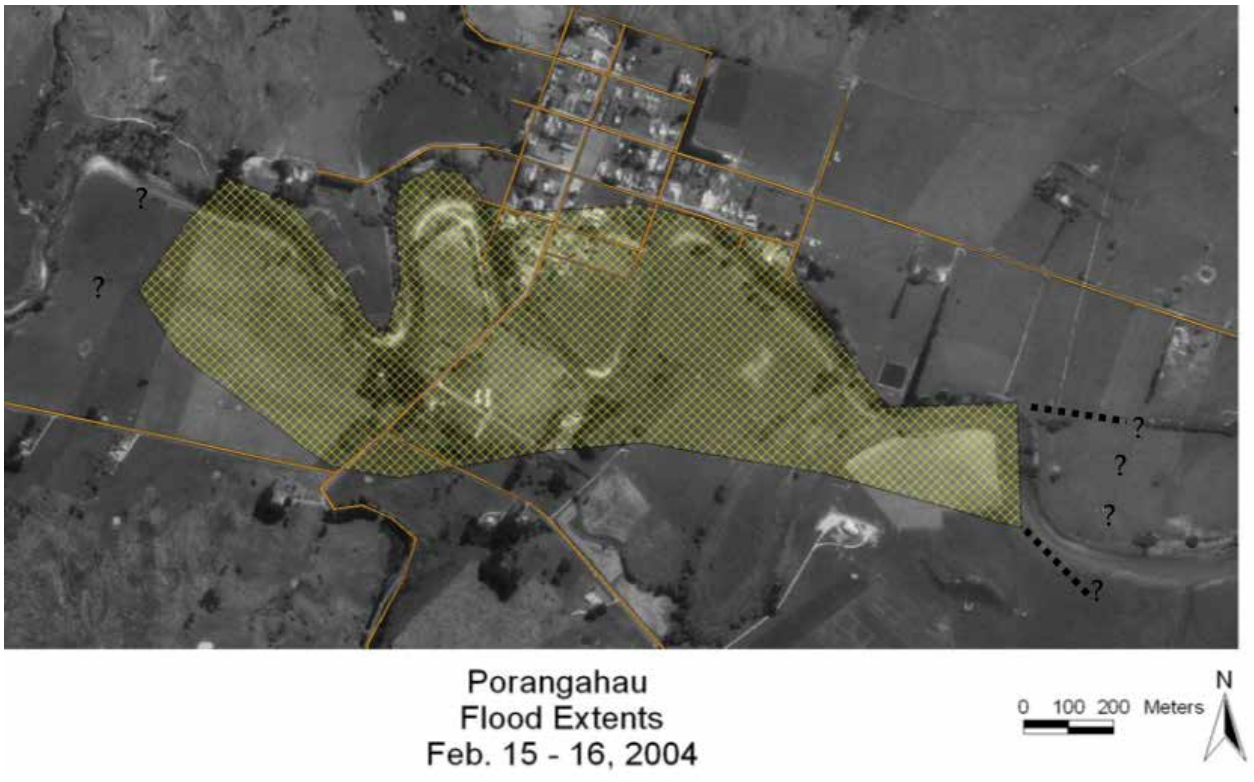


Figure D16 Pōrangahau Flood Extents 2004

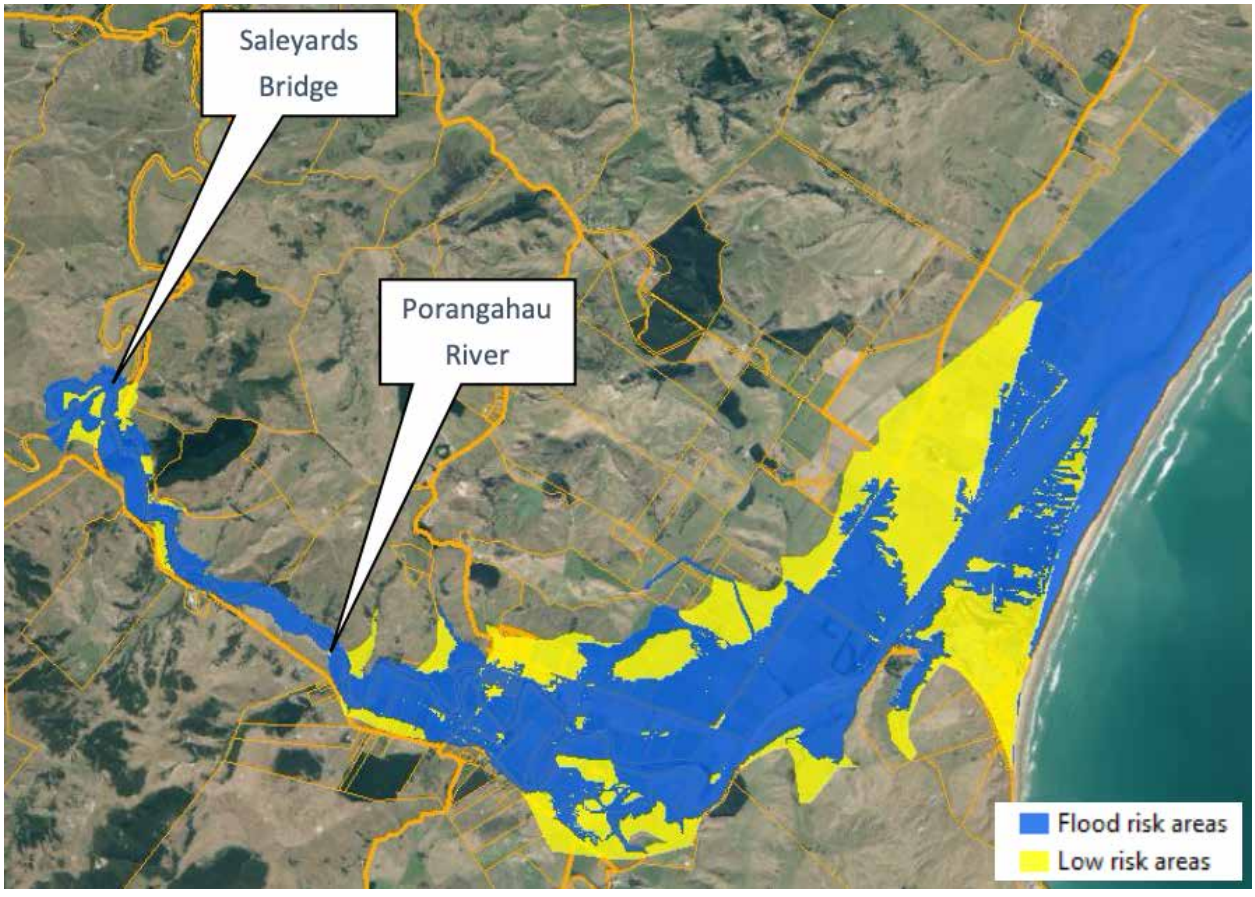
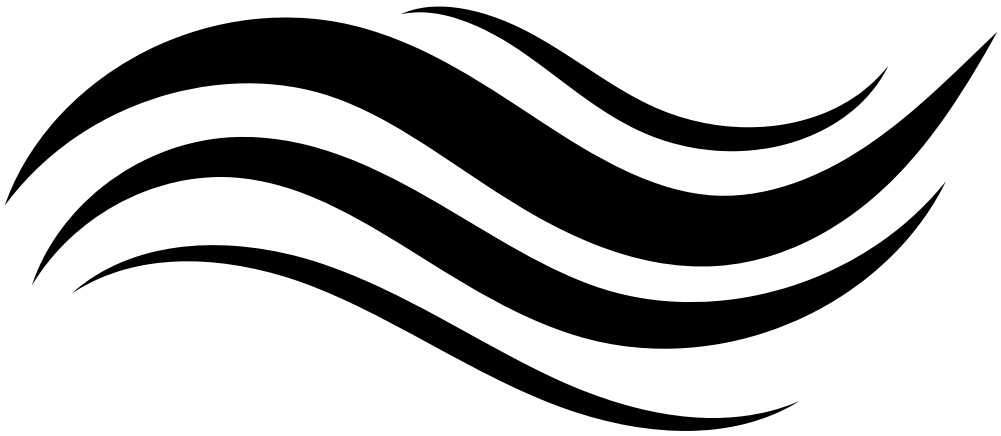


Figure D17 Pōrangahau Flood Hazard Map



APPENDIX E:
Aerial photographs

Wairoa

Figure E1 Wairoa River Downstream of Frasertown

Tangoio – Te Ngarue Stream

Figure E2 Willow encroachment Lower Te Ngarue Stream

Esk Valley

Figure E3 Willow Encroachment into Esk River

Heretaunga Plains

Figure E4 Tutaekuri River Buffers and Channel Pre-Cyclone

Figure E5 Tutaekuri River Buffers and Channel Post-Cyclone

Figure E6 Tutaekuri & Ngaruroro River Mouths

Waipawa

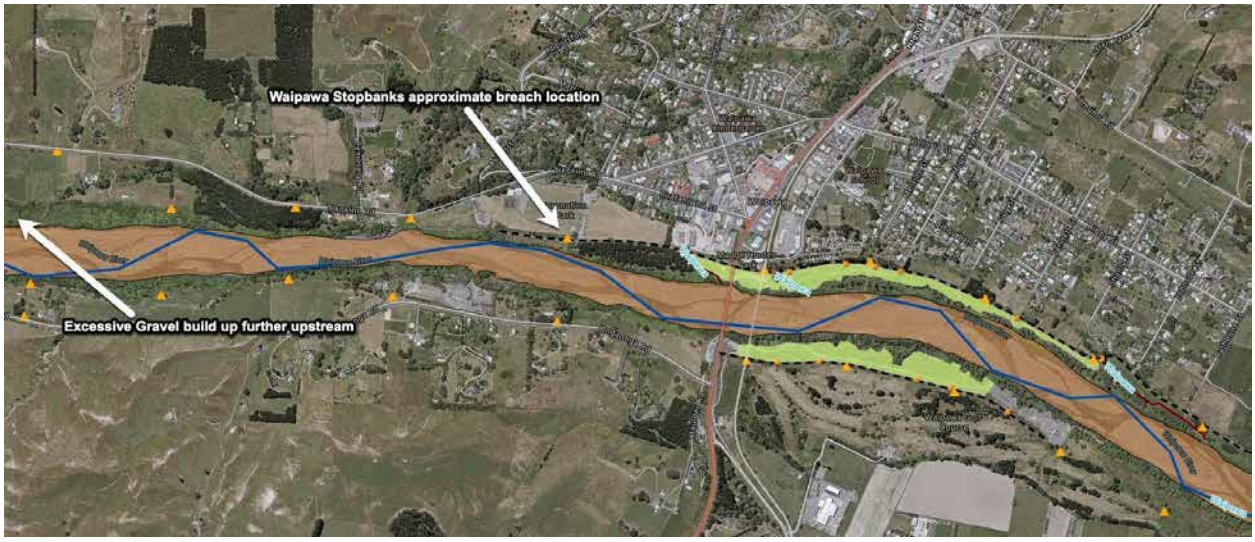


Figure E7 Waipawa Township Stopbanks Relative to Gravel Build Up Area

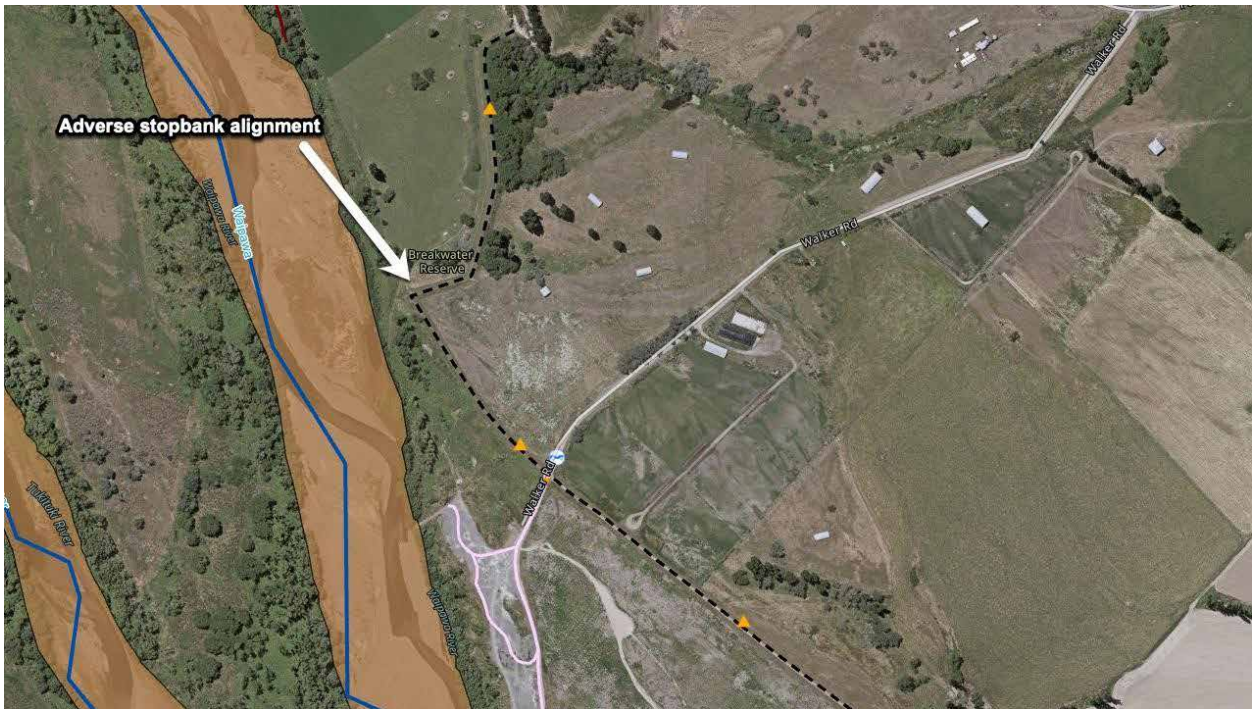
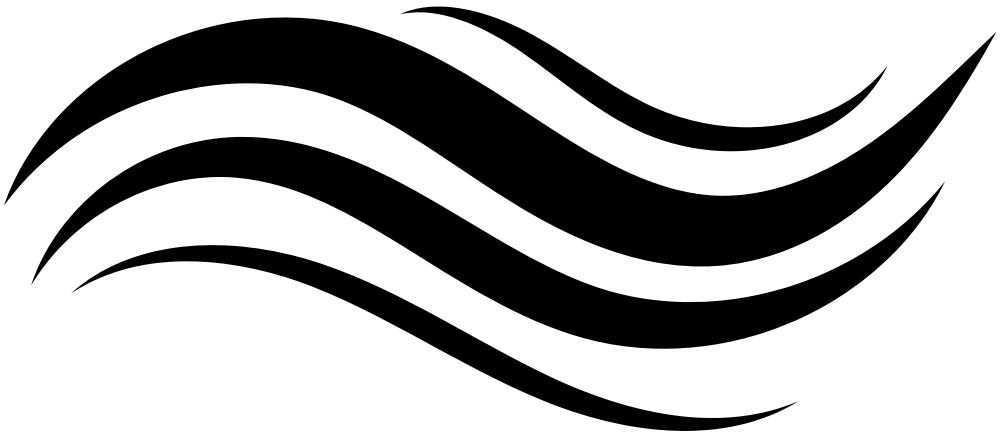


Figure E8 Adverse Stopbank Alignment at Walker Road Breach Site

Figure E9 Walker Road Breach Site Post Event

Pōrangahau

Figure E10 Pōrangahau River Channel Condition Prior to Event



APPENDIX F:
About Pae Matawai Parawhenua

Pae Matawa Parawhenua was developed for us by Brian Morris, Licensed Translator of Ngāti Marau ki Rākautātahi hapū.

The word **Pae** refers to the three-member panel, the word **Matawai** relates to what the panel will be doing, it means to 'examine or look closely at, or into things' while the word **Parawhenua** refers to the flooding and what is left behind as a result of the flood.

The Māori term **parawhenua** is a word used to describe the destructive action of natural events such as avalanches, flooding, earthquakes and tsunamis. On this basis the term **parawhenua** is an appropriate term to describe the destruction caused by Cyclone Gabrielle.

Furthermore, the habit of personifying events by naming them – in this case Cyclone Gabrielle, is entirely in keeping with a te ao Māori perspective of the natural world.

From a Māori perspective **Parawhenua mea** (who is also female) is the personification of floods, avalanches and tsunamis – all destructive water-related events. According to Māori oral traditions **Parawhenua mea** is the wife of **Kiwa** who is one of the principal guardians of the oceans, hence the name **Te Moana-nui-a-Kiwa**, (the great ocean of Kiwa) for the Pacific Ocean.

In the context of the review the word **parawhenua** can have other connotations.

The word **parawhenua** is also a compound word – made up of **para** + **whenua** – **para** is the Māori word for sediment and silt, **whenua** is the Māori word for land.

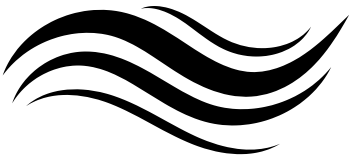
As mentioned above, the term **Pae Matawai** refers to the panel and its task. Generally, the word Pae refers to anything horizontal. In this case it is chosen for the independent position or seat(s) that the panel members will occupy in order to carry out the review.

Brian says as we follow a process to unpack Māori terms to find meaning and understanding of te ao Māori, it is useful to highlight a key difference between the Māori and English languages. **The Māori language has one word for many things, while the English language has many words for one thing**.

A good example is the word **parawhenua** – the Māori term for water-related destructive events.

In contrast, the English language has a number of different words such as **flooding, avalanche and earthquake**.

For Māori, **Parawhenua mea** is the source of these events and adequately covers any corresponding English terms.



HAWKE'S BAY INDEPENDENT FLOOD REVIEW

Pae Matawai Parawhenua