AGENDA/KAUPAPA

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

P O Box 747, Gisborne, Ph 06 867 2049 Fax 06 867 8076
Email service@gdc.govt.nz Web www.gdc.govt.nz

MEMBERSHIP: Her Worship the Mayor Rehette Stoltz, Deputy Mayor Josh Wharehinga, Colin Alder, Andy Cranston, Larry Foster, Debbie Gregory, Ani Pahuru-Huriwai, Rawinia Parata, Aubrey Ria, Tony Robinson, Rob Telfer, Teddy Thompson, Rhonda Tibble and Nick Tupara

EXTRAORDINARY COUNCIL/TE KAUNIHERA

DATE: Wednesday 20 March 2024

TIME: 9:00AM

AT: Te Ruma Kaunihera (Council Meeting Room), Awarua, Fitzherbert Street, Gisborne

AGENDA – OPEN SECTION

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

Council

Chairperson:	Mayor Rehette Stoltz
Deputy Chairperson:	Deputy Mayor Josh Wharehinga
Membership:	Mayor and all Councillors
Quorum:	Half of the members when the number is even and a majority when the number is uneven
Meeting Frequency:	Six weekly (or as required)

Terms of Reference:

The Council's terms of reference include the following powers which have not been delegated to committees, subcommittees, officers or any other subordinate decision-making body, and any other powers that are not legally able to be delegated:

1. The power to make a rate.
2. The power to make a bylaw.
3. The power to borrow money, or purchase or dispose of assets, other than in accordance with the Long Term Plan.
4. The power to adopt a Long Term Plan, Annual Plan, or Annual Report.
5. The power to appoint a Chief Executive.
6. The power to adopt policies required to be adopted and consulted on under the Local Government Act 2002 in association with the Long Term Plan or developed for the purpose of the Local Governance Statement.
7. The power to adopt a remuneration and employment policy.
8. Committee Terms of Reference and Delegations for the 2019–2022 Triennium.
9. The power to approve or amend the Council's Standing Orders.
10. The power to approve or amend the Code of Conduct for elected members.
11. The power to appoint and discharge members of Committees.
12. The power to establish a joint committee with another local authority or other public body.
13. The power to make the final decision on a recommendation from the Ombudsman where it is proposed that Council not accept the recommendation.

14. The power to make any resolutions that must be made by a local authority under the Local Electoral Act 2001, including the appointment of an electoral officer.
15. Consider any matters referred to it from any of the Committees.
16. Authorise all expenditure not delegated to staff or other Committees.

Council's terms of reference also includes oversight of the organisation's compliance with health and safety obligations under the Health and Safety at Work Act 2015.

Note: For 1-7 see clause 32(1) Schedule 7 Local Government Act 2002 and for 8-13 see clauses 15, 27, 30 Schedule 7 of Local Government Act 2002

3.1. Action Register

Meeting Date	Item No.	Item	Status	Action Required	Assignee/s	Action Taken	Due Date
14/12/23	11.2	23-328 Draft Financial Strategy for the 2024-2027 Three Year Plan	In progress	Advise Councillors the portion of the roading asset which is owned by Waka Kotahi in our District.	Dave Hadfield		09/04/24
14/12/23	11.9	23-316 Three Year Plan Capital Programme	In progress	Provide Councillors with the Asset Management Plan in relation to Community Housing.	Ally Campbell, Pauline Foreman	**05/03/2024 Pauline Foreman** Draft Asset Management Plan for Gisborne Holdings Ltd forecast to be delivered at the 18 April 2024 Operations Committee.	26/03/24
25/01/24	10.1	24-3 Three Year Plan 2024-2027 Draft Estimates	In progress	Cost of community housing to be discussed at the next Gisborne Holdings Limited meeting.	Ally Campbell, Pauline Foreman	Update at the June Finance & Performance Committee Meeting.	05/06/24
25/01/24	10.3	24-1 Dangerous, Affected and Insanitary Buildings Policy 2024 - Deliberation and Adoption Report	In progress	Concerns regarding the Dangerous, Affected, and Insanitary Buildings be discussed with the Minister of Housing and Urban Development.	Annie Cousins		09/04/24
25/01/2024	15.1	Additional Action Items	In progress	**24-3 Three Year Plan 2024-2027 Draft Estimates** Funding information for Taruheru Cycleway/Walkway be provided to councilors.	Ally Campbell, Pauline Foreman		09/04/2024

3.2. Governance Work Plan

2024 COUNCIL						Meeting Dates							
HUB	**Activity**	**Name of agenda item**	**Purpose**	**Report type**	**Owner**	**25-Jan**	**14-Mar**	**2-May**	**27-Jun**	**8-Aug**	**17-Oct**	**14-Nov**	**12-Dec**
Office of the Chief Executive	Risk & Performance	Chief Executive Activity Report	The purpose of this report is to provide elected members with an update on Council activities from 1 November 2023 to 29 February 2024.	Information (I)	Joy Benioni								
Sustainable Futures	Strategy and Science	Freshwater Policy Planning - Scientific Evidence for Groundwater and Surface Water	Report to give an overview of the findings from latest GDC-commissioned groundwater report and NIWA report	Information (I)	Janic Slupski; Sarah Thompson; Paul Murphy								
Sustainable Futures	Strategic Planning	Freshwater Policy Planning Update	Report to give an update on the freshwater policy planning under the TRMP review	Information (I)	Janic Slupski; Ariel Yann le Chew								
Sustainable Futures	Strategy and Science	Freshwater Implementation Update	Report to give an update on the freshwater implementation projects	Information (I)	Janic Slupski; Ariel Yann le Chew								
Sustainable Futures	Strategic Planning	Regional Policy Statement - Public notification	Report to seek Council resolution to publicly notify the Regional Policy Statement as part of the TRMP review	Decision (D)	Yvonne Legarth; Paula Hansen								
Community Lifelines	Water	Workshop Water Services Options	Water services options	Workshop	Yvette Kinsella, Leo Kelso								

2024 COUNCIL

HUB	Activity	Name of agenda item	Purpose	Report type	Owner	Meeting Dates							
						25-Jan	14-Mar	2-May	27-Jun	8-Aug	17-Oct	14-Nov	12-Dec
Sustainable Futures	Strategic Planning	Adoption of the Tairawhiti Future Development Strategy 2024-2054	Summary of consultation and seeking the adoption of Tairawhiti Future Development Strategy 2024-2054	Decision (D)	Drew Williams								
Sustainable Futures	Strategic Planning	Cemeteries Bylaw and Policy	Report to seek the Council decision for determinations report for bylaw	Decision (D)	Summer Agnew								
Sustainable Futures	Strategic Planning	Easter Sunday Trading Policy	Report to seek the Council decision for policy review	Decision (D)	Summer Agnew								
Sustainable Futures	Strategic Planning	Climate Risk Assessment	Decision report	Decision (D)	Abi Wiseman								
Sustainable Futures	Recovery	Elevating Tairawhiti - adoption of policy framework	To adopt the Category 2P: Elevating Tairāwhiti Policy that provides a framework for funding or part funding house lifting for some of the dwellings inundated during Cyclone Gabrielle	Information (I)	Steve Fabish /contractor								
Sustainable Futures	Strategic Planning	Update on a new Emissions Inventory	Overview of process and timeframes	Information (I)	Jacqui Wallens								
Sustainable Futures	Strategic Planning	Mobile shops and other traders' bylaw	Decision report to seek Council decision around consultation	Decision (D)	Makarand Rodge								
Sustainable Futures	Strategic Planning	DC Policy	Council to decide around adoption on DC Policy	Decision (D)	Charlotte Knight								

2024 COUNCIL

HUB	Activity	Name of agenda item	Purpose	Report type	Owner	Meeting Dates 25-Jan	14-Mar	2-May	27-Jun	8-Aug	17-Oct	14-Nov	12-Dec
Sustainable Futures	Strategic Planning	Procurement Policy	Council to decide around consultation on procurement Policy	Decision (D)	Chris Gilmore								
Sustainable Futures	Strategic Planning	TRMP Committee	To revive TRMP Committee	Decision (D)	Janic Slupski								
Sustainable Futures	Strategic Planning	Contract: Navigational Safety Bylaw	Decision report to seek Council decision to/not to consult on the policy	Decision (D)	Makarand Rodge								
Engagement and Māori Partnerships	Communication and Engagement	2024-2027 Three Year Consultant Document	Present the 3YP consultation document for adoption	Decision (D)	Melanie Thornton								
Finance & Affordability	Risk & Performance	2024-2027 Three Year Plan	Present the 3YP document for adoption	Decision (D)	Kim Everett								
Sustainable Futures	Strategic Planning	Draft Uawa Catchment Forestry Plan workshop	Workshop to socialise draft forestry plan, approximately 2 hours	Workshop	Janic Slupski								

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

24-64

Title:	**24-64 Approval to Consult - Navigation Safety Bylaw**
Section:	Sustainable Futures
Prepared by:	Makarand Rodge - Policy Advisor
Meeting Date:	Wednesday 20 March 2024

Legal: No	Financial: No	Significance: **Low**

Report to COUNCIL/TE KAUNIHERA for decision

PURPOSE - TE TAKE

The purpose of this report is to seek Council adoption of the Statement of Proposal for the Ture ā-rohe Haumaru Whakatere o Te Tairāwhiti – Tairāwhiti Navigation Safety Bylaw 2024 (including the proposed Bylaw) for public consultation.

SUMMARY - HE WHAKARĀPOPOTOTANGA

The Gisborne District Council has a statutory role in ensuring maritime safety in its district by developing Navigation Safety Bylaws under section 33M in the Maritime Transport Act 1994 (MTA). The Gisborne District Navigation and Safety Bylaw 2012 (the 2012 Bylaw) is currently in force to minimise the risk of fatalities, injuries, nuisance, accidents, collision, and damage in the navigable waters within the Gisborne District.

The Local Government Act 2002 (LGA) requires Council to undertake a review of its bylaws 10 years after the last review; and complete that review within a two-year timeframe from that review date.

Changes were made to the 2012 Bylaw in 2018, where a number of minor amendments were made, to correct references to old legislation, make formatting corrections and some other minor wording changes. As these changes were not material, there was no requirement for public consultation.

In June 2022, the Sustainable Tairāwhiti Committee (the Committee) approved the review of the current bylaw. At this meeting, the Committee also determined that a bylaw is still the most appropriate and proportionate way of regulating navigational safety.

Early engagement on the review occurred in late 2022. **Attachment 1** contains a summary of this pre-consultation.

The Committee initially approved a review of the 2012 Bylaw; however, as the review has progressed, more substantial changes have been identified. Because of the extent of these changes, staff propose that instead, a new bylaw be made, and the 2012 bylaw be revoked and replaced.

This paper seeks Council's adoption of the Statement of Proposal in **Attachment 2**, including the proposed Bylaw, for public consultation using the special consultative procedure. These determinations are required to be made under section 155 of the Local Government Act 2022.

The proposed changes are listed below:

1. **Revoke the Navigation and Safety Bylaw 2012 and replace it with a new Bylaw** to reflect the more comprehensive review undertaken.
2. **Extend bylaw coverage** to all navigable waters throughout the district.
3. **Extend the life jacket requirement** to require every person on board a recreational craft of six metres of less to wear a personal flotation device when a vessel is underway.
4. **Prohibit the discharge of cargo** into navigable waters.
5. **Require vessels to be identified** by either a name or number, visible on the vessel.
6. **Increase requirements for oil spill contingency plans**, including notification to the Council in advance.
7. **Require two operational means of communication** to be carried on most vessels with some exceptions such as for sporting events and surfing.
8. **Increase safety for swimmers in open water** by requiring swimmers 200 meters or more from shore to tow a safety float or wear a bright swim cap.
9. **Increase the available space to catch crayfish** by reducing the cray pot exclusion area within the harbour.
10. **Revoke historic exemptions on the Waiapu River** (the Water Recreation (Waiapu River) Notice 1979) which exempted the area from speed rules.
11. **General changes** proposed to improve the readability of the Bylaw.

The decisions or matters in this report are considered to be of **Low** significance in accordance with the Council's Significance and Engagement Policy.

RECOMMENDATIONS - NGĀ TŪTOHUNGA

That the Council/Te Kaunihera:

1. **Determines that a bylaw is the most appropriate means of addressing the perceived problems of navigational safety on Gisborne District waterways.**
2. **Determines that the proposed Ture ā-rohe Haumaru Whakatere o Te Tairāwhiti – Tairāwhiti Navigation Safety Bylaw 2024 in Attachment 2 to this report:**
   a. **Is in the most appropriate form of the bylaw; and**
   b. **Does not give rise to any implications under the New Zealand Bill of Rights Act 1990.**
3. **Adopts the Statement of Proposal including the proposed Ture ā-rohe Haumaru Whakatere o Te Tairāwhiti – Tairāwhiti Navigation Safety Bylaw 2024 in Attachment 2 of this report for consultation using the special consultative procedure.**

Authorised by:

Joanna Noble - Director Sustainable Futures

Keywords: navigation safety, bylaw, maritime, waterways.

BACKGROUND - HE WHAKAMĀRAMA

1. The Council's navigation safety functions are set out in the Maritime Transport Act 1994 (MTA). The authority to make bylaws comes from s33M of the MTA, which sets out the scope of matters that can be included in the bylaw. The MTA (s33F) also gives Harbourmasters the authority to act to ensure maritime safety, and enforce secondary legislation, including bylaws.
2. The Bylaw can only address matters in respect to maritime safety. It cannot be inconsistent with the Resource Management Act 1991 (RMA) and cannot be used to control environmental matters that should be addressed through the RMA processes.
3. On 2 June 2022, (**Report 22-110**), the Sustainable Tairāwhiti Committee determined that the Navigation and Safety Bylaw 2012 (the current Bylaw) should be amended, and that a bylaw is the most appropriate way of regulating navigational safety.
4. A workshop was held with elected members in mid-2022 to seek guidance and feedback during the development of the bylaw. The feedback from these workshops informed pre-consultation activities which were held in late 2022. **Attachment 1** contains the summary of this pre-consultation.
5. The cyclone in January 2023 meant this work was put on hold while Council re-prioritised resources to support the cyclone response and recovery. This has not affected Council's ability to regulate navigation safety as the current bylaw does not expire until December 2024.
6. The MTA requires that navigation bylaws are made by regional councils in consultation with the Director of Maritime New Zealand (MNZ). Staff consulted with the Maritime Director in late 2023, and their feedback on a draft of the Bylaw was included in the review and is reflected in the proposed Bylaw. The Bylaw has also been subject to an internal legal review.
7. The feedback from the Maritime Director largely related to some clauses within this draft Bylaw that were considered by Maritime New Zealand (MNZ) as being ultra vires or inconsistent with the MTA, and its regulations and rules. Staff have actioned this by specific wording changes and this has been reflected in the draft proposed Bylaw in **Attachment 2**.

The 2012 Bylaw

8. The current bylaw aims to ensure the safety of all users on the waterways of the Gisborne District. It sets out requirements for safe operations for people using the lakes, rivers, harbours and coastal waters for towing, boating, kayaking or other water activities, and seeks to reduce the conflicts between different activities.
9. Section 159 of the LGA states a local authority must review a bylaw made by it under the LGA or MTA, no later than ten years after it was last reviewed.
10. The current bylaw expires on 4 December 2022, however s160A of the LGA provides that a bylaw which is not reviewed under s159 of the LGA is revoked on the date that is two years after the last date on which the bylaw should have been reviewed. This means the 2012 bylaw can continue to be enforced in its current form until 4 December 2024.

11. The Harbourmaster is tasked with the execution of the 2012 bylaw and the changes suggested by the Harbourmaster during this review will help to bring the bylaw in line with best practice based on other councils throughout New Zealand, will make enforcement of the rules of the bylaw easier, will enhance the safety of users of the navigable waters within the Gisborne District, and will provide additional clarity for current and future users of the bylaw.

DISCUSSION and OPTIONS - WHAKAWHITINGA KŌRERO me ngā KŌWHIRINGA

12. Staff are proposing that the current Bylaw be revoked, and that the new proposed Bylaw be consulted on and adopted.

13. Once adopted, the new Bylaw would need to be reviewed within five years. The ten year review period will commence after this first review.

14. The Statement of Proposal and the proposed Bylaw are included in **Attachment 2** to this report.

15. Staff are proposing the following eleven key changes from the current approach to managing navigation safety in Tairāwhiti:

    1. Revoke the Navigation and Safety Bylaw 2012 and replace it with a new Bylaw to reflect the more comprehensive review undertaken.
    2. Extend bylaw coverage to all navigable waters throughout the district.
    3. Extend the life jacket requirement to require every person on board a recreational craft of six metres of less to wear a personal flotation device when a vessel is underway.
    4. Prohibit the discharge of cargo into navigable waters.
    5. Require vessels to be identified by either a name or number, visible on the vessel.
    6. Increase requirements for oil spill contingency plans, including notification to the Council in advance.
    7. Require two operational means of communication to be carried on most vessels with some exceptions such as for sporting events and surfing.
    8. Increase safety for swimmers in open water by requiring swimmers 200 meters or more from shore to tow a safety float or wear a bright swim cap.
    9. Increase the available space to catch crayfish by reducing the cray pot exclusion area within the harbour.
    10. Revoke historic exemptions on the Waiapu River (the Water Recreation (Waiapu River) Notice 1979) which exempted the area from speed rules. The area is now subject to the district-wide speed rules within the bylaw.
    11. General changes proposed to improve the readability of the Bylaw, to include and formalise existing Harbourmaster directions, ensure consistency with existing national regulation, consistency where appropriate neighbouring regional councils, and make the bylaw more straightforward to administer and enforce.

16. The draft statement of proposal, and the proposed new Bylaw which reflect these changes is attached to this report as **Attachment 2**.

17. The rationale and cost-benefit considerations for each of these proposals is set out below.

Proposal one: Revoke the Navigation and Safety Bylaw 2012 and replace it with a new Bylaw

18. The current bylaw was due for review in 2022, which when this review commenced, and will automatically revoke in December 2024.

19. During the review, staff identified more comprehensive changes were required to the existing bylaw. To ensure compliance with the review requirements of the Local Government Act 2002, a new bylaw is proposed as opposed to a reviewed 2012 Bylaw.

Table one: Cost-benefit analysis of Proposal one

Options	**Costs / risks**	**Benefits**
Status quo: do not change the current 2012 bylaw and complete the review without the changes in the proposed Bylaw	Some of the changes proposed can be managed operationally through Harbourmaster directions and within the national Maritime Rules, but these are not as visible or transparent as a bylaw, and many of the changes suggested in the proposed Bylaw will not be able to be enforced. This option means community and key stakeholders do not have a say on some proposals which they had previously indicated as desirable through pre-consultation, so there is some reputational risk associated with this option.	The current rules remain in place, and the scope and nature of the regulation of navigation safety is consistent.
Revoke and replace the current Bylaw (2012) *(staff preferred option)*	Council will incur costs of undertaking public consultation. There will also be costs associated with updating educational material, signage, and other communication tools. A new bylaw is required to be reviewed after five years of operation, so Council will incur the costs of another review sooner than if it kept its current bylaw, with a ten year review requirement.	This option enables Council to receive feedback from the public and stakeholders on the proposed changes described within this statement of proposal, which reflect best practice, provide consistency with the Maritime Transport Act 1994 (the Act) and the Maritime Rules, and provides more consistency with our neighbouring councils.

Proposal two: Increase the area the bylaw covers to the entire Gisborne District

20. Currently, the bylaw is limited to Tūranganui-a-Kiwa/Poverty and Tolaga Bay. Under the Maritime Transport Act councils have the ability to make bylaws which cover all navigable waters within their district or region.
21. Given that the purpose of the bylaw is to minimise the risk of fatalities, injuries, nuisance, accidents, collision, and damage it is suggested that the bylaw be extended to cover the whole district so that the Harbourmaster has the ability to manage vessels which are being operated in a manner which may cause harm or nuisance to others.
22. This proposal has been included to ensure navigation safety rules are consistent across all of the district's navigable waters. This means any waters in the Gisborne District whether coastal or inland which are able to be navigated out to the 12 nautical mile limit and includes harbours.

Table two: Cost-benefit analysis of Proposal two

Options	**Costs / risks**	**Benefits**
Retain the status quo, only covering Tūranganui-a-Kiwa/Poverty Bay and Tolaga Bay	In this option, rules will remain inconsistent across the district's navigable waters. If vessels are being operated in an undesirable manner outside of these areas the Harbourmaster may not be able to intervene. This leads to a risk of reputational damage to Council if they are seen as not acting in relation to something the public perceives as an area of responsibility.	The current rules remain in place, and the scope and nature of the regulation of navigation safety is consistent.
Widen the coverage of the bylaw to include the navigable waters in the whole district. *(Proposed option)*	There may be more work initially for the Harbourmaster to educate the public about the rules and how they apply, however, this may happen as a result of reviewing the bylaw even without changing the area the bylaw covers.	This option means there would be consistent rules across the district, and Council can act immediately if there is a navigation safety risk outside Tūranganui-a-Kiwa/Poverty Bay or Tolaga Bay. It is common practice for Navigation Safety Bylaws to cover the whole region/district, therefore bringing Gisborne in line with other councils.

Proposal three: Require life jackets to be worn by people on vessels 6m or less while the vessel is underway.

23. Staff are also proposing a change to the provision for wearing life jackets, with several options available to Council as outlined in Table three. This provision relates to recreational crafts of six meters or less only.

24. The proposal aims to reduce safety risks by requiring life jackets to be worn, not just be on board. This is consistent with our Hawkes Bay, and with the approach taken by the NZ Safer Boating Forum. It also brings Gisborne's approach in line with most of the country.

Table three: explanation of options within Proposal three

Options	Explanation
Status quo. In 2012 Bylaw life jackets must be available on board and worn in adverse conditions.	This is the minimum requirement as per the Act. Skippers must carry a correctly sized lifejacket for each person on board and ensure that lifejackets are worn in circumstances where tides, river flows, visibility, rough seas, adverse weather, emergencies or other situations cause danger or a risk to the safety of person on board.
Life jackets required to be worn when the vessel is making way	This captures the minimum requirement as per the Act, with the additional requirement that life jackets must also be worn when the vessel is being propelled by an engine, oars, sails or other instrument.
Life jackets required to be worn when the vessel is underway. *(Staff preferred option)*	This captures the minimum requirement as per the Act, with the additional requirement that life jackets must also be worn when the vessel is not at anchor, moored, made fast to a structure or the shore, or aground. This proposed requirement doesn't apply in certain situations like sporting events, training, ceremonial events, where a support vessel can provide adequate assistance.
Life jackets to be worn at all times.	This captures the minimum requirement as per the Act, with the addition that life jackets must be worn at all times.

25. The preferred option by staff would bring this provision in line with a number of councils who have recently reviewed their bylaws (Wellington, Waikato and Otago), meaning more consistency across the country. It would also be consistent with Hawke's Bay and Bay of Plenty rules, giving consistency when boaties move from one region to the next.

Proposal four: Prohibit discharging cargo into navigable waters from a vessel, wharf or land.

26. The current bylaw does not contain a clause in relation to discharges from vessels. Staff propose to add a provision which prevents the discharging of cargo that may constitute a danger to maritime safety. There would also be a corresponding infringement fee for this offence.

27. By adding this clause, and a corresponding infringement fee, Council would be able to recover the costs of removing cargo discharged into navigable waterways. It would also make the Gisborne Bylaw consistent with other bylaws across the country which prevent the discharge of cargo from vessels into navigable waters.

Table four: Cost-benefit analysis of Proposal four

Options	**Costs / risks**	**Benefits**
Status quo – no clause to prevent discharge of cargo	Costs for removing discharged cargo will be borne by Council. Discharged cargo could present a danger to vessels in navigable waters. Potential reputation damage to Council if they are unable to limit vessels from discharging cargo and/or recover the costs of clean-up.	There would be no administrative costs of issuing infringement notices.
Prohibit the discharge of cargo into navigable waters. *(Staff preferred option)*	There may be administrative costs to identifying the vessel which discharged cargo and issuing the infringement notice	The likelihood of discharges is reduced. Clean-up costs are covered.

Proposal five: Requiring a boat name or number on vessels over 4 meters long

28. This proposal makes it easier to identify all motorised boats over 4 meters by requiring them to display a name or number on the side of the vessel. This is a new requirement.

Table five: Cost-benefit analysis of Proposal five

Options	Costs / risks	Benefits
Status quo: there is no provision to require naming or numbering of vessels in the current bylaw	Not consistent with other councils. Makes it harder for Council to contact or locate owners or users of vessels in distress, compromising the safety of these people.	Consistency in regulation within the district by staying with the current regulation, if a boat does not have a name or number the boat owner does not have to incur costs to comply. Some potential savings in resources required to communicate and enforce this change in approach
Add a requirement to require naming or numbering of vessels over 4m long. *(Staff preferred option)*	There may be some costs associated with the resources required to communicate and enforce this change in approach.	This provision would be in line with other councils around the country including Hawke's Bay and Bay of Plenty. This enables quick identification of a vessel in distress, a vessel found with no one on it, or if the Harbourmaster needs to communicate with the owner of a boat. As most boats already have an identifying name, this requirement is not likely to place an onerous burden on boat owners, and Council can take an educational approach to achieving compliance.

Proposal six: Include safety requirements for oil transfer activities

29. Staff are proposing additional clauses are included which require oil spill contingency plans, which comply with the requirements of the Marine Protection Rule 130B, when transferring oil to or from a ship, and an associated infringement fee if this clause is not complied with.

30. This proposal also requires that Council be notified of an oil transfer, and an associated infringement fee if this clause is not complied with.

Table six: Cost-benefit analysis of Proposal six

Options	Costs / risks	Benefits
Status quo. There is no provision for oil spill contingency plans and no requirement for notification to Council when undertaking oil transfers	Potential for environmental damage if oil spills occur and there is no contingency plan in place. There is no ability for Council to enforce an infringement fee for such events, and costs fall to Council for clean-up.	There will be no administration resource associated with receiving notifications of oil transfers.
Require oil spill contingency plans and notification to Council when undertaking oil transfers. *(Staff preferred option)*	There is likely to be some administration duties associated with receiving notifications of oil transfers.	This option means Council Staff are aware of large oil transfers and can be ready to respond in the event of a spill, and the likelihood of environment damage from oil spills is reduced. Infringement fees can be enforced on those who breach this clause, which can be used to cover the cost of clean-ups.

Proposal seven: Require at least two operational means of communication to be carried on vessels

31. Staff are proposing to include a requirement for an additional means of communication to be on vessels to increase safety, from one to two means of communication. This proposed requirement will not apply to some situations such as sporting events where there is an adequate support vessel present which complies with the requirement.

Table seven: Cost-benefit analysis of Proposal seven

Options	Costs / risks	Benefits
Status quo – The 2012 Bylaw is silent on this matter. The Maritime Rules only requires one means of communication to be on board vessels.	Risk of safety being compromised on vessels if the sole form of communication fails.	There is some voluntary compliance with having two means of communication, as the Harbourmaster undertakes advocacy and education to encourage people in charge of vessels to consider having two means of communication on board, as a safer option than the minimum.
Increase the requirement to having two means of communication on board a vessel, as opposed to one. *(Staff preferred option)*	Some costs may be incurred by people in charge of vessels to source a second means of communication.	This option will increase safety on the water and is consistent with the current advocacy of the Harbourmaster and with other councils. This is a relatively easy requirement to comply with, as a communication device can be a VHF radio or a cellphone, and also includes affordable options such as flares and whistles.

Proposal eight: Require swimmers 200 meters or more from shore to tow a safety float or wear a brightly coloured swim cap

32. This proposal is suggested by staff in order to increase the ability to identify swimmers in open water, outside demarked swimming areas and to make it easier to help in case of distress.

Table eight: Cost-benefit analysis of Proposal eight

Options	Costs / risks	Benefits
Status quo. The 2012 Bylaw is silent on this matter.	Currently while vessels must stay 50 meters away from swimmers as per the Maritime Rules, windsurfers do not have this requirement. Swimmers who are not visible are harder to avoid which increases the likelihood of near misses, injury or death.	There are no benefits identified for this option.
Require swimmers who are swimming 200 meters or more from the shore to either tow a safety float or wear a brightly coloured swim cap. *(Staff preferred option)*	There may be some administrative costs associated with implementing the new requirement.	This requirement will increase the visibility of swimmers in the open water which will in turn make it easier for people in control of vessels to see and avoid them. While no incidents have occurred in Tairāwhiti, there have been incidents (near misses/ injury/ death) between open water swimmers and other water users within New Zealand. This measure will proactively increase the safety of swimmers who choose to swim more than 200 meters off-shore.

Proposal nine: Reduce the cray pot exclusion area within the harbour

33. This proposal maximises space available for cray pot fishing while maintaining the shipping lanes as an exclusion area, balancing the need to set aside areas where activities such as cray pot fishing should be excluded with providing as much area as possible to enable this fishing practice to be undertaken. This proposal is included in response to feedback from the community and the Port.

Table nine: Cost-benefit analysis of Proposal nine

Options	**Costs / risks**	**Benefits**
Status quo. The 2012 Bylaw has a larger exclusion area which covers an area previously utlised by the Port	An opportunity to respond to the desires of the community is missed.	Maintains consistency with the current approach.
Reduce the cray pot exclusion area within the harbour. *(Staff preferred option)*	There may be some administrative costs associated with implementing the reduced exclusion area such as updating signage.	This option means there will be more areas available for people to catch cray fish, and reflects the change in port operational requirements, as the Port no longer needs to use the area proposed to be removed from the exclusion. The new area means the cray pots are away from the shipping lanes, but other areas are maximised. In developing this proposal, the Harbourmaster spoke with the Port and other key stakeholders.

Proposal ten: Revoke the Waiapu River speed limit uplift

34. In 1979 a speed limit uplift was put in place for the Waiapu River. There is limited information as to the reasoning for this specific uplift, however they are often put in place to allow for faster travel for recreational activities such as jet boating. The speed uplift notice is included below:

The Water Recreation (Waiapu River) Notice, 1979

PURSUANT to the Water Recreation Regulations 1979*, I, Owen John Conway, of the Ministry of Transport, in exercise of the powers delegated by the Minister of Transport, hereby give the following notice:

NOTICE

1. (a) This notice may be cited as the Water Recreation (Waiapu River) Notice, 1979.

(b) This notice shall come into force on the date of its publication in the *Gazette* and shall remain in force until revoked by further notice in the *Gazette*.

2. Subject to the conditions set forth in the Second Schedule hereto, regulation 7 (1) (a) and (b) and 7 (2) of the Water Recreation Regulations 1979 shall not apply with respect to the areas described in the First Schedule hereto.

FIRST SCHEDULE

ALL the waters of the Waiapu River from its source to the sea.

SECOND SCHEDULE

1. Notwithstanding any other provision of this notice, no person who is permitted by any such provision to propel or navigate a small craft at a speed through the water exceeding 5 knots shall do so in any manner that is likely to endanger or unduly annoy any person who is on, in, or using the water, or fishing or undertaking any recreational activity in the vicinity of the small craft.

2. All persons in charge of a vessel shall adhere to and keep the provisions of all other Acts and regulations not specifically exempted by this notice.

Dated at Wellington this 14th day of May 1979.

O. J. CONWAY, for Secretary for Transport.

*Water Recreation Regulations 1979/30

(M.O.T. 43/153/10)

35. It is proposed that this uplift be revoked, so the 5 knot limit would apply in the navigable waters of the Waiapu River. Council is able to amend or revoke this notice within a bylaw under the authority of the Maritime Rule 91.22(3).

36. This bylaw review therefore poses an opportunity to consult with the community and seek feedback specifically about removing this uplifting.

Table ten: Cost-benefit analysis of Proposal ten

Options	Costs / risks	Benefits
Status quo. The historical speed uplifting remains in place, and there is no speed limit on the Waiapu River.	There is a safety concern associated with vessels moving fast in areas used for other recreational purposes.	Maintains consistency with the current approach. The proposed extension of scope of the bylaw to include this river as part of the navigable waters in the district will mean Council will still have some regulatory tools to manage issues related to wake or unsafe boating.
Include a provision in the Bylaw to revoke the Waiapu River speed uplifting and apply the default 5 knot rule (200m away from any shoreline). *(Staff preferred option)*	Removing the uplift may impact on users of the river who will need to seek an exemption license if they wish to travel at speeds faster than 5 knots, to be compliant with the Bylaw. This would add an administrative burden on both these users and on Council to consider and process these applications for exemption.	This option, coupled with the proposed extension of scope of the Bylaw to include all navigable waters in the district, will mean Council is better equipped to manage safety on the Waiapu River. This safety measure is appropriate as the river runs through residential areas and swimmers and other users utilise the river for recreation.

Proposal eleven: Other changes in approach

37. Throughout the review, other changes and improvements to the current approach were identified and have been proposed. These changes increase the readability of the Bylaw, include and formalise existing Harbourmaster directions to make these directions more transparent and easier to access, ensure consistency with existing national regulation, achieve consistency where appropriate with the approaches of neighbouring councils, and make the bylaw more straightforward to administer and enforce.

38. These changes from the current approach within the 2012 Bylaw which are reflected in the proposed Bylaw are as follows:

Table eleven: Explanation of key changes within Proposal eleven

Change	Explanation
Add a provision stating the purpose of the Bylaw	To help readers understand the Bylaw, and to be consistent with Council's new bylaw format.
Update and clarify powers and responsibilities of Harbourmaster	To reflect the powers and responsibilities given to the Harbourmaster by the Maritime Rules. This clarifies the scope of the Harbourmaster and ensures consistency with the Maritime Rules
Add further general duties of people in charge of vessels	To follow best practice of noting that other legislation is relevant, and to align the responsibilities of the person in charge with current maritime law.
Add provision enabling flagged areas on beaches, and restricting activities within these areas	This will standardise using flagged areas of beaches for swimming, making these areas easily recognisable. Formalises the flagged swimming areas and makes it easier for council to restrict activities in or near the swimming areas.

Change	Explanation
Change speed of vessels rule for surf lifesaving vessels	To enable more efficient operation of surf lifesaving activities by removing the requirement for surf lifesaving club vessels to comply with speed restrictions when they are operating in accordance with all other appropriate operating procedures. This formalises the status quo as speed limits as they relate to surf lifesaving activities are not enforced. This also reflects a consistent approach with other councils.
Regulate how long a vessel may stay in certain locations and requiring permission for longer moorings or anchorage	To provide regulation around timeframes for anchoring and mooring at public wharves. Currently there are no time limits, and this provision enables the Harbourmaster to move vessels along if required.
Change designated large vessel anchoring positions to set points	To spread out anchoring positions and allow more available points. Set points were already in place via a Harbourmaster direction, and inclusion in the bylaw formalises this. Limiting the number of places where vessels can anchor manages congestion, increases safety on the water, and limits the environmental impact of the anchoring activity on the seabed.
Add permitted anchorage positions for cruise ships	To future proof harbour use by providing two further anchorage positions for cruise ships. Previously these points were managed in a more ad-hoc way, and inclusion in the bylaw will formalise the approach. This gives cruise ship operators assurance and keeps other uses safe as the location of cruise ships will be known. Limiting the number of places where vessels can anchor manages congestion, increases safety on the water, and limits the environmental impact of the anchoring activity on the seabed.
Regulate the use of flashing lights and sound	To increase maritime safety by clarifying when these lights and sounds can and cannot be used in navigable waters. This proposed addition ensures consistency with other regions and gives the Harbourmaster the ability to regulate the misuse of lights and sounds, so bona fide emergencies are not compromised.
Amend clause on moorings	To future proof the Bylaw by providing for any future moorings offered in Gisborne. While there is no current moorings/mooring areas, this makes it easier for any to be established in future by defining the process required to apply, and links moorings to the resource consenting process. This is consistent with the approach taken by other councils.
Amend provision on use of buoys	To clarify requirements of safe use and placement of marker buoys. This makes the rule explicit and requiring contact details to be on these buoys brings this bylaw consistent with other councils. This is likely to capture buoys attached to cray pots and fishing nets.

Add clause on distance from vessel showing Flag B	To require certain distance from vessels showing Flag B or a red all-round light, to reduce chances of maritime incidents. This is consistent with the Maritime Rules. Vessels are required to show Flag B if they are taking in, discharging or carrying dangerous goods.
Require a hot works permit before works begin	To notify the Harbourmaster of the hot works (for example, welding) so any safety risks can be managed. The changes provide more clarity as to the requirements for people planning on undertaking hot works and makes the process easier to administrate and manage for the Harbourmaster.
Require planning and monitoring information when loading and unloading logs,	To ensure any person loading or unloading logs has plans in place if logs are lost, and to assist in their recovery. This formalises the status quo and ensures the rules and expectations of information are clear.
Add a prohibited anchorage area shoreward of Ariel Bank	To manage congestion in this area and restrict anchoring. This area is a poor holding ground, which means anchors drag easily. This is a safety issue because vessels are not properly at anchor. There is also an environmental impact of dragging anchors on the sea floor. This change formalises a Harbourmaster direction and brings it into the bylaw.
Clarify exemptions under the bylaw by providing that an exemption to any provision in the bylaw may be considered by the Harbourmaster and a licence to be exempt may be granted under the Local Government Act 2002	This process utilises the powers Council has under section 151(3) of the Local Government Act 2002 which allows for bylaws made under the LGA or the Maritime Transport Act to provide a licence of persons or property, while also allowing for the payment of licence fees and the recovery of costs in relation to any activity licenced under a Bylaw. This exemption provision does not allow for the Harbourmaster to act outside their scope as defined within Maritime legislation.
Update definitions and descriptions of terms to ensure consistency with the Maritime Rules and legislation, and ensure defined terms add to the readability of the bylaw	For example, the definition of Beacon has been changed for consistency with the Maritime Rules, and a definition of Nuisance has been added to give some clarity of the meaning of that term to make it easier to understand and enforce.
Update and clarify offences and penalties provisions	To ensure alignment with legislation and clear enforceability.
Update the maps within the bylaw	To enable easier use and understanding, as well as adding additional information to maps where required by changes in the bylaw.
Update format and layout of bylaw clauses	To be consistent with Council's other bylaws, and to align with current best practice drafting standards. This will make the bylaw easier to read and understand.

39. The key options for addressing these changes are considered below:

Table twelve: Cost-benefit analysis of Proposal eleven

Options	**Costs / risks**	**Benefits**
Status quo, or partial status quo (make some but not all of the changes)	This may require a redrafting of the proposed Bylaw as many of these changes are fundamental to the structure of the proposed Bylaw, or a reversion to the approach taken to the 2012 Bylaw. This option does not enable Council to fully benefit from the stakeholder engagement which has informed this review, including with Maritime New Zealand and other councils.	No benefits have been identified.
Make these changes to increase readability, ensure consistency with national regulation and neighbouring regional councils, and make the bylaw more straightforward to administer and enforce. *(Staff preferred option)*.	There may be more work initially for the Harbourmaster to educate the public about the rules and how they apply, however, this may happen as a result of reviewing the bylaw regardless.	Allows the community to respond to and give feedback on the proposal through the consultation period. This feedback is likely to further increase the readability of the Bylaw. The Bylaw benefits from the input of those who have given feedback to date.

ASSESSMENT of SIGNIFICANCE - AROTAKENGA o NGĀ HIRANGA

Consideration of consistency with and impact on the Regional Land Transport Plan and its implementation
Overall Process: Low Significance
This Report: Low Significance

Impacts on Council's delivery of its Financial Strategy and Long Term Plan
Overall Process: Low Significance
This Report: Low Significance

Inconsistency with Council's current strategy and policy
Overall Process: Low Significance
This Report: Low Significance

The effects on all or a large part of the Gisborne district
Overall Process: **Low** Significance
This Report: **Low** Significance

The effects on individuals or specific communities
Overall Process: **Medium** Significance
This Report: **Low** Significance

The level or history of public interest in the matter or issue
Overall Process: **Low** Significance
This Report: **Low** Significance

40. The decisions or matters in this report are considered to be of **Low** significance in accordance with Council's Significance and Engagement Policy.

TANGATA WHENUA/MĀORI ENGAGEMENT - TŪTAKITANGA TANGATA WHENUA / COMMUNITY ENGAGEMENT - TŪTAKITANGA HAPORI

41. Staff sought initial feedback from a range of stakeholders and tāngata whenua in the development of the draft Bylaw.

42. Pre-consultation was run through an online platform which asked respondents whether they supported a selection of changes that staff had already identified in collaboration with elected members, as well as asking if there were any other areas of the current Bylaw they had feedback on.

43. An email was sent to iwi and other key stakeholders asking them to provide comments on the existing Bylaw or the areas staff had already been identified for change. An opportunity was provided to meet with the Harbourmaster, and the pre-consultation was also advertised to the wider public on Facebook.

44. A total of 13 responses were received via the online form, with three additional comments made on the Facebook post. The Harbourmaster held three meetings with stakeholders, including meeting with a member of Ngāti Wakarara hapū in Anaura. The summary of this feedback is included in **Attachment 1** and the proposed Bylaw reflects this feedback.

45. The draft Bylaw has also been reviewed by the Harbourmasters special interest group (SIG) and the Maritime Director; the latter being required by the MTA. Feedback from both was incorporated into the review and is reflected in the proposed Bylaw.

46. Consultation requirements for bylaws are set out in section 156 of the Act and must follow the special consultative procedure. The consultation period is planned for 15 April 2024 to 15 May 2024.

CLIMATE CHANGE – Impacts / Implications - NGĀ REREKĒTANGA ĀHUARANGI – ngā whakaaweawe / ngā ritenga

47. There are no climate change impacts or implications arising from the matters discussed in this report.

CONSIDERATIONS - HEI WHAKAARO

Financial/Budget

48. Adoption of a new Navigation Safety Bylaw may have financial implications for Council if updated signage is needed to reflect the changes adopted. There will also be some operational matters such as form updating, and printing of educational materials and updating the website completed as part of the implementation of a new Bylaw.

49. Costs for the review and consulting on a new Bylaw are met by the Strategic Planning budget. Ongoing compliance monitoring and enforcement costs are included in the Harbourmasters budget.

Legal

50. This bylaw is made under the Local Government Act 2002 and Maritime Transport Act 1994.

51. The bylaw will have affect within areas of customary marine title conferred under Ngā Rohe Moana o Ngā Hapū o Ngāti Porou Act 2019. Section 125 of that Act states that: *Except as expressly provided, this Act…. does not affect the manner in which a person considers a matter, makes a decision or recommendation, or exercises a power or performs a function or duty under any enactment or bylaw.*"

52. There is no provision within Ngā Rohe Moana o Ngā Hapū o Ngāti Porou Act 2019 that relates to the Maritime Transport Act or Local Government Act.

53. The matters that the bylaw can address are set out in s33M of the MTA. In general, these include:

    - Regulate and control the use or management of ships.
    - Regulate the placing and maintenance of moorings and maritime facilities.
    - Prevent nuisances arising from the use of ships and sea planes or arising from the actions of persons and things in or on the water.
    - Reserve areas and regulate events.
    - Specify requirements for life jackets, personal watercraft (jet ski) identification.

54. Under section 160 of the LGA, the making, amending, or revoking of a bylaw must follow the special consultative procedure. Section 83 of the LGA required Tas to prepare and adopt a Statement of Proposal and ensure it is publicly available. Section 155 of the LGA requires local authorities, when making/amending or revoking a bylaw to determine:

- Whether a bylaw is the most appropriate way of dealing with the perceived problem or issue:

  A bylaw is determined to be the most appropriate way to ensure public safety on Tairāwhiti waterways as this is the current regulatory mechanism and there are no alternatives.

- Whether the bylaw is in the most appropriate form:

  Council considers the proposed bylaw to be in the most appropriate form of bylaw.

- Whether it gives rise to any implications under the New Zealand Bill of Rights Act 1990:

  Council considers that the proposed bylaw is neither inconsistent with nor raises any implications with the New Zealand Bill of Rights Act 1990 as the proposed changes are reasonable, not overly restrictive, or impractical.

55. Section 155 of the LGA requires that councils, before commencing the process to make a bylaw, determine whether a bylaw is the most appropriate way of dealing with the perceived problem or issue. This determination was made by the Committee in June 2022 (Report 22-110)

POLICY and PLANNING IMPLICATIONS - KAUPAPA HERE me ngā RITENGA WHAKAMAHERE

56. The Proposed Navigation Safety Bylaw has no identified impacts on any other Council policies or planning.

RISKS - NGĀ TŪRARU

57. There are no major risks associated with the decision sought.

NEXT STEPS - NGĀ MAHI E WHAI AKE

Date	Action/Milestone	Comments
April – May	Consultation	Special Consultative procedure will be followed
May-June	Hearings and Deliberations	
August	Final decision on adoption of Bylaw	

ATTACHMENTS - NGĀ TĀPIRITANGA

1. Attachment 1 - Pre-consultation Report [**24-64.1** - 4 pages]
2. Attachment 2 - SOP and Draft Bylaw [**24-64.2** - 58 pages]

Pre-Consultation Findings – Navigation and Safety Bylaw review

1 Introduction

To inform the review of the Gisborne District Council Navigation and Safety Bylaw 2012, Council ran a pre-consultation process for iwi and other key stakeholders throughout September and October 2022. The responses received are summarised in this report.

The pre-consultation was run through an online platform which asked respondents whether they supported a selection of changes that staff had already identified, as well as asking if there were any other areas of the Bylaw that they would like staff to consider making changes to. An email was sent to iwi and other key stakeholders asking them to provide comments on the existing Bylaw or the areas staff had already been identified for change. An opportunity was provided to meet with the Harbourmaster and the pre-consultation was also advertised on Facebook.

A total of 13 responses were received via the online form, with three additional comments made on the Facebook post. The Harbourmaster held three meetings with stakeholders, including meeting with a member of Ngāti Wakarara hapū in Anaura. The information captured through the Facebook post comments and the Harbourmaster meeting has been appropriately captured through the submissions received, and as such are not further counted individually.

Note: all percentages given in this report are rounded totals to the nearest whole number, for ease of reference.

2 Summary of Findings

2.1 Extended area of Bylaw coverage

The Bylaw currently covers activities within Tūrangarui-a-Kiwa/Poverty Bay, and Tolaga Bay. Staff suggested expanding this to cover the whole of the district to provide consistency and better safety regulations governing all navigable waters.

Question posed	**Do you support the option to extend the area the bylaw covers?**					
Responses (tally | percent)	Yes		**No**		Other	
	6	46%	**7**	**54%**	0	0%

Comments:
One respondent noted that the beach as a whole can be very busy during peak summer periods, therefore an extension of the Bylaw onto the coast past Tolaga will help to improve marine safety.

2.2 Life jackets on vessels 6m or less

The Bylaw currently requires that enough correctly fitted lifejackets for everyone be on board, to be carried in a readily accessible location, and to be worm in times of high risk. An alternative option was put to respondents to require correctly fitted and well fastened life jackets to be worn while the vessel is underway and in times of high risk. There would then be exclusions to this requirement in certain instances, such as sporting or ceremonial events where a support vessel can provide adequate assistance.

Question posed	Do you support wearing life jackets on vessels 6m and under?					
Responses (tally | percent)	**Yes**		No		Other	
	11	**85%**	1	8%	1	8%

Comments:
One respondent who supported this change estimated the current number of vessels voluntarily wearing life jackets to be about 20%. They noted that higher alcohol consumption around summer activities and the increased presence of children around the water are key reasons why life jackets were needed. However, this respondent also supported some 'common sense' exclusions for water users such as surfers and divers.

One respondent suggested leaving the decision up to the captain or skipper of each vessel to decide whether to require their passengers to wear life jackets or not. This was because the maritime danger at any point is highly dependent on the conditions, and distance from shore, and so any one rule may not be appropriate to apply at all times.

2.3 Discharge of cargo into waterways

The current Bylaw does not have a specific provision to prevent the discharge of cargo into navigable waters. Staff propose adding a section which would prohibit the dropping of any cargo from a vessel, wharf or from land, that would be a danger to maritime safety. This would also be accompanied by an associated infringement fee.

Question posed	Do you support adding a provision which prevents the discharge of cargo into waterways?					
Responses (tally | percent)	**Yes**		No		Other	
	12	**92%**	1	8%	0	0%

Comments: No comments were made about this potential provision.

2.4 Identification of all boats over 4m

This proposal is to require all vessels over 4m long to have an identification name or number.

Question posed	Do you support adding the requirement that all boats over 4m long have a name or number?					
Responses (tally | percent)	**Yes**		No		Other	
	8	**62%**	3	23%	2	15%

Comments:
One respondent who supported this measure believed that most boat users would respond positively to this change. They also believed that making boats easily identifiable would also help ensure people respect the laws in place and act appropriately, as if they do not, they will be easily identifiable, just as vehicles can be.

One respondent suggested requiring all vessels on the water, including jet skis, to pay a registration fee. This would assign them a vessel number which must be displayed, and lets them operate on the water. Vessels over 4m would then be required to display this number along with a vessel name. The fees collected through this could then be used for actions such as safety education or building a safer boat ramp.

One respondent did not support this change because they believed it would create extra costs for skippers, which may not be affordable. Another respondent questioned whether this would also include jet skis.

2.5 Any other feedback

Respondents were asked for comments on any other relevant issues. The following themes summarise the further feedback received.

Swimming in Harbour

Five respondents in total commented on safety issues of swimmers in the harbour, and around the boat ramp, and requested that swimming be banned from the harbour due to health and safety concerns arising from current activities. Several of the respondents believed injury or death was likely to occur if this was not changed.

One respondent stated that the bylaw provisions were not currently being enforced effectively around the harbour, and that if a swimming area was allowed, it would need to be physically separated from the rest of the waters to ensure safety. Another respondent also observed damage being done to vessels from nearby swimmers interfering with vessels. It was also noted that vessels have limited manoeuvrability, increasing the chance of incidents to occur.

One respondent suggested moving a designated swimming spot to Watties Wharf as a more appropriate location.

Anaura Bay summer safety

In a stakeholder meeting, concerns were raised around water safety in Anaura Bay particularly during mid-December to early February. Concerns include the risk to children swimming (often unsupervised) in the same area that boats are launched and retrieved. In addition, the respondent noted that multiple near-fatalities have been witnessed due to the unsafe use of jet skis. In this meeting the Harbourmaster proposed that an area could be reserved for swimming, and a separate area reserved for launching and retrieving boats.

Crayfish Potting

Two respondents supported changes to the restriction area for crayfish potting, being to reduce the restriction area. Both respondents requested the main restricted area to be the main shipping channel for the Gisborne Port (exclusion zone), with crayfish potting to be allowed on both the middle ground and to the inside of the main shipping channel. The reasons given for this was that crayfish potting in this area has been undertaken in these areas by both recreational and commercial operators for generations, and so should be allowed to continue. To this extent, the respondents also requested a redrafting of the maps to reflect this. This issue was discussed in stakeholder meetings with the Gisborne Tatapouri Sports Fishing Club and the Port.

Vessel Speed

Two respondents requested specific review of regulation around the speed of vessels from the harbour entrance to the main inner harbour marina. They also requested that this area be a ‘no wake zone’ area.

Marine Biosecurity Passports

One respondent noted concern around harbour users importing biosecurity threats such as Mediterranean fanworm. The respondent requested Council implement a programme of requiring marine biosecurity passports for port users, as is being used by other ports in New Zealand.

Tatapouri Channel

Two respondents noted support to not make any changes to the bylaw pertaining to Tatapouri Channel.

River Sewage

One respondent noted the presence of sewage in the rivers as an issue that needs addressing.

Toilets

One respondent noted the toilets located at the Harbour boat ramp have been damaged and are in need of significant repair to be able to better host tourists at the harbour.

Statement of Proposal: Proposed Ture ā-rohe Haumaru Whakatere o Te Tairāwhiti – Navigation Safety Bylaw 2024

Gisborne District Council (GDC) has reviewed its Navigation and Safety Bylaw 2012 and is seeking public feedback on a new bylaw to replace it – the proposed Ture ā-rohe Haumaru Whakatere o Te Tairāwhiti – Navigation Safety Bylaw 2024 (the proposed Bylaw).

The Navigation and Safety Bylaw 2012 was last reviewed 10 years ago, and a lot has changed in that time. To ensure Council continues to comply with maritime law and is aligned with best practice, we are proposing a number of changes to the current Navigation and Safety Bylaw 2012. The scope of the changes led to us choosing to revoke and replace the bylaw, rather than just amending the current bylaw.

This document is the Statement of Proposal for the purposes of Section 83(1)(a) of the Local Government Act 2002. This document contains:

- a summary of relevant information
- a description of the proposed changes
- information on how to have your say
- the relevant legislative requirements
- a draft of the proposed Bylaw.

Summary

Every day people use Gisborne's navigable waters for both recreation and business purposes. The waterways can be busy places with various activities going on in one area. To help ensure these activities can be carried out safely, rules are set under the Navigation Safety Bylaw to manage them.

The number of people and variety of uses of Gisborne's navigable waters can increase the risk of accidents, nuisance and damage. The Navigation Safety Bylaw puts rules in place to minimise those risks.

At the June 2022 meeting (Report 22-110), Council determined that the Navigation and Safety Bylaw 2012 should be amended, and that a bylaw is the most appropriate way of regulating navigational safety.

What Council proposes to change

We recently reviewed the Bylaw to check if the rules we have in place are working as they should be, and to identify improvements that can be made. While most of the rules within the Navigation and Safety Bylaw 2012 still exist in the proposed Navigation Safety Bylaw 2024, they have been redrafted or reordered to make the bylaw easy to read, and some material changes proposed, which are outlined below: -

1. **Revoke the Navigation and Safety Bylaw 2012 and replace it with a new Bylaw** to reflect the more comprehensive review undertaken.
2. **Extend bylaw coverage** to all navigable waters throughout the district.
3. **Extend the life jacket requirement** to require every person on board a recreational craft of six metres of less to wear a personal flotation device when a vessel is underway.
4. **Prohibit the discharge of cargo** into navigable waters.
5. **Require vessels to be identified** by either a name or number, visible on the vessel.
6. **Increase requirements for oil spill contingency plans**, including notification to the Council in advance.
7. **Require two operational means of communication** to be carried on most vessels with some exceptions such as for sporting events and surfing.
8. **Increase safety for swimmers in open water** by requiring swimmers 200 meters or more from shore to tow a safety float or wear a bright swim cap.
9. **Increase the available space to catch crayfish** by reducing the cray pot exclusion area within the harbour.
10. **Revoke historic exemptions on the Waiapu River** (the Water Recreation (Waiapu River) Notice 1979) which exempted the area from speed rules. The area is now subject to the district-wide speed rules within the bylaw.
11. **General changes** proposed to improve the readability of the Bylaw, to include and formalise existing Harbourmaster directions, ensure consistency with existing national regulation, consistency where appropriate neighbouring regional councils, and make the bylaw more straightforward to administer and enforce.

The options for these proposed changes to the current Bylaw are discussed in detail below and are reflected in the proposed Bylaw.

During our review of the Bylaw, we identified areas for improvement. We also asked the public and key stakeholders through a pre-consultation process in September and October 2022 if they had any changes they would like us to consider when drafting the proposed Bylaw. This feedback was incorporated into the review.

In most cases we have identified that the existing rules are effective for ongoing navigational safety. The major changes proposed to the Bylaw are summarised in the table below, along with the reasons for proposing them the options considered, and Council's preferred option.

Proposal (1)	**Revoke the Navigation and Safety Bylaw 2012 and replace it with a new Bylaw**
Reasoning	The current bylaw came due for review in 2022, when this review commenced, and will automatically revoke in December 2024. During the review, staff identified more comprehensive changes were required to the existing bylaw. To ensure compliance with the review requirements of the Local Government Act 2002, a new bylaw is proposed as opposed to a reviewed 2012 Bylaw.
Options Considered	**Option One** – Status quo: do not change the current 2012 bylaw and complete the review without the changes in the proposed Bylaw. This option will mean the current rules will continue to be in place. Some of the changes proposed can be managed operationally through Harbourmaster directions and within the national Maritime Rules, but these are not as visible or transparent as a bylaw, and many of the changes suggested in the proposed Bylaw will not be able to be enforced. This option does not reflect what the community and key

	stakeholders told us through pre-consultation. **Option Two** - *Preferred*. Revoke and replace the current Bylaw (2012). This option enables Council to receive feedback from the public and stakeholders on the proposed changes described within this statement of proposal, which reflect best practice, provide consistency with the Maritime Transport Act 1994 (the Act) and the Maritime Rules, and provides more consistency with our neighbouring councils.
Preferred Option	**Option Two** – Revoke and replace the current 2012 Bylaw with a new proposed Bylaw attached to this statement of proposal.

Proposal (2)	**Increase the area the bylaw covers to the entire Gisborne District**
Reasoning	To ensure all rules are consistent across all of the district's navigable waters.
Options Considered	**Option One** – Retain the status quo, only covering Tūrangarui-a-Kiwa/Poverty Bay and Tolaga Bay. In this option, rules will remain inconsistent across the district's navigable waters. If vessels are being operated in an undesirable manner outside of these areas the Harbourmaster may not be able to intervene. **Option Two** – *Preferred*. Widen the coverage of the bylaw to include the navigable waters in the whole district. This means any waters in the Gisborne District whether coastal or inland which are able to be navigated out to the 12 nautical mile limit and includes harbours. This option means there would be consistent rules across the district, and Council can act immediately if there is a navigation safety risk outside Tūrangarui-a-Kiwa/Poverty Bay or Tolaga Bay. It is common practice for Navigation Safety Bylaws to cover the whole region/district, therefore bringing Gisborne in line with other councils. There may be more work initially for the Harbourmaster to educate the public about the rules and how they apply, however, this may happen as a result of reviewing the bylaw even without changing the area the bylaw covers.
Preferred Option	**Option Two** – Widen the coverage of the bylaw to include the navigable waters in the whole district, as reflected in the proposed Bylaw.

Proposal (3)	**Require life jackets to be worn by people on vessels 6m or less while the vessel is underway.**
Reasoning	To reduce safety risks by requiring life jackets to be worn, not just be on board. This is consistent with our neighbour Hawkes Bay, and with the approach taken by the NZ Safer Boating Forum. It also brings us in line with most of the country.
Options Considered	**Option One** –Status quo. In 2012 Bylaw life jackets must be available on board and worn in adverse conditions. This is the minimum requirement as per the Act. Skippers must carry a correctly sized lifejacket for each person on board and ensure that lifejackets are worn in circumstances where tides, river flows, visibility, rough seas, adverse weather, emergencies or other situations cause danger or a risk to the safety of person on board. **Option Two** – Life jackets required to be worn when the vessel is making way. This captures the minimum requirement as per the Act, with the additional requirement that life jackets must also be worn when the vessel is being propelled by an engine, oars, sails or other instrument. **Option Three** – *Preferred*. Life jackets required to be worn when the vessel is underway. This captures the minimum requirement as per the Act, with the additional requirement that life jackets must also be worn when the vessel is not at anchor, moored, made fast to a structure or the shore, or aground. This proposed requirement doesn't apply in certain situations like sporting events, training, ceremonial events, where a support vessel can provide adequate assistance. **Option Four** –Life jackets to be worn at all times. This captures the minimum requirement as per the Act, with the addition that life jackets must be worn at all times.
Preferred Option	**Option Three** – Life jackets required to be worn when the vessel is underway, as reflected in the proposed Bylaw.

Proposal (4)	**Prohibit discharging cargo into navigable waters from a vessel, wharf or land.**
Reasoning	To prevent dangers associated with dropping cargo into navigable waters and include associated infringement fee
Options Considered	**Option One** –Retain the status quo – no clause to prevent discharge of cargo. Costs for removing discharged cargo will be borne by Council. Discharged cargo could present a danger to vessels in navigable waters. Potential reputation damage to Council if they are unable to limit vessels from discharging cargo and/or recover the costs of clean-up. There would be no administrative costs of issuing infringement notices. **Option Two** - *Preferred*. Prohibit the discharge of cargo into navigable waters. There may be administrative costs to identifying the vessel which discharged

	cargo and issuing the infringement notice. The likelihood of discharges is reduced. Clean-up costs are covered.
Preferred Option	**Option Two** – Prohibit the discharge of cargo to enable Council to recover costs and provide a deterrent to discharging cargo into navigable waters through including an infringement fee, as reflected in the proposed Bylaw.

Proposal (5)	**Requiring a boat name or number on vessels over 4m long**
Reasoning	Add a requirement that all motorised boats over 4m long display a name or number on the side of the vessel for easy identification.
Options Considered	**Option One** – Status quo: there is no provision to require naming or numbering of vessels in the current bylaw, however most vessels already have a name or some form of identification as it is a common requirement in navigation safety bylaws in other regions. **Option Two** – *Preferred*. Add a requirement to require naming or numbering of vessels over 4m long. This provision would be in line with other councils around the country including Hawke's Bay and Bay of Plenty. This enables quick identification of a vessel in distress, a vessel found with no one on it, or if the Harbourmaster needs to communicate with the owner of a boat. As most boats already have an identifying name, this requirement is not likely to place an onerous burden on boat owners, and Council can take an educational approach to achieving compliance.
Preferred Option	**Option Two** – Add a requirement to require naming or numbering of vessels over 4m long, as reflected in the proposed Bylaw.

Proposal (6)	**Include safety requirements for oil transfer activities**
Reasoning	To ensure any oil transfer activities are properly notified and have contingency plans in place.
Options Considered	**Option One** – Status quo. There is no provision for oil spill contingency plans and no requirement for notification to Council when undertaking oil transfers. Potential for environmental damage if oil spills occur and there is no contingency plan in place. There is no ability for Council to enforce an infringement fee for such events, and costs fall to Council for clean-up. However, in this option there will be no administration resource associated with receiving notifications of oil transfers.

	Option Two - *Preferred*. Require oil spill contingency plans and notification to Council when undertaking oil transfers. This option means Council Staff are aware of large oil transfers and can be ready to respond in the event of a spill, and the likelihood of environment damage from oil spills is reduced. Infringement fees can be enforced on those who breach this clause, which can be used to cover the cost of clean-ups. There is likely to be some administration duties associated with receiving notifications of oil transfers.
Preferred Option	**Option Two** – Require oil spill contingency plans and notification to Council when undertaking oil transfers, as reflected in the proposed Bylaw.

Proposal (7)	**Require at least two operational means of communication to be carried on vessels**
Reasoning	To increase safety measures onboard vessels. This will not apply to some situations such as sporting events where there is an adequate support vessel present with means of communication.
Options Considered	**Option One** –Status quo – only one means of communication is required under the Maritime Rules. The 2012 Bylaw is silent on this matter, however, the Harbourmaster has been encouraging people in charge of vessels to consider having two means of communication on board, as a safer option than the minimum. **Option Two** -*Preferred.* Increase the requirement to having two means of communication on board a vessel, as opposed to one. This option will increase safety on the water and is consistent with the current advocacy of the Harbourmaster and with other councils. This is a relatively easy requirement to comply with, as a communication device can be a VHF radio or a cellphone, and also includes affordable options such as flares and whistles.
Preferred Option	**Option Two** – Require at least two operational means of communication to be carried on vessels, as reflected in the proposed Bylaw.

Proposal (8)	**Require swimmers 200 meters or more from shore to tow a safety float or wear a brightly coloured swim cap.**
Reasoning	To increase the ability to identify swimmers in open water, outside demarked swimming areas and to make it easier to help in case of distress.
Options Considered	**Option One** – Status quo. The 2012 Bylaw is silent on this matter. Currently while vessels must stay 50 meters away from swimmers as per the Maritime Rules, and windsurfers do not have this requirement. **Option Two** – *Preferred.* Requiring swimmers who are swimming 200 meters or more from the shore to either tow a safety float or wear a brightly coloured swim cap will increase their visibility in the open water which will in turn make it easier for people in control of vessels to see and avoid them. While no incidents have occurred in Tairāwhiti, there have been incidents (near misses/ injury/ death) between open water swimmers and other water users within New Zealand. This safety measure will proactively increase the safety of swimmers who choose to swim more than 200 meters off-shore.
Preferred Option	**Option Two** – Require swimmers who are swimming 200 meters or more from the shore to either tow a safety float or wear a brightly coloured swim cap, as reflected in the proposed Bylaw.

Proposal (9)	**Reduce the cray pot exclusion area within the harbour**
Reasoning	To maximise space available for cray pot fishing while maintaining the shipping lanes as an exclusion area.
Options Considered	**Option One** – Status quo – the 2012 Bylaw has a larger exclusion area which covers an area previously utlised by the Port. This area is no longer used by the Port. **Option Two** – *Preferred.* Reduce the cray pot exclusion area within the harbour. This option means there will be more areas available for people to catch cray fish, and reflects the change in port operational requirements, as the Port no longer needs to use the area proposed to be removed from the exclusion. The new area means the cray pots are away from the shipping lanes, but other areas are maximised. In developing this proposal, the Harbourmaster spoke with the Port and other key stakeholders.
Preferred Option	**Option Two** – Reduce the cray pot exclusion area within the harbour, as reflected in the maps within the proposed Bylaw.

Proposal (10)	Revoke the Waiapu River speed limit uplift
Reasoning	The speed uplifting was made in the 1970's and this bylaw review poses an opportunity to consult with the community about removing this uplifting, which would mean the standard speed limit of 5 knots would apply to the river.
Options Considered	**Option One** – Status quo. The historical speed uplifting remains in place, and there is no speed limit on the Waiapu River. **Option Two** – *Preferred.* Include a provision in the Bylaw to revoke the Waiapu River speed uplifting and apply the default 5 knot rule (200m away from any shoreline). This, coupled with the proposed extension of scope of the Bylaw to include all navigable waters in the district, will mean Council is better equipped to manage safety on the Waiapu River. This safety measure is appropriate as the river runs through residential areas and swimmers and other users utilise the river for recreation.
Preferred Option	**Option Two** – revoke the Waiapu River speed uplifting, as reflected in the proposed Bylaw.

Proposal (11)	Changes proposed to increase readability of the Bylaw, include and formalise existing Harbourmaster directions, ensure consistency with existing national regulation, consistency where appropriate neighbouring regional councils, and make the bylaw more straightforward to administer and enforce
Reasoning	The key changes from the current approach as included in the 2012 Bylaw which fall within this proposal are as follows: **11.1** **Add a provision stating the purpose of the Bylaw**, to help readers understand the Bylaw, and to be consistent with Council's new bylaw format. **11.2** **Update and clarify powers and responsibilities of Harbourmaster,** to reflect the powers and responsibilities given to the Harbourmaster by the Maritime Rules. This clarifies the scope of the Harbourmaster and ensures consistency with the Maritime Rules. **11.3** **Add further general duties of people in charge of vessels**, to follow best practice of noting that other legislation is relevant, and to align the responsibilities of the person in charge with current maritime law. **11.4** **Add provision enabling flagged areas on beaches, and restricting activities within these areas**. This will standardise using flagged areas of beaches for swimming, making these areas easily recognisable. Formalises the flagged swimming areas and makes it easier for council to restrict activities in or near the swimming areas. **11.5** **Change speed of vessels rule for surf lifesaving vessels**, to enable more efficient operation of surf lifesaving activities by removing the

requirement for surf lifesaving club vessels to comply with speed restrictions when they are operating in accordance with all other appropriate operating procedures. This formalises the status quo as speed limits as they relate to surf lifesaving activities are not enforced. This also reflects a consistent approach with other councils.

11.6 **Regulate how long a vessel may stay in certain locations and requiring permission for longer moorings or anchorage**, to provide regulation around timeframes for anchoring and mooring at public wharves. Currently there are no time limits, and this provision enables the Harbourmaster to move vessels along if required.

11.7 **Change designated large vessel anchoring positions to set points,** to spread out anchoring positions and allow more available points. Set points were already in place via a Harbourmaster direction, and inclusion in the bylaw formalises this. Limiting the number of places where vessels can anchor manages congestion, increases safety on the water, and limits the environmental impact of the anchoring activity on the sea bed.

11.8 **Add permitted anchorage positions for cruise ships**, to future proof harbour use by providing two further anchorage positions for cruise ships. Previously these points were managed in a more ad-hoc way, and inclusion in the bylaw will formalise the approach. This gives cruise ship operators assurance and keeps other uses safe as the location of cruise ships will be known. Limiting the number of places where vessels can anchor manages congestion, increases safety on the water, and limits the environmental impact of the anchoring activity on the sea bed.

11.9 **Regulate the use of flashing lights and sound,** to increase maritime safety by clarifying when these lights and sounds can and cannot be used in navigable waters. This proposed addition ensures consistency with other regions and gives the Harbourmaster the ability to regulate the misuse of lights and sounds, so bona fide emergencies are not compromised.

11.10 **Amend clause on moorings**. To future proof the Bylaw by providing for any future moorings offered in Gisborne. While there is no current moorings/mooring areas, this makes it easier for any to be established in future by defining the process required to apply, and links moorings to the resource consenting process. This is consistent with the approach taken by other councils.

11.11 **Amend provision on use of buoys**, to clarify requirements of safe use and placement of marker buoys. This makes the rule explicit and requiring contact details to be on these buoys brings this bylaw consistent with other councils. This is likely to capture buoys attached to cray pots and fishing nets.

11.12 **Add clause on distance from vessel showing Flag B**, to require certain distance from vessels showing Flag B or a red all-round light, to reduce chances of maritime incidents. This is consistent with the Maritime Rules. Vessels are required to show Flag B if they are taking in, discharging or carrying dangerous goods.

11.13 **Require a hot works permit before works begin** to notify the Harbourmaster of the hot works (for example, welding) so any safety risks

	can be managed. The changes provide more clarity as to the requirements for people planning on undertaking hot works and makes the process easier to administrate and manage for the Harbourmaster. **11.14 Require planning and monitoring information when loading and unloading logs**, to ensure any person loading or unloading logs has plans in place if logs are lost, and to assist in their recovery. This formalises the status quo and ensures the rules and expectations of information are clear. **11.15 Add a prohibited anchorage area shoreward of Ariel Bank** to manage congestion in this area and restrict anchoring. This area is a poor holding ground, which means anchors drag easily. This is a safety issue because vessels are not properly at anchor. There is also an environmental impact of dragging anchors on the sea floor. This change formalises a Harbourmaster direction and brings it into the bylaw. **11.16 Clarify exemptions under the bylaw by providing that an exemption to any provision in the bylaw may be considered by the Harbourmaster and a licence to be exempt may be granted under the Local Government Act 2002**. This exemption does not allow for the Harbourmaster to act outside their scope as defined within Maritime Rules and legislation. **11.17 Update definitions and descriptions of terms to ensure consistency with the Maritime Rules and legislation, and ensure defined terms add to the readability of the bylaw**. For example, the definition of Beacon has been changed for consistency with the Maritime Rules, and a definition of Nuisance has been added to give some clarity of the meaning of that term to make it easier to understand and enforce. **11.18 Update and clarify offences and penalties provisions** to ensure alignment with legislation and clear enforceability. **11.19 Update the maps** to enable easier use and understanding, as well as adding additional information to maps where required by changes in the bylaw. **11.20 Update format and layout of bylaw clauses** to be consistent with Council's other bylaws, and to align with current best practice drafting standards. This will make the bylaw easier to read and understand.
Options Considered	**Option One** – Do not make these changes (status quo) or make some (not all) of these changes. This may require a redrafting of the proposed Bylaw as many of these changes are fundamental to the structure of the proposed Bylaw, or a reversion to the approach taken to the 2012 Bylaw. This option does not enable Council to fully benefit from the stakeholder engagement which has informed this review, including with Maritime New Zealand and other councils. **Option Two** – Make these changes to increase readability, ensure consistency with national regulation and neighboring regional councils, and make the bylaw more straightforward to administer and enforce. This means that the community can respond to the proposal through the consultation period, and this feedback is likely to further increase the readability of the Bylaw.

Preferred Option	**Option Two** – Seek public feedback on the changes described above as included in the proposed Bylaw.

Council proposes to replace the current Navigation Safety Bylaw 2012 **with the new Navigation Safety Bylaw 2024, which will be operative by November 2024.**

We want to know what you think!

Before making any final decisions, we'd like to have your input. We are keen to hear your views on the proposed Bylaw as well as any other changes to the bylaw you may support which can increase safety on the water.

The submission period will be open from XX March until XX April 2024. A summary of the proposed changes, the proposed Bylaw, and information about how to make a submission will be made available on the GDC website: https://www.gdc.govt.nz/council/have-your-say.
You can send us your submission:

- Online: www.gdc.govt.nz
- By Post: P.O Box 747, Gisborne 4040
- In person: At Gisborne District Council – 15 Fitzherbert Street, Gisborne

If you would like to speak to your submission, please indicate this on your submission and provide your contact details so we can get in touch to arrange a hearing time with our elected members.

You can also discuss your feedback with the Harbourmaster before sending us your submission. Email harbourmaster@gdc.govt.nz to set up a conversation,

Timeline

The consultation period begins: XX March 2024

Closing date for submissions: 4pm XX April 2024

Public hearing (if required): XX 2024

Deliberation and decision of Council: XX 2024

Legislative Framework

Determinations under Section 155 of the Local Government Act 2002 (LGA):

Section 155 of the LGA provides that Council must consider certain criteria when making the Navigation Safety Bylaw. This includes whether the proposed Bylaw is:

- the most appropriate way of addressing a perceived problem;
- the most appropriate form of Bylaw, and
- not inconsistent with the New Zealand Bill of Rights Act 1990.

Council is required to complete an analysis against the above criteria when making or amending a bylaw.

This analysis was initially undertaken in June 2022 when Council determined that a bylaw remains the most appropriate way of regulating navigational safety This determinations report was presented to the Sustainable Tairāwhiti Committee on 2 June 2022 and in accordance with the requirements in Section 155 of the LGA, the Committee approved the review of the Navigation Safety Bylaw 2012 (Report 22-110).

Does this proposed Bylaw meet the requirements under the Bill of Rights Act 1990?

Council is revisiting Section 155 criteria of the LGA before they adopt this proposed Bylaw for public consultation. This analysis will confirm the proposed Bylaw to be consistent with the New Zealand Bill of Rights Act 1990, as the proposed Bylaw is reasonable, and not overly restrictive or impractical. The areas of regulation are limited to the areas that require protection and provide a locally tailored approach to enforcing national maritime rules.

Consistency with the Maritime Transport Act 1994

Section 33M of the Maritime Transport Act 1994 (MTA) gives Council the power to make navigation bylaws, in consultation with the Director of Maritime New Zealand. Such bylaws may be made for the purpose of ensuring maritime safety in the region. They must comply with certain requirements in the MTA, such as ensuring the bylaw does not unnecessarily affect commercial port operations. Any navigation bylaw must be consistent with the MTA and any regulations or rules made under the MTA, and with the Natural and Built Environment Act 2023.

Special consultative procedure under Section 83 of the LGA:

Section 83 of the LGA 2002 outlines that when using the special consultative procedure, a local authority must-

a) Prepare and adopt-
   I. A statement of proposal; and
   II. If the local authority considers on reasonable grounds that it is necessary to enable public understanding of the proposal, a summary of the information contained in the statement of proposal; and
b) Ensure that the following is publicly available:
   I. The statement of proposal; and
   II. A description of how the local authority will provide persons interested in the proposal with an opportunity to present their views to the local authority in accordance with section 82(1)(d); and
   III. A statement of the period within which views on the proposal may be provided to the local authority (the period being not less than 1 month from the date the statement is issued); and
c) Make the summary of information contained in the statement of proposal prepared in accordance with paragraph (a)(ii) (or the statement of proposal, if a summary is not prepared) as widely available as is reasonably practicable as a basis for consultation; and
d) Provide an opportunity for persons to present their views to the local authority in a manner that enables spoken (or New Zealand sign language) interaction between the person and the local authority, or any representatives to whom an appropriate delegation has been made in accordance with Schedule 7; and
e) Ensure that any person who wishes to present his or her views to the local authority or its representatives as described in paragraph (d) –
   I. Is given a reasonable opportunity to do so; and
   II. Is informed about how and when he or she may take up that opportunity.

f) For the purpose of, but without limiting, subsection (1)(d), a local authority may allow any person to present his or her views to the local authority by way of audio link or audiovisual link.
g) This section does not prevent a local authority from requesting or considering, before making a decision, comment or advice from an officer of the local authority or any other person in respect of the proposal or any views on the proposal, or both.

Attachment

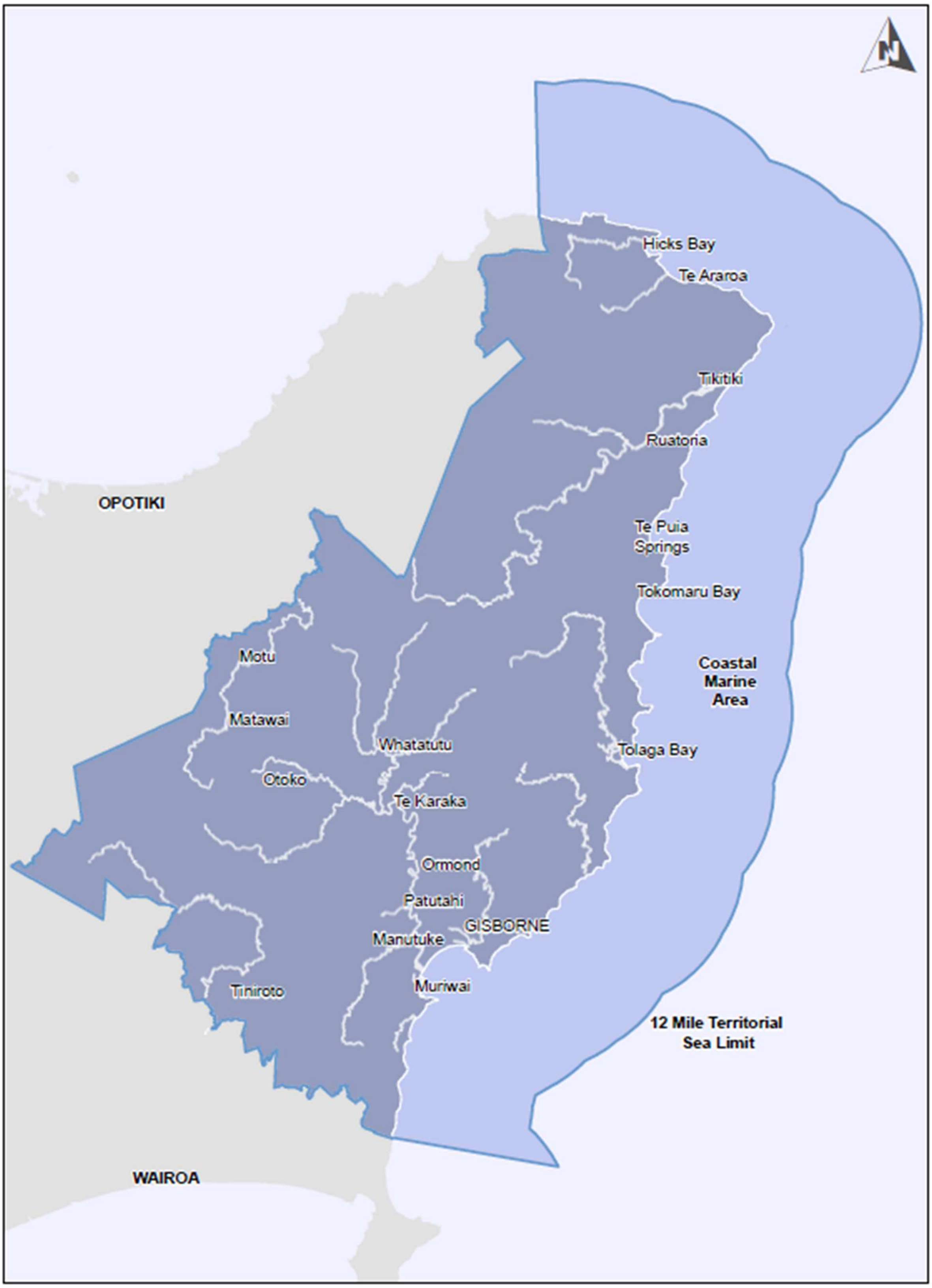
Proposed Navigation Safety Bylaw 2024

Ture ā-rohe Haumaru Whakatere o Te Tairāwhiti 2024

(Tairāwhiti Navigation Safety Bylaw 2024)

Made by Gisborne District Council

Resolution of Council dated __ of ________ 2024



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Contents

1. Title

This bylaw is the Tairāwhiti Navigation Safety Bylaw 2024.

2. Commencement

This bylaw comes into force on [day/month 2024].

3. Application

This bylaw applies to all navigable waters within the Gisborne District. The Harbourmaster has the power to enforce this bylaw.

> **Related information:**
>
> Other legislation and regulatory tools apply to the regulation of maritime activities, including the Maritime Transport Act 1994 and the regulations and rules under that Act. These should be referred to in conjunction with this bylaw.
>
> The Harbourmaster has the power to enforce this bylaw over all internal Tairāwhiti waters and coastal waters out to the 12 nautical mile limit. This area is indicated by the map on page 2 of this bylaw.
>
> The Harbourmaster may grant a license to an applicant which releases them from the requirements of certain provisions in this bylaw. To apply for this license, email harbourmaster@gdc.co.nz

4. Interpretation

(1) In this bylaw, unless the context otherwise requires —

Access lane means those areas defined by words and maps in Parts 1 and 2 of Schedule 1 of this bylaw.

Act means the Maritime Transport Act 1994 and the regulations and rules under that Act.

Anchorage in relation to vessels, means a place (enclosed or otherwise) used for the anchoring of vessels to the bed of waters, whether the place is reserved for such purposes by the Council or not.

Anchor / anchoring / anchored means the securing of a vessel to the bed of waters by means of an anchor, cable or other device that is normally removed with the vessel when it leaves the anchorage.

Beacon means a light or mark which is non-floating and fixed to the seafloor or the coast (such as a pole or a lighthouse) set up as a navigation mark or a warning to vessels.

Body board also known as a boogie board, means a short foam board usually ridden in a prone or kneeling position and not designed to be ridden standing up.

Buoy means an anchored float serving as a navigation or locational mark, or to indicate a mooring, reef or other hazard.

Commercial vessel means a vessel that is not –

(a) a pleasure craft; or
(b) solely powered manually; or
(c) solely powered by sail.

> **Related Information:**
>
> In Maritime Rule 91, **pleasure craft** means a vessel that is used exclusively for the owner's pleasure or as the owner's residence, and is not offered or used for hire or reward; but does not include —
>
> (a) a vessel that is provided for the transport or sport or recreation by or on behalf of any institution, hotel, motel, place of entertainment, or other establishment or business
>
> (b) a vessel that is used on any voyage for pleasure if it is normally used or intended to be normally used as fishing vessel or for the carriage of passengers or cargo for hire or reward
>
> (c) a vessel that is operated or provided by any club, incorporated society, trust, or business.
>
> In Maritime Rule 91, **reward** the payment to or for the benefit of the owner or master of a vessel, of a contribution towards the expenses of a voyage by or on behalf of persons; but does not include payment of any contributions by part owners of the vessel or by persons engaged as bona fide crew members.

Council means the Gisborne District Council and includes any person authorised by the Council to act on its behalf.

Director means the person who holds the position of Director of Maritime New Zealand under section 439 of the Maritime Transport Act 1994.

Dangerous Goods has the same meaning as defined in Part 24A of the Maritime Rules.

Diver's marker float means any float that can be deployed on or before surfacing by a SCUBA diver, and can include a safety sausage or surface marker buoy.

Enforcement Officer means a person appointed by the Council as an Enforcement Officer under section 33G of the Maritime Transport Act 1994.

Explosive has the same meaning as defined in section 2 of the Hazardous Substances and New Organisms Act 1996.

Flag A means flag A of the International Code of Signals (the diver's flag), being a burgee (swallow-tailed) flag, or rigid equivalent, coloured in white and blue with white to the mast, of not less than 600mm by 600mm.

Flag B means flag B of the International Code of Signals, being a burgee (swallow-tailed) flag, or a rigid equivalent, coloured in red, of not less than 600mm by 600mm.

Gisborne District means the area defined by the Local Government (Gisborne Region) Reorganisation Order 1989 as "The Gisborne District" and "The Gisborne Region."

Gisborne Harbour Limits means the area of Gisborne Harbour as defined and mapped in Part 1 of Schedule 2 of this bylaw.

Gisborne Pilotage Area means the area of Gisborne Harbour as defined and mapped in Part 5 of Schedule 2 of this bylaw.

Harbourmaster means a person appointed by the Council as Harbourmaster under section 33D of the Maritime Transport Act 1994 and includes any Deputy Harbourmaster.

Hot work operations includes activities such as welding, grinding, soldering, or other work involving flames or generating sparks.

Length overall in relation to a vessel, means the distance measured at the waterline from the foremost part of the bow to the aftmost part of the stern but not including fixtures such as external engines or bowsprits.

Lifejacket means a personal floatation device as defined by Maritime Rule 91.2.

Related Information:

In Maritime Rule 91.2, a personal floatation device includes:

(a) a device that meets NZ Standard 5823:2005; and

(b) a device that meets any other standard which the Director of Maritime New Zealand is satisfied substantially complies with NZ Standard 5823:2005.

Mooring means any weight or article placed in or on the sea bed or lake bed for the purpose of securing a vessel or floating structure; and

(a) includes any wire, chain, rope, buoy or other device attached or connected to the weight; but
(b) does not include an anchor that is removed with the vessel or floating structure when it leaves an anchorage.

Mooring area means an area defined by the Council as a mooring area in the Tairāwhiti Resource Management Plan.

Navigable Waters means any waters in the Gisborne District whether coastal or inland which are able to be navigated out to the 12 nautical mile limit, and includes harbours.

Related Information:

An indicative map showing the Gisborne District navigable waters is on page 2 of this bylaw.

Navigate means the act or process of managing or directing the course of a vessel on, through, over or under the water.

Nuisance has the same meaning as defined by section 29 of the Health Act 1956 and includes a person, animal, thing or circumstance causing unreasonable interference with the peace, comfort or convenience of another person whether or not that person is in a public place.

Owner includes:

(a) in relation to a vessel, the person or persons having the right to manage the vessel; and
(b) in relation to a vessel, the agent of the owner and also a charterer; and
(c) in relation to any dock, wharf quay or slipway, includes a lessee of the dock, wharf, quay or slipway.

Paddle craft means powered only by a vessel's occupant(s) using a single or double bladed paddle as a lever without the aid of a fulcrum provided by rowlocks, thole pins, crutches or like arrangements, but does not include a raft manoeuvred solely by paddles.

Person in charge of a vessel excludes Pilot, and means:

(a) the master, skipper, or kaihāutu; and
(b) in the absence of a person in (a), the owner of the vessel that is on board or the person steering the vessel; and
(c) in the absence of a person in (a) and (b), the owner of the vessel.

Personal Water Craft (PWC) means a vessel defined as a personal water craft by section 33B of the Act, and includes a jet ski.

Pilot in relation to any vessel, means any person not being the person in charge of a vessel or a member of the crew of the vessel who has the conduct of the vessel and who is duly licensed by Maritime New Zealand.

Power driven vessel means any vessel propelled by machinery.

Proper speed means speed through the water.

Recreational craft means a vessel that is —

(a) a pleasure craft; or
(b) solely powered manually; or
(c) solely powered by sail.

Reserved area means an area of water reserved for a specific purpose as defined by words and maps in Schedule 1 of this bylaw.

Restricted visibility means any condition in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms, or other similar causes.

Sailboard means any type of board that is propelled by a detachable sail apparatus and operated by a person standing on the board. This includes windsurfers, wing sailors, kite surfers, and any hydro foiling variations of these.

Seaplane means a flying vessel or any other aircraft designed to manoeuvre on the water.

Seaworthy means being in a fit condition or readiness to safely undertake a sea voyage as determined by the Harbourmaster.

Shore when referring to distance from shore, means distance from the water's edge.

Shore SCUBA diver means a diver using breathing apparatus that enters and exits the water from shore and not a vessel.

Structure means any building, equipment, device or other facility which is fixed to land; and includes slipways, jetties, pile moorings, swing moorings, rafts, wharves, marine farms and other objects whether or not these are above or below the waterline; but does not include buoys, beacons, anchored floats or navigational aids.

Sunrise/Sunset has the same meaning as defined in the New Zealand Nautical Almanac (NZ204).

Support Vessel means a vessel used for coaching, marshalling, or rescue roles for training, regattas and competitions, ceremonial or other authorised recreational activity.

Surfboard means any type of board that is designed to be used for surf riding and includes hydro foiling variations.

Tanker means any vessel with a compartment or compartments that are specially constructed or adapted for bulk carriage of oil products or noxious liquid substances and:

(a) has oil products or noxious liquid substances on board; or
(b) has an empty tank that is not certified as gas free.

Underway means that a vessel is not at anchor, or made fast to the shore, or aground.

Unseaworthy means, in the opinion of the Harbourmaster, either or both of the following:

(a) not being in a fit condition or readiness to safely navigate or remain on the water;
(b) not being in a fit condition or readiness to safely undertake a voyage within its design capabilities.

Vessel means every description of ship, boat or craft used in navigation, whether or not it has any means of propulsion; and includes:

(a) a barge, lighter, or other like ship:
(b) a hovercraft or other thing deriving full or partial support in the atmosphere from the reaction of air against the surface of the water over which it operates:
(c) a submarine or other submersible:
(d) a seaplane while it is on the surface of the water.

(2) Any undefined words, phrases or expressions used in this bylaw have the same meaning as in the Act or Maritime Rule unless the context plainly requires a different meaning.

(3) The Legislation Act 2019 applies to the interpretation of this bylaw.

(4) Related information is for information purposes only, does not form part of this bylaw, and may be inserted or changed by the Council at any time without amending the bylaw.

Related information:

This bylaw refers to Maritime Rules, made under the Maritime Transport Act 1994. These can be viewed on the Maritime New Zealand website: https://www.maritimenz.govt.nz/rules/.

5. Purpose

The purpose of this bylaw is to ensure maritime safety and minimise the risk of fatalities, injuries, nuisance, accidents, collisions and damage on Gisborne District's navigable waters.

Part 1: General Matters

6. General duties

(1) Compliance with this bylaw does not remove the duty to comply with the requirements of the Act, and applicable rules and regulations made under the Act.

(2) The person in charge of a vessel is responsible for the safety and wellbeing of every person on board and for the safe operation of the vessel.

(3) Where any clause in this bylaw imposes an obligation or duty on both the person in charge of a vessel and the owner that is not complied with, both the person in charge of the vessel and the owner will have committed an offence, jointly and severally. If any such clause is complied with by either the person in charge of the vessel or the owner, then, for the purposes of this bylaw, compliance by one is deemed to be compliance by the other.

(4) Where any clause in this bylaw imposes an obligation or duty on any vessel without reference to its owner or person in charge, it shall be the responsibility of the person in charge of the vessel to ensure the vessel complies with that duty or obligation.

7. Collisions and accidents

(1) No person shall operate any vessel in breach of Part 22 of the Maritime Rules (Collision Prevention), or any other relevant rule made under the Act.

(2) The owner or person in charge of a vessel that has been involved in any collision, accident or incident on navigable waters shall report the details of the occurrence to the Director and the Harbourmaster, that results in or could result in:

(a) damage to a vessel which affects the operational capability of the vessel; or

(b) any damage to a navigation aid or any structure; or

(c) a vessel, or property, being sunk or grounded or becoming stranded in any navigable waters in the Region; or

(d) by reason of accident, fire, defect or otherwise the vessel being in such a condition as to affect its safe navigation or to give rise to danger to any person, other vessels or property; or in any manner gives rise to an obstruction; or

(e) any person being injured.

(3) A notification under clause 7(2) must be provided to the Director as soon as practicable and must comply with any accident reporting requirements of the Act.

(4) A notification under clause 7(2) must be provided to the Harbourmaster:

(a) verbally as soon as possible; and

(b) in writing as soon as practicable or at least within 48 hours.

(5) A notification under clause 7(2) made to the Harbourmaster must include the following information:

(a) the names and addresses of persons in charge of the vessel; and

(b) a full description of any injury to persons; and

(c) a full description of any damage to vessels, navigation aids or structures; and

(d) the time and date of the occurrence; and

(e) an outline of events relating to the occurrence.

(6) If an incident described in clause 7(2) involves damage to a vessel that affects, or is likely to affect, its seaworthiness, the person in charge of the vessel may not move the vessel except:

(a) to allow the vessel to moor or anchor in safety, preventing sinking or other emergency circumstances such as seeking medical attention; or

(b) to prevent the vessel from creating a hazard to navigation; or

(c) in accordance with the directions of the Harbourmaster or an Enforcement Officer.

(7) The Harbourmaster may require further information from the person in charge of a vessel or owner of a vessel following a notification under clause 7(2) which must be provided within 48 hours (or such longer timeframe as the Harbourmaster may permit).

Related information:

Notifications to the Harbourmaster can be sent to harbourmaster@gdc.govt.nz.

To report an accident or incident to Maritime New Zealand, you can use their online form at https://www.maritimenz.govt.nz/forms/incident/.

8. Lifejackets

(1) The person in charge of a recreational craft may only use it or allow it to be used if it carries, lifejackets of an appropriate size for each person on board in a readily accessible location at the time of use.

(2) The person in charge of any recreational craft that is 6 metres or less in length overall must ensure that every person on board is wearing a properly secured lifejacket of an appropriate size for that person while the craft is underway.

(3) The person in charge of any recreational craft must ensure that every person on board is wearing a properly secured lifejacket of an appropriate size for that person, whenever there is any risk to the safety of the people on board, including circumstances such as tides, river flows, visibility, rough seas, adverse weather, emergencies or other situations which may cause danger or a risk to the safety of any person on board the craft.

(4) Clauses 8(1), (2) and (3) do not apply to:

(a) any surfboard or similar unpowered craft being used to ride travelling waves; and

(b) any sailboarder if a wetsuit is worn at all times; and

(c) a diver on a vessel of six metres or less in length overall that is used for recreational diving within five nautical miles of shore, if a full body dive suit is worn at all times; and

(d) a person training for or participating in a sporting event, if the training or the event is supervised in accordance with Maritime Rule 91.4(2)(d); and

(e) any surfboard or similar unpowered craft, not covered by clause 8(4)(a), provided:

(i) a leash is used as appropriate for the conditions, and

(ii) it is being used within 200 metres of the shore.

(5) In respect of any sporting event, training activity, ceremonial event or other organised recreational activity, clauses 8(1) and 8(2) shall not apply if a support vessel that is capable of providing adequate assistance in the event of an emergency remains in the immediate vicinity of the recreational craft and the support vessel carries lifejackets of an appropriate size for each person on board the support vessel and the recreational craft.

(6) In respect of any sporting event, training activity or other organised recreational activity, the organising body may, where it is not practical to meet the requirements of clause 8(5), apply for a written exemption to clauses 8(1) and 8(2) from the Harbourmaster, who may grant an exemption for a specified time period, provided that the Harbourmaster is satisfied that adequate safety precautions are made for rescuing any persons participating in the event or activity.

(7) The person in charge of a vessel must not allow the vessel to tow any person, unless the person being towed wears a properly secured lifejacket of an appropriate size for that person.

(8) The person allowing themselves to be towed by any vessel must wear a properly secured and appropriately sized lifejacket.

(9) Clauses 8(7) and 8(8) do not apply to a person:

(a) training for any trick water skiing element of a sporting event administered by a national sporting organisation approved under Maritime Rule 91.4(3); or

(b) participating in a sporting event that is administered by a national sporting organisation approved under Maritime Rule 91.4(3).

9. Means of communication

(1) Every person in charge of a vessel must carry on board their vessel at least two means of communication in good working condition that:

(a) provides the ability to communicate with land based and/or seaborne parties from any point within the area the vessel will be operated; and

(b) in the case of vessels under 6 metres in length overall, is able to be operated following submersion in sea water; and

(c) is adequate to provide communications for the duration of the voyage.

(2) Despite clause 9(1), a person in charge of an unpowered vessel being operated within the Gisborne Harbour Limits, or within 1000 metres of the coast, must ensure that at least one waterproof means of communication in good working condition is carried on board the vessel.

(3) Clauses 9(1) and 9(2) do not apply to:

(a) a person participating in a sporting event or training activity if there is a support vessel present that complies with clause 9(1); and

(b) any surfboard or similar unpowered craft being operated within the Gisborne Harbour Limits, or within 1000 metres of the coast.

Part 2: Activities and Specified Areas

10. Diving

(1) Every person diving from a vessel must ensure that Flag A is displayed in such a manner that it can be clearly identified by the watchkeeper of another vessel at a distance in excess of 200 metres.

(2) The person in charge of a vessel from which dive operations are in progress must ensure that Flag A is displayed in such a manner that it can be clearly identified by the watchkeeper of another vessel at a distance in excess of 200 metres.

(3) Any free-diver from shore intending to dive more than 200 metres from shore must either tow a bright-coloured safety float or use a raft displaying Flag A.

(4) Any shore SCUBA diver that intends to surface or is likely to surface more than 200 metres from shore must have a diver's marker float that marks their position when surfacing.

(5) Any person undergoing dive operations must submit a completed Dive Notification form to the Harbourmaster at least 2 hours prior to the intended start time of operations.

(6) Any person undergoing dive operations must comply with all conditions imposed by the Harbourmaster after receiving their Dive Notification Form.

Related information:

A **Dive Notification form** template can be found on the Council's website at https://www.gdc.govt.nz/environment/coast-and-harbour .

Completed forms can be sent to the Harbourmaster at harbourmaster@gdc.govt.nz .

11. Prohibited activities around wharves

(1) Any person in navigable waters must not dive, jump, or swim within 50 metres of:

(a) any structure in the commercial port area as defined in the Tairāwhiti Resource Management Plan; or

(b) any wharf, boat ramp or designated boat launching area while a vessel is within 50 metres of the area.

(2) Clause 11(1) does not apply to any person operating in accordance with a Dive Notification form submitted to and approved by the Harbourmaster.

(3) Notwithstanding clause 11 (2), no person may undergo dive operations in the areas identified in clause 11 (1) if, upon receiving their Dive Notification form, the Harbourmaster directs them not to (either temporarily until a certain time or at all).

12. Swimming more than 200 metres from shore

Any person swimming in navigable waters more than 200 metres from shore must tow a bright-coloured safety float or swim buoy or must wear a brightly coloured swim cap, unless accompanied by a support vessel.

13. Water skiing and towing any person

(1) The person in charge of a vessel that is towing another person or object must:

(a) have at least one additional person on board who is 10 years of age or older who is responsible for immediately notifying the person in charge of every mishap that occurs to the person and/or object being towed; and

(b) not tow any person or object between sunset and sunrise or in restricted visibility.

(2) Any person allowing themselves to be towed by a vessel must ensure the provisions of clause 13(1) are met.

14. Access lanes

(1) Access lanes are defined in Parts 1 and 2 of Schedule 1 of this Bylaw.

(2) The person in charge of a vessel must manoeuvre it by the most direct route through the access lane and on the side of the access lane that lies to the starboard or right-hand side of the vessel.

(3) Any person allowing themself to be towed through an access lane must ensure they, and any other object being towed alongside them, travel by the most direct route and on the side of the access lane that lies to the starboard or right-hand side of the vessel.

(4) The person in charge of a vessel operating within an access lane must ensure that they do not obstruct or cause any damage to any other vessel or to any other person in the access lane.

(5) If any person is using an access lane for the purpose for which it is declared, no other person may enter, remain in, use or obstruct the lane for any other purpose.

Related information:

Access lanes are clearly marked on shore with signage communicating the purpose of the access lane, as well as by pairs of posts in transit. The posts will be orange with black horizontal bands. The access lane may also be marked in the water by orange buoys with vertical black stripes.

15. Reserved areas

(1) Reserved areas are defined in Schedule 1 of this Bylaw.

(2) If any person is using a reserved area for the purpose for which it is reserved, no other person may enter, remain in or use the area for any other purpose.

(3) No person may obstruct another person while the other person is using a reserved area for the purpose for which it is reserved.

Related information:

Any permanent reserved areas will be clearly marked on shore with signage communicating the purpose of the reserved areas. Any permanent reserved area will also be marked either:

(a) on shore, by pairs of white posts in transit, with black horizontal bands; or

(b) at sea, by black buoys with white vertical stripes.

16. Flagged areas on beaches

(1) Surf Life Saving New Zealand or a person authorised by Surf Life Saving New Zealand, may, from time to time, subject to clause 17, set aside areas of beaches as flagged areas for the purposes of swimming and body boarding only.

(2) Flagged swimming areas set aside under clause 16(1) shall consist of two red/yellow flags forming the area boundary. These flags shall meet NZ Standard NZS8690:2003 – 5.1 Design of flags and 5.2 Use of flags.

(3) Any person within navigable waters and 200 metres of the shore of a flagged area of a beach must only carry out activities for which the area has been flagged, with the exception of Surf Lifesaving or other rescue services operating a vessel in this area in case of an emergency.

17. Temporary event authorisation

(1) Any person intending to conduct a race, speed trial, competition, hire operation, or other organised water activity in any area to which this bylaw applies must apply to the Harbourmaster to:

(a) temporarily suspend the relevant speed clause(s) and any other relevant clause of this bylaw in that area during the conduct of the activity; and/or

(b) temporarily reserve the area for the purpose of that activity; and/or

(c) temporarily suspend the designation of permanent access lanes or reserved areas; and/or

(d) temporarily install course markers of similar such structures in the water.

(2) Where the Harbourmaster is satisfied, on considering an application under this bylaw, that the application may be granted without endangering the public, the Harbourmaster may grant the application accordingly, for a period not exceeding 10 days, and on such conditions (if any) as they may specify.

(3) No grant of an application under this bylaw shall have effect unless, not less than seven days or more than 14 days before the commencement of the activity, the applicant publicly notifies the purpose, period and location of the activity and details of any suspension or reserved area.

Related information:

Temporary event authorisation application forms can be found on the Council's website at https://www.gdc.govt.nz/environment/coast-and-harbour.

Completed forms can be sent to the Harbourmaster at harbourmaster@gdc.govt.nz.

Commercial operations within any area to which this bylaw applies may also be subject to a licencing regime under the Maritime Rules (including but not limited to a Maritime Transport Operator Certificate), or other regulatory instruments such as the Amusement Devices Regulations 1978, or the Health and Safety at Work (Adventure Activities) Regulations 2016.

Part 3: Operating Requirements

18. Minimum age for operating power driven vessels

(1) No person may allow a person under the age of 15 years to be in charge of, or propel or navigate, a power-driven vessel that is capable of a proper speed exceeding 10 knots unless under the direct supervision of a person over the age of 15 years who is in immediate reach of the controls.

(2) The owner of a power driven vessel that is capable of a proper speed exceeding 10 knots must not allow any person who is under the age of 15 years to be in charge of, or propel or navigate that vessel in contravention of clause 19(1).

(3) The Harbourmaster, for the purposes of training, competitions or other sporting events:

(a) may give exemptions to clauses 18(1) and 18(2); and

(b) when considering whether or not to grant such an exemption, must have regard to the competence of the person, the level of supervision, and awareness of other relevant navigation safety matters.

(4) Clauses 18(1) and 18(2) do not apply to any person who has a written exemption from:

(a) the Harbourmaster under clause 18(3); or

(b) the Director under the Act.

19. Speed of vessels

(1) A person in charge of a vessel (including a vessel towing a person or object) must not propel or navigate the vessel at a proper speed exceeding 5 knots:

(a) within 50 metres of any other vessel or person in the water; or

(b) either within 200 metres of the shore or of any structure, which includes on the inshore side of any buoy(s) demarcating 200 metres from the shore or structure; or

(c) within 200 metres of any vessel or floating structure that is flying Flag A; or

(d) when knowingly or deliberately approaching within 200 metres of a marine mammal.

(2) A person in charge of a power driven vessel must not propel or navigate the vessel at a proper speed exceeding 5 knots while any person has any portion of their body extending over the fore part, bow or side of that vessel.

(3) No person may cause or allow themself to be towed by a vessel or any other means (whether or not on a water ski, aquaplane or other towed object) at a proper speed exceeding 5 knots in any circumstances specified in clauses 19(1)(a), (b), or (c).

(4) A person in charge of a vessel must not permit the vessel to continue onwards, after any person being towed by that vessel has dropped (whether accidentally or otherwise) any water ski which may cause danger to any other person or vessel, without taking appropriate action to recover that water ski or take measures to ensure that the water ski is visible to other water users.

(5) A person in charge of a vessel must not navigate that vessel in a manner that causes a nuisance to others.

(6) Clause 19(1)(a) does not apply to:

(a) a vessel over 500 gross tonnage, if the vessel cannot be safely navigated in compliance with clause19(1)(a); or

(b) a vessel powered by sail in relation to any other vessel powered by sail, while the vessels are participating in a yacht race or training administered by:

(i) a club affiliated to Yachting New Zealand; or

(ii) a non-profit organisation involved in sail training or racing; or

(c) a craft training for or participating in competitive rowing or paddling; or

(d) a tug, pilot vessel, harbourmaster vessel, emergency response craft or police vessel, if the vessel's duties cannot be performed in compliance with Clause 19(1)(a).

(7) Clause 19(1)(b) does not apply to:

(a) a vessel operating in an access lane or a reserved area for the purpose for which the access lane or reserved area was declared; or

(b) a vessel over 500 gross tonnage, if the vessel cannot be safely navigated in compliance with clause 19(1)(b); or

(c) a vessel powered by sail in relation to any other vessel powered by sail, while the vessels are participating in a yacht race or training administered by:

(i) a club affiliated to Yachting New Zealand; or

(ii) a non-profit organisation involved in sail training or racing; or

(d) a sailboard; or

(e) a vessel training for or participating in competitive rowing or paddling; or

(f) a tug, pilot vessel, harbourmaster vessel, emergency response craft or police vessel when the vessel's duties cannot be performed in compliance with clause 19(1)b).

(8) Clauses 19(1)(b) and 19(2) shall not apply to a vessel operated by a Surf Lifesaving Club affiliated to Surf Lifesaving New Zealand, that is being operated in accordance with the appropriate operating procedures that have been approved by the Harbourmaster.

20. Wake

Subject to clause 19, every person who propels or navigates a recreational craft must ensure that its wake or the wake from any person or object being towed:

(a) does not prevent other people from safely using the waterway;

(b) does not cause unnecessary danger or risk of damage to other vessels or structures, navigational aids; and

(c) does not cause risk of harm to other persons or property.

21. Use of vessel engine around structures

(1) No person in charge of a vessel may operate the propulsion system of the vessel while at any wharf, boat ramp, or designated boat launching area, in such a way that it may damage any structure or property, scour the bed of the waters, or injure any person.

(2) Clause 21(1) does not preclude the use of the propulsion system for the safe berthing or unberthing of any vessel at a wharf.

22. Vessels to be serviceable or removed

(1) The person in charge of a vessel anchored or moored in navigable waters must keep the vessel in a seaworthy condition at all times. If the Harbourmaster notifies a person in charge of a vessel that their vessel is in an unseaworthy condition, they may not anchor or moor the vessel without written approval from the Harbourmaster

(2) The written approval from the Harbourmaster may be subject to such conditions as the Harbourmaster may determine appropriate to ensure navigation safety.

(3) If the Harbourmaster has notified a person that any vessel is unseaworthy and the Harbourmaster has determined that it may become a navigation hazard, then:

(a) the Harbourmaster may give a written direction to the person in charge of a vessel to move the vessel to an alternative location or to remove it from the waters within a reasonable time as specified in the direction; and

(b) the owner and person in charge of a vessel are jointly and severally responsible for ensuring the direction is complied with.

(4) If any person fails to move the vessel in accordance with a direction given under clause 21(2), the Harbourmaster may move that vessel to a position where it is no longer a hazard to navigation, or remove it from the water. The costs incurred may be recovered from the owner or person in charge of the vessel in any court of competent jurisdiction as a debt due to the Council.

(5) If the Harbourmaster has notified a person in charge of a vessel that their vessel is in an unseaworthy condition, they may not operate the vessel within navigable waters except to comply with the directions of the Harbourmaster or an Enforcement Officer to move the vessel to an alternative location or:

(a) to allow the vessel to moor or anchor in safety, preventing sinking or other emergency circumstances such as seeking medical attention; or

(b) to prevent the vessel from creating a hazard to navigation.

Related information:

The Harbourmaster has the power to sell and dispose of a vessel and recover any costs if the owner fails to comply with this bylaw and pay any costs associated with the seizure, impoundment, transport and storage under Sections 164, 167 and 168 of the Local Government Act 2002.

23. Seaplanes and aircraft approach areas

(1) No person navigating a vessel may impede a seaplane in the process of landing or taking off.

(2) No person may navigate a vessel with a mast or superstructure in excess of 15 metres above sea level within the defined Aircraft Approach Area as described and shown in Part 6 of Schedule 2 of this bylaw.

24. Anchoring and mooring

(1) No person may anchor a vessel so as to:

(a) obstruct the passage of other vessels or obstruct the approach to any wharf, pier or jetty; or

(b) create a hazard to other vessels at anchor, or

(c) leave the vessel unattended for more than 24 hours without prior permission of the Harbourmaster.

(2) Except in an emergency involving danger to life or property, no person may cut, break, destroy or unlawfully detach:

(a) the mooring of any vessel; or

(b) the fastening securing any vessel lying in, at or near a wharf, dock or at or near any wharf or landing place.

(3) When a vessel is moored in, at or alongside a wharf or dock or other landing place, the person in charge of a vessel must ensure that adequate and safe means of access to the vessel is provided, properly installed, secured and adjusted to suit all tidal conditions.

(4) The person in charge of a vessel berthed at a wharf must ensure that it is securely fastened at all times and, if required by the Harbourmaster, maintain a person on board to keep watch.

(5) No person may moor to a public wharf for more than eight hours without permission of the wharf owner. This does not preclude the wharf owner from restricting berthage to a shorter time.

(6) No person may allow a vessel to be anchored in the same location or within one nautical mile of the previous overnight anchorage for longer than 14 consecutive days without the prior permission of the Harbourmaster.

(7) Any person intending to live on board a vessel at anchor or on a mooring for more than five consecutive nights shall inform the Harbourmaster of where the vessel will be anchored or moored and the expected duration of their living on board.

(8) No person may allow a vessel to use a mooring without the mooring owner's permission.

Related information:

In the event of adverse weather, the Harbourmaster will issue timely direction to a person in charge of a vessel at anchor to depart the anchorage prior to adverse weather that may cause vessels to drag their anchors onto a lee shore. Directions will be issued in accordance with Standard Operating Procedure 001/2022, which is available on Council's website at https://www.gdc.govt.nz/environment/coast-and-harbour.

25. Prohibited anchorages

No person may anchor or moor any vessel within any prohibited anchorage as defined in Part 4 of Schedule 2 of this Bylaw.

26. Large vessel anchoring position

(1) No person in charge of a large vessel (over 500 gross registered tonnage) may allow it to be anchored or moored at any place within the Gisborne Harbour Limits other than at the three permanent anchorage positions as defined in Part 3(a) of Schedule 2of this Bylaw.

(2) No person in charge of a cruise ship may allow it to be anchored or moored at any place within the Gisborne Harbour Limits other than at the cruise ship anchorage positions as defined in Part 3(b) of Schedule 2 of this Bylaw.

(3) Only one vessel may be anchored at any anchorage position defined in Part 3 of Schedule 2 of this bylaw at any one time.

27. Obstructions and hazards

(1) No person may obstruct the passage of any other vessel, or restrict the navigation of any waterway, or the access by water to any wharf, pier, jetty, landing place, boat ramp, designated launching area, slipway or mooring.

(2) Unless exempted by the Harbourmaster, no person may navigate a vessel under their control in the swinging basin, or in the entrance channel when a vessel exceeding 500 gross tonnes is in the channel between Tokomaru Rock Light Buoy and the entrance to the swinging basin or is in the swinging basin, as shown in Part 2 of Schedule 2 of this bylaw.

(3) No person may cause or allow any thing to be placed, left behind, dropped, or discharged over or near any navigable waters that may:

(a) restrict or cause a danger to the navigation of any other vessel; or

(b) cause or have the potential to cause injury or death to any person; or

(c) cause or have the potential to cause damage to any vessel or any other property.

(4) No person may place any obstruction, including any fishing apparatus, in any waters that is likely to:

(a) restrict navigation; or

(b) cause or have the potential to cause, loss of life or injury to any person; or

(c) cause or have the potential to cause, damage to any vessel or any property.

(5) No person may place any obstruction, including any fishing apparatus within the Crayfish Pot and Set-Net Exclusion areas described in Part 7 of Schedule 2of this bylaw.

(6) Any person who loads, discharges or drops cargo or any other material into navigable waters, or in contravention of clauses 27(4) and 27(5) of this bylaw, shall be liable for the costs of removal.

28. Damage to navigational aids

(1) No person may tie a vessel to any buoy, beacon or other device or structure erected as a navigation aid, warning marker or sign without the prior written permission of the Harbourmaster.

(2) No person may damage, remove, deface or otherwise interfere with any buoy, beacon or other device or structure erected as a navigation aid, warning marker or sign.

(3) No person may erect, maintain or display any beacon, buoy or other device, which may be used as, or mistaken for, a recognised navigation aid, without the written permission of the Harbourmaster and the Director.

29. Flashing lights and sounds

(1) No person shall use any flashing lights, sirens or other sound or light signals not prescribed in a Maritime Rule for that vessel, without the permission of the Harbourmaster.

(2) For the avoidance of doubt, the application of clause 29(1) includes the use of blue flashing lights and/or sirens which is restricted to Police, Customs, Harbourmaster or other enforcement vessels authorised by the Harbourmaster.

(3) A person in charge of a vessel authorised to use purple flashing lights by the Harbourmaster shall only display them when:

   (a) The use is required to assist the location of a vessel or person in need of assistance.

   (b) The use is required to assist the identification of the vessel to an aircraft involved in an incident.

   (c) Is otherwise directed to do so by the Police or Harbourmaster.

(4) No person may blow or sound the whistle, siren or horn of a vessel, within the Gisborne harbour limits, except as a navigation safety signal or with permission of the Harbourmaster, or for testing of equipment before the vessel leaves any wharf.

30. Moorings

(1) No person may place a mooring in any navigable waters, whether in a mooring area or not, unless:

   (a) the mooring has valid resource consent; or

   (b) a mooring licence has been granted by the Harbourmaster per clause 30(3) of this bylaw.

(2) The Harbourmaster may remove or authorise the removal of any unauthorised mooring and all costs of so doing are a debt by the owner of the mooring to the Council.

(3) The Harbourmaster may, at their discretion, grant a mooring licence, and impose such terms and conditions on the licence as they deem appropriate.

(4) Every mooring licence issued by the Harbourmaster under clause 30(3) shall apply only to the vessel and owner(s) named in the licence.

(5) The Harbourmaster shall not grant any licence for a mooring under clause 30(3) unless satisfied that:

(a) there is adequate space in the mooring area for the proposed mooring; and

(b) the mooring is of adequate specifications to accommodate the proposed vessel to be moored there.

(6) No owner of a licensed mooring may leave a mooring vacant or unattended for a period of longer than six months without the written permission of the Harbourmaster.

(7) Where the owner of a mooring has left it vacant or unattended for a period of longer than six months without the written permission of the Harbourmaster, the Harbourmaster may cancel the licence and direct that the mooring be removed.

(8) No owner of a licensed mooring may, except with the written permission of the Harbourmaster:

(a) part with the possession of the mooring; or

(b) assign the mooring to any other person; or

(c) suffer any such other person to have the use of the mooring; or

(d) use the mooring for a vessel other than the vessel named in the licence.

31. Buoys

(1) No person may place a marker buoy in any navigable waters unless that buoy is clearly and permanently marked, or fitted with a permanent tag, showing at least one of the following—

(a) the owner's initials and surname, and contact telephone number or address; or

(b) in the case of a mooring, the mooring licence number.

(2) No person may place a marker buoy in any navigable waters unless that buoy is sufficiently buoyant to remain at least 50 per cent afloat or otherwise clearly visible.

(3) No person shall place a buoy in any navigable waters so that it becomes a hazard to navigation.

32. Bunkering Operations and (non-cargo) Liquid Transfer Management

(1) A person conducting bunkering operations to or from a vessel must:

(a) Notify the Harbourmaster, in accordance with the Fuel Transfer notification form, at least two hours before the commencement of the operations; and

(b) Monitor the operation in accordance with International Convention for the Prevention of Pollution from Ships (MARPOL) regulations and recommendations and otherwise in accordance with the Marine Protection Rules.

(2) No person may conduct a transfer of oil to or from any vessel or otherwise operate an oil transfer site without being in physical possession of an approved marine oil spill contingency plan that complies with the requirements of Marine Protection Rule 130B.

(3) Any automatic pumping arrangement within the Gisborne Harbour Limits shall be monitored at all times by the person conducing bunkering operations under clause 32(1), and that person shall not leave the pumping unattended.

Related information:

A **Fuel Transfer Notification form** template can be found on the Council website at https://www.gdc.govt.nz/environment/coast-and-harbour .

Completed forms can be sent to the Harbourmaster at harbourmaster@gdc.govt.nz .

Part 4: Commercial operations

33. Duties of person in charge of a Tanker

(1) While in harbour, the person in charge of an oil tanker must operate in accordance with the International Safety Guide for Oil Tankers and Terminals (ISGOTT).

(2) The person in charge of a tanker must:

(a) berth or moor the tanker only at such berth or place as permitted in writing by the Harbourmaster; and

(b) keep the tanks containing Class 3 packing groups I and II oil cargo securely closed, except when opened for loading or discharging; and

(c) ensure that sufficient motive power and minimum safe crewing is available at all times to enable the vessel to be moved from the berth in case of fire or other emergency; and

(d) submit to the Harbourmaster a plan showing the layout of the vessel's tanks and contents, giving the products and approximate quantities that will be on board when arriving at Harbour, at least 12 hours prior to arrival.

34. Duties of a person in charge of a large commercial vessel (over 500 gross tonnes)

(1) The person in charge of a commercial vessel over 500 gross tonnage that wishes to conduct safety drills or exercises, including, but not limited to, lowering of lifeboats, must notify the Harbourmaster, in accordance with the Lifeboat Drill Notification form no less than two hours before commencing the drill or exercise, and notify the Gisborne Port.

(2) The person in charge of any commercial vessel over 500 gross tonnage that wishes to immobilise and/or test engine must notify the Harbourmaster, no less than 24 hours before immobilising the vessel's main engines, and notify the Gisborne Port.

(3) Activities notified under clauses 34(1) and 34(2) must only occur while the commercial vessel is at anchor, and not when alongside.

(4) The person in charge of a large vessel with inoperative or faulty navigational or manoeuvring equipment must obtain the written approval of the Harbourmaster before the vessel navigates within a pilotage area.

Related information:

A **Lifeboat Drill Notification form** template can be found on the Council website at https://www.gdc.govt.nz/environment/coast-and-harbour .

Completed forms can be sent to the Harbourmaster at harbourmaster@gdc.govt.nz .

35. Vessels carrying explosives

(1) The person in charge of a vessel that has on board, or who intends to load or discharge, explosives must ensure that:

   (a) no person loads or unloads explosives inside of the Gisborne Harbour Limits except with the written permission of the Harbourmaster; and

   (b) no person loads or discharges class 1 explosives in navigable waters except with the written permission of the Harbourmaster; and

   (c) the Harbourmaster is provided with a Dangerous Goods declaration for the explosives.

(2) A Dangerous Goods declaration provided under clause 35(1)c) must:

   (a) be provided at least 48 hours prior to loading or discharging; and

   (b) include Net Explosive Quantity and gross weight; and

   (c) for weekend loading or discharging, be provided no later than 12 noon on the previous business day.

(3) Nothing in clause 35(1) applies to any vessel which:

   (a) is carrying not more than 27 kilograms of explosives; or

   (b) is carrying or is intending to load:

(i) Fireworks in dangerous goods classifications 1.3G, 1.4G and 1.4S that are controlled under the Hazardous Substances (Fireworks) Regulations 2001 in amounts less than 500kg gross weight; or

(ii) Emergency flares and signalling devices in dangerous goods classifications 1.3G, 1.4G and 1.4S in amounts less than 100kg gross weight; or

(iii) All other 1.4S consignments in amounts less than 2,000kg gross weight.

36. Berthage requirements for vessels carrying Class 1 explosives

(1) The person in charge of a vessel carrying Class 1 explosives must not allow that vessel to be berthed within 30 metres of another vessel without prior written approval of the Harbourmaster.

(2) The person in charge of a vessel carrying Class 1 explosives in excess of the quantities that require a test certificate shall berth only at a berth which complies with the Designated Transfer Zone provision of a Dangerous Goods Handling Plan. Such a plan will illustrate the limits of the Designated Transfer Zones on a case by case basis.

37. Display signals of a vessel with Dangerous Goods.

While in the Gisborne Harbour, the person in charge of a vessel that has on board, or who intends to load or discharge dangerous goods must:

(a) display Flag B on a prominent place of the vessel where it can best be seen from all directions between sunrise and sunset; and

(b) display an all-round red light at the masthead or where it can best be seen from all directions between sunset and sunrise.

38. Distance from vessels showing Flag B

(1) Where possible, the person in charge of a vessel underway must not allow that vessel to approach within 200 metres of a vessel showing Flag B or a red all-round light while it is at a berth, anchored, or underway.

(2) Where it is not possible for a vessel underway to be more than 200 metres away from a vessel showing Flag B or a red all-round light while it is at a berth, anchored, or underway, the person in charge of that vessel must maintain as much clearance as possible.

(3) Clause 38(1) and (2) shall not apply to a vessel acting in accordance with clause 36(1).

39. Hot work operations

(1) The person in charge of a vessel on which hot works operations are to be carried out or a person who intends to conduct hot works operations on a vessel must notify the Harbourmaster, in accordance with the Hot Work Notification form no less than two hours before commencing the work.

(2) Any person carrying out the hot work or the person in charge of a vessel or vessel's engineer, if available, of the vessel must ensure that before any welding operations are commenced, precautions are taken for the detection, prevention and extinguishing of fire on board the vessel or elsewhere during the welding operations, and that the requirements of the Hot Work Notification are met. Provision must be made for the continuance of the precautions until the operations are completed.

(3) The person in charge of a vessel must ensure that any hot works operations on the vessel are undertaken in accordance with the conditions of the Hot Work Notification for the work to be undertaken.

(4) The Harbourmaster may grant a licence which allows the person in charge of a vessel lying at any ship-repairing establishment to carry out hot works operations without complying with the requirements in clause 39(1).

(5) In any case where the Harbourmaster is not satisfied adequate precautions have been taken, the Harbourmaster may stop any hot work operations commencing, or continuing, until satisfied that adequate precautions have been taken.

Related information: A **Hot Work Notification form** template can be found on the Council website at https://www.gdc.govt.nz/environment/coast-and-harbour Completed forms can be sent to the Harbourmaster at harbourmaster@gdc.govt.nz To apply for a licence under clause 38 (4), email the Harbourmaster at @harbourmaster.gdc.govt.nz

40. Loading and unloading of logs

(1) Any person that intends to load logs shall ensure that a plan has been submitted to the Harbourmaster that relates to the loading and recovery of lost logs. The loading needs to be monitored to immediately identify any logs that have been lost in the Gisborne Harbour Limits and track them until they can be removed.

(2) The person referred to in clause 40(1) must inform the Harbourmaster of any logs lost into the Gisborne Harbour Limits as soon as they are observed missing and again once they have been recovered.

41. Gisborne Pilotage Area

(1) The person in charge of a vessel 500 gross tonnes or more navigating in the Gisborne Pilotage Area must ensure that:

(a) automatic-steering "pilot" devices are not used, unless a helmsman is standing by in the immediate vicinity of the helm or wheel; otherwise the vessel is to be in the hand-steering mode; and

(b) main engines are immediately available for reducing speed, stopping or going astern at all times without delay; and

(c) anchors are immediately available for use in an emergency, and capable of being used without power; and

(d) all information from aids to navigation and charts are fully monitored; and

(e) while within Gisborne Pilotage Area, all aids to navigation on board vessels, including but not limited to radar and depth recording devices, are to be in continuous operation and fully utilised; and

(f) the number of persons on the bridge of the vessel shall be sufficient to enable compliance with clause 41(1)(a).

Part 5: Administrative matters

42. Identification of personal water craft (jetskis)

(1) The owner and person in charge of a personal water craft (PWC) being used on navigable waters must display a distinctive individual identification number, which must be either the registration number of the PWC's trailer, or a PWC identification number.

(2) If the PWC subject to clause 42(1) does not use a trailer registration number, the owner of the PWC must obtain a PWC identification number from the Council (or another regional council that undertakes an equivalent process for PWC) before the PWC is used on navigable waters.

(3) The owner and person in charge of the PWC subject to clause 42(1) must ensure the PWC identification number or trailer registration number is clearly displayed above the water line on both sides of the PWC at all times. Each number used shall be a minimum height of 90 millimetres, in a contrasting colour and the numbers must be legible by day from 50 metres away.

(4) The owner and person in charge of the PWC subject to clause 42(1) must ensure the PWC identification number is displayed prominently on the PWC's trailer.

(5) The owner and person in charge of the PWC subject to clause 42(1) must notify Council of the identification number of the PWC before it is used on navigable waters.

(6) The owner of a PWC must notify the Harbourmaster within 30 days of the craft being sold or disposed of.

Related information:

A **Jet ski identification notification** form can be found on the Council's website at https://www.gdc.govt.nz/environment/coast-and-harbour.

43. Vessel identification

(1) The person in charge of a vessel not covered by clause 42 shall ensure the vessel is clearly marked with a minimum of two letters or numbers which must not be a vessel's brand, make or model, and must not have the potential to be mistaken for a vessel operated by the Harbourmaster, coastguard, police, customs, fisheries officers, or other enforcement agency. The marking shall be clearly displayed when on navigable waters in a position above the water line on both sides of the vessel at all times.

(2) Each letter or number required by clause 43(1) shall be a minimum height of 90 millimetres, in a contrasting colour and the letters or numbers must be legible by day at a distance no less than 50 metres.

(3) If the vessel is normally carried to the water on a trailer, the vessel name or identifying letters and numbers required by clause 43(1) must also be prominently displayed on that trailer.

(4) Clause 43(1) does not apply to:

(a) non power-driven vessels; or

(b) power-driven vessels of 4 metres or less in length overall.

(5) The identification of any vessel exempted under clause 43(4)(a) or (b) must include the name and contact details of the owner displayed somewhere on the vessel.

(6) A commercial ship to which clause 43(1) applies shall be deemed to have met the requirements of clause 43(1) if it displays a Maritime New Zealand or Maritime Safety Authority number.

44. Offences and Enforcement

(1) A person commits an offence against this bylaw and is liable to a penalty under the Maritime Transport Act 1994 or Local Government Act 2002 if:

(a) they fail to comply with (breach) this bylaw; or

(b) they fail to comply with an instruction given to them by the Harbourmaster.

(2) Despite clause 44(1), a person does not commit an offence if they prove that the failure to comply was due to compliance with the directions of the Harbourmaster.

(3) The Harbourmaster may under section 163 of the Local Government Act 2002:

(a) remove or alter a work or thing that has been constructed in breach of this bylaw; and

(b) recover any costs of removal or alteration from the person who committed the breach.

(4) The Harbourmaster may use their powers under the Maritime Transport Act 1994, Maritime Rules, and Local Government Act 2002 to enforce this bylaw.

Related information:

The Harbourmaster has the power to –

(a) enter and remain on any vessel, marine facility, land or property of a port company or operator

(b) direct any vessel or person to take any action to ensure compliance with this bylaw

(c) move or remove a vessel that is unseaworthy or causing a hazard

(d) cause any floating, submerged, or stranded object to be moored, unmoored, anchored, secured, unsecured, placed, or removed

(e) cause a vessel to be moored, unmoored, anchored, secured, unsecured, placed, or removed, or to weigh anchor

(f) seize a vessel using a mooring for which a mooring licence has been cancelled

(g) seize an unoccupied vessel that has broken free from or dragging its mooring, obstructing or endangering another vessel, becoming unseaworthy or sinking

(h) sell or dispose of a vessel and recover any costs if the owner fails to comply with the Bylaw and pay any costs associated with the seizure, impoundment, transport and storage.

(section 33F(1) Maritime Transport Act 1994 and sections 164, 167 to 168 Local Government Act 2002)

A person who is convicted of an offence against a bylaw is liable to a fines under the Maritime Transport Act 1994 or the Local Government Act 2002.

45. Fees and charges

(1) Council may set fees and charges for any activity undertaken in this bylaw.

(2) The fees and charges set under clause 45(1) must be paid on invoice by the specified person to the Council.

> **Related information:**
>
> Current fees and charges are available on the Council's website at https://www.gdc.govt.nz/council/plans-policies-and-bylaws/fees-and-charges .

46. Limitation of Liability

(1) The Harbourmaster and Council shall exercise reasonable care but shall have no liability for any damage caused by any action taken in accordance with this bylaw.

(2) The Harbourmaster and Council are not liable for any damage or loss that may arise to any vessel or other property caused by:

(a) The Harbourmaster securing a vessel to a mooring; or

(b) The Harbourmaster seizing or storing a vessel; or

(c) A vessel that has not been securely moored; or

(d) A third party, natural disaster, natural event, natural process, or any other cause to a vessel that has been securely moored.

47. Revocation

Under Rule 91.22(3)(a) of the Maritime Rules, the Water Recreation (Waiapu River) Notice 1979 is revoked on the date this bylaw comes into force.

Schedule 1

Reserved Areas

1. Turanganui River access lane

This access lane has been reserved for the launching and operation of power driven vessels at the mouth of the Turanganui River as shown on the map below.

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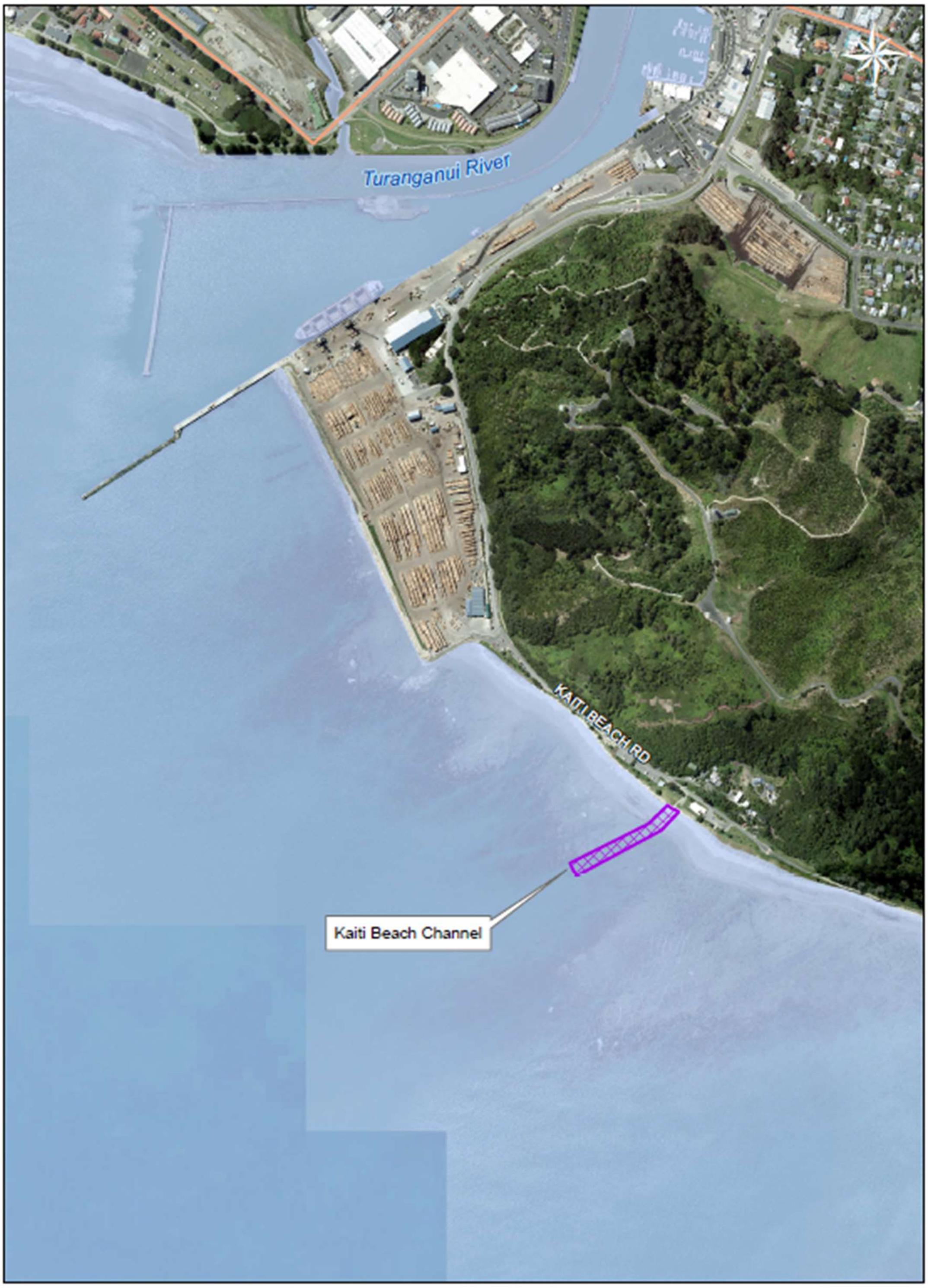
2. Kaiti beach channel access lane

The Kaiti Beach Channel, as shown on the map below, has been reserved for the purpose of providing access for vessels navigating between the shore and the open sea. This excludes other activities from the channel, including swimmers when vessels are navigating through the channel.



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3. Personal water craft (jet ski)

A specific area has been reserved for the purpose of the operation of personal water craft, located between mean High Water Springs and 200 metres offshore, extending 400 metres parallel to the short with its western end located 50 metres west of the extended centre line of Pacific Street and its eastern end located 350 metres east of the extended centre line of Pacific Street and as shown on the map below.

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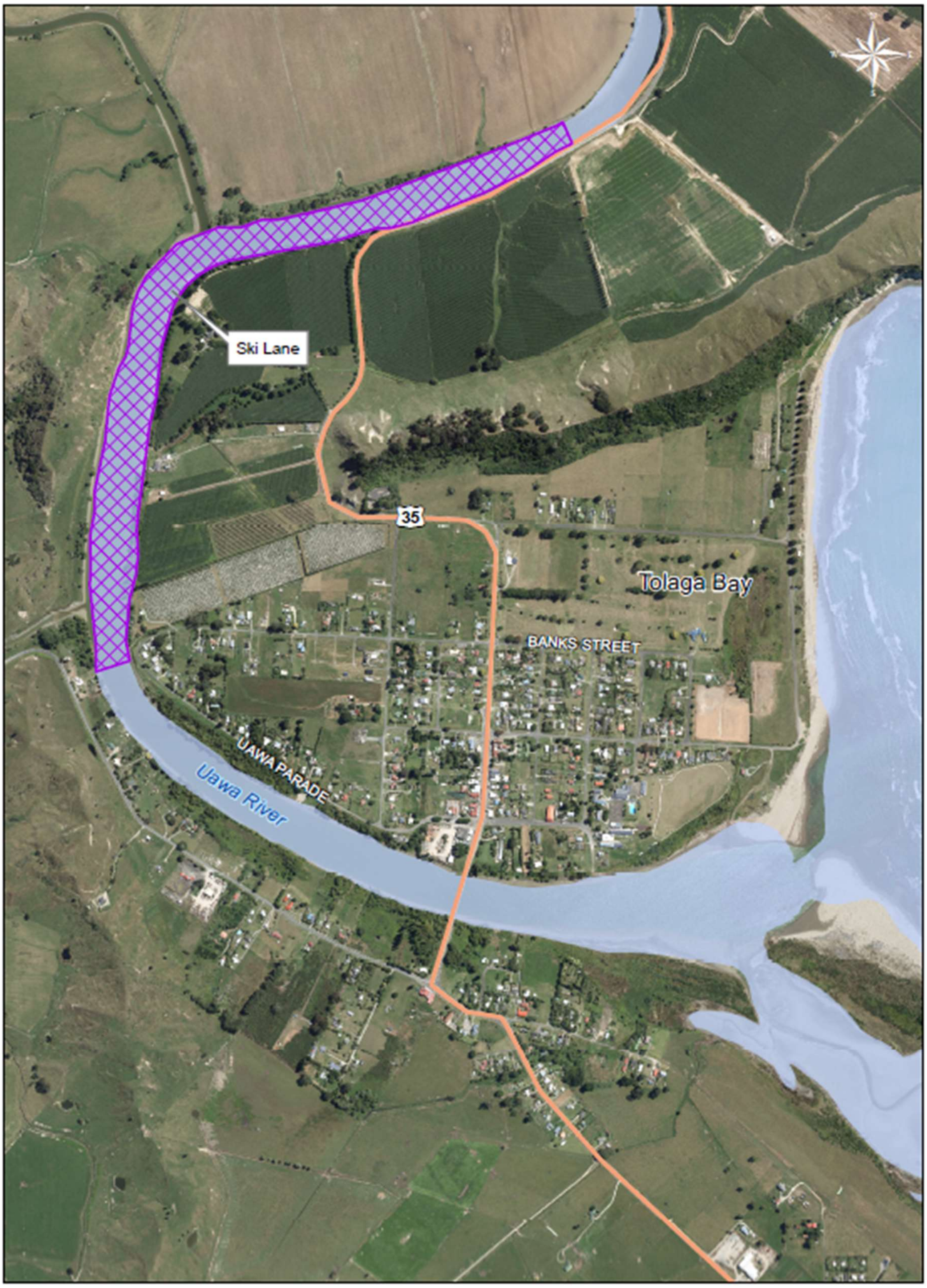
4. Tolaga Bay ski lane

An area of the Uawa River, Tolaga Bay has been reserved for water skiing purposes, as shown on the map below.



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Schedule 2

Defined Areas

1. Gisborne Harbour Limits

The Gisborne Harbour Limits is the area of Tūranganui-a-Kiwa / Poverty Bay waters enclosed by a line drawn from Tuaheni Point to Young Nicks Head as shown on the map below.

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2. Entrance channel and swinging basin

(a) The entrance channel and swinging basin are shown on the map below.

(i) Waihora rock west cardinal mark - 38 42.21 S Lat 178 01.65 E Long

(ii) Far Port hand channel entrance buoy – 38 41.008 S Lat 178 00.300 E Long

(iii) Port hand mid channel marker – 38 40.822 S Lat 178 00.687 E Long

(iv) Starboard mid channel marker – 38 40.901 S Lat 178 00.761E Long

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3. Large vessel anchoring position

(a) Anchoring of large vessels (over 500 gross registered tonnage) is limited to three permanent anchorage positions, as shown on the map below. The designated permanent anchoring areas are located in the following positions:

(i) Anchorage 1 – Lat. 38° 43.25'S Long. 177° 58.6'E.

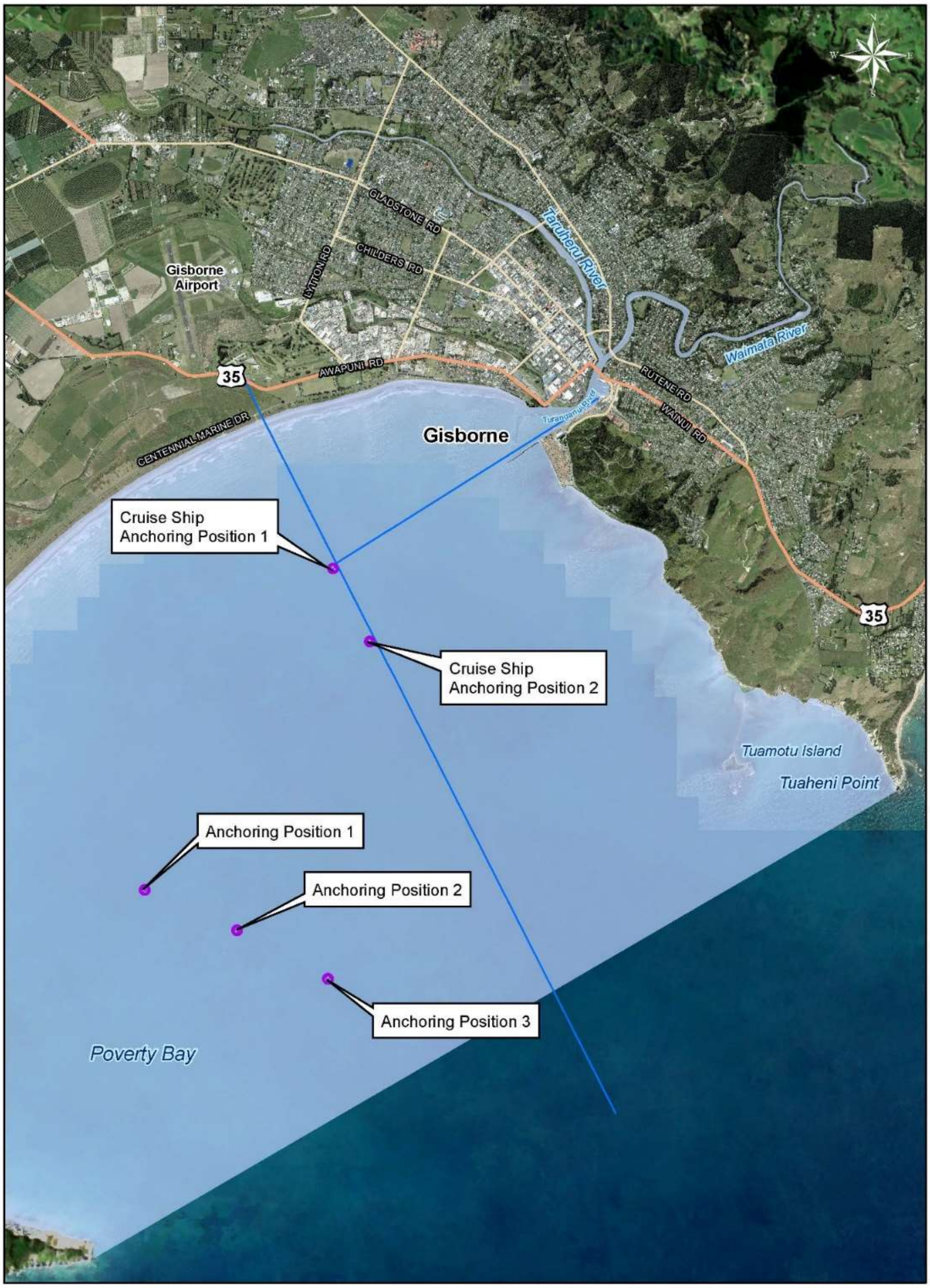
(ii) Anchorage 2 – Lat. 38° 43.50'S Long. 177° 59.3'E

(iii) Anchorage 3 – Lat. 38° 43.75'S Long. 178° 00.0'E.

(b) Cruise ships are permitted at the following anchorage positions as shown on the map below:

(i) Anchorage 1 – Lat. 38˚41.35'S Long 177˚59.88'E

(ii) Anchorage 2 – Lat. 38˚41.76'S Long 178˚00.18'E



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4. Prohibited anchorage areas

(1) All prohibited anchorage areas are those that are defined by New Zealand Hydrographic charts NZ 55 and NZ 5571 and as shown on the map below. The co-ordinate positions (WGS 1984) are:

(a) the wastewater outfall from 38° 40.4' S 178° 00.2' E, hence south for a distance of 1NM;

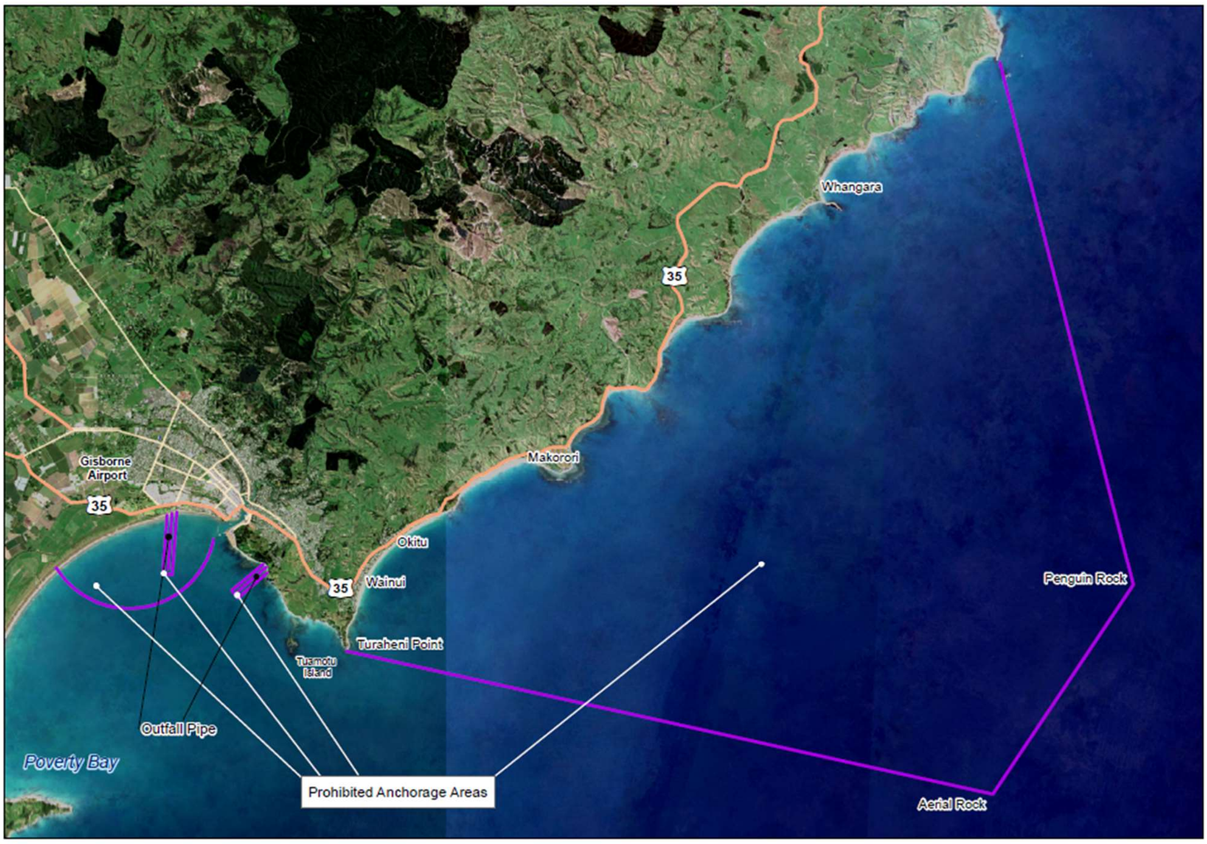
(b) the wastewater outfall from 38° 41.1' S 178° 02.3' E, hence in a direction of 226°(T) for a distance of 0.65NM;

(c) the area encompassed within a circle with a radius of 1.5NM centred on a position of 38° 40.5' S 177° 59.25' E (Front Lead);

(d) Waihora Rock Buoy in position 38 42.21 S Lat 178 01.65 E Long

(e) Shoreward of Ariel Bank, within an area bounded by coordinate positions (WGS 1984):

(i)	Tuaheni Point	Lat. 38° 42.50' S Long. 178° 04.16' E
(ii)	Ariel Rock	Lat. 38° 43.76' S Long. 178° 17.81' E
(iii)	Penguin Rock	Lat. 38° 39.96' S Long. 178° 21.08' E
(iv)	Gable End Foreland	Lat. 38° 31.76' S Long. 178° 17.53' E



5. Gisborne Pilotage area

The Gisborne Pilotage Area is defined as the area bounded seaward by the arc of a circle, radius 3 nautical miles, centred on the southern end of Butlers Wall (38° 40'.6S, 178° 01'.2E) and as shown on the map below.

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6. Aircraft approach area

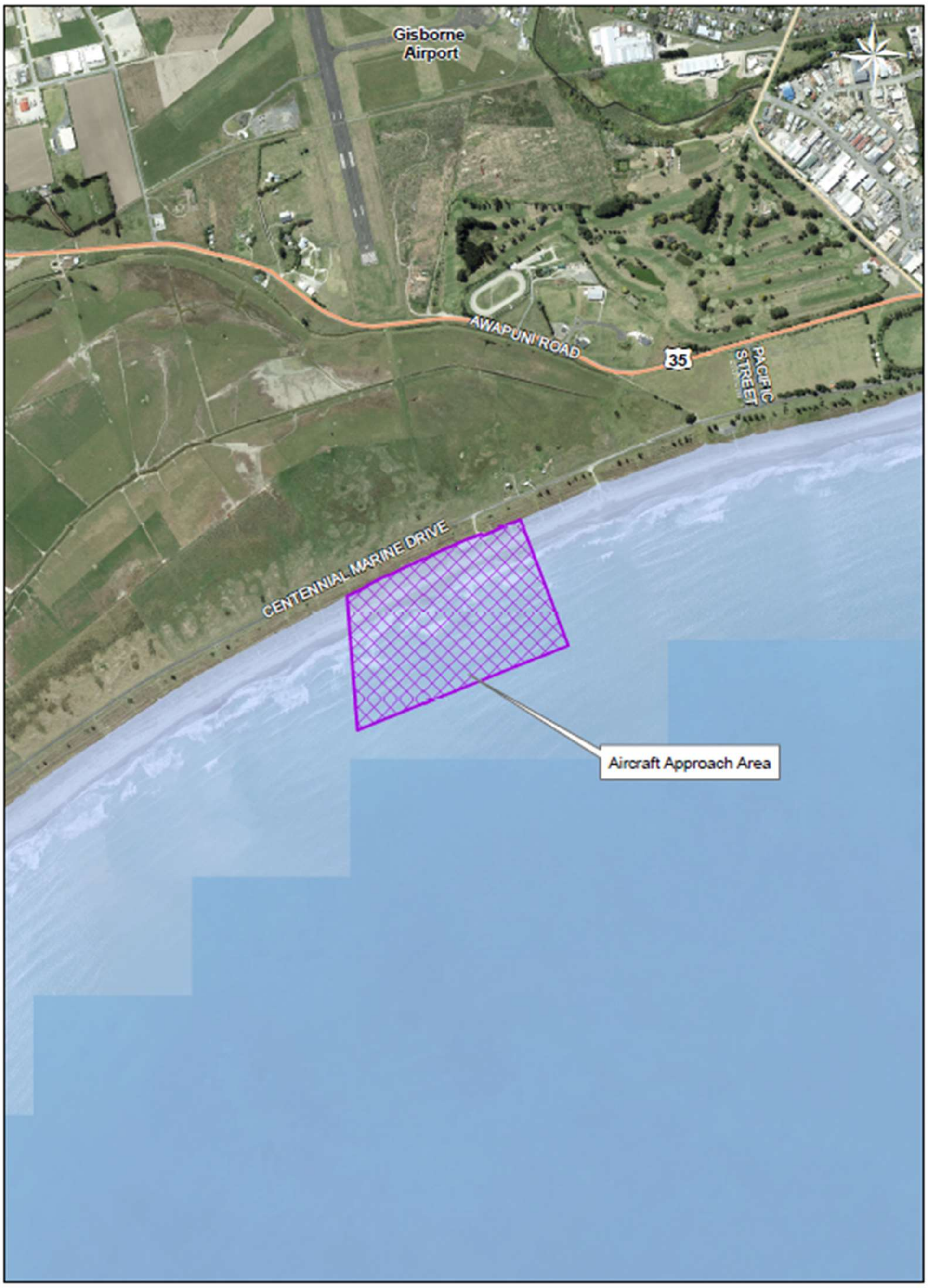
(1) An aircraft approach area is located in the Gisborne Harbour, within co-ordinates (WGS 1984) as shown on the map below:

(a) 38° 4.7' S 177° 58.7' E;

(b) 38° 40.9' S 177° 58.8' E;

(c) 38° 40.8' S 177° 59.2' E;

(d) 38° 40.6' S 177° 59.1' E.



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7. Crayfish pot and set-net exclusion areas

(1) Gisborne Harbour Limits

A crayfish pot and set-net exclusion area is located in the Gisborne Harbour Limits bounded by co-ordinate positions (WGS 1984) as shown on the map below:

(a) 38° 40.5' S 177° 59.1' E Beach (MHWS), 200m w of lead line;

(b) 30° 43.9' S 178° 1.4' E Gisborne Harbour limits, 200m of lead line;

(c) 30° 42.5' S 178° 4.1' E Tuahine Point;

(d) 38° 42.4''S 178° 2.8' E Tuamotu Island;

(e) 38° 42.2' S 178° 1.6' E Waihora Buoy

(f) 38 ° 40.7' S 178° 1.1' E Breakwater

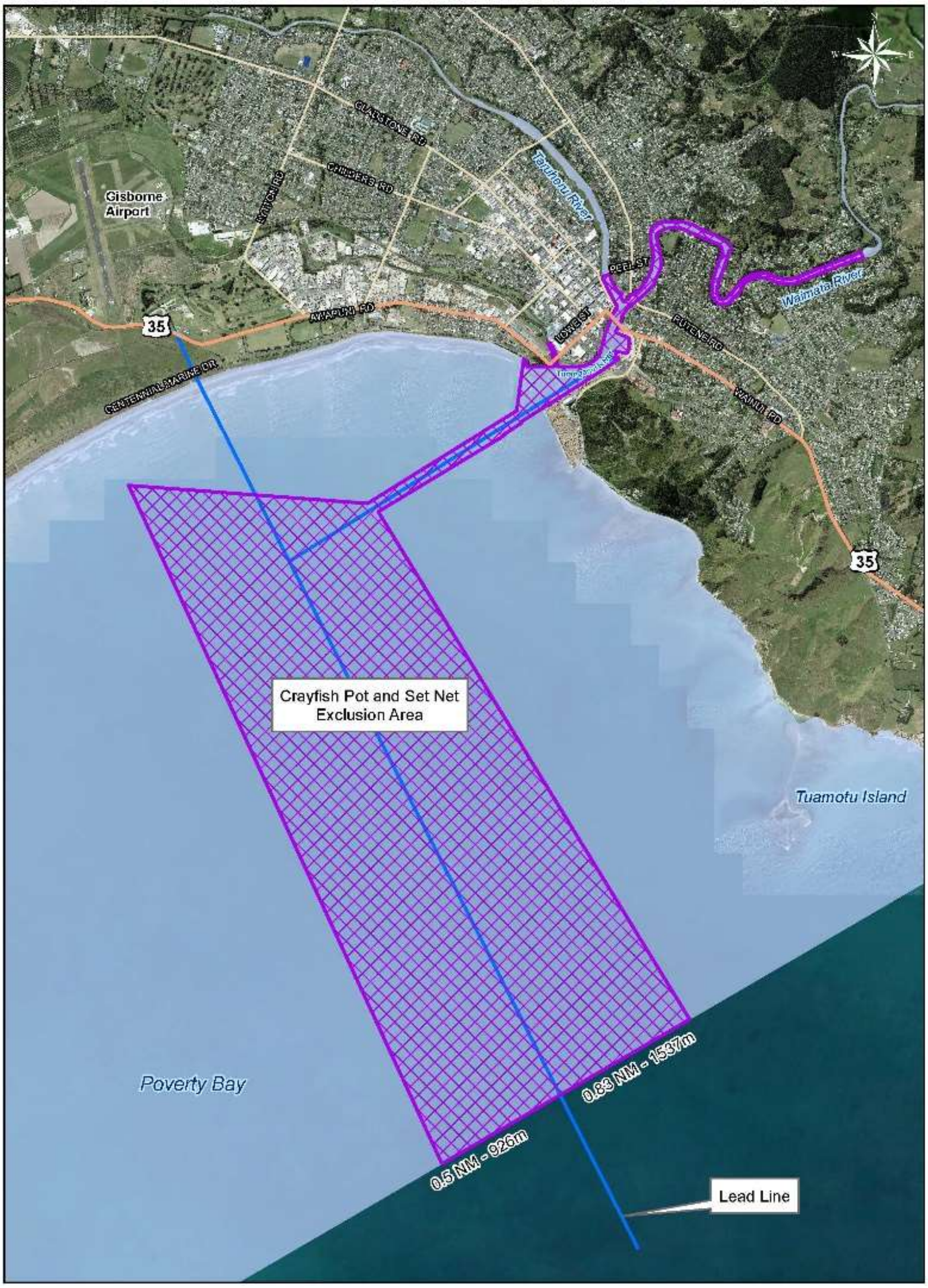
and seaward of:

(g) A right line drawn across the Waikanae Creek along the extended centreline of Lowe Street;

(h) A right line drawn across the Taruheru River along the line of the seaward side of the Peel Street Bridge;

(i) A right line drawn across the Waimata River above stream at the landmark commonly referred to as the Island.

(j) Waihora Rock Buoy in position 38 42.21 S Lat 178 01.65 E Long.



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(2) Tatapouri

A crayfish pot and set-net exclusion area is located in the Tatapouri Channel Area bounded by co-ordinate positions (WGS 1984) as shown on the map below:

(a) 38°38.734'S 178°8.746'E

(b) 38°38.752'S 178°8.742'E

(c) 38°38.796'S 178°8.948'E

(d) 38°38.814'S 178°8.944'E

(e) 38°38.185'S 178°9.015'E

(f) 38°38.815'S 178°9.0155'E

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Title:	**24-41 Cemeteries and Crematoria Bylaw Review**
Section:	Strategic Planning
Prepared by:	Summer Agnew - Intermediate Policy Advisor
Meeting Date:	Wednesday 20 March 2024

Legal: Yes	Financial: Yes	Significance: **Low**

Report to COUNCIL/TE KAUNIHERA for decision

PURPOSE - TE TAKE

The purpose of this report is to:

- provide an overview of the findings of the research and analysis undertaken to inform the review of the Cemeteries and Crematoria Bylaw 2015
- request staff prepare a draft bylaw and issues and options analysis that responds to the findings.

SUMMARY – HE WHAKARĀPOPOTOTANGA

Under the Burial and Cremation Act 1964 (the BCA) Gisborne District Council (Council) has a statutory role to provide and maintain cemeteries in the Gisborne district. The Gisborne Cemeteries and Crematoria Bylaw 2015 (the current bylaw) is in place to maintain regulatory control of cemeteries and crematoria in the district. The current bylaw is attached to this report as **Attachment 1**.

In addition to the current bylaw, Council has the Gisborne Cemeteries and Crematoria Policy 2015 (the current policy). The current policy is attached to this report as **Attachment 2.** A cemeteries policy is not a statutory requirement.

The Local Government Act 2002 (the LGA) requires Council to undertake a review of this bylaw no later than ten years after it was last reviewed. When reviewing a bylaw, Council must determine whether the bylaw is the most appropriate way of regulating the matters addressed by the bylaw.

Staff have identified several focus areas for the review of the current bylaw based on research to date. A summary of research and findings to date is included in this report. Issues and options based on the focus areas will be presented to Council in the next stage of the review alongside a draft bylaw.

The focus areas identified for this review are:

- Inconsistencies between the current bylaw and the current policy
- Suspension of burials due to adverse weather events
- Guidance around "offensive" and oversize monuments
- Alcohol and unruly behaviour in cemeteries
- Animals in cemeteries
- The current requirement of an out-of-region burial fee for stillborn children.

The review process includes:

- Council endorsement of findings report and determinations (March 2024)
- Engagement with Tangata Whenua during the development of a draft bylaw (March-April 2024)
- Bylaw drafting (March-May 2024)
- Adoption of draft bylaw for consultation (June 2024)
- Formal consultation (July 2024)
- Hearings (August 2024)
- Deliberations (August 2024)
- Consideration by Council for resolution making the bylaw (November 2024).

The decisions or matters in this report are considered to be of **Low** significance in accordance with the Council's Significance and Engagement Policy.

RECOMMENDATIONS - NGĀ TŪTOHUNGA

That the Council/Te Kaunihera:

1. **Endorses the Gisborne Cemeteries and Crematoria Bylaw 2015 findings outlined within this report.**
2. **Determines that the statutory review of the Gisborne Cemeteries and Crematoria Bylaw 2015 Bylaw has found that:**
    a) **a bylaw is still the most appropriate way to address the perceived problem**
    b) **the current Bylaw does not give rise to any implications and is not inconsistent with the New Zealand Bill of Rights Act 1990**
    c) **the current bylaw structure and wording could be improved.**
3. **Requests that staff prepare a draft bylaw and issues and options analysis in response to the findings outlined within this agenda report.**

Authorised by:

Joanna Noble - Director Sustainable Futures

Keywords: cemeteries and crematoria bylaw, burial and cremation act, Gisborne cemeteries and crematoria bylaw

BACKGROUND - HE WHAKAMĀRAMA

1. Council maintains 13 Public Cemeteries in the district, occupying 51 hectares. In addition, Council owns a crematorium building leased to a commercial entity, Tairāwhiti Cremation Services (a subsidiary of Evans Funeral Home).
2. The Burial and Cremation Act 1964 (BCA) prescribes how local authorities approach services and options available to New Zealanders for the care and final disposition of human remains. The BCA requires local authorities to provide and maintain cemeteries and enables them to make bylaws that regulate their operation. The Gisborne Cemeteries and Crematoria Bylaw 2015 (the current bylaw) is attached to this report as **Attachment 1**.
3. The process of reviewing bylaws is detailed in s159 of the Local Government Act 2002 (LGA), which requires local authorities to review a bylaw no later than ten years after it was last reviewed. The current bylaw is due for review by 25 June 2025, at which point it will expire, and a new bylaw will need to be drafted.
4. LGA s160A determines that a bylaw not reviewed under s159 by its due date is revoked two years after the last date on which the bylaw should have been reviewed (its expiry date). This means the bylaw can continue to be enforced in its current form until 25 June 2027, providing two years of continuity while a new bylaw is drafted.
5. As the first step in the review process (as per s155(1) and s160 of the LGA) Council must consider if a bylaw is still the most appropriate way of addressing the perceived problem. Council must also consider whether the current bylaw is the most appropriate form of the bylaw and whether the bylaw gives rise to any implications under the New Zealand Bill of Rights Act 1990 (BORA).
6. These decisions will inform the next decision in the process: whether to keep the current bylaw as it is, amend it, revoke and replace it, or revoke it.
7. In addition to the current bylaw, Council has the Gisborne Cemeteries and Crematoria Policy 2015 (the current policy), which was reviewed in parallel with the current bylaw. The current policy is attached to the report as **Attachment 2**.
8. Staff have identified several issues for the review of the current bylaw and policy, outlined in the Discussion and Options Section of this report.

DISCUSSION and OPTIONS - WHAKAWHITINGA KŌRERO me ngā KŌWHIRINGA

9. The research and analysis to inform the bylaw review was guided by the following key questions:
    a) Is there still a problem?
    b) Has the problem changed, are there any new elements to the overall problem?
    c) What has the Bylaw achieved?
    d) Could the Bylaw be improved?
    e) Does the Bylaw comply with and align to the current legislation?

Research undertaken.

10. Research and engagement to answer the key questions has included:
    - Face to face interviews with Liveable Communities management and cemetery staff
    - Research on burial and cremation trends and domestic approaches provided by other councils.
11. Limitations on the scope of the research include Government inaction on the modernisation of the BCA, which is outdated and does not reflect the widening ethnic makeup of our society or anticipate growing interest in alternative modes of burial. These were the findings of the 2015 Law Commission review[1] (the LC Review), which was published after the adoption of Council's current bylaw and policy. The LC Review made several modernisation recommendations, including that the BCA address:
    - Growing demand for alternatives to traditional funeral arrangements such as Eco funerals and DIY funerals
    - The rightful claims of Māori and other ethnicities to have their cultural and spiritual concerns recognised.
12. While changing values may bring a need for the provision of alternate cemetery services, the revised bylaw should not dictate their provision. Care should be taken to ensure the revised bylaw does not explicitly exclude the provision of identified needs. However, those services can be addressed via Council's Community Facilities Strategy, which includes a Cemeteries Plan.
13. Based on the research conducted, staff have identified several focus areas for the bylaw review to target. A brief overview of each focus area is included in the **Issues Identified Section**.

Legal framework of the Bylaw

14. The current bylaw is made under the LGA and the BCA.
15. Council can make a bylaw under section 145 of the LGA for the following purposes:
    - Protecting the public from nuisance
    - Protecting, promoting, and maintaining public health and safety
    - Minimising the potential for offensive behaviour in public places.
16. Also, the LGA explicitly provides for making Bylaws to manage cemeteries. Section 146 of the LGA states, regarding cemeteries, that a territorial authority may make bylaws to manage, regulate against, or protect from damage, misuse, or loss, or to prevent the use of the land, structures, or infrastructure.

[1] Law Commission (2015) Death Burial and Cremation, A New Law for Contemporary New Zealand

17. The BCA provides for the making of a bylaw by the local authority (relating to cemeteries) and the extent of the Bylaw. Under the BCA, Council is empowered to:
    - Make bylaws to regulate activities at council owned or operated cemeteries and crematoria (s16, 40 and 59)
    - Approve or refuse applications for and prohibit monuments as it thinks fit (s9)
    - Grant exclusive rights of burial (s10).

Problem definition and bylaw purpose

18. Cemeteries are essential to our community as a physical remembrance of our people, stories, and history. They provide for contemplation and social connectivity that aids emotional healing. However, physical activities occurring within cemeteries and crematoria have the potential to cause public safety hazards, damage to Council property, and distress to mourners through antisocial behaviour or improper operational practice. The current bylaw seeks to mitigate and manage these issues through regulation.
19. The purpose of the current bylaw is to maintain regulatory control of cemeteries and crematoria in the district. It does this by setting and controlling standards for their operation. While changing values may bring a need for the provision of alternate cemetery services, the revised bylaw should not dictate their provision. Care should be taken to ensure the revised bylaw does not explicitly exclude the provision of identified needs. However, those services can be addressed via the Community Facilities Strategy.

Scope of the review

20. Issues in scope of the current bylaw review:
    - Matters relating to the regulation of burial and cremation in Council-controlled facilities.
    - Internal stakeholder operational needs
    - Review of the current bylaw and current policy.
21. Issues outside the scope of the current bylaw:
    - Cemetery planning and operational matters, such as the physical reorganisation of cemeteries or implementation of new services, which are managed under Council's Community Facilities Strategy.
    - Māori Urupā, which the BCA[2] specifically excludes.
    - Issues relating to the scattering of ashes outside of cemetery grounds.

[2] Sec 3 of the BCA states it does not apply to Māori Urupa or the burial of bodies therein. However, some restrictions within the BCA apply to Urupa, including the removal of bodies and restrictions covered in Sections 46, 47 and 48 of the BCA.

Issues identified

Current policy and regulatory framework

22. The current policy contains inconsistencies with the current bylaw and current practice. It also includes regulations, which are best suited for inclusion in a bylaw.

23. There is no statutory requirement to maintain the current policy. Revoking the current policy and using a bylaw as the only regulatory tool would remove inconsistencies and provide regulatory certainty for cemetery staff and the community.

24. Inconsistencies include the timeline for burial plot payment plans, provision of vaults and guidance around ash scattering.

    a) Burial plot payment plans: The current bylaw states that "burials will only be carried out on payment of all the prescribed fees or suitable financial arrangements acceptable to the council have been made." Contradicting this, the current policy allows for payment within twelve months. Current practice is for cemetery staff to allow payment within six months.

    b) Provision of vaults: The current policy allows for vaults. However, cemetery staff do not offer vaults as lawn cemeteries do not have sufficiently sized plots to accommodate their installation. Staff report vaults are no longer a common customer request.

    c) Ash scattering: The current bylaw states that scattering ashes is permitted in the cemeteries "with prior approval of Council". The current policy states that scattering ashes is possible once the prescribed fee has been paid; however, Council's fee schedule does not prescribe a fee. The significance of ash scattering varies culturally. Limited guidance on scattering locations exists on Council's website due to few acceptable sites. Issues related to the scattering of ashes outside the cemetery (for example, in the Rose Garden) are out of the scope of the current bylaw, which regulates cemeteries. Issues relating to ash scattering in other public places could be addressed in the upcoming review of the Reserves Bylaw 2015 and the Public Places Bylaw 2015 (scheduled for review in 2024/2025).

Suspending Burials due to Adverse Weather Events

25. As the climate changes, Council's ability to provide casket burials is increasingly subject to weather events during which high groundwater interrupts burials. Taruheru, our most popular cemetery (90% of casket burials), is the most susceptible to suspensions during (and following) rain events. Interruptions to service mean Council does not have the certainty of providing casket burials within a particular timeframe.

26. There is currently no clear guidance/mechanism (in the BCA, Regulations, or current bylaw) that allows Council to temporarily suspend burials. As a result, the current bylaw does not adequately articulate a legal justification for suspending burials.

27. The current bylaw states, "*Extra depth burials can only occur if the water table permits, and ground conditions are suitable*." Introduced during the 2015 review, this regulation does not reflect the reality that Council must suspend all burials when ground conditions are unsuitable, not just extra-depth burials.

Guidance on "Offensive" and Oversize Monuments

28. Staff have trouble justifying to customers why they cannot have problematic designs (offensive or large monuments) because historical installations have established precedents. Some historical monuments are larger than the current 1m size restriction. Two monuments that could be considered offensive were installed in Taruheru Cemetery before the 2015 bylaw review. These headstones have large gang patch designs, and customers have complained to Council that the offensive nature of these headstones interferes with their mourning.

29. The current bylaw and policy reference the need for monuments to "meet the aesthetic requirements of the Council"[3]. However, this is insufficient for cemetery staff who have requested that a revised bylaw provide clearer guidelines for staff on what Council considers a permissible monument size and non-permissible content. The ability to refer customers to clear guidelines would also help provide better clarity for the public on what is considered an offensive or oversized monument.

30. Council has the authority to set standards and refuse monuments that do not meet those standards. However, care must be taken to avoid violating individual rights guaranteed under the New Zealand Bill of Rights Act 1990 (BORA) or discriminating against any sector of the community.

31. In 2008, legal advice to the Attorney General concluded[4] that the Whanganui District Council Prohibition of Gang Insignia Bill was inconsistent with the freedom of expression guaranteed under BORA. In 2012, legal advice to the Attorney General concluded[5] that the Prohibition of Gang Insignia in Government Premises Bill (the Government Premises Bill) was consistent with BORA because:

    - Gang insignia can be considered a form of expression and may fall under the protection of BORA s14; however, gang insignia is at the lower end of protected expression as it is associated with intimidation and criminal activity.
    - The Government Premises Bill served the sufficiently important objective of providing workplaces and *public services* free from intimidation associated with gang insignia, and the limitations on freedom of expression were deemed reasonable, proportionate, and justified under section 5 of the Bill of Rights Act.

32. The Prohibition of Gang Insignia in Government Premises Act 2013 states that no person may display gang insignia at any time in Government premises, which are defined as whole or part of any structure (including any associated grounds) owned by or under the control of the Crown or a local authority.

[3] Gisborne Cemeteries and Crematoria Bylaw 2015 (the current bylaw) Section 9.1.4

[4] Legal Advice prepared for the Attorney-General on Consistency with The New Zealand Bill of Rights Act 1990: Wanganui District Council (Prohibition of Gang Insignia) Bill

[5] Legal Advice prepared for the Attorney-General on Consistency with The New Zealand Bill of Rights Act 1990: Prohibition of Gang Insignia In Government Premises Bill

33. Despite a legal precedent restricting gang insignia due to its association with intimidation and criminal activity, attempts to regulate it remain a contentious area of legislation, capturing media attention and public opinion. Scrutiny is high within a local government context where consideration of community views is both a legislative requirement and essential to the democratic process.

34. In 2012, a Porirua Council decision to ban gang insignia was eventually amended by Councillors to allow for patches as long as they do not cause offence to "reasonable" people or unfairly overwhelm neighbouring graves.

35. To address complaints about three existing headstones featuring gang insignia, the Wairoa District Council proposed in 2022 to prohibit headstones that could be considered offensive. The majority of public submissions were unfavourable. Concerns expressed by submitters included conflict with BORA freedoms, whether a cemetery meets the definition of a Government premise, and disturbing the peace of the departed and the memories of their whanau. Submitters also questioned whether the proposed bylaw was the most appropriate and *proportionate* way of addressing the "offensive" headstones, given that they hold significance for many in the Wairoa community. Subsequently, Wairoa District Council adopted a bylaw stipulating that monuments must be aesthetically acceptable to the Council. However, the adopted bylaw does not contain any measure prohibiting "offensive" monuments.

36. Central Hawkes Bay District Council (CHBDC) states in their Cemeteries Bylaw that any memorial must comply with the requirements of the Council. Additionally, the CHBDC Cemeteries Policy states, "no offensive graphics, insignia, words, phrases or offensive nicknames are allowed… the memorial must be approved by Council staff prior to installation. If approval is not granted, the applicant can request that the decision be reviewed at a public-excluded Council meeting. This decision will be final and binding."

37. Waipā District Council are more explicit. Their Bylaw states that "all memorial headstones and monuments… shall be devoid of offensive language, offensive symbols or gang insignia [and comply with a size schedule attached to the Bylaw]". Waipā expressly states they may exercise discretion in allowing or denying the use of specifically requested symbols and include a provision for a right of appeal to the Council to determine requests.

38. The revised bylaw could include a clause clearly defining and prohibiting monuments displaying offensive and intimidating content. The clause could also state that applications must be made, and they can be declined. Expressly prohibiting gang insignia on funerary monuments may prove as contentious in Tairāwhiti as it was in Porirua and Wairoa. The appropriateness of any measure to address the issue will face BORA scrutiny and the question of whether any proposed limitation is "demonstrably justifiable in a free and democratic society."[6]

[6] New Zealand Bill of Rights Act 1990, Section 5: Justified limitations

Alcohol and Unruly Behaviour in Cemeteries

39. Cemetery staff report increasing difficulties with drunken and disorderly behaviour, particularly at Taruheru, where several gang members have recently been interred. The cemetery staff report instances of unruly behaviour that have affected other grieving members of the public. Asking those unruly persons to quiet down for burial proceedings has been successful, but it is intimidating for cemetery staff to deal with these situations. The current bylaw does not consider alcohol.

40. Amendment of the current bylaw is not required to put up signs stating alcohol is prohibited (as the Public Places Bylaw 2015 prohibits the consumption of alcohol in a public place). Signage to this effect could be installed. However, this is not budgeted for in current operational budgets and the Public Places Bylaw has no infringement powers. Therefore, it is not a flexible enforcement tool, relying on prosecution.

41. Another solution could be to amend the Gisborne District Council Alcohol Control Bylaw 2015 (the Alcohol Bylaw). The Alcohol Control Bylaw does not currently include any cemeteries in its restricted areas, but this bylaw is due for review (2024) and could be amended to include cemeteries. The Alcohol Control Bylaw carries enforcement powers: infringement fines can be issued, and the police can be called for non-compliance.

42. Any proposed amendment to the Alcohol Bylaw must be scrutinised under s147A of the LGA. This section requires, before making a bylaw, a territorial authority must be satisfied that:
    - The bylaw can be justified as a reasonable limitation on people's rights and freedoms.
    - There is evidence the area in question has experienced a high level of crime or disorder that can be shown to have been caused or made worse by alcohol consumption in the area.
    - The bylaw is appropriate and proportionate in light of that crime or disorder.

Animals in Cemeteries

43. Cemetery staff indicate dog walkers using Taruheru cemetery leave behind dog faeces, which is both a nuisance for mourners seeking quiet reflection and a burden on staff time.

44. The BCA enables Council to make cemeteries bylaws that prohibit or regulate the entry of animals into cemeteries. Animals includes, but is not limited to, dogs under the current bylaw.

45. The current Cemeteries and Crematoria Bylaw allows *animals* to enter cemeteries during daylight hours if they are under the control of their owner. However, the current Cemeteries and Crematoria Policy permits *animals* to enter cemeteries only with prior approval from the Council but does not require the animal to remain under their control.

46. Regardless, the Tairāwhiti Dog Control Bylaw 2023 (the Dog Control Bylaw) and Tairāwhiti Dog Control Policy 2023 (Dog Control Policy) are the appropriate mechanisms for addressing dog-specific issues in the region.

47. The Tairāwhiti Dog Control Bylaw 2023 (the Dog Control Bylaw) establishes on-leash rules for certain urban areas[7]. However, the region's cemeteries, including Taruheru Cemetery, are located outside those areas.

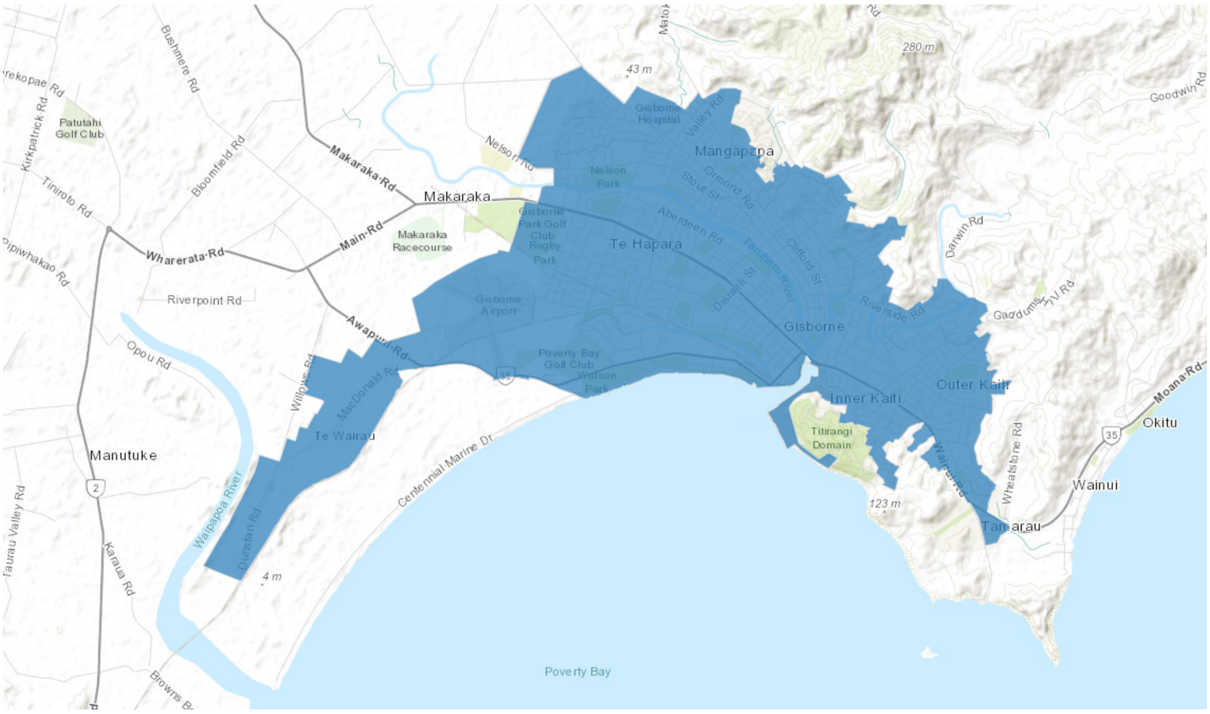

Figure 1 Map indicating area of the current reticulated services boundary

48. The Gisborne Reserves Bylaw (due for review soon) contradicts the Dog Control Bylaw by mandating prior approval from the Council to bring animals into reserves and imposing impoundment as a penalty for non-compliance. Some cemeteries in the region are reserves, but Taruheru is not one of them. When this bylaw is reviewed, consideration of rules relating to dogs will need to take into account the current regulations and practices under the updated Dog Control Bylaw and Policy.

49. Seeking to provide dog owners with a reasonable level of access to public places without compromising public safety and comfort, the Dog Control Policy states that "when making bylaws controlling the access of dogs to public places, Council will protect sensitive public areas… where their presence may be offensive or disturbing, e.g., cemeteries". However, the Dog Control Bylaw does not yet consider cemeteries.

50. Prohibiting dogs from cemeteries would require an amendment to the Dog Policy. Council would need to consult on updating the Dog Policy schedule containing prohibited areas, which would allow the use of the Dog Control Act 1996 (the Dog Control Act) to enforce a dog ban in cemeteries. To do this, the Dog Control Act requires Council to notify every registered dog owner in the region of a proposed change to the Dog Policy Schedule.

[7] Dogs must be on a leash at all times in a public place, in the area defined as the reticulated boundary (on the map) that's not designated as an off-leash or prohibited area. Dogs must also be on a leash in Titirangi Doman and Waihirere Domain.

51. However, the Dog Control Bylaw and Policy already require the owner of a dog in any public place or premises to ensure the immediate removal and disposal of the dog's faeces. Warranted officers can issue a $300 fine for failure to comply with the Dog Control Bylaw. Signage stipulating faeces removal could be introduced to cemeteries as an operational decision without amending the current bylaw.

52. The Reserves Bylaw and Public Places Bylaw are scheduled for review in 2024/2025, and alignment with the Dog Control Bylaw and Policy and Cemeteries and Crematoria Bylaw will be progressed.

Removing the Requirement of out-of-region Burial Fees for Stillborn Children

53. The current bylaw specifically mentions an additional fee for the burial of stillborn children who are from out of district. Cemetery staff indicate the fee was removed from the fee schedule by Te Ranga Whakahau[8], but it has not yet been removed from the current bylaw.

54. Burials of this nature are exceedingly rare (none are known to cemetery staff), as those from outside the region are usually returned to their home region. Removal of the fee would not impact on budgets for cemeteries services.

Summary of review findings

55. Inconsistencies exist between the current policy and bylaw (the regulatory framework), causing difficulties in implementation and compliance. The current bylaw lacks a clear mechanism for temporarily suspending burials or restricting monument designs, particularly regarding offensive or large monuments. Persistent issues with alcohol-related, unruly behaviour and with dog walkers leaving behind animal faeces that impact grieving individuals and staff. The current bylaw mentions a now-discontinued fee for the burial of stillborn children who are from outside the district. The range of identified issues necessitates revisions be made to the current bylaw.

56. There is a strong consensus among staff that a bylaw remains a necessary and appropriate way to manage cemeteries and crematoria. A bylaw is currently Council's only regulatory method to manage cemetery and crematoria activities.

57. A bylaw that regulates activities that take place at Council cemeteries and crematoria remains the most appropriate way to manage activities that may cause public safety hazards, damage to property, and unnecessary distress to mourners or relatives.

Determinations

Is a bylaw still the most appropriate way to address the problem?

58. When reviewing a bylaw, Council is required by s155 of the LGA to make this determination. Research indicates that the identified problems can be addressed by a bylaw. A bylaw is determined to be the most appropriate way to regulate cemeteries and crematoria in the district, as there are no alternative regulatory mechanisms.

[8] Senior management team at Council

Does the bylaw align and comply with legislation?

59. The current bylaw attempts to achieve matters described in s145 of the LGA:

    a) Protect the public from nuisance.

    b) Protect, promote, and maintain public health and safety.

    c) Minimise the potential for offensive behaviour in public places.

60. Additionally, the current bylaw does not exceed the scope of matters set out in the BCA (Sections 9, 10, 16, 40, and 59). Therefore, the current bylaw is aligned and compliant with both the LGA and BCA.

61. Initiating the review of the current bylaw prior to its expiry date, then consulting on and subsequently adopting a new bylaw, will satisfy Council's statutory requirements under the LGA.

Is the current bylaw the most appropriate form of bylaw?

62. Staff support the current Bylaw framework but identify that the content requires amending to address identified issues. Potential amendments include:
    - Resolving inconsistencies between the current bylaw and the current policy.
    - Articulating legal justification for the suspension of burials due to adverse weather events.
    - Incorporating guidance around "offensive" and oversize monuments.
    - Limiting alcohol to mitigate unruly behaviour in cemeteries.
    - Limiting animals in cemeteries.

63. Also, the review of the current bylaw finds that its language could be improved. A plain English rephrasing would improve readability, providing the public with greater certainty.

Does the current bylaw have any implications under the Bill of Rights Act 1990?

64. Under the LGA, a bylaw review must consider whether a bylaw has any implications under BORA. Legally a bylaw must be consistent with BORA.

65. The stipulation that monuments meet the aesthetic requirements of Council[9] is an arbitrary statement that, when put into practice assessing monuments, has the potential to limit freedom of expression (BORA s14), manifestation of religion and belief (BORA s15) and rights of minorities to enjoy their culture (BORA s20).

66. "Expression" can be defined as any human activity that attempts to convey meaning and therefore, has expressive value.[10]

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[9] Gisborne Cemeteries and Crematoria Bylaw 2015 (the current bylaw) Section 9.1.4

[10] Auckland Council citing the Supreme Court of Canada (1989) decision on Irwin Toy Ltd v Attorney-General of Canada

67. Although gang insignia could be considered a form of expression protected under BORA, that expression is likely mitigated through its association with intimidation and criminal activity. Given that Council is obliged to provide workplaces and public services free from intimidation, limitations on freedom of expression (as it relates to gang insignia on funerary monuments) are likely to be seen as reasonable, proportionate, and justified under BORA.[11] This is because these limitations seek to reduce offence or intimidation caused to others.

68. While limiting the form and content of funerary monuments could be viewed as a restriction on freedom of expression, Council has an obligation to maintain cemeteries as an orderly environment through regulation of excessive personal expression. One person's excessive expression might overwhelm another's right to quiet reflection. Council's obligation is supported by BCA provisions that provide Council with the means to permit any monument it thinks proper and, at its discretion, refuse permission or prohibit monuments as it thinks fit.[12]

69. Potential limitations upon religion, the rights of minorities, and expression (where it causes offence or intimidation of others) likely meet the threshold of reasonable limitations that are demonstrably justified. Therefore, the current bylaw is assessed as not having any conflicts with the freedoms guaranteed under BORA.

70. Any future measure to address the issue of "offensive" funerary monuments by expressly prohibiting them from displaying gang insignia is very likely to attract concerns for personal freedoms.

71. However, the possibility that a revised bylaw may in the future, be inconsistent with BORA does not influence the assessment of whether the current bylaw is consistent with BORA. Commentary on expression is included for completeness and to provide the basis for future determinations. When adopting any revised bylaw Council must again determine that the bylaw is appropriate in addressing the perceived problem, the most appropriate form of the bylaw and does not give rise to implications under BORA.

72. The review, in accordance with the statutory review requirements under s160(1) of the LGA has found that:
    - A bylaw remains the most appropriate way to regulate activities that take place at Council cemeteries and crematoria. This is because a bylaw is currently the only regulatory method to manage activities at cemeteries and crematoria.
    - A bylaw enables Council to provide certainty and guidance for the public, related agencies, and funeral industry members.
    - The current bylaw is the most appropriate form of bylaw because it provides a clear regulatory framework however, it requires amendment to address identified issues.
    - The current bylaw does not give rise to any unjustified implications under the New Zealand Bill of Rights Act 1990.

[11] New Zealand Bill of Rights Act 1990, Section 5: Justified limitations

[12] Burial and Cremation Act, Section 9: Powers as to Vaults, Monuments, etc

ASSESSMENT of SIGNIFICANCE - AROTAKENGA o NGĀ HIRANGA

Consideration of consistency with and impact on the Regional Land Transport Plan and its implementation
Overall Process: Low Significance
This Report: Low Significance

Impacts on Council's delivery of its Financial Strategy and Long-Term Plan
Overall Process: Low Significance
This Report: Low Significance

Inconsistency with Council's current strategy and policy
Overall Process: Low Significance
This Report: Low Significance

The effects on all or a large part of the Gisborne district
Overall Process: Medium Significance
This Report: Low Significance

The effects on individuals or specific communities
Overall Process: Low Significance
This Report: Low Significance

The level or history of public interest in the matter or issue
Overall Process: Medium Significance
This Report: Low Significance

73. The decisions or matters in this report are considered to be of **Low** significance in accordance with Council's Significance and Engagement Policy.

74. Because the review focuses on clarifying operational matters rather than major changes to the current bylaw, the matters in this report are assessed to be of low overall significance.

TANGATA WHENUA/MĀORI ENGAGEMENT - TŪTAKITANGA TANGATA WHENUA

75. Staff plan to seek tangata whenua input on the current bylaw during a pre-engagement window and then again during formal consultation on the draft bylaw.

COMMUNITY ENGAGEMENT - TŪTAKITANGA HAPORI

76. Under s156 of the LGA, Council is required to use the special consultative procedure when amending a bylaw if the matters are identified as being of significant interest or if there is a significant impact on the public due to the proposed changes.

77. Staff plan to notify a wide range of stakeholders of the draft bylaw, ensuring relevant stakeholders are provided an opportunity to provide feedback on the draft bylaw during the formal consultation period.

CLIMATE CHANGE – Impacts / Implications - NGĀ REREKĒTANGA ĀHUARANGI – ngā whakaaweawe / ngā ritenga

78. There are no identified climate change impacts or implications generated by this bylaw.

CONSIDERATIONS - HEI WHAKAARO

Financial/Budget

79. The bylaw review and subsequent amendments and adoptions will be undertaken by staff. There will be one-off costs to Council due to the need of community consultation.

Legal

80. The legislative framework surrounding the current bylaw and policy includes:
    - The Burial and Cremation (Removal of Monuments and Tablets) Regulations 1967, which regulates the removal and maintenance of monuments
    - The Cremation Regulations 1973, which prescribe requirements for cremations, disposal of ashes and record-keeping
    - The Health (Burial) Regulations 1946, which relates to the requirements of registration of funeral directors, construction and maintenance of mortuaries and burials at sea and does not limit the extent of the Council's bylaws.

81. There are no legal consequences for making a s155 determination. This would be the ordinary course of action for a review recommending such changes.

82. Revising the current bylaw to address identified issues carries significant risk and requires Legal involvement at the drafting stage.

83. The Government plans to introduce legislation banning all gang insignia in public places, regardless of any conflict with BORA. As of this report's writing, a bill is expected in Parliament within days, alongside a report from the Attorney-General on its legality. Indications are the bill will propose a fine for anyone wearing patches in public. It is unclear if the bill will ban the *display* of gang patches (as worded in the Government Premises Bill).

POLICY and PLANNING IMPLICATIONS - KAUPAPA HERE me ngā RITENGA WHAKAMAHERE

84. The Cemeteries and Crematoria Bylaw 2015 review and report have no policy and planning implications for the Council beyond those discussed in this report.

RISKS - NGĀ TŪRARU

85. **Reputation:** The definition of "offensive" regarding funerary monuments, and any prohibition of monuments meeting that definition, may be seen as a restriction upon a sector of the community. This has potential to create controversy and negatively impact Council's reputation. Council's reputation could also be impacted if regulatory processes are not followed to an adequate standard and the public is not appropriately consulted on any proposed changes. To mitigate this, staff have developed a project plan that ensures the legislative process is followed correctly and public consultation will be in line with the LGA.

86. **Legislation:** If the current bylaw is revoked due to inaction, Council will have no regulatory control over burials and cremation beyond provisions available under the Burials and Cremation Act 1964.

NEXT STEPS - NGĀ MAHI E WHAI AKE

Date	Action/Milestone	Comments
March – May 2024	Drafting Bylaw and engage with tangata whenua and key stakeholders.	
27 June 2024	Council Report (including SOP and draft bylaw) seeking approval to consult.	
July 2024	Public consultation on draft bylaw.	Seeking public feedback in line with the Special Consultative Procedure.
August 2024	Hearings on submissions.	
August 2024	Deliberations Report.	
14 November 2024	Adoption Report.	

ATTACHMENTS - NGĀ TĀPIRITANGA

1. Attachment 1 - Gisborne Cemeteries and Crematoria Bylaw 2015 [**24-41.1** - 20 pages]
2. Attachment 2 - Gisborne Cemeteries and Crematoria Policy 2015 [**24-41.2** - 8 pages]

Gisborne District Cemeteries and Crematoria Bylaw 2015

June 2015

GISBORNE DISTRICT COUNCIL

Contents Page

1. Introduction Title

1.1 This Bylaw may be cited as the Gisborne District Council Cemeteries and Crematoria Bylaw 2015.

2. Commencements and Application

2.1 This Bylaw shall come into force on the 26 June 2015.

2.2 This Bylaw shall apply to the whole of the Gisborne District.

3. Repeals

3.1 The Gisborne District Council Cemeteries & Crematoria Bylaw 2008 is hereby repealed.

4. Purpose

4.1 The purpose of this Bylaw is to enable the Council to set and control standards for the operation of cemeteries and crematoria within the boundaries covered by the Council's responsibility or ownership.

5. Interpretation

5.1 The Interpretation Act 1999 shall apply to this Bylaw.

5.2 For the purposes of this Bylaw the following definitions shall apply:

Act	**Means the Local Government Act 2002.**
Adult	In this Bylaw, except where inconsistent with the context, means any person over the age of 12 year.
Berm	Means a load bearing structure fabricated from concrete of prescribed dimensions, set flush with the ground and supplied by the Council, for the purpose of mounting monuments.
Body	Has the same meaning as in section 2 of the Burial and Cremation Act 1964.
Burial	Means to bury, or place the ashes of, a dead body.
Burial Warrant	Means a certificate issued by the Council, after approval of an application by the funeral director or other person responsible for the management or control of a burial, which gives authority for the person named on the warrant to be buried by the Council.
Cemetery	Has the same meaning as in Section 2 of the Burial and Cremation Act 1964.
Child	Means any person twelve years of age or younger.
Closed Cemetery or Area	Means a cemetery which has been closed by a closing order as stated in Part VI of the Burial and Cremation Act 1964 and subsequent amendments.

Act	**Means the Local Government Act 2002.**
Council	Means the Gisborne District Council.
Exclusive Right of Burial	Is as defined in Section 10 of the Burial and Cremation Act 1964.
Funeral Director	Means a person, who in the course of their business, carries out burials and related matters.
Holder of the Exclusive Right of Burial	Includes his or her duly authorised agent or a relative where such person is deceased.
Maintenance in Perpetuity	Means that the Council will maintain all cemeteries to an appropriate standard as set by the Council from time to time, for the period that the cemetery is under the control and management of the Council. Where cemeteries are disused or closed, the level of service could be to a minimal standard to preserve access and maintain safety, as per Section 43 of the Burial and Cremation Act 1964 and subsequent amendments.
Memorabilia	Includes wreaths, vases, artificial or natural cut flowers or foliage, plants, figurines, toys and ornaments and other objects placed on a grave in memory of a deceased person but that are not permanently attached to that grave.
Monument	Has the same meaning as in Section 2 of the Burial and Cremation Act 1964.
Monumental Area	Means a part of a cemetery in which full grave cover by monuments is permitted, subject to prior approval of such structures by the Council.
Plot	Means a gravesite as shown on a cemetery plan held available for public inspection at a cemetery and/or offices of the Council.
Prescribed Fee	Means the fees determined by the Council in accordance with section 150 of the Local Government Act 2002.
Relatives	Means a person's first and second degree blood relationships (parent, sibling, child, uncle, aunt, nephew, niece, grandparent, grandchild or half-sibling).
Returned Services Area	Means an area of a cemetery set aside for the burial of bodies or ashes of eligible servicemen or service women as defined by the most recent version of the Office of Veterans' Affairs publication, "War Graves and Services Cemeteries Handbook." or subsequent amendments.
Sexton	Means any person appointed by the Council to manage the day to day activities of any cemetery under its jurisdiction. Such activities include arranging for the provision of plots for burials.
Stillborn Children	Has the meaning as set out in Section 2 of the Births and Deaths Registration Act 1951.
Tablet	Has the same meaning as in Section 2 of the Burial and Cremation Act 1964.
Working Hours	Means the hours from 8am to 5pm from Monday to Friday inclusive, but excludes Saturday, Sunday, New Year's Day, ANZAC Day, Good Friday and Christmas Day.

5.3 Words importing the masculine gender include the feminine gender.

5.4 Words importing the singular number include the plural number, and words importing the plural number include the singular number.

5.5 For the purposes of this Bylaw the word "shall" refers to practices that are mandatory for compliance with the Bylaw, while the word "should" refers to practices which are advised or recommended.

5.6 The headings to the sections of this Bylaw shall not affect the construction thereof.

5.7 Council is the owner of a building at Taruheru Cemetery which is leased to a commercial entity. This building houses a cremator which is owned and operated by a commercial entity.

6. Purchase of Exclusive Right of Burial

6.1 Burials and the Sale of Plots:

6.1.1 Burials may be made in any plot in any cemetery vested in the Council or under its control that is not closed, subject to this Bylaw and the terms and conditions determined by the Council.

6.1.2 The Council may determine the size and location of the plots that may be sold and the allocation of the sold plots.

6.1.3 Burial plots shall be sold upon the terms and conditions as may be determined by the Council and the exclusive right of burial may be granted for such limited period as the Council determines.

6.1.4 The Council, upon receipt of the prescribed fees for any exclusive right of burial, shall issue a Certificate of Title to Plot to the applicant, and on request and payment of the prescribed fee the Council may issue a duplicate Certificate of Title to Plot to replace any lost Certificate of Title to Plot.

6.1.5 Unless the exclusive right of burial has been obtained, a burial shall take place in a plot and in a cemetery determined by the Council.

6.1.6 No person shall place any monument on a grave until all the prescribed fees have been paid.

6.2 Exclusive Right of Burial

6.2.1 The exclusive right of burial shall be granted to the purchaser of a plot once the Council has received the prescribed fees or suitable financial arrangements acceptable to the Council have been made, for the exclusive right of burial to have been completed.

6.2.2 The purchase of the exclusive right of burial excludes the digging and closing of a grave or the opening and closing of the ground for burial.

6.2.3 The holder of an exclusive right of burial must comply with any conditions imposed by the Council before a burial may take place.

6.2.4 Burial of any other person than the owner of the exclusive right to be buried within a plot will only take place with the express prior consent of the holder of the right.

6.3 Transfer of Exclusive Right

6.3.1 The holder of the exclusive right to be buried in a plot in which no burial has taken place may sell or transfer that right to any other person with the consent of the Council, subject to the payment of the prescribed fee to the Council.

6.3.2 The holder of the exclusive right of burial in a plot in which no burial has taken place may, if able to prove to Council that they are suffering significant financial hardship or experiencing extraordinary circumstances, sell or transfer that right to the Council on such terms and conditions as the Council may determine, subject to the payment of the prescribed fee to the Council. Plots that have been bought back may be resold by the Council.

6.4 Lapse of Right of Burial

6.4.1 When an application is made to buy the exclusive right to burial in any plot and the payment of the prescribed fee is not made in full within the period determined by the Council, it may extend the period of payment or determine that the application has lapsed.

6.4.2 Where an application has lapsed the Council may buy the exclusive right to burial back in accordance with clause 6.3.2 of this Bylaw.

6.5 Fees

6.5.1 The Council may pursuant to section 150 of the Local Government Act 2002 prescribe fees for all the services that it provides in cemeteries.

6.5.2 Except as provided for in clause 8.4, burials will only be carried out on payment of all the prescribed fees or suitable financial arrangements acceptable to the council have been made, for the exclusive right of burial has been completed.

6.5.3 <u>Out of District Fees</u>

6.5.3.1 An out of District fee shall be payable under the following circumstances:

a) Where the burial is of a deceased person not permanently residing within the boundaries of the Gisborne District for at least twelve months prior to date of death; or

b) Where the deceased person is a child of less than twelve months of age, including stillborn children, unless one of whose parents was a resident or ratepayer of the District for at least twelve months prior to date of death.

6.5.3.2 Temporary absences of short duration from the district will not detract from the permanency of residence.

6.5.3.3 The Council will determine if payment of the Out of District fees are required.

7. Burial Warrants

7.1 Requirement

No burial shall be made in any cemetery without a burial warrant for that purpose, obtained by the funeral director or other person having the management or control of the burial from the Council and presented to the sexton as authority for burial.

7.2 Application

A person requiring a burial warrant shall apply to the Council on the approved form of application for a burial warrant as issued by the Council.

No burial warrant may be issued unless ground conditions are suitable for burial and until:

a. the Council has received written certification as defined under Section 26 of the Births and Deaths Registration Act 1951; and

b. suitable financial arrangements acceptable to the Council have been made, for the exclusive right of burial.

7.4 Delivery in Advance

The application for a burial warrant shall be delivered to the sexton at least eight working hours before the burial by the funeral director or other person responsible for the management or control of the burial.

7.5 Authority to Bury

Receipt of the original burial warrant shall be sufficient authority for the sexton to proceed with the burial of the person named on that warrant. After completion of the burial the sexton shall sign the certificate at the foot of the warrant.

8. Services and Burials

8.1 Hours of Services and Burials

8.1.1 Burials at cemeteries administered by the Gisborne District Council may be held on such days and at such times as the Council shall determine.

8.1.2 Except to comply with the duties of the Council under Section 86 of the Health Act 1956 relating to the burial of people who have died of an infectious and/or notifiable disease, burial may take place:

Operating Hours
Monday to Saturday - 10am – 3.30pm
Sunday & Statutory Holidays -11am - 2pm

No burials shall take place on, New Year's Day, ANZAC Day, Good Friday or Christmas Day.

8.1.3 The sexton will, after consultation with the funeral director or other person responsible for the management or control of the burial, determine the time of burial.

8.1.4 Burials may take place at other times by special arrangement with the Council and on payment of the prescribed additional fee.

8.2 Notice of Services

8.2.1 The sexton shall be given not less than eight working hours notice of any burial or service.

8.2.2 If such notice is not given, the burial or service may be delayed for a reasonable period of time as the sexton decides to enable the sexton to complete the necessary arrangements.

8.2.3 Any extra expenses incurred shall be the responsibility of the funeral director or other person responsible for the management or control of the burial.

8.3 Responsibility for Arrangements

8.3.1 The funeral director or other person responsible for the management or control of the burial must ensure that the remains are in a suitable receptacle when presented for burial and ensure that all equipment associated with the burial is provided at the time of burial.

8.3.2 Any additional expenses incurred by the Council shall be the responsibility of the funeral director or other person responsible for the management or control of the burial.

8.4 Burial of Persons in Financial Need

8.4.1 Where application is made to the Council for the interment of a deceased person in financial need, the applicant shall provide a declaration signed by a Justice of the Peace, certifying that:

(a) Such deceased person has not left sufficient means to pay all the prescribed fees; and

(b) All the prescribed fees are not covered by an Accident Compensation or Government entitlement or subsidy; and

(c) The deceased person's relatives are unable or unwilling to pay the same.

8.4.2 Additional proof to confirm the declaration may be required by the Council.

8.5 Burials Outside of the Council Cemeteries

Burials outside of cemeteries owned or controlled by the Council are subject to Sections 46, 47 and 48 of the Burial and Cremation Act and subsequent amendments.

8.6 Burial Plots and Graves

8.6.1 Digging of Graves

8.6.1.1 No person other than the sexton or assistants of the sexton or any other person authorised by the Council shall dig any grave in or open the ground for burial in any part of a cemetery.

8.6.1.2 No person other than the sexton or assistants of the sexton or person duly authorised by the sexton shall fill in any grave.

8.6.1.3 Extra depth burials can only occur if the water table permits and ground conditions are suitable.

8.6.2 Burial of Ashes

8.6.2.1 With the prior approval of the Council any person may scatter the ashes of a deceased person in a cemetery.

8.6.2.2 With the prior approval of the Council and on payment of the prescribed fees any person may bury a container holding the ashes of a deceased person in any plot, subject to the exclusive right of burial.

8.6.3 Size of Caskets

If a casket for a child is too large for a child burial plot, it shall be buried in an adult burial plot subject to the payment of the prescribed fees.

8.6.4 Reopening of Graves

No grave may be re-opened for a further burial except with the consent of the holder of the exclusive right of burial.

8.6.5 Disinterment

8.6.5.1 Where a request for a disinterment and/or reinterment is received by the Council, the disinterment shall be conducted pursuant to section 51 and 55 of the Burial and Cremation Act 1964 and subject to the payment of the prescribed fees.

8.6.5.2 The disinterment and/or reinterment of a body must be conducted with the prior approval of the Council and must take place in the presence of the sexton, a funeral director and staff and an inspector of the Ministry of Health. Any other person may only attend with prior approval of the Council.

8.6.5.3 It will be the responsibility of the Council to open the grave only to the extent of exposing the lid of the casket. Removal of the casket from the grave will be the responsibility of the funeral director present.

8.6.5.4 No plot from which a disinterment has taken place will be used for any subsequent burial and no refund of the cost of the original burial or any part of that cost will be made.

9. Installation, Maintenance and Removal of Monuments

9.1 Construction and Installation

9.1.1 Minimum structural design, installation and renovation for all monuments shall be those specified in New Zealand Standard for Headstones and Cemetery Monuments NZS4242:1995.

9.1.2 Only one tablet or monument will be allowed on any one grave, including extra depth burial graves, and it shall be placed on the grave in a position approved by the Council. A tablet may be attached to an existing monument. Monuments may only be erected within the plot boundary.

9.1.3 All monuments shall be constructed of permanent materials. The Council may from time to time by resolution publicly notified determine a list of permanent materials that may be used in the construction of monuments.

9.1.4 All monuments will be constructed in accordance with sound engineering principles and will meet the aesthetic requirements of the Council.

9.1.5 Delivery and installation of monuments will be at the expense of the owner and will be carried out at times agreed with the sexton.

9.1.6 Any rubble and earth not required in the filling in of the grave or in connection with the levelling will immediately be removed either from the cemetery or to a place within the cemetery approved by the sexton.

9.1.7 All monuments must be consistent with the Gisborne District Council Cemeteries and Crematoria Policy.

9.2 Work Practices

9.2.1 No person erecting or repairing any monument or carrying out other work in any cemetery shall use any footpaths or other part of the cemetery for placing or depositing there, any tools, planks or materials for a longer time than is reasonably necessary to complete the work.

9.2.2 Any person mixing cement or mortar within a cemetery shall do so on a proper mixing board approved by the Council. Residue shall be removed from the cemetery.

9.2.3 Any person installing or attending a monument or carrying out any other work in a cemetery shall withdraw for the duration of an adjoining funeral service. Such person shall also remove tools, planks and other materials which may obstruct access to an adjoining service for the duration of said service.

9.3 Maintenance of Monuments

9.3.1 All monuments shall be kept in proper order and repair by the holder of the exclusive right of burial.

9.3.2 Should a monument fall into a state of decay or disrepair, or be deemed by the Council to be unsafe, it may at any time be dealt with by the Council pursuant to the Burial and Cremation (Removal of Monuments and Tablets) Regulations 1967. A photographic record of the monument shall be taken prior to removal and retained in cemetery records.

9.4 Safety

The Council may carry out regular audits of all monuments to ensure the health and safety of any persons or property within the cemetery boundaries.

9.5 Removal of Monuments

No person will be allowed to remove from a grave or plot any monument without obtaining the prior written permission of the Sexton.

9.6 Authorisation

Maintenance and any other work in a cemetery may only be carried out by a person duly authorised by the Council, or under the supervision of a Council employee.

10. Types of Cemetery

10.1 Lawn Areas Cemeteries

10.1.1 Types of burials

Lawn area cemeteries may inter either ashes or full body remains.

10.1.2 Provision by the Council

The Council will provide a continuous concrete berm at ground level approximately 500mm wide for a single row or approximately 1 metre wide for a double row for monuments to be placed on.

10.1.3 Conditions and criteria

The following conditions and criteria are applicable to lawn cemeteries:

(a) Headstone bases will not stand higher than 150mm above the berm and will be a maximum depth front to back of 400mm;

(b) The base will maintain clear space of 100mm at the front of the berm;

(c) No monument including the base will be wider than 1 150mm for a single plot or 2 300mm for a double width plot. No monument, inclusive of its base will stand higher than 1 metre above the berm;

(d) Headstone bases will allow for inserts for flower containers where this is required;

(e) No grave shall be enclosed with any railing or kerbing or similar and no monument except a tablet shall be placed on any grave;

(f) No person shall place on any plot any memorabilia except flowers and foliage which shall be placed in the flower containers inserted in the headstone.

10.2 Berm Areas

10.2.1 Ash Berm Areas

10.2.1.1 Types of burials

Ash berm areas may inter only crematorial ashes. A maximum of two sets of ashes may be interred in an ash berm cemetery plot.

10.2.1.2 Provision by the Council

The Council will provide a concrete berm at ground level of approximately 350mm for a single plot or 700mm width for a double plot.

10.2.1.3 Conditions and criteria

The following conditions and criteria are applicable to the construction of monuments in ash berm areas:

(a) The concrete based work for all monuments will not stand higher than 100mm above the berm and will be of a depth (front to back) not exceeding 250mm, length 600mm;

(b) No monument including the base will stand higher than 700mm above the berm;

(c) Headstone bases will allow for inserts for flower containers where this is required.

10.2.2 Ash Garden Berm Areas

10.2.2.1 Types of Burials

Ash garden berm areas may inter only crematorial ashes. A maximum of two sets of ashes may be interred in each plot.

10.2.2.2 Provision by the Council

The Council will provide a continuous concrete ("desk type") berm on a ground level concrete platform.

10.2.2.3 Conditions and criteria

The following criteria are applicable to the construction of tablets in ash garden berm areas:

(a) No monument or structure other than a tablet may be placed on the berm. The tablet will be set in a position and manner approved by the Council;

(b) No tablet will exceed a depth of 230mm or be wider than 370mm for a single plot or 750mm for a double plot.

10.3 Monumental Cemeteries

10.3.1 Application for Approval

Any person wishing to install a monument in any part of a cemetery must apply on the prescribed form for the Council approval to carry out such work. The applicant must submit details of the monument design, including materials and dimensions, and details of all inscriptions and their positions on the monument and pay the prescribed fee.

10.3.2 Types of Burial

Monumental cemeteries may inter either ashes or full body remains.

10.3.3 Construction criteria

The following criteria are applicable to the construction of monuments in monumental cemeteries:

(a) The holder of an exclusive right to burial may enclose the plot or plots allotted to him or her with kerbing. Where the allocated plots are contiguous they may be enclosed as a single unit;

(b) The kerbing of the plots in a monumental area will be constructed of permanent materials approved by the Council and shall not exceed a maximum height of 300mm above the ground level;

(c) Monuments may be erected within the plot boundary.

10.4 Services Cemeteries

10.4.1 Eligibility

10.4.1.1 Areas of cemeteries may be laid out as Services Cemeteries.

10.4.1.2 Those eligible for burial there are as defined in the most recent version of the Office of Veterans' Affairs publication, "War Graves and Services Cemeteries Handbook".

10.4.1.3 Notwithstanding section 10.4.1.2, the body or ashes of the spouse or partner of a returned service person may at the request of the surviving returned services partner be interred in an extra depth plot in the Services Cemetery.

10.4.2 Commemoration

Commemoration shall be as described in the above-mentioned publication, or by other means as agreed with the Office of Veteran's Affairs.

10.4.3 Waiver of Fees

The Council may waive the prescribed fee payable for the exclusive right of burial in the Services Cemeteries. Other prescribed fees shall be payable.

10.5 Closed Cemeteries

10.5.1 Closure and Maintenance in Perpetuity

As deemed appropriate, the Council may apply to officially close cemeteries under Part VI of the Burial and Cremation Act 1964.

10.5.2 The Council shall maintain such cemeteries in perpetuity, subject to conditions as set under Part IV of the Act.

11. Memorabilia

11.1 Memorabilia Placed at Time of Interment

11.1.1 Memorabilia may be placed on graves at the time of burial.

11.1.2 After the lapse of five days from the date of burial, the Council may remove from any grave, any memorabilia placed there at the time of burial and cause the surface of the grave to be levelled off and sown with grass.

11.2 Permitted Memorabilia

After a grave has been levelled and sown as described above, artificial or natural cut flowers may be placed in a container or containers set in recesses in the monument or the base of the monument.

11.3 Removal and Disposal of Memorabilia

11.3.1 Memorabilia placed or remaining on any grave which have become unsightly or which has been broken or damaged may be removed by the sexton.

11.3.2 Artificial or natural cut flowers or foliage, plants or broken or damaged receptacles may be destroyed.

11.3.3 The Council may in any cemeteries permanently remove and dispose of memorabilia that impedes or constrains the Council's ability to maintain the cemetery or causes littering.

11.3.4 Subject to sections 11.1.2 and 11.3.1 of this Bylaw, memorabilia may not be removed from a grave except with the approval of the holder of the exclusive right of burial of the plot.

12. Crematoria

12.1 Compliance with Conditions

The Cremations Regulations 1973 are applicable to all crematoria within the District.

12.2 Restriction on access

Subject to section 12.3 of this Bylaw access to any crematorium and any cremation process within the District is restricted and general entrance by members of the public is not allowed.

12.3 Limited access permitted

Where a cremation takes place in accordance with a religious ceremony that traditionally practices cremation, persons directly concerned with the deceased may at the manager of the crematorium's discretion attend the placing of the coffin in the incineration hall.

13. Vegetation

13.1 No vegetation shall be planted on any grave or within the cemetery boundaries without the prior consent of the Council.

13.2 Vegetation planted in any portion of the cemetery may at any time be trimmed, removed or cut down at the discretion of the Council.

13.3 No person shall disturb, damage, take or pick any cutting or flower from any tree, shrub, plant or other vegetation in any cemetery without the consent of the Council.

13.4 No person shall plant, cut down or destroy any tree or shrub in any cemetery without the consent of the Council.

14. Vehicles

14.1 Hours of Entry

Unless authorised by the Council, no person shall take any vehicle of any kind into any cemetery except during the hours of daylight. Vehicles shall be removed from the cemetery during the hours of darkness.

14.2 Traffic to Keep to Roads

Within cemeteries, vehicles may only be driven on formed roads which are open to vehicular traffic and park only in designated parking areas.

14.3 Right of Way for Funerals

All vehicles (other than hearses) shall yield unconditional right of way to any funeral procession.

14.4 Drivers to Obey Instructions

Any person driving a vehicle in a cemetery shall stop or move that vehicle as directed by the sexton or other authorised officer.

14.5 Traffic Signs

14.5.1 Any person driving a vehicle in a cemetery shall obey all signs or notices concerning traffic movement and parking displayed in that cemetery.

14.5.2 No vehicle shall be driven at a greater speed than indicated on any road within the cemetery, and in any other direction other than indicated by traffic notices.

14.5.3 In the absence of speed limit signs, no vehicle may be driven at a speed greater than 10 kilometres an hour in any cemetery.

14.6 Exemption

These provisions will not apply to an emergency vehicle (as defined in the Land Transport (Road User) Rule 2004) used at the time to save or protect life or health, or prevent injury or serious damage to property.

15. Soliciting Trade

15.1 Trade

With the exception of the transactions of the Council employees, undertaken in the course of management of the cemetery, no person may solicit trade or advertise goods or services within any cemetery.

15.2 Display of manufacturer's name

15.2.1 Notwithstanding section 15.1 of this Bylaw and with the consent of the holder of the exclusive right to burial in a plot a manufacturer of a monument, other than a tablet, may display his or her name in a space no larger than 50mm by 100mm on the monument.

15.2.2 The display of the manufacturer's name will be unobtrusive and meeting the aesthetic requirements of the Council.

15.3 Photography

15.3.1 No person shall take any photograph or make video recordings for commercial or editorial purposes, or for the purposes of publication, at a funeral without prior approval of the funeral director or other person responsible for the management or control of the burial.

15.3.2 No person shall take any photograph or make video recordings for commercial or editorial purposes, or for the purposes of publication, of a grave without prior approval from the holder of the exclusive right to burial.

16. Animals

16.1 Subject to the provisions of other Bylaws, no person shall take into or allow to remain in any cemetery, any animal, other than during the hours of daylight.

16.2 Any animal in a cemetery must be under the control of the owner at all times.

17. Conduct

17.1 Damage

No person shall damage, paint, write or carve on any building or monument within a cemetery or crematorium or damage property within any cemetery.

17.2 Interference with Services

No person shall unlawfully or improperly interfere with, interrupt or delay the carrying out of any funeral service or ceremony within any cemetery or crematorium.

17.3 Offensive behaviour

A person entering or present in a cemetery or crematorium shall not behave in a manner that creates a nuisance or is offensive or is likely to create a nuisance or offensive to any other person.

17.4 Offensive articles

No person will bring into or exhibit in any cemetery or crematorium any article that is a nuisance or is offensive to any other person.

18. Records

The Council will keep plans of the cemeteries it controls, records of all rights of burial granted, and a record of all burials in the cemeteries. Plans and records will be open for inspection by the public at the offices of the Council during normal office hours.

19. Offences and Breaches

19.1 No person shall do anything or cause any condition to exist for which prior approval from the Council is required under this Bylaw without first obtaining that approval and the failure to do so shall constitute a breach of this Bylaw.

19.2 No application for a prior approval from the Council, and no payment of or receipt for any fee paid in connection with such application or approval, shall confer any right, authority, or immunity on the person making such application or payment.

19.3 Any person commits a breach of this Bylaw who:

(a) does, or causes to be done, or knowingly permits or suffers to be done anything whatsoever contrary to or otherwise than as provided by this Bylaw; or

(b) omits or neglects to do, or knowingly permits or suffers to remain undone, anything which according to the true intent and meaning of this Bylaw, ought to be done by them at the time and in the manner therein provided; or

(c) does not refrain from doing anything which under this Bylaw they are required to abstain from doing; or

(d) knowingly permits or suffers any condition of or things to exist contrary to any provision contained in this Bylaw; or

(e) refuses or neglects to comply with any notice duly given to him/her under the Bylaw; or

(f) obstructs or hinders any authorised officer of Council in the performance of any duty to be discharged by that officer under or in the exercise of any power conferred upon them by this Bylaw; or

(g) fails to comply with any notice or direction given under this Bylaw.

19.4 Any person commits a breach of this Bylaw who:

(a) having constructed, affixed or provided, or caused to be constructed, affixed, or provided, any monument or any work or material of any description whatsoever, contrary to, or otherwise than in accordance with the provision of this Bylaw; or

(b) having omitted to construct, affix, or provide any work or materials as required thereby, and who does not within a reasonable time after notice in writing has been given to them by the Council or any authorised officer of the Council, fails to carry out the remedial action specified in that notice.

19.5 The notice issued under section 19.3 and 19.4 shall state the time within which the remedial action is to be carried out, and may be extended from time to time by written authority of the Council.

20. Penalties for Breach of the Bylaw

20.1 Every person who fails to comply with any part of this Bylaw commits an offence and shall be subject to the penalty provisions outlined in the offences, penalties, infringement offences, and legal proceedings provisions of the Act and the other enabling enactments contained in section 1.5 of this Bylaw.

20.2 Where any person is alleged to have committed an infringement offence, that person may either—

(a) Be proceeded against summarily for the offence; or

(b) Be served with an infringement notice as provided in the Act.

20.3 Any person found guilty of breaching the following sections of this Bylaw, will be liable to an infringement fine in accordance with Section 16(i) of the Burial and Cremation Act 1964:

(a)	Section 8.6.1	Unauthorised digging or closing of a grave or opening or closing of the ground for burial;
(b)	Section 8.6.4	Unauthorised reopening of grave;
(c)	Section 9.2	Failure to remove tools and material;
(d)	Section 9.5	Unauthorised removal of a monument;
(e)	Section 11.3.4	Unauthorised removal of memorabilia;
(f)	Section 13	Offences relating to vegetation;
(g)	Section 14	Offences relating to vehicles;
(h)	Section 15	Offences relating to soliciting trade
(i)	Section 16	Offences relating to animals;
(j)	Section 17	Offences relating to misconduct;

20.4 The Council may in accordance with Section 162 of the Local Government Act 2002 apply for an injunction restraining a person from committing a breach of this Bylaw.

20.5 The continued existence of any work or object in a state contrary to this Bylaw shall be deemed a continuing offence within the meaning of this section.

21. Removal of Works

21.1 The Council may pull down, remove or alter or cause to be pulled down, removed or altered any vegetation, work, material or thing erected or being in contravention of this Bylaw or section 163 of the Local Government Act 2002.

21.2 The Council may recover from any person responsible for the erection or from any person permitting the continued existence of any such vegetation work material or object all costs incurred by it, in connection with such pulling down, removal or alteration.

21.3 The exercise of this authority shall not relieve any such person from responsibility for any penalty for erecting or permitting the continued existence of any such vegetation work, material or object.

22. Officers to Continue in Office

22.1 All officers appointed by the Council under or for the purpose of the repealed Gisborne District Council Cemeteries and Crematoria Bylaw 2008, and holding office at the time of the coming into operation of this Bylaw, shall be deemed to have been appointed under this Bylaw.

23. Dispensing Power

23.1 Where in the opinion of the Council full compliance with any of the provisions of this Bylaw would needlessly or injuriously affect any person, or the course or operation of the business of, or be attended with loss or inconvenience to any person without any corresponding benefit to the community, the Council may, on the special application of that person, dispense with the full compliance with the provisions of this Bylaw; provided that any other terms or conditions (if any) that Council may deem fit to impose shall be complied with by that person.

23.2 The Council may, after consideration of any representation by affected persons and if in its opinion it is justified, extend, withdraw or amend the dispensation granted in terms of section 23.1.

23.3 Except if expressly granted otherwise, the dispensation by the Council in terms of section 23.1 shall only be applicable to the person it is granted to and shall be restricted to the particular issue considered by the Council and such dispensation will not constitute a justification for the breach of the provisions of this Bylaw outside the expressed terms of the dispensation.

THE COMMON SEAL OF GISBORNE DISTRICT COUNCIL WAS HERETO AFFIXED PURSUANT TO RESOLUTION PASSED AT A MEETING OF THE GISBORNE DISTRICT COUNCIL HELD ON 25th OF JUNE 2015.

MAYOR

CHIEF EXECUTIVE

Cemeteries and Crematoria Policy

Policy References

Policy Number:	POL 14/16
Objective Reference:	A528492
Policy Owner:	Team Leader, Community and Recreation Facilities
Date Adopted:	25 June 2015
Review Due:	20 May 2020
Associated documents:	Cemeteries and Crematoria Bylaw 2015 (A527829), Cemeteries and Crematoria Bylaw 2015 Statement of Proposal (A526665), Burial Plot Policy (A226833)

1.0 Introduction

It is a legislative requirement that Councils provide sufficient land and management for the burial of the deceased. Gisborne District Council maintains 13 gazetted Public Cemeteries in the district occupying 51 ha. It operates a number of serviced, un-serviced and closed cemeteries throughout the district. The closed cemetery at Makaraka is maintained as an historic cemetery site. Cemeteries at Taruheru, Patutahi, Tokomaru Bay and Tolaga Bay are fully maintained to a high standard. Cemeteries at Te Araroa (two), Matahiia, Ruatoria, Te Puia, Rakauroa, Ormond and Motu are maintained to a lower standard and fees are set accordingly. In addition, the Council is the owner of a crematorium that is leased to and operated by a commercial entity.

The Long Term Plan 2015 – 2025 provides for planning for the cemeteries within the District that are controlled by the Council. Regulatory control is provided by the Gisborne District Council District Cemeteries and Crematoria Bylaw 2015, which is to be reviewed by 30 June 2025. In addition the Gisborne District Public Places Bylaw 2015 has some relevant items. These bylaws are to be reviewed in accordance with the provisions of the Local Government Act 2002 before 30 June 2025.

2.0 Policy Scope

The scope of this Policy includes all existing relevant policy provisions and changes to the Policy as a result of the 2015 Bylaw review.

This policy does not include a fee schedule or operations forms (eg. burial warrants application form) used for the management of the cemeteries operation.

3.0 Purpose and Outcomes

The purpose of this Policy is to provide for the management of cemeteries and the crematoria owned by the Council to meet the need of the community to bury and remember their dead in a dignified and orderly manner with consideration of cultural sensitivities. It will further ensure that the Council is able to control and maintain the assets and recover a measure of its costs. Any activity will be subject to the Cemeteries Act 1964 and the Gisborne District Council Cemeteries and Crematoria Bylaw.

4.0 Relationship to Other Council Documents

Cemeteries contribute to a Connected Tairawhiti by ensuring cemeteries and crematoria are accessible, affordable and cater for the cultural, spiritual and burial needs of the district.

Council's principal objectives are to:

- provide a safe and efficient service through compliance with relevant legislation and Council policy
- manage the cemetery operations effectively to recover 80% of costs from users of the services and facilities
- focus on delivering and maintaining essential services and infrastructure at their current levels.

5.0 Policy Provisions

The Policy provides for three **types of cemeteries**. These are:

- **Serviced,** which will consist of lawn, monumental and closed cemeteries. Serviced Cemeteries are maintained to a high level, burial plots are filled, levelled and mown regularly. These cemeteries are located at Taruheru, Patutahi, Tokomaru Bay and Tolaga Bay. The cemetery at Makaraka is maintained as a closed cemetery.
- **Unserviced cemeteries**, have vegetation control three to four times per year.
- **Closed cemeteries.**

Burials may be made in any plot in a cemetery under the control of the Council that is not closed, subject to conditions determined by policy or by Bylaw. Any person may be buried in any plot in a cemetery provided that the exclusive right of burial has been obtained for that plot and for that person, or the consent of the owner of the exclusive right of burial for that plot has been obtained, a burial warrant has been issued by the Council, the burial complies with any rules made by the Council; and all applicable fees have been paid or arrangements for the fees to be paid have been made with the Council.

5.1 Purchase of exclusive right of burial

The Council may sell the exclusive right of burial for any plot in any section of a cemetery. The Council may by resolution, subject to the decision making provisions of the Local Government Act 2002 determine a limitation to the period for the right to use plots in its cemeteries. The Council will determine the size of burial plots for which exclusive right of burial are offered for sale. Burial plots may allow for extra depth interment to allow for a second burial above the first interment, where conditions permit. In many instances the ground does not permit the extra depth burial.

Where an extra depth burial is requested but not possible, the customer can purchase an adjacent plot for half price within a 10 day period. Where no adjacent plot is available, the customer can transfer their right of burial to another plot with an adjacent plot available for sale, and be offered the adjacent plot for half price within a 10 day period.

Except as provided for in provision 5.5.6 of this Policy, every application to obtain an exclusive right of burial must contain the information that the Council requires to issue the exclusive right of burial certificate and be accompanied by any prescribed fees. The holder of an exclusive right of burial must comply with any conditions imposed by the Council before a burial may take place. The Council, upon receipt of the prescribed fees for any exclusive right of burial, will issue a Certificate of Title to the applicant, and on request the Council may issue a duplicate Certificate of Title to replace any lost Certificate of Title.

Plots may be reserved by payment of a deposit of ten percent of the purchase price with the Council and payment of the balance of the purchase price in monthly equal instalments over a 12 month period.

The Council will determine fees that may be payable in addition to the normal costs for interment of a person who has not permanently resided in the district for a continuous period of 12 months before the date of their death. Temporary absences of short duration from the district will not detract from the permanency of residence. The delegated manager will determine if payment of the additional fees are required.

Burial of any other person than the owner of the exclusive right to be buried within a plot will only take place with the express prior consent of the holder of the right.

5.2 Purchaser or owner of private ground may transfer

The holder of the exclusive right to be buried in a plot in which no burial has taken place may, transfer the right to any other person with the consent of the Council, subject to the payment of an administration fee determined by the Council.

Any person with an exclusive right of burial to any plot in which no burial has taken place may, if able to prove to Council that they are suffering significant financial hardship or experiencing extraordinary circumstances, sell, transfer or transmit that right to the Council, subject to the retention by the Council of an administrative fee of determined by the Council. Plots that have been bought back may be resold by the Council.

Significant financial hardship is defined as:

(a) unable to meet minimum living expenses; or

(b) unable to meet mortgage repayments on the home the applicant lives in, resulting in an enforcement of the mortgage on the applicant's property; or

(c) home modifications to meet special needs because the applicant or a dependent family member having a disability; or

(d) paying for medical treatment if the applicant or a dependent family member:
- becomes ill
- has an injury, or
- requires palliative care; or

(e) suffering from a serious illness; or

(f) incurring funeral costs if a dependent family member dies.

5.3 Lapsing of applications

When an application is made to buy the exclusive right to burial in any plot and the payment is not made in full in the time determined by the Council, it may either extend the period of payment when it is justified or it may determine that the application has lapsed. Where an application has lapsed the Council will buy the exclusive right to burial back by reimbursement of the amount paid to date less an administration fee determined by the Council.

5.4 Burial plots

Where the purchase price to a reserved plot has not been paid in full before the intended burial the Council (or its delegated manager responsible for the activity) may consent to the interment being proceeded with on condition that another person undertakes to be responsible for the payment of the full purchase price within 12 months from date of interment. The undertaking to be responsible for the payment of the full purchase price will be in writing in a format acceptable to the Council. The Council may determine the terms and conditions of payment, including the determination of monthly instalments and default provisions. The interment will be subject to a restriction on the placing of any fence, headstone or other adornment on the grave until the purchase price for the plot has been paid in full.

5.5 Interments

5.5.1 Provisions for all interments

No burial will take place without a burial warrant that has been issued by the Council (or its delegated manager responsible for the activity). A burial warrant will be issued on production of evidence of death and payment of the required fees has been made to the Council.

5.5.2 Warrant to be authority to sexton

The burial warrant will be sufficient authority for the sexton to proceed with the burial and he will confirm that the burial took place by countersigning the warrant.

5.5.3 Hours of funerals

Funerals may only take place on the following days and between the following hours:

Operating Hours
Monday to Saturday - 10am – 3.30pm
Sunday & Statutory Holidays -11am - 2pm

No burials shall take place on New Year's Day, ANZAC Day, Good Friday or Christmas Day.

If it is intended to inter the deceased outside of the prescribed hours prior written permission must be obtained from the Council who may impose terms and conditions.

Notice of the intention to intern the deceased is to be given at least eight working hours before the intended time of burial to allow sufficient time for the grave to be dug or the earth to be opened. Working hours refer to the normal hours of duty of the sexton. The sexton will, after consultation with the plot holder, determine the time of burial.

5.5.4 Sexton, authorised community caretaker or assistant only to dig grave

Unless the sexton or authorised community caretaker determines otherwise only he or his assistant may dig a grave or open the ground for a burial. Where the family members or friends of the deceased that is to be interned indicate that they wish to dig the grave it will only occur with the permission and under the direct supervision of the sexton or authorised community caretaker after payment of an administration fee determined by the Council. Any person being the family or friends of the deceased may close any grave or area opened for burial under the supervision of the sexton, authorised community caretaker or his assistant. No person may dig a grave or open the ground or close any grave or area opened for burial without the supervision of the sexton, authorised community caretaker or his assistant.

5.5.5 Placement of ashes

Any person may bury or scatter the ashes of a deceased person in a cemetery, provided that they have the prior approval of the Council; and all applicable fees have been paid or arrangements for the fees to be paid have been made with the Council. The placement of ashes will only occur with the consent of the sexton.

5.5.6 Interment charges: persons in financial need

Where an application is made to the Council for the interment of a deceased person in financial need the applicant must furnish the Council with a Statutory Declaration witnessed by a Justice of the Peace verifying the following:

(a) The applicant has received a Funeral Grant from Work and Income;

(b) Neither the deceased nor his or her relatives (parent, sibling, child, uncle, aunt, nephew, niece, grandparent, grandchild or half-sibling) have sufficient means to pay the required fees to the Council;

(c) All the prescribed fees are not covered by an Accident Compensation or Government entitlement or subsidy; and

(d) The deceased person's other relatives not listed above are unable or unwilling to pay the same.

Additional proof to confirm the Declaration may be required by the Council. Where the Council consents to the burial of the person no tombstone, headstone, memorial, tablet or plaque may be erected on the grave until the full outstanding fees have been paid to the Council. However Council allows for a wooden cross to be erected to identify the grave. The grave will be within the marked area of the cemetery.

5.5.7 Deceased servicemen

The body or ashes of the spouse or partner of a returned service person may at the request of the surviving returned services partner be interred in an extra depth plot in the Returned Services Association section of a cemetery. The Council waives the plot fee in the Returned Services association section of a cemetery. The burial fee remain payable.

5.5.8 Disinterment

The disinterment of a body must be conducted pursuant to sections 51 and 55 of the Burial and Cremation Act 1964. The disinterment of a body must be conducted only with the prior approval of the Council and must take place only in the presence of the sexton, a funeral director and staff, an inspector of the Ministry of Health and any other person with prior approval of the Council.

It will be the responsibility of the Council to open the grave only to the extent of exposing the lid of the casket. Removal of the casket from the grave will be the responsibility of the funeral director present. No plot from which a disinterment has taken place will be used for any subsequent burial and no refund of the cost of the original burial or any part of that cost will be made.

5.5.9 Monuments/Headstones/Plaques

The following provisions apply to the erection of tombstones, headstones, monuments, plaques and tablets within the monumental and lawn areas of cemeteries as well as the ash berms and garden berm areas. It is the intention of the Council to ensure that these areas are regulated in a harmonious and uniform manner. The Council may from time to time by resolution determine a list of materials that may be used in the construction of tombstones, headstones, memorials, plaques and tablets. The Council may further require that the construction of a memorial, headstone or tombstone be approved by it before erection. Except as provided for in provision 5.5.6, no tombstone, headstone, memorial, tablet or plaque may be erected unless the full purchase price of the plot and the burial has been paid. All tombstones, headstones, memorials, plaques and tablets will be constructed according to sound engineering principles and will be in accordance with the aesthetic requirements of the Council and will be in accordance with sound engineering principles.

No individual monument shall cause offence or unfairly overwhelm adjacent areas either by design, wording or other mark. The word 'Offence' refers to a proposed monument's design, wording or marks that are capable of wounding feelings or arousing real anger, disgust, resentment or outrage in the mind of a reasonable person (where a reasonable person visits a cemetery).

5.7 Erection of memorials

5.7.1 Monumental areas

The holder of an exclusive right to burial may surround the plots allotted to him or her with kerbing. The kerbing of the plots in a monumental area will be in permanent materials and up to a maximum height of 300 mm above the ground level. Tombstones, headstones and memorials may be erected within the plot boundary. If a person encloses a plot of ground he or she will do so at own expense and in accordance with the Council's requirements.

Any rubbish and earth not required in the filling in of the grave or in connection with the levelling will immediately be removed either from the cemetery or to a place within the cemetery approved by the sexton.

5.7.2 Lawn areas

The Council will construct a continuous concrete platform at ground level approximately 500 mm wide for a single row or 1 metre wide for a double row for memorials to be placed on. Headstone bases will not stand higher than 150 mm above the berm and be a maximum depth front to back of 400 mm and will allow for inserts for flower containers where this is required. The base will maintain clear space of 100 mm at the front of the berm. No memorial including the base will be wider than 1 075 mm for a single plot or 2 150 mm for a double width.

5.7.3 Ash berms

The Council will construct a concrete berm at ground level of approximately 350 mm for a single plot or 700 mm width for a double plot. The concrete based work for all memorials will not stand higher than 100 mm above the berm and will be of a depth (front to back) not exceeding 250 mm, length 600mm and where allowed will provide inserts for flower containers. No memorial including the base will stand higher than 700 mm above the berm.

5.7.4 Garden berms

The Council will construct a continuous concrete berm on a ground level concrete platform and no headstone, tombstone, monument or structure other than a memorial plaque or tablet may be placed on the berm. No plaque will exceed a depth of 230 mm or be wider than 370 mm for a single plot or 750 mm for a double plot. The tablet or plaque will be set in a position and manner approved by the Council.

5.8 Vaults

A person who has the exclusive right to burial may excavate a vault within the boundaries of the plot. The excavation and construction of the vault will not commence before the submission to the Council of the plans and specifications for the work and his prior written approval has been obtained. The Council (through its authorised officer) may determine the material that may be used for the construction of the vault and may require amendment of the construction to ensure adherence with sound engineering principles. In all cases the work will be done to the satisfaction of the Engineer.

5.9 General provisions applicable to cemeteries

5.9.1 Placing of decorations

The holder of the exclusive right of burial to a plot, or their assignee, may decorate the plot by placing or attaching flowers, vases, figurines or ornaments, provided that the decorations comply with the conditions prescribed by the Council.

5.9.2 Removal of fences, headstones, vegetation

No person will be allowed to remove from a grave any kerb, tombstone, headstone, monument, tablet or plaque, without obtaining the prior written permission of the Council. Other memorabilia, including wreaths, vases, plants, flowers, figurines and ornaments not permanently affixed to the grave may not be removed from a grave except with the approval of the holder of the exclusive right of burial to a plot or their assignee.

The Council retains the right to remove any broken or neglected material from graves. The Council may also remove memorabilia, including wreaths, vases, plants, flowers, figurines and ornaments from graves after five days from date of burial to enable it to relevel the ground. The Council may in serviced lawn areas permanently remove memorabilia, including wreaths, vases, plants, flowers, figurines and ornaments that encroaches onto the lawn and impedes the ability to maintain the cemetery.

5.9.3 Keeping graves in order

The holder of the exclusive right of burial, or his or her assignee, is responsible for the maintenance of every decoration, monument and the physical works associated with that plot and must:

- Appropriately secure all decorations;
- Maintain all monuments so that they do not fall into a state of decay, disrepair or create a risk to the health of any other person; and
- Ensure that the decorations do not detract from or inhibit the proper maintenance of the cemetery.

The Council may carry out any physical works necessary to maintain any plot. Before the Council undertakes any physical works it will give any known person entitled to maintain the plot up to three months written notice requiring repairs to be made. The Burial and Cremation (Removal of Monuments and Tablets) Regulations 1967 requires the Council to give any known person entitled to maintain the plot notice requiring repairs to be made or for the removal of the monument. After that notice the Council may within three months effect repairs or undertake physical works but must make a photographic record of the plot and monument and file that photographic record with the cemetery records.

The holder of the exclusive right of burial will be liable to recompense the Council for the costs of repairs or physical works undertaken.

5.9.4 Physical works associated with plots

Any authorised person undertaking physical works associated with any plot must obtain prior approval from the Council for the physical works. All applicable fees must be paid or arrangements for the fees that are to be paid are to be made with the Council; The authorised person must adequately protect the surrounding plots, monuments and cemetery infrastructure and may not deposit any tools or materials on any adjacent plot, without prior approval from the holder of the exclusive right of burial to that plot, or his or her assignee. All tools or materials used for the physical works must be removed as soon as practicable upon the completion of the physical works.

If any authorised person undertaking physical works fails to comply with any conditions of the approval given by the Council, the Council may revoke the approval for the physical works and remove any monument, or part thereof, that fails to meet the conditions. The Council may remove any unauthorised physical works.

5.9.5 Keeping in order

The Council may agree to keeping a grave in order upon payment of such fee as it determines and it may prescribe annual fees for this purpose.

5.9.6 Vegetation

No trees and shrubs may be planted in any section of a cemetery or on any grave without the prior written approval of the Council. Trees and shrubs planted in a cemetery or on any grave may be trimmed, removed or cut down by the Council.

5.9.7 What fees cover

The fees paid to the Council by the plot owner do not include any work to be done beyond the digging of an ordinary grave and after burial the filling of the grave.

5.9.8 Vehicles

Except with the prior permission of the Council every person driving or in charge of any vehicle in a cemetery must:

- Drive only on a road and park only in a designated parking area;

- Drive only in the direction indicated by any traffic sign at a speed not exceeding that indicated on the road or, if no speed is indicated, not exceeding 20 kilometres per hour;
- Yield unconditional right of way to any funeral procession; and
- Not take the vehicle into a cemetery between the hours of sunset and sunrise.
- Remove the vehicle during the hours of darkness.
- Stop or move the vehicle as directed by the sexton or his assistant.

These provisions will not apply to an emergency vehicle (as defined in the Land Transport (Road User) Rule 2004) used at the time to save or protect life or health, or prevent injury or serious damage to property.

5.9.9 <u>Misconduct</u>

A person entering or present in a cemetery must not behave in a manner that creates a nuisance or is offensive to any other person. No person will bring into or exhibit in the cemetery any article that is a nuisance or is offensive to any other person or bring any animal into the cemetery without prior approval from the Council. No person will damage any cemetery property, or damage or interfere with any monument, decoration or the property of any other person or take any photograph or make video recordings for commercial or editorial purposes, or for the purposes of publication, without prior approval from the Council. No person may disrupt, prevent or delay any funeral service by improper behaviour.

5.10 Soliciting trade

With the exception of the transactions of Council employees, undertaken in the course of management of the cemetery, no person may solicit trade or advertise goods or services within any cemetery.

A manufacturer of a tombstone, headstone or memorial may, with the consent of the holder of the exclusive right to burial, display his or her name on the manufactured item in a space no larger than 50mm by 100mm. The display of the manufacturer's name will be unobtrusive and meeting the aesthetic requirements of the Council. Similar provision is not made for plaques and tablets due to their size and the negative aesthetic impact that the display of the manufacturer's name has on the limited available space on the plaque or tablet.

5.11 Plaque Lawn Cemeteries

The Council does not provide plaque lawn cemeteries due to the disproportional expensive costs associated with the maintenance thereof.

5.12 Cremation and Crematorium

5.12.1 <u>Maintenance of records of disposal</u>

The Council-owned crematorium is leased to and operated by a commercial enterprise that is bound by the provisions of the Cremation Regulations 1973. The crematorium and the cremation process is not open to the public. Where a cremation takes place in accordance with a religious ceremony that traditionally practice cremation up to two persons directly concerned with the deceased may at the manager of the crematorium's discretion attend the placing of the coffin in the incineration hall.

The Council (or its delegated manager) must be advised in writing by the manager of the crematorium of any cremation within two months from date of cremation and such notification must include, where possible, the method of disposal of the ashes of the deceased.

Authorised by Chief Executive (signature)

11. Reports of the Chief Executive and Staff for INFORMATION

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

24-22

Title:	**24-22 Freshwater Planning Update**
Section:	Strategic Planning
Prepared by:	Ariel Yann le Chew - Policy Planner
Meeting Date:	Wednesday 20 March 2024

Legal: Yes	Financial: Yes	Significance: **Medium**

Report to COUNCIL/TE KAUNIHERA for information

PURPOSE - TE TAKE

The purpose of this report is to inform Council on progress made in the drafting of the freshwater provisions as part of the Tairāwhiti Resource Management Plan (TRMP) review.

SUMMARY - HE WHAKARĀPOPOTOTANGA

This report provides an update on progress in the freshwater planning programme since **Reports 23-22** and **23-236** to ensure our legislative requirements can be achieved and delivered within the timeframe set by Central Government.

The impacts of severe weather events in 2023 and the subsequent recovery efforts delayed all Council teams' planned deliverables for 2023. The freshwater workstream and the wider TRMP programme were not exempted from this delay. Engagements and Advisory Group meetings are expected to continue throughout 2024. The Waimatā – Pakarae catchment will have had its first Advisory Group meeting on 27 February 2024 and both the Regional and Waipaoa Catchment Advisory Groups are set to reconvene on 13 March 2024. The Waiapu Catchment Plan is still procuring technical assessments to build a substantive evidence base for the policy development, while progress had been resumed following diversion of Council capacity to recovery efforts for the Mōtū Catchment Plan, where we expect to publicly notify this Plan in mid-2024. Staff had good discussions with Te Aitanga a Hauiti on the Ūawa Catchment Plan, with engagement expected to start mid-2024. The Southern Tairāwhiti (Hangaroa – Ruakituri) and the Wharekahika – Waikura catchments are expected to start engagements no later than this year.

The newly elected Coalition Government announced its 100-day plan on 29 November 2023, which resulted in the repealing of the Natural and Built Environment Act (NBEA) and Spatial Planning Act (SPA) that were in force from 24 August 2023. In December, Government announced its intention to replace the National Policy Statement for Freshwater Management (NPS-FM) 2020 and gave all councils a three-year extension of 31 December 2027 to publicly notify their freshwater planning instruments. This is to allow councils and their communities more time to consider the implications of a new or changed NPS-FM.

More recently, the Government has signalled its intention to amend the Resource Management Act (RMA) 1991 to change how the Te Mana o te Wai hierarchy of obligations is applied to individual consent applications. This means that consent applicants will not have to demonstrate how their individual activity adheres to the hierarchy, and consent authorities won't be able to consider the hierarchy of obligations in their decision-making. Staff will keep Council updated as more information is released.

The decisions or matters in this report are considered to be of **Medium** significance in accordance with the Council's Significance and Engagement Policy.

RECOMMENDATIONS - NGĀ TŪTOHUNGA

That the Council/Te Kaunihera:

1. **Notes the contents of this report.**

Authorised by:

Joanna Noble - Director Sustainable Futures

Keywords: National Policy Statement for Freshwater Management 2020, Freshwater Planning, TRMP

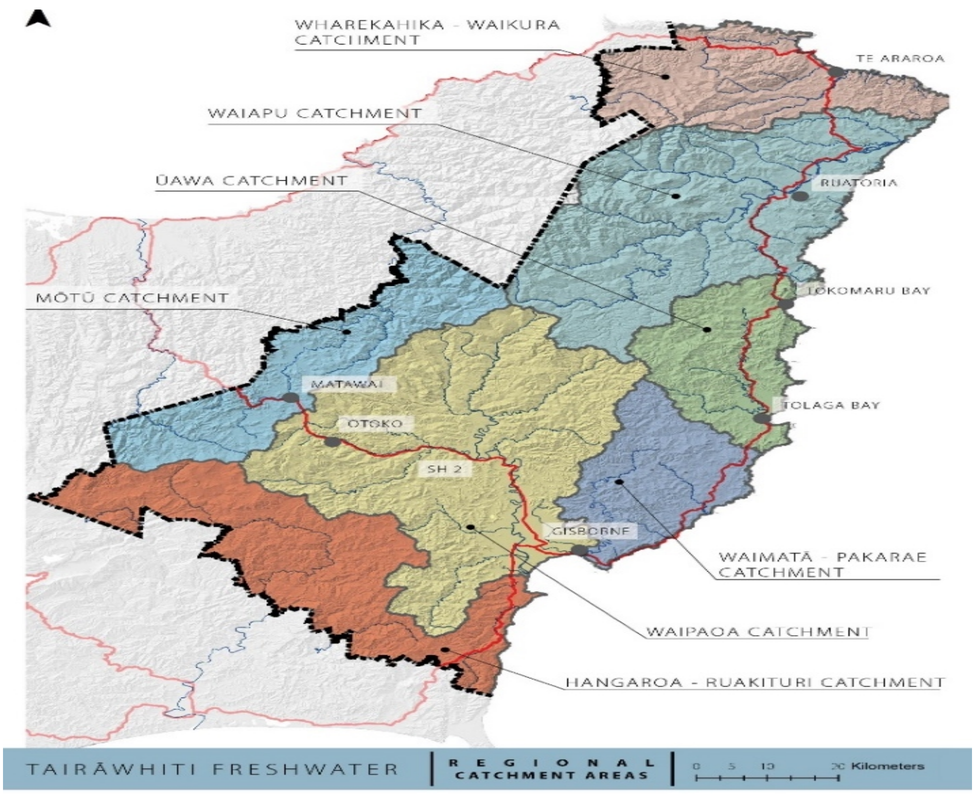
BACKGROUND - HE WHAKAMĀRAMA

1. This report provides a progress update on freshwater planning since **Report 23-236** in November 2023. The background information to this report is covered in **Report 23-22**.

2. The Resource Management Act 1991 (RMA) requires all regional councils to prepare freshwater plans that give effect to the NPS-FM 2020. Council has given effect to an earlier version of the NPS-FM 2014 through the operative Regional Freshwater Plan and Waipaoa Catchment Plan. These plans were publicly notified together in 2015 and made fully operative on 30 August 2023 (see **Report 23-79** for full details).

3. Freshwater planning is one of three workstreams within the Tairāwhiti Resource Management Plan (TRMP) review programme. The freshwater planning workstream includes research, engagement and policy development and has been underway since mid-2020.

4. The freshwater planning framework is divided into two parts:
   - A Regional Freshwater Plan containing provisions managing freshwater-related activities that apply anywhere within the region.
   - Seven catchment plans containing provisions managing freshwater quality and quantity issues specific to catchment areas. These areas are:
     - Waipaoa
     - Mōtū
     - Southern Tairāwhiti (Hangaroa – Ruakituri)
     - Waimatā – Pakarae
     - Ūawa
     - Waiapu
     - Wharekahika – Waikura.



Projects underway

Review of Regional Freshwater Plan and Waipaoa Catchment Plan

5. ***Overview:*** Developed and publicly notified together in 2015, these plans are now also being reviewed together.

6. Gisborne's Regional Freshwater Plan objectives, policies and rules for the management of freshwater quantity and quality, and activities that impact on freshwater across Tairāwhiti. Within this plan there are four main sections:

   - Water quantity and allocation.
   - Water quality and discharges to land and water.
   - Activities in the beds of rivers and lakes.
   - Riparian margins and wetlands.

7. The Waipaoa Catchment incorporates 12 major sub-catchment areas with a combined land area of 2,200 km². It is an important source of water for irrigation, a back-up source of water for Gisborne city, and the major recharge source for extensively used aquifers. Key sub-catchments of the Waipaoa include the Waikohu, Mangatu, Waingaromia, Wharekopae, and Te Arai.

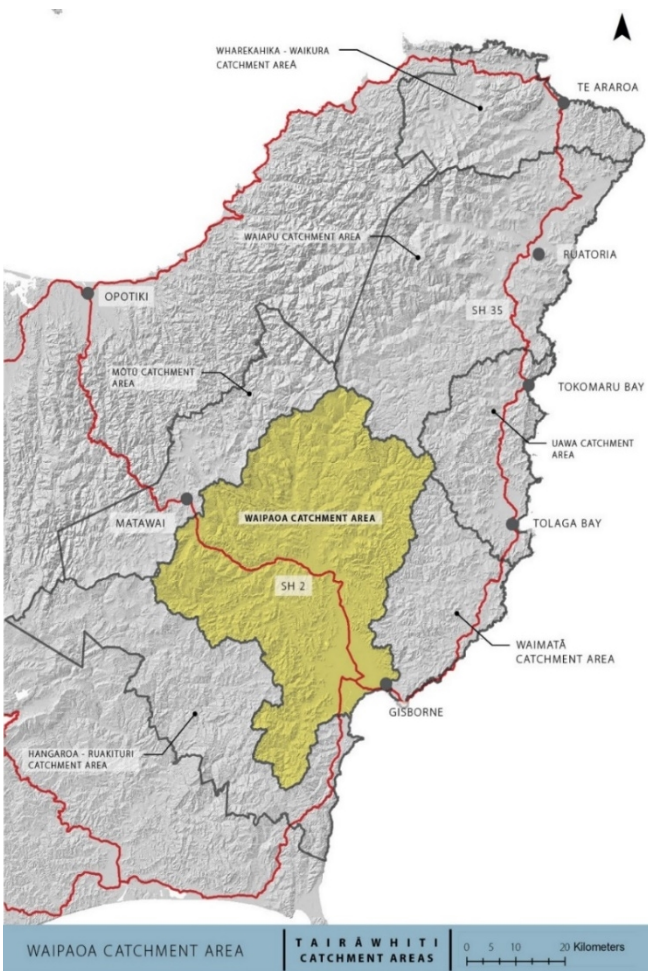


Figure 2: Map of the Waipaoa Catchment Area

8. ***Engagement:*** Staff have established separate advisory groups for each of these plans. The groups represent tangata whenua and a range of stakeholder interests including farming, forestry, conservation and horticulture. Its 6th hui is planned for 13 March 2024. The advisory groups will wrap up at the end of the year when each of the topics covered is synthesised into a draft plan.

9. Staff have also engaged with tangata whenua on smaller sub-projects including:

   - Working with Nga Uri o Te Kooti Rikirangi to apply Te Mana o te Wai principles to the Maungarongo wetland and develop a management plan to guide its future use and protection.
   - Engaging Rongowhakaata hapū across several wananga to apply Te Mana o te Wai to Te Arai River. We intend to engage the recently established Te Arai catchment group and the wider catchment community this year. We will look to develop an all of catchment approach to managing Te Arai.

- Support to groups involved Wai Tuwhera o te Taiao programme[13] to deploy eDNA kits across the region. The programme has assisted in developing skills in environmental monitoring and helped create a picture of stream health in the wake of Cyclone Gabrielle.

10. ***Research:*** We continue to do research and technical work to support both the Regional Freshwater Plan and the Waipaoa Catchment Plan. These include:

11. Convening a panel of experts to help set targets for water quality across three contaminant problems in Tairāwhiti:
    - Nutrient leaching on the Poverty Bay Flats – particularly as it relates to the Taruheru River.
    - Sediment across the region.
    - E. coli across the region.

12. Developing a model that builds our understanding of the major sources of nutrients in freshwaters of the Poverty Bay flats and the current land use practices that may be contributing to elevated levels of nitrate and phosphorus[14]. Plant and Food Research (a Crown Research Institute) have been engaged to do this work. Progress on this work has been slow due to limited survey data gathered from local growers, and capacity issues at Plant and Food Research[15].

13. Developing a better understanding of flow requirements for the Te Arai and Waipaoa rivers. The National Institute of Water & Atmospheric Research (NIWA) undertook a hydrology review of these two awa last year. A report was completed in November and outlines options for how river flows might be managed to support habitat and other instream values. This work is discussed in more detail in **report 24-24**, which will also be on the agenda at the 14 March Council meeting.

14. Undertaking a geomorphology assessment of the Te Arai catchment, in collaboration with Rongowhakaata Iwi Trust. The goal is to better understand how the geology and landform influences the hydrology of the catchment. This study will help us to identify areas prone to erosion, sediment deposition, and channel migration (for example, meanders that are particularly dynamic). The study will also consider options and the potential for increasing flood resilience and the restoration of the riparian zone along Te Arai River.

15. Procuring oblique aerial imagery to support the identification of wetlands across the region. This imagery will also be invaluable to verifying the extent of the region's worst eroding land (called Land Overlay 3B). This work is central to the forestry plan change work that is currently underway.

[13] A programme initiated and funded by the Environmental Protection Agency, with support from Wilderlab who have provided eDNA kits and guidance on their use in freshwater monitoring.

[14] Referred to as the Soil Plant Atmosphere System Model, or SPASMO. SPASMO models the transport of water, microbes and nutrients through soils, integrating variables such as climate, soil, water uptake by plants in relation to farm and orchard practices, and any other factors affecting environmental process and plant production.

[15] Demands from other regional councils across Aotearoa has put pressure on all Crown Research Institutes to deliver work within the timeframes initially required for freshwater planning.

16. Council's Environmental Monitoring Team have been deploying eDNA[16] kits across all our biomonitoring sites in the region during the summer period. The results can indicate the presence of rare and invasive species and be used for ecosystem health evaluation and environmental impact assessments. We will report back on this once the results have been analysed.

17. Inanga spawning sites and salt wedge mapping will provide further understanding around exact inanga spawning locations and opportunities for their future restoration/protection.

18. ***Next steps:*** The team will continue to engage the two freshwater advisory groups for the remainder of the year. We will also look to support further tangata whenua engagement where there is interest to do so. Water quantity and allocation will become an important conversation in 2024 and to support this we will also look to discuss this topic with local growers and the community.

19. The freshwater planning team will look to round off the technical work this year to set the evidence base for policy development.

Mōtū Catchment Plan:

20. ***Overview:*** The Mōtū Catchment Plan area represents two freshwater catchments that straddle the Tairāwhiti and Bay of Plenty regions. These catchments are:
    - The Waioeka – Otara Catchment, including the Koranga River on the Gisborne side; and
    - The Mōtū Catchment.

21. Their combined area is 886km² and includes the only upland streams and rivers in the Tairāwhiti Region.

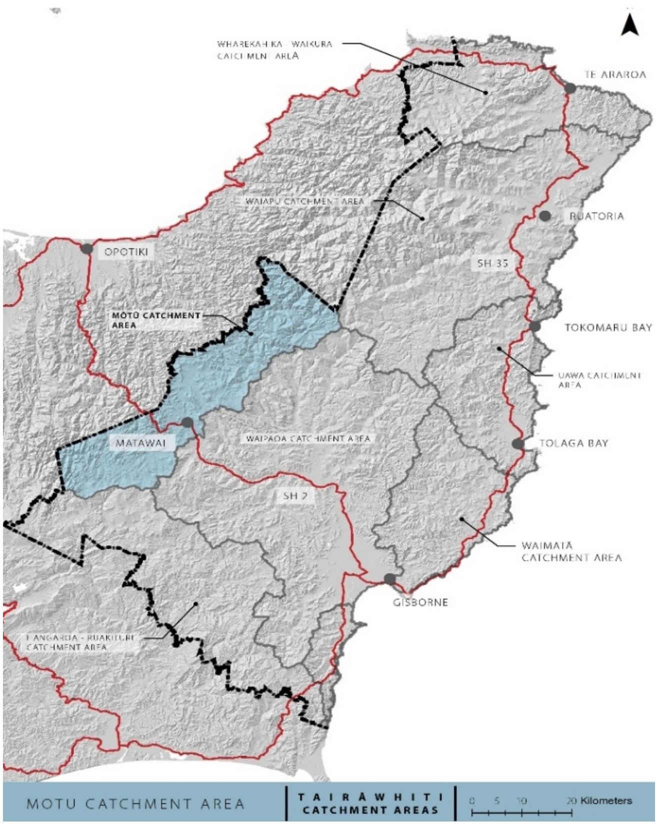


Figure 3: Map of Mōtū Catchment Plan area

16 Environmental DNA, or eDNA, refers to all the tiny traces of genetic material that is left behind as living things pass through water or soil. By collecting up discarded DNA and sequencing it, we can get a picture of the plants and animals in a local area.

22. ***Progress:*** The draft plan and accompanying section 32 report have both been completed. However, progress to plan notification was put on hold as Council staff capacity was redirected to recovery efforts post-cyclone. Legal review of the draft plan was completed in September 2023.

23. ***Next steps:*** Once internal review of the draft Plan and section 32 report has been completed and the proposal circulated to iwi authorities, we expect to publicly notify this Plan mid-2024.

Waimatā – Pakarae Catchment Plan

24. ***Overview:*** The Waimatā-Pakarae Catchment Plan area represents eight freshwater catchments that flow to the eastern coastline from Gisborne city at its southern extent to Waihau Bay just south of Tolaga Bay. These catchments include:
    - the Waimatā River which is located directly north of Gisborne City,
    - the Pakarae River which is located south of Tolaga Bay,
    - several smaller catchments located along the coastal margin between the Pakarae River and Gisborne City. These catchments include the Waiomoko River, Pouawa River, Hamanatua Stream, Wainui Stream and Kopuawhakapata Stream.

25. Their combined total area is 650km². The two largest are the Waimatā (227km²) and the Pakarae (243km²).

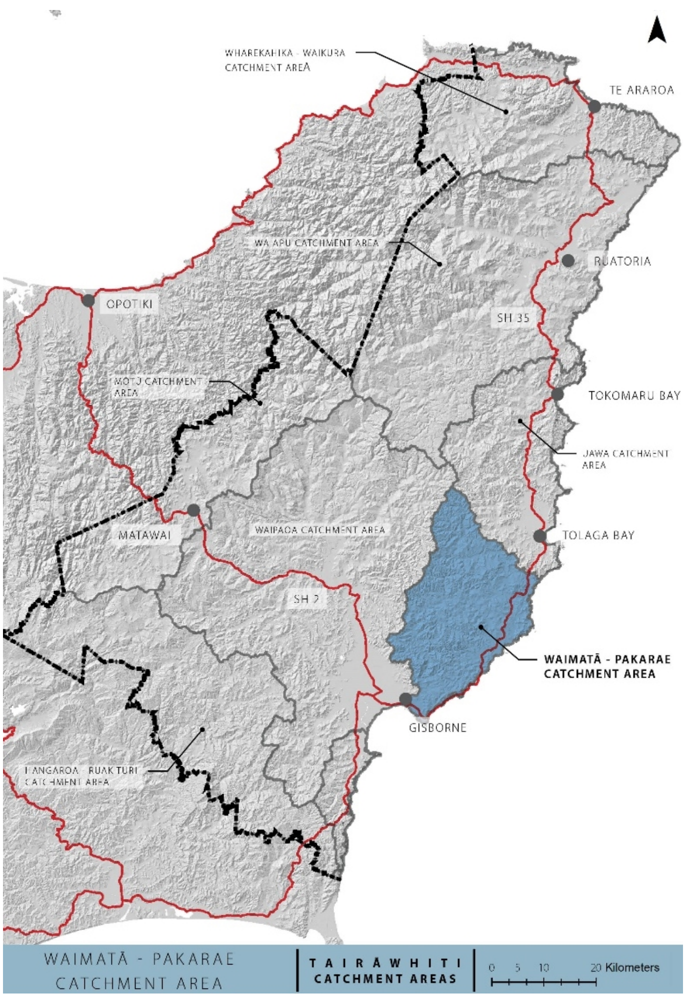


Figure 4: Map of Waimatā - Pakarae Catchment Area

26. ***Engagement:*** Consultation and engagement for this project proceeded throughout 2023 and included discussions with:
    - The Waimatā Catchment Group and Whangara Catchment Group
    - Whangara B5 representatives
    - Ngati Kanohi
    - Ernslaw One
    - Mahaki Mahinga Kai team
    - The Whangara community

27. Staff held a community hui at the Wainui Surf Club in October. Following this a Catchment Advisory Group of 10 local people from the catchment was formed in November. The group's first hui is set for 27 February 2024. Local consultant Ranell Nikora (Whainga consultancy) is supporting tangata whenua engagement for this project.

28. ***Next steps:*** Advisory group hui will progress throughout this year and inform the development of a draft catchment plan. The draft plan will be socialised with the community for feedback following this engagement.

Waiapu Catchment Plan

29. ***Overview:*** The Waiapu Catchment is the second largest catchment in the Gisborne-Tairāwhiti region with a catchment area of 1730 km². It rises in the eastern part of the Raukumara Range and drains northwards to Ruatorea and meets the coast at Port Awanui. It has seven major tributary sub-catchments as well as the Waiapu River itself. These are:
    - Maraehara River
    - Poroporo River
    - Mangaoporo River
    - Tapuaeroa River
    - Lower Matā River
    - Waitahaia River
    - Ihungia River
    - Upper Matā River

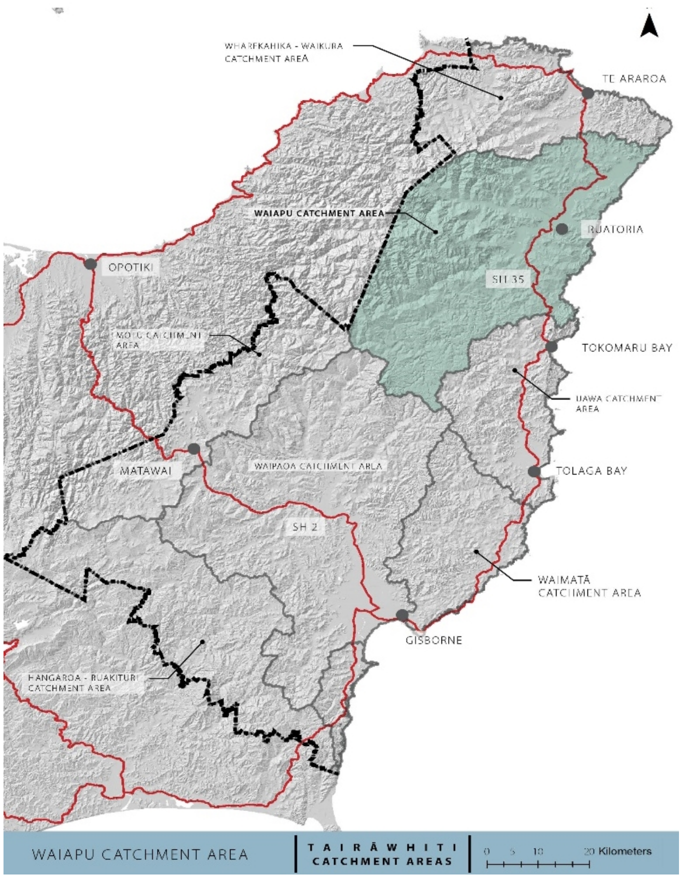


Figure 5: Map of Waiapu Catchment Area

30. The Waiapu Catchment Plan is being developed as a partnership between Council and Te Runanganui o Ngāti Porou. This partnership gives effect to the Joint Management Agreement (JMA) in place between Council and Te Runanganui o Ngāti Porou (TRONPnui) for the Waiapu Catchment.

31. ***Engagement:*** Engagement began with Ngāti Porou representatives holding a series of wananga with hapū collectives including:
    - August 2021 - Hikurangi Takiwā, Te Papatipu o Uepohatu.
    - September 2021 – Te Wiwi Naati, Tokomaru Akau.
32. After several preliminary hui, representatives of Ngāti Porou and Council staff formed a technical roopu and have since progressed through a work programme to develop the Waiapu Catchment Plan.
33. Community hui were held at Tikitiki RSA and Ruatoria RSA on 7 December 2022. The focus of this engagement was to provide an overview of the project and to provide people with an opportunity to feed into the process. Participants included local residents, farmers and gravel contractors.
34. Regular hui with the technical roopu proceeded until mid-2023 after which a change in priorities at TRONPnui created a pause in our collaboration. This impacted on our goal to develop a draft plan by the end of 2023. Council is now working with the Ngāti Porou Taiao Team to renew commitments to completing the catchment plan by the end of 2024.
35. ***Research:*** Staff are still working on undertaking technical work to support better decision making around gravel management. This includes an ecological assessment and cultural values assessment for the Waiapu river. This will help determine areas of the river that may be particularly sensitive to gravel extraction activities and require a higher level of protection.
36. ***Next steps:*** Our priority is to confirm working arrangements with TRONPnui. This approach and a work programme for the year could be confirmed through the Joint Management Agreement Forum (JMAF) which has not convened since February 2022.

Ūawa Catchment Plan

37. ***Overview:*** The Ūawa Catchment Plan incorporates the stream and river systems in and around Tolaga Bay and Tokomaru Bay. It includes the small coastal stream catchments from Waihau Bay to Koutunui Head – including stream systems flowing into Karaka Bay and Anaura Bay as well as the two main river catchment areas of the Ūawa and Mangahauini River systems. The Catchment Plan has a combined land area of 699km². Within the Ūawa River system the key tributaries are the Waiau River, Mangaheia River, Mangatokerau River, and Hikuwai River.

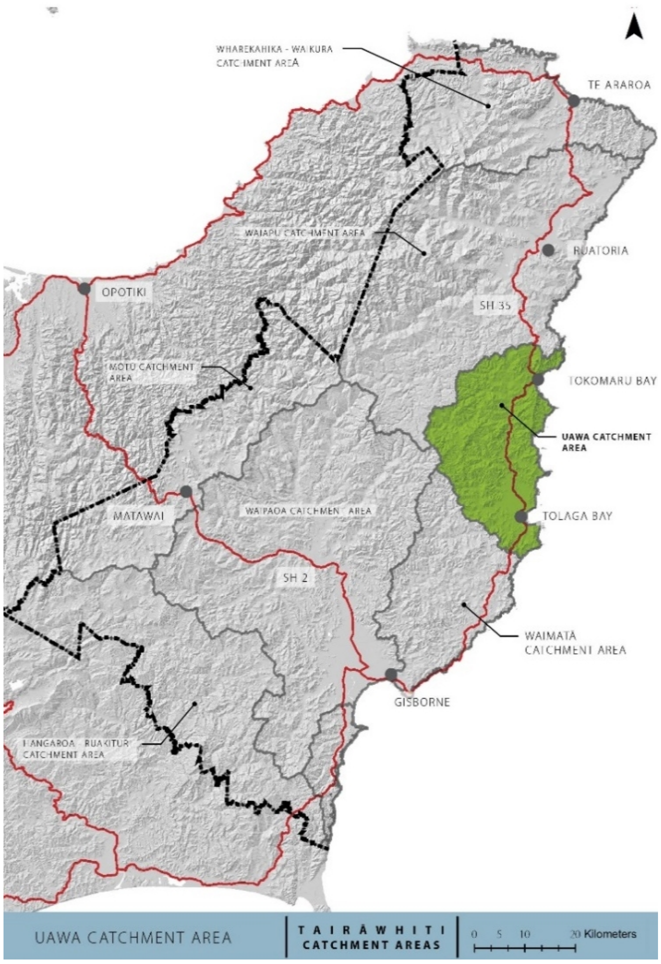


Figure 6: Map of Ūawa Catchment Area

38. ***Engagement:*** Staff met with Hauiti Mana Kaitiaki in July 2023 to begin discussions on how to work together in the development of the Ūawa Catchment Plan. Several meetings have followed to explore and confirm scope of the project. There are other threads of important mahi that intersect with this catchment area including:
    - Cyclone Gabrielle recovery efforts
    - Forestry Plan Change
    - Freshwater Farm Planning

39. We will look to bring these threads together as we move forward in our engagement with mana whenua and the community.

40. ***Next steps:*** Staff will start the catchment planning process with a community hui in March. From there we will look to form a catchment advisory group that can inform the plan development. We expect Hauiti Mana Kaitiaki representatives to be a part of that group along with other stakeholders from the Ūawa community.

__Southern Tairāwhiti (Hangaroa – Ruakituri) Catchment Plan__

41. ***Overview:*** The Hangaroa-Ruakituri Catchment Plan area represents five freshwater catchments that flow towards Hawke's Bay in the south and four catchments that flow into Tairāwhiti's eastern coastline from the boundary with Wairoa up to the Wherowhero Lagoon.

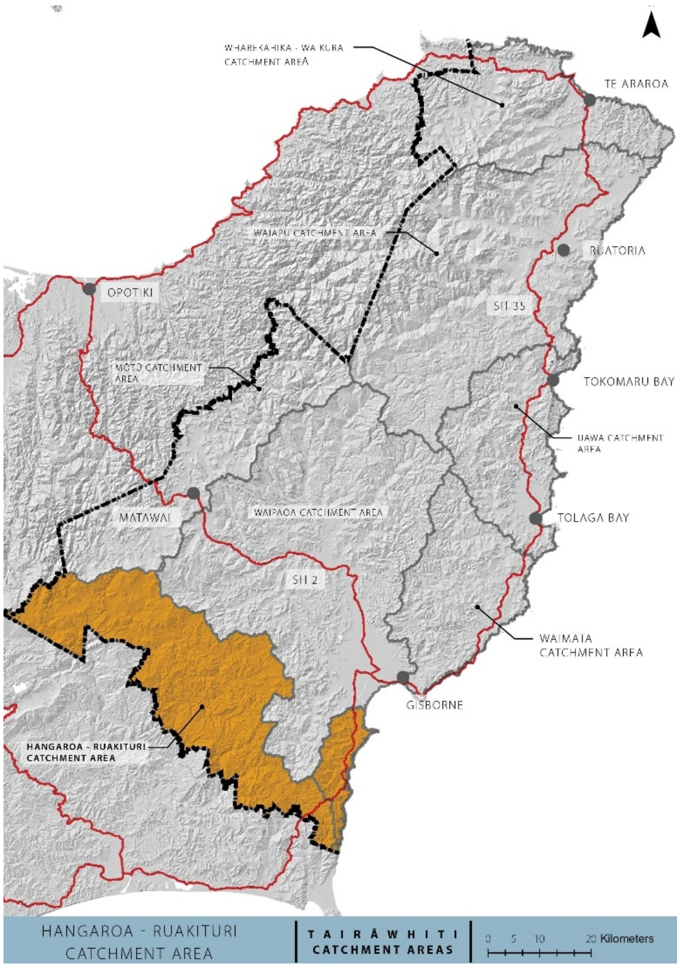


Figure 7: Map of Southern Catchment Area

42. Their combined total area is 650km^2. The largest catchment area is the Hangaroa (726 km^2), followed by Mangapoike (185 km^2) and Ruakituri (130 km^2).

43. ***Engagement/Next steps:*** Staff are still looking to confirm suitable dates for engaging with Ngai Tāmanuhiri as an entry point into the catchment planning process. Several productive meetings have been held with Hawkes Bay Regional Council (HBRC) to discuss cross-boundary matters. HBRC have put their mahi on hold to focus on recovery from Cyclone Gabrielle.

44. While there is flexibility in our current timeframes, the team would ideally be placed to begin by no later than mid-2024.

__Northern Tairāwhiti (Wharekahika – Waikura) Catchment Plan__

45. ***Overview:*** The Wharekahika-Waikura Catchment incorporates 8 sub-catchment areas with a combined land area of 859 km², north of Gisborne. These catchments include:
    - Waikura catchment
    - Whangaparaoa catchment
    - Wharekahika catchment
    - Karakatuwhero catchment
    - Awatere catchment
    - Orutua catchment
    - Waipapa catchment

46. Several smaller catchments along the coastal margin: between the Wharekahika and Karakatuwhero catchments, between Awatere and Orutua catchments, between Orutua and Waipapa catchments, and the eastern coast of the Waipapa catchment.

47. ***Engagement/Next steps:*** Staff are currently working with tangata whenua on Council's bore drilling project. This mahi has formed a solid platform of engagement which we will look to continue into the catchment planning process.

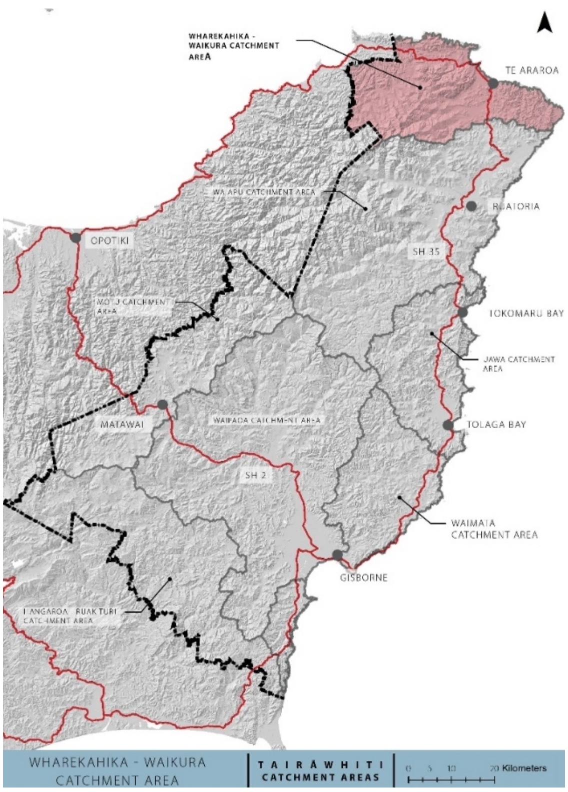


Figure 8: Map of Northern Catchment Area

DISCUSSION and OPTIONS - WHAKAWHITINGA KŌRERO me ngā KŌWHIRINGA

Shifting timeframes for completion of freshwater planning

48. Until recently, the RMA (s80A) required all regional councils to notify their freshwater planning instruments by 31 December 2024.

49. Cyclone Gabrielle heavily impacted Tairāwhiti and Hawke's Bay. With recovery being a key focus for 2023, Gisborne District Council and Hawke's Bay Regional Council both advised the Ministry for the Environment of their limited capacity to meet statutory deadlines set out under the RMA and associated regulations.

50. The Ministry of the Environment responded and issued the Severe Weather Emergency Recovery (Resource Management – Time Extensions) Order 2023. By clause 6(a) of this order, Gisborne District Council was required to notify all freshwater planning instruments by **31 December 2026**.

Implications for freshwater planning with the newly elected coalition government

51. New Zealand held its 54th general election on 14 October 2023. The final results saw the formation of a coalition government, consisting of the National Party, ACT, and New Zealand First on 27 November 2023. On 29 November 2023 Prime Minister Christopher Luxon unveiled the Coalition Government's 100-day plan.[17]

52. As part of the 100-day plan, the Coalition Government passed legislation repealing the Natural and Built Environment Act (NBEA) and the Spatial Planning Act (SPA). The Bill[18] includes provisions to give all councils an extra three years, until **31 December 2027**, to publicly notify their freshwater plan changes. Both Acts had only taken effect three months before the repeal. The previous Government intended for the NBEA to replace the Resource Management Act (RMA).

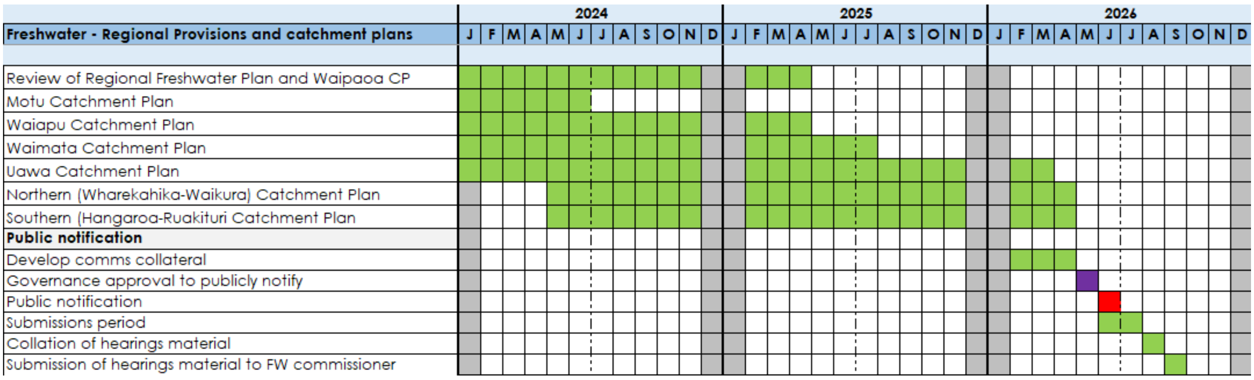
53. The Government has also announced its intention to begin work on a replacement for the National Policy Statement-Freshwater Management (NPS-FM) in 2024. The now three-year extension is to provide councils and communities more time for this work.

54. As an interim measure, the Government intends to amend the RMA to change how consent authorities apply the Te Mana o te Wai hierarchy of obligations to individual consent applications. The intention is to clarify that consent applicants do not have to demonstrate how their individual activity adheres to the hierarchy, and consent authorities won't be able to consider the hierarchy in their decision-making. These changes do not affect Freshwater Farm Plans, which are continuing to be implemented.

55. Staff will keep Council updated as more information is released.

[17] https://www.rnz.co.nz/news/political/503534/government-confirms-its-100-day-plan
[18] Changes to resource management | Ministry for the Environment

56. Staff remain committed to progressing the freshwater workstream in a way that meets both our statutory requirements and the aspirations of our Treaty partners and our community. Our current aim is to ready our freshwater plans for notification by mid-2026. This involves:
    - Focusing on engagement across all catchments during 2024 and into the first half of 2025.
    - Completing any outstanding research and technical work in 2024.
    - Developing plan content from mid-2024 and packaging up draft plans in 2025.
    - Readying the freshwater plan package for notification in the first half of 2026.



ASSESSMENT of SIGNIFICANCE - AROTAKENGA o NGĀ HIRANGA

Consideration of consistency with and impact on the Regional Land Transport Plan and its implementation
Overall Process: Low Significance
This Report: Low Significance

Impacts on Council's delivery of its Financial Strategy and Long Term Plan
Overall Process: Low Significance
This Report: Low Significance

Inconsistency with Council's current strategy and policy
Overall Process: Low Significance
This Report: Low Significance

The effects on all or a large part of the Gisborne district
Overall Process: High Significance
This Report: Medium Significance

The effects on individuals or specific communities
Overall Process: High Significance
This Report: Medium Significance

The level or history of public interest in the matter or issue
Overall Process: High Significance
This Report: High Significance

57. The decisions or matters in this report are considered to be of **Medium** significance in accordance with Council's Significance and Engagement Policy.

58. Freshwater is essential to our people (social and cultural values) and our economy, while also part of the intrinsic values of waterbodies and their ecosystems. The historic approach to water allocation has led to an inequity between those who have and those who don't have access to water. This has been particularly the case for tangata whenua where whenua Māori has not been developed and now is prevented from accessing water despite often being located adjacent to waterbodies.

59. Council remains committed to meaningfully engage with our Treaty partners and our community to reduce the gap of inequity through the freshwater planning process.

TANGATA WHENUA/MĀORI ENGAGEMENT - TŪTAKITANGA TANGATA WHENUA

60. Council have progressed a Te Mana o te Wai review of the operative Regional Freshwater Plan and Waipaoa Catchment Plan in collaboration with the iwi technicians. The review provides information to Council and tangata whenua on ways in which we may want to consider applying Te Mana o te Wai in the new Regional Freshwater Plan and seven catchment plans. The Te Mana o te Wai review will also complement the evaluation that Council staff are conducting under section 35 of the RMA.

61. The outcome of the Te Mana o te Wai review is intended to:
    - Inform how Council support mana-enhancing partnerships with iwi and hapū.
    - Provide recommendations on how the National Objectives Framework (NOF) may be applied through early engagement with iwi and hapū, outlining the components of the plans that are not well aligned and successfully aligned with Te Mana o te Wai.

62. Staff will be progressing the recommendations in the final report of this review in the first quarter of 2024.

63. Tangata whenua have been engaged through the development of the Mōtū and Waiapu Catchment Plans. Staff have been working with hapū on freshwater planning for Te Maungarongo o te Kooti and Te Arai since 2023. We expect to continue these engagements alongside other engagements planned for 2024.

64. The joint development of the Waiapu Catchment Plan is made possible through a Joint Management Agreement (JMA)[19] in place between Council and Te Runanganui o Ngāti Porou (TRONPnui). The establishment of the JMA has provided another pathway to meaningful engagement for the Waiapu Catchment Plan. More information on the JMA was previously informed in **Report 23-129**.

[19] Enabled under section 36B of the Resource Management Act 1991. A JMA provides for both parties in the agreement to jointly perform the local authority's functions in relation to a natural or physical resource in all or part of the region/district.

COMMUNITY ENGAGEMENT - TŪTAKITANGA HAPORI

65. Ongoing engagement with our Treaty partners and our community is fundamental to the development of the Regional Freshwater Plan and the seven catchment plans.

66. One way of engaging with our Treaty Partners and community is through the establishment of Advisory Group for each catchment. An Advisory Group is composed of local people with experience from different sectors and interest groups: farming, conservation, forestry, horticulture and Māori landowners. We support tangata whenua to be members within this group as well, in addition to catchment-specific iwi and hapū engagement.

67. Webpages for the Regional Freshwater Plan and the seven catchment plans are now available to the public:

    - **Regional Freshwater Plan** - https://www.gdc.govt.nz/council/review-of-tairawhiti-resource-management-plan/regional-freshwater-plan-review
    - **Waipaoa Catchment Plan** - https://www.gdc.govt.nz/environment/our-rivers/catchment-plans/waipaoa-catchment-plan-review
    - **Mōtū Catchment Plan** - https://www.gdc.govt.nz/environment/our-rivers/catchment-plans/motu-catchment-plan
    - **Waiapu Catchment Plan** - https://www.gdc.govt.nz/environment/our-rivers/catchment-plans/waiapu-catchment-plan
    - **Waimatā – Pakarae Catchment Plan** - https://www.gdc.govt.nz/environment/our-rivers/catchment-plans/waimata-pakarae
    - **Ūawa Catchment Plan** - https://www.gdc.govt.nz/environment/our-rivers/catchment-plans/uawa
    - **Southern Tairāwhiti Catchment Plan** - https://www.gdc.govt.nz/environment/our-rivers/catchment-plans/catchment-plan-5
    - **Wharekahika – Waikura Catchment Plan** - https://www.gdc.govt.nz/environment/our-rivers/catchment-plans/catchment-plan-6

CLIMATE CHANGE – Impacts / Implications - NGĀ REREKĒTANGA ĀHUARANGI – ngā whakaaweawe / ngā ritenga

68. The climate change implications on our region have been previously reported in **Report 23-22**.

69. The accompanying **Report 24-24** to this Council meeting provides new information on the state of our freshwater and the implications of the information on the freshwater planning.

CONSIDERATIONS - HEI WHAKAARO

Financial/Budget

70. Resourcing for freshwater planning and the wider TRMP review is included as part of the operational budgets in the **2021 – 2031 Long Term Plan**.

71. The extension of the freshwater legislative timeframes to December 2027 may have financial implications on the overall allocation of the TRMP budget. The TRMP programme team are working together with the workstream leads in updating the project plan to ensure coordinated delivery in this Phase 1.

Legal

72. The development of the Regional Freshwater Plan and the seven catchment plans gives effect to the requirements of the NPS-FM 2020. These plans will form part of the TRMP, help Council and Tairāwhiti communities make informed decisions around freshwater management and support the improvement of water quality across our region.

POLICY and PLANNING IMPLICATIONS - KAUPAPA HERE me ngā RITENGA WHAKAMAHERE

73. The freshwater planning process is expected to meet the following outcomes identified in Tairāwhiti's Spatial Plan (**Tairāwhiti 2050**):

    - **Outcome 1: A driven and enabled Tairāwhiti**, where Council works with iwi, hapū and stakeholders to promote and enable change in the region.
    - **Outcome 2: Resilient communities**, where Council engages in community-led adaptation planning to increase resilience of our infrastructure, communities and our economy.
    - **Outcome 5: We take sustainability seriously**, where Council recognises the threat of climate change on the future of our region and ensures planning will enhance Tairāwhiti's natural and built environment for our future generations.
    - **Outcome 6: We celebrate our heritage**, where Council supports mana whenua in the exercise of kaitiakitanga over the environment and showcasing the multiple benefits of the Tairāwhiti's rich dual heritage.
    - **Outcome 8: Delivering for and with Māori**, where Council and iwi build and maintain strong partnerships that ensure our region's taonga are restored and protected for generations to come.

RISKS - NGĀ TŪRARU

74. **Financial** – The extension to the freshwater legislative timeframes, from previously December 2024 to the extended December 2027, is expected to have financial implications. Council is committed to undertake meaningful engagement with our Treaty partners and stakeholders, which contributes to the operating expenses in the allocated freshwater workstream budget. Meanwhile technical procurement may still occur should any evidence gaps be identified. The Freshwater Planning workstream lead has been in discussions with the TRMP programme team to ensure uninterrupted delivery of the Regional Freshwater Plan and the seven catchment plans. This is a **low** risk, as long as sufficient budget is allocated through the 2024 Three Year Plan process.
75. **Changing national direction** – The review of the Regional Freshwater and Waipaoa Catchment plans and the development of the other six catchment plans are currently being developed under the current NPS-FM 2020.
76. The new government has already signalled its intent to replace the NPS-FM 2020. Work on this will start immediately, will be expected to take 18 to 24 months, and will include a robust and full consultation process with all stakeholders including iwi and the public[20]. At this stage, the scope and nature of the changes are unknown.
77. There is a risk that the new NPS-FM will introduce changes that are not aligned to the plans we develop under the existing framework. If this is the case, then our plans may need to be reworked to ensure consistency with legislation.
78. However, the fundamental need to address water quality and quantity issues will remain. How far and how fast these issues are addressed remains for Council to determine through decisions on policy options. It is unlikely that the new NPS-FM will fundamentally affect Council's choices in this regard.
79. At this point in time, we consider this issue to be a **low** risk but will continue to appraise the situation as we receive more information.
80. **Engagement fatigue due to lack of capacity** – The impacts of Cyclones Hale and Gabrielle have led to increased attention from our Treaty partners and our community on the state of our environment in Tairāwhiti. Despite the extension to the freshwater legislative timeframes, it is crucial for our region to not lose the momentum built from acknowledging the climate-related crisis and its impact on freshwater. There is a **medium** risk that engagement fatigue will arise from Council, Treaty partners and community as competing priorities will stretch peoples' time and availability. However, this risk can be mitigated by a cross-Council coordination of engagement with tangata whenua and our community.

NEXT STEPS - NGĀ MAHI E WHAI AKE

Date	Action/Milestone	Comments
Mid-2024	Public notification of the Mōtū Catchment Plan	

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[20] https://www.beehive.govt.nz/release/government-takes-first-steps-towards-pragmatic-and-sensible-freshwater-rules

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

24-23

Title:	**24-23 Freshwater Implementation Update**
Section:	Strategic Planning
Prepared by:	Ariel Yann le Chew - Policy Planner
Meeting Date:	Wednesday 20 March 2024

Legal: No	Financial: No	Significance: **Medium**

Report to COUNCIL/TE KAUNIHERA for information

PURPOSE - TE TAKE

The purpose of this report is to provide an update to Council on projects currently being implemented that give effect to or relate to freshwater policy.

SUMMARY - HE WHAKARĀPOPOTOTANGA

This report provides an overview of several projects underway that implement freshwater policy with the aim of improving outcomes for the state of our freshwater. These environmental improvement projects demonstrate the central role that Council plays in facilitating these projects while working together with tangata whenua and other stakeholders in achieving our environmental aspirations for freshwater. These projects also reinforce the need for integration across Council teams and with the community.

This report provides an update on the Freshwater Improvement Fund (FIF), Stormwater Integrated Catchment Management Plan (ICMP), Taruheru River Restoration Project and Freshwater Farm Plans (FWFPs) since the last update in September 2023 (**Report 23-21**). This report adds a new project of exploring nature-based solutions for flood resilience in the Waimatā catchment. With growing importance and legislative focus on improving freshwater outcomes, the success of these projects is heavily dependent on adequate resourcing and capacity to support the implementation of these projects.

The newly elected Coalition Government announced its intention to replace the National Policy Statement for Freshwater Management (NPS-FM) 2020, with all councils given a three-year extension until 31 December 2027 to publicly notify their freshwater planning instruments. This extension also allows councils and their communities more time to adapt to this replacement. At the time of writing this report, Freshwater Farm Plans are expected to roll out as planned with no changes. However, staff will update this Council when more information about the NPS-FM replacement is released.

The decisions or matters in this report are considered to be of **Medium** significance in accordance with the Council's Significance and Engagement Policy.

RECOMMENDATIONS - NGĀ TŪTOHUNGA

That the Council/Te Kaunihera:

1. Notes the contents of this report.

Authorised by:

Joanna Noble - Director Sustainable Futures

Keywords: Freshwater implementation, Non-regulatory projects, Freshwater, Freshwater Farm Plan

BACKGROUND - HE WHAKAMĀRAMA

1. This report provides a progress update on freshwater improvement projects covered previously in **Report 23-21**.

2. The National Policy Statement for Freshwater Management (NPS-FM) 2020 provides councils national direction on freshwater. Te Mana o te Wai is the central concept that introduces a hierarchy of obligations where water is placed at the centre of all decisions. The priorities are:

   - **1st priority**: put the health and wellbeing of water first.
   - **2nd priority**: health needs of people (such as drinking water).
   - **3rd priority**: ability of people and communities to provide for their social, economic and cultural wellbeing.

3. Council is required to give effect to Te Mana o te Wai through planning, engagement, and actively involving tangata whenua (to the extent they wish to be involved) in freshwater management[21].

4. The NPS-FM 2020 also introduces the National Objectives Framework (NOF), which is a process that all councils must undertake in outlining a roadmap from the current state of its waterbodies to the aspirational and achievable vision for its waterbodies within a specified timeframe. Action plans may be necessary for some waterbodies where the current state needs improvement to achieve the long-term vision. The ten non-regulatory projects in the operative Waipaoa catchment provisions in the Tairāwhiti Resource Management Plan (TRMP) are an example of action plans for a catchment.

Progress Update

Freshwater Improvement Fund (FIF)

5. The Freshwater Improvement Fund (FIF) - Haumanu tu Ora (H2O) - is a programme of works aimed at restoring the mauri and ora of the Tūranganui Estuary System to improve freshwater and estuarine values. The programme consists of several projects. These projects include riparian planting, wetland restoration, the removal of fish passage barriers, enhancing fish spawning, and fencing off awa in Gisborne's urban and peri-urban waterways. Another key element of the programme is removing stormwater contaminants using wetlands.

6. The total project cost is $4,950,000, where Ministry for the Environment (MfE) funds $2,250,000 and Council contributing $2,700,000 through existing budgets. The project will run from January 2022 until the end of June 2026.

7. It is being carried out in partnership with Ngāti Oneone (Ngāti Porou), Te Whanau a Iwi (Māhaki) and Ngai Tawhiri (Rongowhakaata).

8. ***Progress made***: The pilot programme for monitoring and trapping along the Kopuawhakapata stream in collaboration with Whaia Titirangi currently has 12 traps in this residential area.

9. The spartina pilot programme was delivered on the 12 January 2024. H2O and Biosecurity successfully sprayed 0.6ha of spartina on the Taruheru river.

[21] Essential Freshwater Te Mana o te Wai factsheet (environment.govt.nz)

10. The team moved 15,000 plants to Aberdeen nursery and built shade structures and installed irrigation.

Figure 9: Photo of Aberdeen nursery with the 15,000 plants.

11. The maintenance of existing sites is being undertaken, and 12,950m^2 of planted sites were maintained/released in this reporting period.

Figure 10: Matokitoki Stream, July 2022.

Figure 11: Matokitoki Stream, January 2024.

Figure 12: Te Papa o Nelson, August 2022.

Figure 13: Te Papa o Nelson, January 2024.

Figure 14: Te Papa o Waiteata, July 2022.

Figure 15: Te Papa o Waiteata, February 2024.

12. The 2024 planting season (June – August) is planned, and site preparation is underway.

13. We had our first workshop with mana whenua regarding the wetland feasibility study and four preferred sites (Te Hapara, Botanical Garden, Innes Street and a private farm in Sponge Bay) have been chosen for an in-depth feasibility study).

14. **Next Steps**:

    a. On-going maintenance for planted sites

    b. Remediation of six fish barriers over summer

    c. Community engagement for 2024 planting season

    d. Planning of main spartina replacement project on Taruheru River

    e. Algae bloom risk assessment for human and dog health in city rivers

    f. Expansion of pest animal trapping pilot through requiring additional external funding

    g. Launch H2O Webpage for public information

    h. Inanga spawning project of 4 sites in the Taruheru, Waikanae and Waimatā catchments.

Stormwater Integrated Catchment Management Plan (ICMP)

15. Council owns and maintains stormwater infrastructure to manage stormwater from roads, houses, buildings and impervious areas (hard surfaces) in Gisborne City and rural settlements across Tairāwhiti. Stormwater from private property and state highways also flow into this network and the receiving environment.

16. The operative TRMP requires the development of an Integrated Catchment Management Plan (ICMP) for stormwater by July 2025 and/or obtaining stormwater network consents where required. The TRMP defines an ICMP as:

> *"A plan detailing the management of stormwater discharges from the public stormwater network that looks at the issues of water quality and quantity within the catchment and stormwater discharges, their effects on the receiving environments and any water quality limits or targets set in a catchment plan, and details the management actions, capital works and timeframes in which issues will be addressed."*

17. The Four Waters Infrastructure team is working together with relevant Council teams to progress the ICMP. The work programme includes further technical work, development of integrated stormwater approaches, consultation with our Treaty partners and key stakeholders. The work programme will culminate in a final ICMP and submission of stormwater resource consent applications in early 2025.

18. ***Progress made:*** Work in the 2023/24 year includes catchment planning, the addition of hydrological models to the geospatial system, work to capture more reliable stormwater capital asset information, development of contaminant heat maps and flood levels, and analysis of network capacity constraints. Council staff have held initial discussions with iwi regarding the ICMP.

19. ***Next Steps***: The work started will continue alongside tangata whenua consultation, data collection, environmental sampling, and drafting the ICMP report. The work projected for the 2024/25 period will support the iwi engagement process, the completion of the integrated catchment plan, resource consent application and lodgement, legal support, and the hearing process. Initial implementation budgets are included in the draft Three Year Plan budget and 2024 Infrastructure Strategy.

Taruheru River Restoration Project

20. In terms of water quality, one of our worst affected waterways in the region is the Taruheru River. The river flows from its headwaters at Waihirere, through intensive horticultural lands of Poverty Bay Flats and then through Gisborne City before converging with the Waimatā River.

21. While water quality has been found to be good around Waihirere Domain, monitoring data indicates a gradual reduction in quality as it progresses through farm, cropland and the urban environment. Water quality is poor for E. coli, turbidity, ammoniacal nitrogen and dissolved reactive phosphorus. During heavy rainfall events, water quality in the urban sections also suffers from discharges of diluted wastewater.

22. The Taruheru River Restoration Project is one of the ten non-regulatory projects formed for the Waipaoa Catchment. The project recognises the impact of upstream and urban land uses on the values of the waterway and seeks to improve our understanding of those causes.

23. Council must work to ensure nutrient and pathogen levels are reduced for the Taruheru awa so they fall within acceptable levels for ecological, cultural and recreational values. The project's output will contribute to a better understanding of how land uses on the Poverty Bay Flats are contributing to poor water quality and how to progressively improve water quality.

24. ***Progress made***: Working alongside mana whenua from Tarere and Parihimanahi Maraes we established a project plan to undertake a Watercourse Assessment (stream walk) of the Taruheru River, Te Koiwi and Waru tributaries. The report was to identify key findings and the potential enhancement and work opportunities along the 19.8km of surveyed watercourse.

25. The report identified six enhancement opportunities and four operational works projects for the enhancement of the Taruheru. With support from tangata whenua, residents, industry, and Council, these opportunities and projects have potential to benefit the environmental, cultural, social, and economic wellbeing of the Taruheru and its community.

26. The opportunities include:
    - Taruheru awa enhancement program - grazing retirement, derelict stock fence removal, riparian planting, and pathway creation.
    - Stream bank regrading and Inanga spawning habitat enhancement through riparian planting.
    - Waru floodplain enhancement – retirement of grazing land, riparian planting, instream habitat features.
    - Te Koiwi awa enhancement – pest plant control, riparian planting, erosion remediation.
    - Community awareness and education – litter dumping campaign.
    - Industry partnership for point and diffuse runoff reduction and mitigation.

27. Operational works include:
    - Tile/Sub-Surface Drainage Investigation.
    - Flap Gate Assessment – Flow Rehabilitation, Flood Mitigation and Fish Passage Remediation.
    - Fish Passage Remediation – enabling migration up- and downstream for native fish by removing or retrofitting fish passage barriers.
    - Stormwater Asset Remediation – improving asset condition and functionality by resolving faults through asset assessments.

28. ***Next Steps***: Refinement and feasibility analysis of opportunities is needed following collaboration and planning with identified partners, particularly Te Whānau a Iwi as mana whenua, residents, and the horticultural industry. The Māhaki Mahinga Kai kaimahi group are actively working to enhance the Taruheru and have indicated their desire to carry out further restoration work along the awa; so, should be considered a key partner for enhancement and restoration work. An understanding of the aspirations of partners and stakeholders including other plans for the enhancement areas will be essential to the success of any actions taken.

Freshwater Farm Plan (FWFP)

29. Freshwater Farm Plans (FWFPs) are part of the Essential Freshwater Package, including National Environmental Standards for Freshwater (NES), and the new stock exclusion regulations. It is all part of a national direction to protect and improve our rivers, streams, lake and wetlands. FWFP regulations will apply to farmers with:
    - 20 hectares or more in arable or pastoral use.
    - 5 hectares or more in horticultural use.
    - 20 hectares or more in combined use.
30. FWFPs will be developed by farmers with farm planners on a farm-by-farm basis. They will need to be certified by a suitably qualified and experienced person, audited by independent auditors and enforced by regional councils. They will be phased in over time throughout New Zealand, with Gisborne aiming to be mid-2025.
31. Councils Land Management (LM) Team received funding from several avenues to improve capability and capacity in the Land Management space. We currently have a team of 11 with one vacancy, consisting of:
    - Manager: Kerry Hudson
    - Team Leader: Sandy Gorringe
    - 2 x Senior Land Management Advisors: Allan Hughes and Bryce McLaughlin
    - 2 x Senior Catchment Advisors: Craig Sproule and Nicky Haisman and one vacancy
    - 3 x Catchment Advisors: George Kool, Emily Graham and Karepa Maynard
    - Regional Catchment Facilitator: Georgina Golling
    - Iwi/hapu Catchment Advisor: Nadine McKinnon
32. Regarding FWFPs the LM Team will provide the following:
    - Assist with coordinating an internal FWFP Programme to ensure the rollout is successful for Council and the community.
    - Provide support to the community to understand the FWFP process.
    - Assist with writing the catchment, context, challenges and values (CCCV) documents for each catchment.
    - Assist with establishing and implementing regional training for certifiers and auditors.
    - Provide Land Use Capability (LUC) and Erosion Control Plans (ECP) to landowners who would like to uptake these services for a small cost. These maps and plans can inform certain modules of FWFPs.
33. The existing Farm Environment Plan under the operative TRMP is different from the FWFP regulations.

Nature-based solutions to flood resilience

34. Nature-based solutions look to work with the natural characteristics of a river and its floodplain and can include measures such as reforestation of erosion prone areas, the planting of large riparian margins and the restoration of or construction of wetlands. The feasibility study will look at these nature-based solutions and determine what are the outcomes of using one or a combination of these different solutions in different places.

35. Council has successfully secured $350,000 from MfE to determine the feasibility of using Nature-Based solutions to support flood resilience in the Waimatā catchment. This funding is available until June 2025 and includes in kind Council contributions.

36. ***Progress made***: The project is in the very early stages. A Governance Group for this project has been identified and formed. Members of the Group include representatives from the Waimatā Catchment Group, Council, and mana whenua.

37. ***Next steps***:
    - Create a detailed project plan.
    - Partner with University of Auckland to determine university research that will guide the feasibility study.
    - Socialise the project to key stakeholders.

DISCUSSION and OPTIONS - WHAKAWHITINGA KŌRERO me ngā KŌWHIRINGA

Implications for freshwater management with the newly elected coalition government

38. The accompanying **Report 24-22** explains in more detail the implications on freshwater planning with the newly elected Coalition Government.

39. As part of the Coalition Government's 100-day plan, the Government repealed the Natural and Built Environment Act (NBEA) and the Spatial Planning Act (SPA). Both Acts had only taken effect three months before the repeal. The previous Government intended for the NBEA to replace the Resource Management Act (RMA).

40. Of direct relation to freshwater implementation, the Coalition Government has announced its decision to begin work on a replacement for the NPS-FM this year. In preparation for this work, the Government granted all councils a three-year extension until 31 December 2027 to publicly notify their freshwater planning instruments.

41. None of the changes mentioned in this section and in **Report 24-22** will affect the FWFPs. The rollout of FWFPs across New Zealand will continue to be implemented as planned.

42. Staff will keep this Council updated when more information about the Coalition Government's NPS-FM replacement is released.

ASSESSMENT of SIGNIFICANCE - AROTAKENGA o NGĀ HIRANGA

Consideration of consistency with and impact on the Regional Land Transport Plan and its implementation
Overall Process: **Low** Significance
This Report: **Low** Significance

Impacts on Council's delivery of its Financial Strategy and Long Term Plan
Overall Process: **Medium** Significance
This Report: **Low** Significance

Inconsistency with Council's current strategy and policy
Overall Process: **Low** Significance
This Report: **Low** Significance

The effects on all or a large part of the Gisborne district
Overall Process: **Medium** Significance
This Report: **Medium** Significance

The effects on individuals or specific communities
Overall Process: **High** Significance
This Report: **Medium** Significance

The level or history of public interest in the matter or issue
Overall Process: **High** Significance
This Report: **High** Significance

43. The decisions or matters in this report are considered to be of **Medium** significance in accordance with Council's Significance and Engagement Policy.

TANGATA WHENUA/MĀORI ENGAGEMENT - TŪTAKITANGA TANGATA WHENUA

44. Tangata whenua are central to the delivery of the projects underway and continue to play a central role in all environmental improvement work. Meaningful relationships have been solidified through Council staff working alongside tangata whenua for the collective goal of restoring the environment.

45. An extract from the document '<u>Te Mana o te Wai Guidelines for Mana Whenua</u>', commissioned by the National Science Challenge – Our Land and Water, provides context to the approach Council is taking to partnering with tangata whenua in the first instance, and then wider land user and stakeholder groups.

> *"Te Mana o te Wai is a concept that is derived from mātauranga Māori. As such it cannot be defined without the leadership of hapū and iwi in their respective takiwā (tribal areas). These definitions are shaped, by the unique mana whenua (indigenous people of Aōtearoa within their takiwā) who belong to each type of water, of each spring, of each river, of each puia (geothermal spring), of each expanse of ocean."*

46. The guidance is clear on the position of tangata whenua within freshwater planning and emphasises the importance of a Māori worldview to inform the foundation of planning and the design and delivery of implementation and monitoring frameworks.

47. As part of the Waipaoa Catchment Plan review, staff have been working with Ngā Uri o Te Kooti Rikirangi Trust on the Maungarongo wetland and with Rongowhakaata hapū on Te Arai te Uru. Action plans that arise from these two collaborations may see a continued joint effort between Council and mana whenua in improving the state of the freshwater in that waterbody or catchment.

COMMUNITY ENGAGEMENT - TŪTAKITANGA HAPORI

48. The wider community in Tairāwhiti plays a vital role in the implementation activities that Council has coordinated. An example is the community planting days for the FIF had a well attendance record. We expect that we will continue to provide opportunities for our communities to continue participating in such projects throughout 2024.

CLIMATE CHANGE – Impacts / Implications - NGĀ REREKĒTANGA ĀHUARANGI – ngā whakaaweawe / ngā ritenga

49. Severe weather events like those of Cyclone Hale and Gabrielle demonstrated the vulnerability of our environment. Meteorologists have signalled that we are transitioning back to El Niño conditions with consequential warnings. NIWA has published the January – March 2024 Seasonal Climate Outlook, which projected that the type of El Niño being experienced will likely result in more variable rainfall patterns than experienced in the past.

50. Gisborne is projected to have:

    - Very likely above average temperatures (60% chance), with spells of hot and very humid conditions in mid-January.
    - Most likely near normal rainfall totals (45% chance), with spells of heavy rain in the second half of January. However, the season may also be defined by longer dry spells in February-March.
    - Soil moisture levels and river flows are about equally likely to be near normal (45% chance) or below normal (40% chance).

51. The success of the implementation projects is weather-dependent. The increased variability of weather patterns will see a higher uncertainty of the success of implementation projects. Severe storms like Cyclone Gabrielle bring silt through high volumes of flood water, where silt is deposited on riparian plants along riverbanks. The restoration projects that led to the planting of these riparian plants will end up with a reduced success rate as the plants are smothered to death or survived but have stunted growth.

CONSIDERATIONS - HEI WHAKAARO

Financial/Budget

52. While resourcing for freshwater planning in the wider TRMP review is included as part of the operational budgets in the **2021 – 2031 Long Term Plan** (LTP), implementation projects require additional budget and staff to deliver them.

Legal

53. There are no legal implications associated with the information in this report.

POLICY and PLANNING IMPLICATIONS - KAUPAPA HERE me ngā RITENGA WHAKAMAHERE

54. Council's involvement in the environmental improvement projects gives effect to the intent and requirements of the NPS-FM 2020 and to freshwater provisions outlined in the operative TRMP.

55. In the 2021 – 2031 LTP, environmental wellbeing is identified as one of the four wellbeings that form the pillars of our community and region. Council's commitment to these freshwater projects aligns with the intention of the 2021 – 2031 LTP.

56. The freshwater projects are expected to also meet the following outcomes identified in Tairāwhiti's spatial plan (Tairāwhiti 2050):

    - **Outcome 1: A driven and enabled Tairāwhiti**, where Council works with iwi, hapū and stakeholders to promote and enable change in the region.
    - **Outcome 5: Taking sustainability seriously**, where Council recognises the threat of climate change on the future of our region and ensures planning will enhance Tairāwhiti's natural and built environment for our future generations.
    - **Outcome 6: Celebrating our heritage**, where Council supports mana whenua in the exercise of kaitiakitanga over the environment and showcasing the multiple benefits of Tairāwhiti's rich dual heritage.
    - **Outcome 8: Delivering for and with Māori**, where Council and iwi build and maintain strong partnerships that ensure our region's taonga are restored and protected for generations to come.

RISKS - NGĀ TŪRARU

57. **Funding and Capacity**: Securing the funding needed to employ personnel and undertake improvement projects will remain a significant challenge for this organisation, in light of other competing priorities within Council. While external funding is vital, relying solely on it carries its own risk.

58. Staff capacity will continue to be a challenge for Council, iwi and hapū groups interested in participating in the freshwater improvement projects. We expect implementation of the NPS-FM will further increase the need for more resourcing and people to deliver the work.

59. If funding and capacity remain a long-term issue, Council faces a reputational risk in being unable to deliver on aspirations and the identified projects. The environment will face the risk of continued and possibly increased rate of degradation without the intervention of these projects.

NEXT STEPS - NGĀ MAHI E WHAI AKE

Date	Action/Milestone	Comments
1st Quarter of 2025	Annual Freshwater Implementation Update Report	

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

Title:	**24-24 NIWA Flow and Groundwater Modelling Reports - Implications for Freshwater Planning**
Section:	Environmental Monitoring & Science Strategic Planning
Prepared by:	Janic Slupski - Principal Policy Advisor
Meeting Date:	Wednesday 20 March 2024

Legal: No	Financial: No	Significance: **High**

Report to COUNCIL/TE KAUNIHERA for information

PURPOSE - TE TAKE

The purpose of this report is to provide Council with summaries of two recent scientific reports relating to surface and groundwater take limits. The report also explores how the findings will influence the development of new freshwater provisions as part of the Tairāwhiti Resource Management Plan review.

SUMMARY - HE WHAKARĀPOPOTOTANGA

Council is updating the freshwater provisions within the Tairāwhiti Resource Management Plan (TRMP). This review is essential to ensure compliance with the Resource Management Act (RMA) 1991 and the National Policy Statement for Freshwater Management (NPS-FM) 2020.

The freshwater team's focus has shifted to include water quantity and allocation. Two significant scientific reports have recently been completed relating to this topic. The first report, conducted by the National Institute of Water & Atmospheric Research Ltd (NIWA), examines the flow requirements of Te Arai and Waipaoa rivers, crucial for upholding freshwater values. The second report, authored by Wallbridge Gilbert Aztec (WGA), summarises the Poverty Bay Flats Groundwater Modelling Programme, providing insights into groundwater dynamics.

The NIWA report emphasizes the importance of setting appropriate flows to prioritise the health of water bodies and ecosystems. Critical Low Flow management options were identified as a starting point for beginning informed decision-making to safeguard environmental values. Similarly, WGA's groundwater modelling underscores the urgent need for action to mitigate declining groundwater levels, predicting adverse consequences on water quality and ecosystem integrity if left unaddressed.

The implications of these findings on water allocation are significant. It is critical that changes to flow, level, and allocation limits align with Te Mana o te Wai principles. However, such adjustments may entail reduced water reliability and pose challenges for existing and prospective water users, particularly where water is already over-allocated.

Addressing these challenges requires a paradigm shift in water allocation approaches. The current system's inequities necessitate a more holistic framework that prioritises sustainability and equity. The Essential Freshwater package of 2020 represents a crucial step towards this goal, highlighting the imperative of genuine collaboration with tangata whenua to ensure meaningful recognition of their freshwater interests.

In conclusion, the findings presented in this report underscore the critical need for proactive and collaborative freshwater management strategies. By leveraging the insights provided by NIWA and WGA, Council can navigate the complexities of freshwater governance, ensuring the long-term sustainability and integrity of Tairawhiti's freshwater resources.

The decisions or matters in this report are considered to be of **High** significance in accordance with the Council's Significance and Engagement Policy.

RECOMMENDATIONS - NGĀ TŪTOHUNGA

That the Council/Te Kaunihera:

1. **Notes the contents of this report.**

Authorised by:

Joanna Noble - Director Sustainable Futures

Keywords: Freshwater Planning, NIWA flow report, Groundwater modelling report, Water allocation

BACKGROUND - HE WHAKAMĀRAMA

1. Gisborne District Council is currently reviewing the freshwater provisions of the Tairāwhiti Resource Management Plan (TRMP)[22].

2. An important part of this process is the gathering of research reports and data to create the evidence base for our freshwater plans and to ensure we are consistent with statutory requirements (RMA and NPS-FM).

3. The freshwater team has been moving its focus to water quantity and allocation – for surface and groundwater. This is an incredibly important and challenging topic, particularly for the Poverty Bay Flats (Turanga Flats) where intensive cropping, residential and commercial activities place significant demands on water.

4. Council has the difficult task of managing water so that it provides for the health of waterways themselves as well as enabling access to water for community use, stock water and food production. Finding a balance between these two contrasting needs can be contentious, particularly when the demand for water exceeds its availability.

5. Two recently completed scientific reports that will improve our understanding of surface and ground water on the Turanga Flats are:
   - Flow requirements of Te Arai and Waipaoa Rivers, by the National Institute of Water & Atmospheric Research Ltd (NIWA, 2023) (see **Attachment 1**).
   - Poverty Bay Flats Groundwater Modelling Programme Summary Report, by Wallbridge Gilbert Aztec (WGA, 2023) (see **Attachment 2**).

6. This Council report provides a summary of these important pieces of work. They will be central to conversations about water quantity with tangata whenua and our communities this year.

7. In addition to these two pieces of work, Council engaged Aqualinc in September 2023 to complete a Regional Water Assessment which was presented to Council in December 2023[23].

Introduction to environmental flows and limit setting

8. Under the NPS-FM, we are required to set environmental flows and levels for waterbodies to provide for the freshwater values associated with them – these are also referred to as ***environmental flow regimes*** (EFR). An environmental flow regime is a planned state for river flows that must be maintained to support instream values such as ecosystem health and mahinga kai. Supporting these values in turn helps to achieve Te Mana o te Wai – the central concept and objective of the NPS-FM 2020[24]. An environmental flow regime is particularly important where water use may have an effect on low flows. Having an environmental flow regime for the Turanga Flats is important for managing use during the critical summer months when irrigation and municipal take begin to intersect with low surface and groundwater levels.

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22 An accompanying report to this Council (see **Report 24-22**) provides a progress update on work happening in the freshwater planning workstream.
23 Direction on Council's Future Role in Terms of Managing Water Demand and Supply (see Report 23-303)
24 The sole objective of the NPS-FM 2020 is to ensure that natural and physical resources are managed in a way that prioritises:
(a) first, the health and well-being of water bodies and freshwater ecosystems
(b) second, the health needs of people (such as drinking water)
(c) third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.

9. One way to create an environmental flow regime is by setting ***take limits*** in regional plans. There can be several parts to take limits.

10. One part involves identifying the point where all takes need to stop. This point is referred to as a ***'Cease To Take Flow'*** (CTTF). Where abstraction of water is likely to affect low flow hydrology, a **'Critical Low Flow'** (CLF) may also be included.

11. Figure 1 below shows how the CTTF and CLF work together to protect instream values. In summary[25]:

    - Cease-to-Take Flows are the flows that will trigger water abstractions to turn off. The CTTF is an operational flow.
    - Critical Low Flows are the flows that we want to avoid happening because it is likely to be harmful to the environment. CLF is the environmental flow.

12. Defining both a CTTF and a CLF helps reduce the risk of undesirable environmental outcomes by accounting for the lag between reaching a CTTF and the response by consented water users.

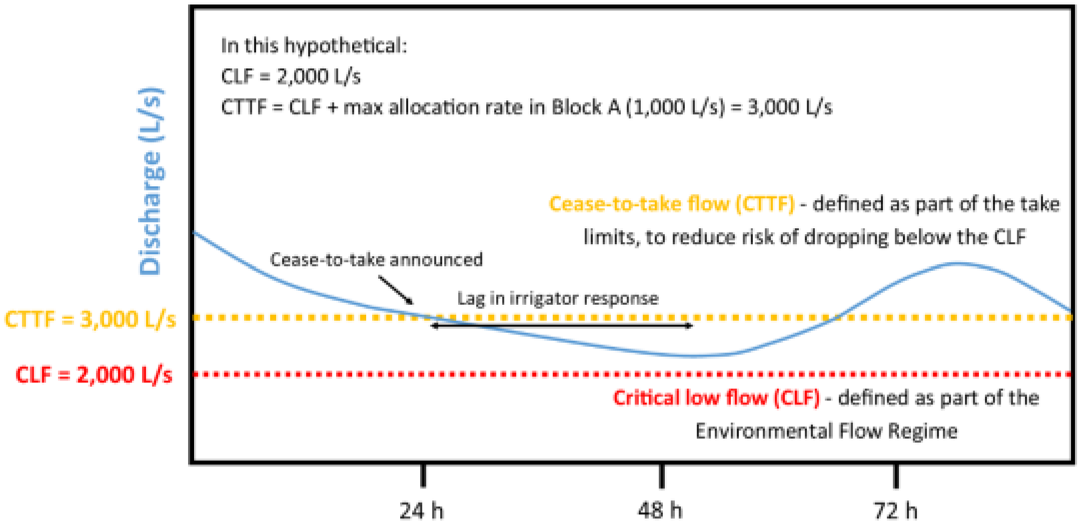

Figure 16: Conceptual diagram explaining the difference between the critical low flow and a cease-to-take flow. Taken from page 12 of the 2023 NIWA report.

13. Related to cease to take flows are allocation blocks. These blocks sit above the CTTF and are the volumes of water set aside by Council for abstraction. The purpose of having more than one block of water (for example, A Block, B Block, C Block) is to allocate more water based on differing reliabilities for users. The block of water closest to the CTTF (A-Block) is more likely to be available for a longer period of time and is therefore associated with a higher reliability of access and use. There is strong demand for this water because it is often the only water available when the demand is highest (during summer).

[25] NIWA (2023) Flow requirements of Te Arai and Waipaoa Rivers, pg. 6

14. B Block water relies on higher flows. Compared to water in the A-Block, water in the B-Block is less likely to be available in peak water demand periods (December-February) and consequently has a lower reliability. The demand for this block of water has historically been lower than that of A-Block (although we forecast an increasing interest in this block for harvest of winter flows for storage). Figure 2 provides a simple illustration of how these blocks look in section.

15. The Waipaoa Catchment (through the Waipaoa Catchment Plan) is the only catchment that has an EFR. This catchment plan currently maintains a two-tiered approach (A-Block and B-Block) to water allocation. Applications for water permits are assessed based on the availability of water within these two blocks as well as criteria set out in the rules.

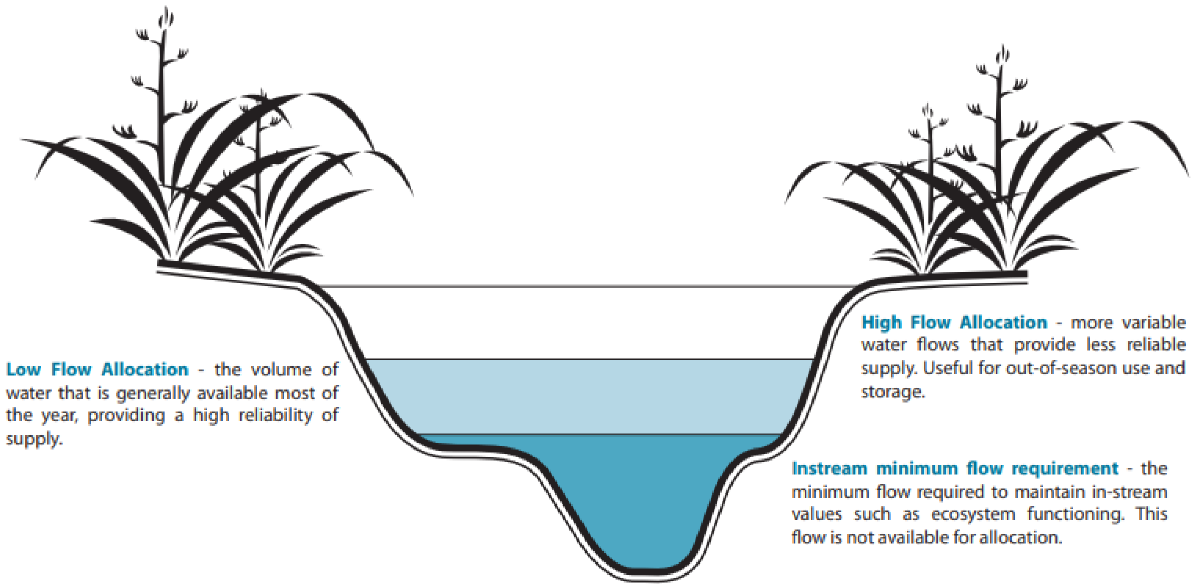

Figure 17: Cross section of instream flow allocation

Reliability is critical to crop growing.

16. Reliability is a critical concern to all water users but the horticulture industry especially. Growers seek a high degree of reliability in a water supply to ensure they have water available during peak irrigation periods when flows are typically lowest. For example, a reliability of 90% would mean 9 out of 10 peak irrigation periods without any restrictions. The lower the reliability the greater the risk that water will not be available to irrigate crops during peak irrigation season. This not only impacts on crop production and quality but also the survival of some crops.

17. Growers locked into a supply market may stop growing crops if the reliability deteriorated. This could cause growers to move operations and post-harvest employment to locations outside of Tairawhiti with more reliable water access. Alternately, reduced reliability may lead to change of water usage behaviours – with more efficient use of water and a change to crop regimes that require less water.

How was the current allocation framework formed?

18. The TRMP is a combined plan and includes policies and rules relating to water use for the whole region as well as water allocation limits at the catchment level (currently only the Waipaoa Catchment Plan).

19. The Waipaoa Catchment Plan sets limits and targets for the water sources of the Turanga Flats. These limits and targets were developed using various information sources but were largely guided by a National Institute of Water & Atmospheric Research Ltd (NIWA) report for the Waipaoa Water Quantity Zone and GNS reports for the two groundwater Water Quantity Zones (Deep Groundwater and Te Hapara Sands)[26].

2009-2010 NIWA study

20. In 2009-2010 GDC contracted NIWA to determine how alternative critical low flows may affect the availability of physical habitat for aquatic organisms within Te Arai and Waipaoa Rivers.

21. Models were used to assess the effects of three critical low flow management options on the habitat availability of native fish, macroinvertebrates and periphyton (algae).

22. Three critical low flow management options were presented (L/s) and are shown in Table 1. A qualitative assessment of the impact of each option on instream values is provided in brackets. Option 3 is used as the point of reference for options 1 and 2.

Table 1: Critical low flow management options considered in the 2010 NIWA report (Preferred options in bold).

	Option 1 (status quo	**Option 2 (NES default)**	**Option 3 (instream values)**
Waipaoa @ Kanakanaia	**1,300 (moderate)**	1,600 (moderate-high)	2,000 (high)
Waipaoa @ Ford Road	1,300 (moderate)	1,600 (moderate-high)	2,000 (high)
Te Arai @ Water Works	No minimum flow (low)	60 (moderate)	150 (high)
Te Arai @ Reays Bridge	15 (low-moderate)	**60 (moderate)**	150 (high)

23. The Freshwater Advisory Group's preferred options were 60l/s for Te Arai River at Reays Bridge (Option 2) and 1,300l/s for Waipaoa River at Kanakanaia (Option 1)[27].

24. These preferred options were incorporated in the proposed Waipaoa Catchment Plan and subsequently adopted.

[26] Note that for areas outside of the Waipaoa Catchment, a default framework applies that sets out allocation and flow limits. This approach is also being reassessed as part of the TRMP review.

[27] Note, there is currently no minimum flow for Te Arai at Waterworks however there is a requirement to establish a minimum flow at the Waterworks site by 2026.

Table 2 shows the allocation blocks in the current Waipaoa Catchment Plan.

Table 2: Current critical low flow management and allocation caps for Te Arai and Waipaoa Rivers. Taken from page 13 of the 2023 NIWA report.

Freshwater management unit	Water quantity zone	Monitoring location	Block A minimum flow	Block A allocation cap	Block B minimum flow	Block B allocation cap
Poverty Bay Flats	Waipaoa surface water	Kanakanaia	1,300 L/s	2,000 L/s	4,000 L/s	2,000 L/s
Waipaoa Hill Country	Waipaoa Hill Country	Kanakanaia	No A block		4,000 L/s	2,000 L/s
Te Arai	Upper Te Arai	Water supply intake	RD Activity – Municipal Supply. All Other takes Discretionary Activity			
Te Arai	Lower Te Arai	Pykes Weir	60 L/s	70 L/s	220 L/s	100 L/s

2023 NIWA REVIEW – FLOW REQUIREMENTS OF TE ARAI AND WAIPAOA RIVERS

25. The following is a summary of the report titled 'Flow Requirements of Te Arai and Waipaoa Rivers', prepared by the National Institute of Water & Atmospheric Research Ltd (NIWA).

26. The NPS-FM 2020 directs Councils to set EFRs to achieve the environmental outcomes that we set for freshwater values. Setting appropriate flows is an important part of giving effect to Te Mana o te Wai. In particular, we must manage flows in a way that prioritises the health and wellbeing of water bodies and their ecosystems.

27. To inform this process, Council contracted NIWA to review its current allocation framework within the context of the NPS-FM 2020.

28. The objective of NIWA's review was to determine how alternative low flow scenarios might affect the availability of physical habitat for aquatic organisms within the Te Arai and Waipaoa Rivers.

29. The key outputs of the hydrology review were a) identifying reliable periods of data for estimating hydrological statistics for Te Arai and Waipaoa rivers and b) using the reliable data to calculate flow duration curves and observed 7-day MALFs.

30. Data and models for understanding how low flows affect environmental outcomes were poor. Little to no flow-dependent data has been collected in the Te Arai and Waipaoa Rivers since 2010. However, the best data and models available have been used to present a transparent assessment of CLF management options in the Te Arai and Waipaoa Rivers.

31. Three critical low flow management options were assessed for the lower Te Arai and Waipaoa Rivers. Only one critical low flow management option is presented for Te Arai at Waterworks because NIWA determined that (a) a natural record was available enabling what is a more defensible approach to critical low flow setting; (b) there are no substantial water takes above the waterworks; and (c) the major take below the water works is for domestic supply and there is currently no CLF limit or allocation cap applied to limit abstraction at the waterworks.

32. CLF options considered for lower Te Arai and the Waipaoa River at Kanakanaia were:
    - Option 1 - Instream values
    - Option 2 - Observed mean annual low flow (observed MALF)
    - Option 3 - Status quo (as outlined in tables 1 & 2)

33. Option 1 - Instream values, presents CLF management options that, given the limited data and models available, may provide a high level of support for values identified in the NPSFM-2020, including all aspects of ecosystem health, threatened species and physical habitat associated with mahinga kai. Option 1 is used as the point of reference for options 2 and 3.

34. The potential outcomes for Options 2 and 3 are summarised using a five-point scale relative to Option 1 under the assumption Option 1 supports 'high' values. Relative to 'high', the other four levels of value maintenance were 'moderate-high', 'moderate', 'moderate-low' and 'low'. The outcome of the assessments is summarised in Table 3.

35. An assessment of relative maintenance of instream values is provided in brackets after each minimum flow.

Table 3: Critical low flow management options for the Waipaoa and Te Arai Rivers presented in units of litres per second (L/s). Taken from page 59 of the 2023 NIWA report.

	Option 3 (status quo)	**Option 2 (Observed MALF)**	**Option 1 (instream values)**
Waipaoa @ Kanakanaia	1,300 (moderate)	2,550 (moderate-high)	3,000 (high)
Te Arai @ Reays Bridge	60 (low-moderate)	60 (low-moderate)	150 (high)
			Option 1 (instream values; naturalised MALF default)
Te Arai @ Water Works			36 (high)

Critical Low flow (CLF) and Cease To Take Flow (CTTF) options

36. NIWA looked at how CLFs and CTTFs can affect the health of the rivers and the organisms living in them.

37. The review involved using physical habitat simulation models to estimate the effects of different CTTF options on habitat availability for fishes, mayflies, and periphyton. NIWA compared three options for CLFs and CTTFs.

Critical Low flow options

38. Assessment of CLF options was based on modelling informed by:

    a. habitat availability of native fish, macroinvertebrates and periphyton; and

    b. water temperature (Waipaoa River at Kanakanaia only).

39. Three CLF options were assessed for the lower Te Arai and Waipaoa Rivers. Only one CLF management option is presented for Te Arai at Waterworks[28]. The outcome of the assessments is summarised in Table 3.

[28] One option was presented because (a) a natural record was available allowing a more defensible approach to critical low flow setting; (b) there are no substantial water takes above the waterworks; and (c) the major take below the water works is for domestic supply and there is currently no critical low flow limit or allocation cap applied to limit abstraction at the waterworks.

40. Option 1 presents a CLF management option that may support high levels of instream values. This includes all aspects of ecosystem health, threatened species and physical habitat associated with mahinga kai. Option 1 is used as the point of reference for options 2 and 3.

Cease To Take Flow options.

41. The NIWA review highlights the importance of having a CTTF to protect the CLF. As outlined in paragraphs 10-11, the CTTF functions as a safety net that accounts for the lag between when notice is given to cease takes and when abstraction actually stops. During that time, flows may continue to drop below the CTTF limit. The CTTF is set at a flow that allows for this drop without breaching the CLF.

42. The report determines the CTTF using a simple equation:
    - CTTF = CLF + A-Block allocation cap

43. This equation highlights a water-supply trade-off: a larger A Block allocation cap increases A-Block water availability while flow is above the CTTF, but it also increases the CTTF. This results in cessation of abstraction at higher flows than would be the case for a smaller A Block allocation.

44. The larger the allocation cap relative to the CTTF the larger the effect of a 'yo-yo' effect in flows as flows fall below the CTTF and then rise above the CTTF on consecutive days because cease-to-take restrictions are triggered and then withdrawn. These fluctuations may have a detrimental effect on instream values.

45. To illustrate this, the study translated the CLFs into allocation caps and CTTFs (see Table 4). In this NIWA created an allocation cap based on 33% of the CLF which reduces the magnitude of potential fluctuations.

Table 4: Translation of the example CLFs for the Waipaoa and Te Arai Rivers (in Table 2) into allocation. (Allocation caps and CTTFs are presented in units of litres per second (L/s). Here, allocation caps are set at 33% of the CLFs in Table 1). Taken from page 61 of the 2023 NIWA report.

	Option 3 (status quo)		**Option 2 (Observed MALF)**		**Option 1 (instream values)**	
	CTTF	Cap	CTTF	Cap	CTTF	Cap
Waipaoa @ Kanakanaia	1,733	433	3,400	850	4,000	1,000
Te Arai @ Reays Bridge	80	20	80	20	200	50
					Option 1 (instream values; naturalised MALF default)	
Te Arai @ water works					48	12

GROUND WATER MODEL OF THE TURANGA FLATS AQUIFERS

46. The following is a summary of the report titled 'Poverty Bay Flats Groundwater Modelling Programme Summary Report', prepared by Wallbridge Gilbert Aztec (WGA).

47. In 2021, GDC engaged WGA/Aquasoil to produce a comprehensive Groundwater Model (GWM) of the Turanga Flats Aquifers. The GWM sets out to help manage our degrading groundwater resources and its interactions with surface ecosystems, activities and the environment. The modelling process utilised existing data and knowledge from council, mana whenua and the stakeholder community.

48. The GWM process reviewed the long-term groundwater level monitoring data in the Makauri Aquifer, which is the largest source of water for horticultural purposes. The review indicated that both summer pumped groundwater levels and recovered winter peak levels are declining. A similar decline is seen in the Matokitoki aquifer. However, the shallower Waipaoa Gravel, Te Hapara Sands and Shallow Fluviatile aquifers showed stable groundwater level trends.

49. The declines in the Makauri aquifer are due to historical increasing groundwater pumping over time, which reduces the ability for the system to reach equilibrium. In addition, analysis showed that the time required for groundwater levels to recover following drought is increasing. As the frequency and severity of droughts are predicted to worsen, it will take longer for the Makauri Aquifer to recover in the future.

50. The current state of the aquifers was first modelled using NIWA climate change predictions out to 2090. The model predicts impacts from climate change will make the Makauri aquifer more susceptible to receiving potential contaminants from overlying aquifers. Predictions also included increased salinity due to saline intrusion from the coast and the west (the Western Saline aquifer on the southern side of the Waipaoa River). Finally, the model also predicts current abstraction depletes surface water features (wetlands, rivers and springs) connected to the shallower aquifers.

51. The results from this modelling process have:

    - assisted current knowledge of the functioning relationships of each aquifer system.
    - predicted potential impacts of groundwater human usage and the wider interactions with climate change and surface ecosystems.
    - provided insight to where alterations could potentially be made to the current groundwater management policies.
    - provided insight to concepts of surface water security and the impacts groundwater use or replenishment can also have on surface water features (i.e., river baseflows)
    - highlighted the importance for increased groundwater monitoring within the western and coastal aquifers, in relation to saline intrusion, to assist any potential future decisions of whether managed replenishment is required in these areas.

Findings

52. If we do nothing, the groundwater model predicts an additional ~3m decline in groundwater levels, which is a further 120% drawdown on current summer groundwater levels in the Makauri aquifer. This would also increase saline intrusion from the coast and the west, degrading water quality further.

The shallower aquifers would see minimal change in drawdown; however, their connection to the river would cause a decrease in the Waipaoa River summer base flow as well as a predicted 20cm decline in the surface water levels at Te Maungarongo o Te Kooti Rikirangi Wetland, which may affect the wetland ecosystem.

54. Hydraulic pressures in the Makauri aquifer would be reduced and the aquifer would be susceptible to receiving potential contaminants from overlying aquifers.

55. The model predicts a 15% reduction in annual abstraction will stabilise the current aquifer decline and assist the recovery of groundwater levels during effects of climate change and droughts out to 2045.

DISCUSSION and OPTIONS - WHAKAWHITINGA KŌRERO me ngā KŌWHIRINGA

NIWA Report - Implications

56. The NIWA review of environmental flows ultimately points to is the need to change the way we currently manage low flows if we wish to provide greater protection to instream values, noting that these are an important component of the mauri and ora of waterways.

57. Council will need to consider raising the current Critical Low Flow (referred to as minimum flow in the Waipaoa Catchment Plan) to better provide for instream values and to give effect to Te Mana o te Wai. Even the more conservative option of maintaining a CLF of 1,300l/s would require a cease in takes at a higher flow rate than is used in the current Waipaoa Catchment Plan.

58. The existing flow, level and allocation limits for the Waipaoa catchment and the default methodology for determining them must be reviewed to ensure they give effect to Te Mana o te Wai.

Ground Water Model – Implications

59. The model shows that summer and winter water levels are declining in our deep groundwater sources.

60. There is predicted saltwater intrusion from the coast and from the west into these aquifers and that our current water use depletes wetlands, rivers and springs connected to the shallower aquifers despite the shallower aquifers showing stable groundwater level trends.

61. As with the NIWA review, Council will need to consider how aquifers are managed in order to give effect to Te Mana o te Wai.

62. Groundwater has the additional challenge of water quality, in that the quality of the water sources will continue to decline (in addition to the availability).

63. The impact of both pieces of science on existing water users, as well as those on waiting lists and those that are yet to secure water could be significant – potentially a reduction in access to freshwater for food producers as well as municipal use.

The need for a new approach to water allocation.

64. The current approach to allocating water under the TRMP has created inequities between existing and potential water users, particularly in over-allocated catchments. With our current 'first in first served' approach to allocation, which is the default mechanism under the RMA, there is no prioritisation of uses and there has been over-allocation of some water sources. In many locations, no new entities can gain a permit to take water unless an existing permit holder gives up their consented take.

65. The TRMP provides for the transfer of water permits and there is currently limited ability for Council to decline these applications to prioritise uses or reduce over-allocation of a water source. The transfer of water permits can provide benefits of increasing the efficiency of water use by permit holder maximising their efficient use and freeing up allocation that can be transferred to another party.

66. However, this transfer process has led to water take allocation being "purchased", with those able to afford to pay for water, being able to gain new water permits through arrangements with existing consent holders via a transfer. This side steps those on the waiting lists in over-allocated catchments and commodifies water allocation.

67. The final Critical Low Flows for both the Waipaoa and Te Arai Rivers will be developed through the freshwater planning process, including engagement with the Waipaoa Catchment Freshwater Advisory Group, mana whenua and the horticultural sector. The final plan proposal will be subject to final direction from Council prior to notification.

68. From here, the freshwater team will explore the following questions:
    - What is an appropriate Critical Low Flow for the Waipaoa and Te Arai Rivers?
    - Where should we set the Cease To Take Flow?
    - How much water is available for allocation and how could it be structured for use?

69. Once these questions are explored and options considered, the freshwater team will be able to evaluate how we evaluate options for another critical water quantity issue: equity of allocation.

ASSESSMENT of SIGNIFICANCE - AROTAKENGA o NGĀ HIRANGA

Impacts on Council's delivery of its Financial Strategy and Long Term Plan
Overall Process: **Low** Significance
This Report: **Low** Significance

Inconsistency with Council's current strategy and policy
Overall Process: **Low** Significance
This Report: **Low** Significance

The effects on all or a large part of the Gisborne district
Overall Process: **High** Significance
This Report: **Low** Significance

The effects on individuals or specific communities
Overall Process: High Significance
This Report: Low Significance

The level or history of public interest in the matter or issue
Overall Process: High Significance
This Report: High Significance

70. The decisions or matters in this report are considered to be of **High** significance in accordance with Council's Significance and Engagement Policy. Our community and economy in our region depend on the availability and security of water supply. Freshwater is also of great significance to tanga whenua. Many of the waterways in the region are a source of spiritual and physical sustenance, and there are deep and complex relationships between iwi and hapu and these waterbodies. Changes to the way that freshwater is managed have the potential to impact all communities in Tairāwhiti.

TANGATA WHENUA/MĀORI ENGAGEMENT - TŪTAKITANGA TANGATA WHENUA

71. Council staff worked with our Treaty Partners during development of the groundwater model. This included joining WGA's groundwater modelling training sessions, where the sessions covered how the groundwater model works and learnings from the model used on the Turanga Flats groundwater system. There were 12 training sessions in total, from 15 June 2021 to 29 June 2022.[29]

72. Iwi and hapū have made submissions on freshwater, including water allocation, since the development of the operative freshwater provisions. However, historic water allocation has persisted to date. To correct this, Council is committed to engage with tangata whenua on how we should approach water allocation in an equitable manner. We are still developing how this process will occur.

73. The NIWA report summarised in this agenda is one component of the information that will be used in the process to set flow regimes and develop allocation frameworks. Other values and knowledge, including mātauranga Māori and place-based articulations of Te Mana o te Wai, will also be important components.

COMMUNITY ENGAGEMENT - TŪTAKITANGA HAPORI

74. As part of the freshwater planning process, we will be consulting our community and stakeholders on options for setting flow regimes and allocation limits.

CLIMATE CHANGE – Impacts / Implications - NGĀ REREKĒTANGA ĀHUARANGI – ngā whakaaweawe / ngā ritenga

75. A NIWA report on climate change projections and impacts for Tairāwhiti (and Hawke's Bay) has indicated that the region can expect:
    - Warmer average temperature (an increase of 0.5 – 1.0 C by 2040) and a greater number of heatwave days when temperatures exceed 25 for three or more consecutive days.
    - Generally, a small decrease in average rainfall across the district – but with local and seasonal variations in the level of change projected.

[29] Table 2: Community Engagement, Internal Workshops and Trainings. Taken from the WGA report.

- Eastern Tairāwhiti is projected to experience some of the largest increases in Potential Evapotranspiration Deficit (drought conditions measure) in the country by 2090.
- Potential increase in storm intensity (wind extremes and rainfall).

76. Overall, this means that the region will experience warmer and drier weather conditions, resulting in less water available for allocation. The NIWA and WGA reports consider climate change, but it is worth noting for completeness, given there will likely be less available water, demand is also likely to increase.

CONSIDERATIONS - HEI WHAKAARO

Financial/Budget

77. Resourcing for freshwater planning and the wider TRMP review is included as part of the operational budgets in the 2021 – 2031 Long Term Plan (LTP).

Legal

78. This research will contribute to the development of a refreshed allocation framework that will sit within the TRMP and help give effect to the requirements of the NPS-FM 2020.

POLICY and PLANNING IMPLICATIONS - KAUPAPA HERE me ngā RITENGA WHAKAMAHERE

79. Council engaged Aqualinc in September 2023 to complete a Regional Water Assessment (RWA) which is a technical piece of work that focusses on the regions supply and demand dynamics as it assesses where pressure is most likely to be felt and how. The findings from the RWA reinforce the pressures on the region's freshwater resources now and projected in the future (see **Report 23-303**).

80. The development of evidence-based freshwater policies aligns with the recently adopted Strategic Framework in the **2024 – 2027 Three Year Plan** (see **Report 23-314**). In particular the research reports meet the strategic priorities, which of relevance are:
    - **We will prioritise resilient waters** – includes flood control and drainage, clean and clear rivers, water security, while also recognising the relationship between catchment planning, TRMP, and addressing wood debris with urgency.
    - **We will enable effective regulatory functions.**

81. The freshwater policies also aligns with the longer term community outcomes identified in the **Tairāwhiti 2050**. In particular:
    - **Outcome 2: Resilient communities**, where long-term water availability is secured and protected for our communities.
    - **Outcome 3: Vibrant city and townships**, where regional business development is enabled through appropriate planning and the provision of core infrastructure.

- **Outcome 5: We take sustainability seriously**, where Council recognises the threat of climate change on the future of our region and ensures planning will enhance Tairāwhiti's natural and built environment for our future generations.
- **Outcome 6: We celebrate our heritage**, where Council supports mana whenua in the exercise of kaitiakitanga over the environment and showcasing the multiple benefits of Tairawhiti's rich dual heritage.
- **Outcome 7: A diverse economy**, where an economy that is diverse, inclusive and sustainable is supported and enabled for our region.
- **Outcome 8: Delivering for and with Māori**, where Council and iwi build and maintain strong partnerships that ensure our region's taonga are restored and protected for generations to come.

RISKS - NGĀ TŪRARU

Climate-driven water supply challenge: mitigating community division and avoiding an environmental disaster.

82. Historic water allocation policies and management have created social inequity at the expense of the environment. This has been particularly the case for tangata whenua where whenua Māori has not been developed and now is prevented from accessing water despite often being located adjacent to waterbodies.

83. Meanwhile, climate change has been projected to have increased the volatility of our water supply, with the timing and intensity largely unpredictable. As water becomes less reliable, existing commercial water users in Tairāwhiti may be less confident to continue their investment in such high value land use, which may lead to them taking their investment to other regions. At the same time, potential commercial water users looking to invest in the region may be deterred from making the investment based on the state of our freshwater availability.

84. Council will need to have extensive engagement with our Treaty partners and key stakeholders in balancing water supply and the demands for our region. The balance will be based on the Te Mana o te Wai hierarchy as set out in the NPS-FM, where the health of the environment is the first priority, then the health of the people second, and on the third tier commercial uses.

Changing national direction creates uncertainty.

85. The review of the Regional Freshwater and Waipaoa Catchment plans and the development of the other six catchment plans are currently being developed under the current NPS-FM 2020.

86. The new government has already signalled its intent to replace the NPS-FM 2020. Work on this will start immediately, will be expected to take 18 to 24 months, and will include a robust and full consultation process with all stakeholders including iwi and the public8. At this stage, the scope and nature of the changes are unknown.

87. There is a risk that the new NPS-FM will introduce changes that are not aligned to the plans we develop under the existing framework. If this is the case, then our plans may need to be reworked to ensure consistency with legislation.

88. However, the fundamental need to address water quality and quantity issues will remain. How far and how fast these issues are addressed remains for Council to determine through decisions on policy options. It is unlikely that the new NPS-FM will fundamentally affect Council's choices in this regard.

89. At this point in time, we consider this issue to be a low risk but will continue to appraise the situation as we receive more information.

NEXT STEPS - NGĀ MAHI E WHAI AKE

Date	Action/Milestone	Comments
18 April 2024	Councillor workshop on water supply and demand and options for future management	

ATTACHMENTS - NGĀ TĀPIRITANGA

1. Attachment 1 - NIWA Flow requirements of Te Arai and Waipaoa Rivers November 2023 [**24-24.1** - 72 pages]
2. Attachment 2 - WGA Poverty Bay Flats Groundwater Modelling Programme Summary Report November 2023 [**24-24.2** - 125 pages]

NIWA
Taihoro Nukurangi

Flow requirements of Te Arai and Waipaoa Rivers

Prepared for Gisborne District Council

November 2023

Climate, Freshwater & Ocean Science

Prepared by:
Rick Stoffels, Doug Booker, Lawrence Kees, David Wood

For any information regarding this report please contact:

Rick Stoffels
Freshwater Scientist
Freshwater Modelling
+64 3 343 7832
rick.stoffels@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
PO Box 8602
Riccarton
Christchurch 8440

Phone +64 3 348 8987

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	Formatting checked by:	Rachel Wright
	Approved for release by:	Phillip Jellyman

Contents

Tables

Figures

Executive summary

Councils must define ‘environmental flow regimes’ (EFRs) that are expected to support instream values to meet the requirements of the National Policy Statement for Freshwater Management (NPSFM 2020). The mechanism by which councils achieve EFRs is by setting ‘take limits’ in regional plans. The NPSFM directs councils to set take limits that prioritise river health over non-environmental uses of water, hence limits that are ‘environmentally conservative’.

Where low flows are a concern, councils should define a ‘cease-to-take flow’ (CTTF), *the flow rate at which ‘Block A’ consented takes must cease*. Block A limits apply when river flows are relatively low. Of all the water allocation blocks applying to a river, Block A consents have the lowest CTTFs. Block A limits do not affect permitted takes and discretionary activities. In accordance with the NPSFM, the CTTF of a river—as a component of take limits—should be based on the planned EFR for that river. It follows that, where irrigation is likely to affect low flow hydrology, an EFR may include a ‘critical low flow’ (CLF). We define the CLF of a river as *the rate of river flow below which the environmental values we wish to maintain are threatened if that flow is experienced for prolonged periods*.

In summary:

- CLF is the flow that we want to avoid happening because it is likely to be harmful to the environment.
- CTTF is the flow that will trigger the Block A abstractions to turn off.

The CLF is a component of an environmental flow regime and a response to Clause 3.16 of the NPSFM 2020. The CTTF is an operational flow; a component of a river’s take limits and a response to Clause 3.17 of the NPSFM 2020. It follows that differentiation of the CLF and the CTTF is consistent with the NPSFM. Further, we argue that defining both a CLF and a CTTF helps reduce the risk of undesirable environmental outcomes by explicitly accounting for the lag between reaching a CTTF (notifying those with consented takes that CTTF has been reached) and the response by consented water users to that CTTF (cessation of water takes).

Gisborne District Council (GDC) require information to support specification of CTTFs. Te Arai River and the Waipaoa River are of particular concern, as these two rivers account for the majority of consented water takes in the district, either directly from surface flows or from associated aquifers. Gisborne District Council contracted NIWA to review the current CTTFs in light of the requirements of the NPSFM. They also requested we participate with GDC staff to review Gisborne’s hydrology data and its hydrological monitoring practices.

The outputs of the hydrology review were:

- Identification of periods in the available time series suitable for estimating flow duration curves (FDCs) and hydrological statistics (e.g. MALF) for the Waipaoa River and Te Arai River.
- FDCs and observed (not naturalised) MALF estimates for Te Arai River at the water supply intake and at Pykes Weir, and for the Waipaoa River at Kanakanaia. An estimate of naturalised MALF for Te Arai at the water supply intake (also known as the ‘water works’) is also provided.

- Estimates of flow gains and losses downstream of key flow monitoring gauges, such that GDC may better understand how CTTFs set and monitored at gauging sites are translated downstream.
- Recommendations for how flow monitoring could be improved within the Gisborne District.

Data and models for understanding how low flows affect environmental outcomes were poor. Little to no flow-dependent data has been collected in the Waipaoa and Te Arai Rivers since 2010. Nevertheless, consistent with NPSFM Clause 3.6 (Transparent decision-making) and Clause 1.6 (Best information) we used the best data and models available to present a transparent assessment of CLFs in the Waipaoa and Te Arai Rivers.

Our assessment of CLFs was undertaken to illustrate how the information presented may be used. We do not 'recommend' any particular CLF or resultant CTTF and understand that the choice made by GDC will represent a balance among the competing objectives of maintaining/improving freshwater values and maintaining outcomes for out-of-stream water use.

We assessed potential instream outcomes of CLFs within three water quantity zones (WQZs) of two freshwater management units (FMUs):

1. The Waipaoa surface WQZ within the Poverty Bay Flats FMU.
2. The Upper Te Arai WQZ within Te Arai FMU.
3. The Lower Te Arai WQZ within Te Arai FMU.

Data used for our assessments come from the Waipaoa River at Kanakanaia, Te Arai at the water supply intake (water works) and Te Arai at Reays Bridge, which respectively correspond to the above three WQZs. Reays Bridge is ca. 3 km downstream of Pykes Weir flow recorder.

Assessment of CLFs was based on flow-response models where responses were (a) habitat availability (weighted usable area) of native fishes, macroinvertebrates and periphyton; and (b) water temperature (Waipaoa River at Kanakanaia only). Trout response to flow was not considered as trout are not a major value in the Gisborne District.

Three CLFs were assessed for the Waipaoa River at Kanakanaia and the Lower Te Arai River. By contrast we offer assessment of only a single CLF for Te Arai at the water works. Te Arai River at the water works was treated differently because (a) a natural flow record was available, enabling what is arguably a more defensible approach to minimum flow setting; (b) there are no substantial water takes above the water works; and (c) the major take below the water works is for domestic water supply and so there is currently no Block A CTTF or allocation cap applied to limit abstraction at the water works.

Critical low flow options considered for the Waipaoa River at Kanakanaia and the Lower Te Arai River were:

1. *Instream values*.
2. Observed mean annual low flow *(Observed MALF)*.
3. *Status quo*.

Option 1—instream values—presents CLFs that, given the limited data and models available, may support high levels of NPSFM values, including all aspects of ecosystem health, threatened species and physical habitat associated with mahinga kai (see Appendix 1A of the NPSFM 2020). Option 1 is used as the point of reference for Options 2 and 3. The potential outcomes from Options 2 and 3 are summarised using a five-point categorical scale relative to Option 1 and under the assumption that Option 1 supports '*high*' values. Relative to '*high'* the other four levels of value maintenance were '*moderate-high*', '*moderate*', '*moderate-low*' and '*low*'.

The outcome of our assessments are summarised in the table below.

Table 1: Critical low flow (CLF) options for the Waipaoa and Te Arai Rivers. CLFs presented in units of litres per second (L/s). An assessment of relative maintenance of instream values given currently available data and models provided in brackets after each minimum flow.

	Option 3 (status quo)	Option 2 (Observed MALF)	Option 1 (instream values)
Waipaoa @ Kanakanaia	1,300 (moderate)	2,550 (moderate-high)	3,000 (high)
Te Arai @ Reays Bridge	60 (low-moderate)	60 (low-moderate)	150 (high)
			Option 1 (instream values; naturalised MALF default)
Te Arai @ water works			36 (high)

To reduce the risk of dropping below the CLF, CTTFs may be set using a simple equation:

CTTF = CLF + Block A allocation cap (Eqn. 1)

This very simple equation highlights a water-supply trade-off: a larger Block A allocation cap increases Block A water availability while flow is above the CTTF, but it also increases the CTTF, so results in cessation of abstraction at higher flows than would be the case for a smaller Block A allocation cap.

The larger the allocation cap relative to the CTTF the larger the chances of a 'yo-yo effect' in flow as flows fall below the CTTF and then rise above the CTTF on consecutive days because cease-to-take restrictions are triggered and then withdrawn. These fluctuations may have a detrimental effect on instream values. The magnitude of potential fluctuations may be reduced by using a Block A allocation cap that is a relatively low percentage of the CLF (say, 33% of CLF). For illustrative purposes only, in Table 2 we have translated the CLFs of Table 1 into allocation caps and CTTFs.

Table 2: Translation of the example CLFs for the Waipaoa and Te Arai Rivers (in Table 2) into allocation caps and CTTFs. Allocation caps and CTTFs are presented in units of litres per second (L/s). Here, allocation caps are set at 33% of the CLFs in Table 1. CTTFs are then determined using Eqn. 1.

	Option 3 (status quo)		Option 2 (Observed MALF)		Option 1 (instream values)	
	CTTF	Cap	CTTF	Cap	CTTF	Cap
Waipaoa @ Kanakanaia	1,733	433	3,400	850	4,000	1,000
Te Arai @ Reays Bridge	80	20	80	20	200	50

	Option 3 (status quo)	Option 2 (Observed MALF)	Option 1 (instream values)	
			Option 1 (instream values; naturalised MALF default)	
Te Arai @ water works			48	12

Looking ahead, to improve evidence-based take limits within Gisborne District we recommend:

1. Exploring the use of alternative, mechanistic flow-response models for minimum-flow setting during 2024–2025.
2. Naturalising flow series for the Waipaoa and Te Arai Rivers.
3. Implementing monitoring for adaptive management of river flows.
4. Considering a banded water allocation system with several CTTFs controlling separate groups of abstractions.

1 Introduction

1.1 Policy context

Flow is a 'master' variable exerting a strong influence on most physical and biological processes of rivers (Walker et al., 1995). The 'flow regime[1]' of a river interacts with underlying geology to shape habitat structure at multiple spatial scales. Traits of riverine animal and plant species have coevolved with the river's 'natural flow regime[2]' and the habitat associated with that regime. This dependence of species' population processes (e.g., reproduction, movement, recruitment, mortality) on the natural flow regime is a central tenet of the 'Natural Flow Paradigm' (Lytle and Poff, 2004), which has become one of the most fundamental principles in river ecology and management. Disruption of the natural flow regime threatens the physical and biological processes that support the ecosystem values of rivers.

Aotearoa New Zealand's National Policy Statement for Freshwater Management (NPSFM, 2020) acknowledges the detrimental effects that flow alteration has had on New Zealand's rivers and the values they support (NPSFM Policy 11). The NPSFM directs councils to define 'environmental flow regimes' (EFRs) that are expected to support environmental objectives (NPSFM Clauses 3.9 and 3.16).

Defining an EFR requires an understanding of:

A. environmental values of communities and tangata whenua;

B. which types of water takes require management and how those water takes are affecting—or are likely to affect—a river's flow regime; and

C. how those hydrological effects, in turn, affect a river's geomorphology and ecology, hence its values.

Planned EFRs may vary among rivers, depending on variation in natural flow regimes and environmental objectives among rivers.

The mechanism by which councils achieve EFRs is by setting 'take limits' in regional plans (NPSFM Clause 3.17). The NPSFM states that take limits must be expressed as the total volume and/or a total rate at which water is taken from a river (NPSFM Clause 3.17.2). In practice, however, setting take limits to achieve an EFR at a particular site requires defining when, where and at what rate water can be taken by all consented water takes upstream of that site (Booker et al., 2022).

A fundamental concept underpinning the NPSFM is 'Te Mana o te Wai'. Te Mana o te Wai '*refers to the fundamental importance of water and recognises that protecting the health of freshwater protects the health and well-being of the wider environment. It protects the mauri of the wai. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community*' (Clause 1.3.1 NPSFM, 2020). Subclause 1.3.5 presents a particularly challenging directive to councils; it states that there '*is a hierarchy of obligations in Te Mana o te Wai that prioritises:*

[1] We define the flow regime as a quantifiable representation of the main characteristics of a time series of discharge, calculated over a period spanning many years (ideally > 20 years). The flow regime may present variability at several temporal resolutions (e.g., variability within a year, among seasons, as well as interannual variability in gross features of annual hydrographs).
[2] The natural flow regime is the flow regime of a river whose flows have not been significantly altered by humans. The natural flow regime is primarily shaped by interactions between precipitation (snow, rain,…), climate (affecting evaporation, ice formation, etc.) and geology (e.g., influencing runoff).

A. *first, the health and well-being of water bodies and freshwater ecosystems;*

B. *second, the health needs of people (such as drinking water);*

C. *third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future*.'

The implication of Te Mana o te Wai is that councils must set water take limits that prioritise river health over non-environmental uses of water, hence limits that are 'environmentally conservative.'

1.2 Critical low flows and cease-to-take flows

Recent collaborative work between numerous councils and scientific organisations identified two types of water take[3] most relevant to flow management in New Zealand (Stoffels et al., 2022):

1. Water takes during dry periods that increase the duration, magnitude and/or frequency of low river flows within and among years.
2. Water takes during mid-high discharges for off-channel storage, and subsequent use during dry periods ('flow harvesting'). Flow harvesting may decrease the frequency of mid-high discharges within and among years.

This categorisation of water take types is consistent with the report of Hickford et al. (2023) that refers to run-of-river takes and high-flow harvesting takes.

Low flows are of particular concern to many councils. Where low flows are a concern, EFRs should include specification of a 'cease-to-take flow' (CTTF), the flow rate at which 'Block A' consented takes must cease. Block A limits apply when river flows are at their lowest. Block A limits do not affect permitted takes and discretionary activities (see next section). In accordance with the NPSFM, the CTTF of a river—as a component of take limits—should be based on the planned EFR for that river. It follows that, where irrigation is likely to affect low flow hydrology, an EFR may include a 'critical low flow' (CLF). We define the CLF of a river as *the rate of discharge below which the environmental values we wish to maintain are threatened*[4]. Included in this definition of CLF are cultural values such as natural form/character, swimming, boating and transport (tauranga waka; Appendix 1B of the NPSFM 2020).

Note that the CLF is an environmental flow and a response to Clause 3.16 of the NPSFM 2020. By contrast, the CTTF is an operational flow; a component of a river's take limits and a response to Clause 3.17 of the NPSFM 2020. It follows that differentiation between the CLF and the CTTF is consistent with the NPSFM. Further, we argue that defining both a CLF and a CTTF helps reduce the risk of undesirable environmental outcomes by explicitly accounting for the lag between reaching a CTTF and responding to that CTTF (water abstraction ceasing), as explained in Figure 1-1. By reducing the risk of undesirable outcomes, differentiation of the CLF and a CTTF is consistent with Te Mana o te Wai.

[3] For the purposes of this report water 'taken' from a flow regime includes all surface and groundwater abstractions, diversions and damming.

[4] Low-flow ecology of New Zealand rivers is poorly understood. Although we have offered a working definition of CLF here, we acknowledge that quantitatively defining a CLF is an ongoing challenge of an evolving discipline.

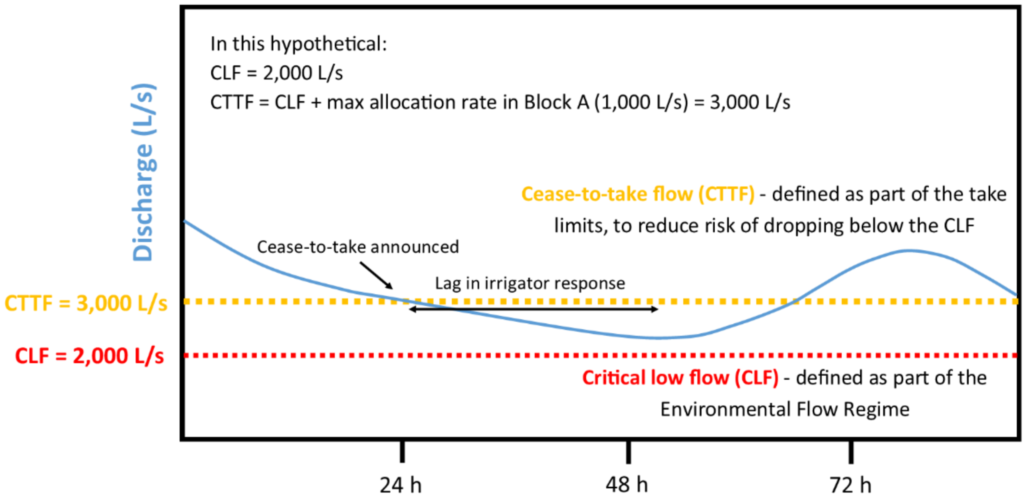


Figure 1-1: Conceptual diagram explaining the difference between the critical low flow and a cease-to-take flow. This figure presents a hypothetical of 2,000 L/s as the CLF, with a maximum allocation rate (referred to as an allocation cap in Gisborne) of 1,000 L/s, hence a CTTF of 2,000 + 1,000 = 3,000 L/s. Lag in irrigator response is only hypothetical.

There is much uncertainty about how low river flows affect environmental outcomes in New Zealand. Despite this uncertainty councils are required to define take limits of rivers subject to abstraction (NPSFM Clause 1.6). We appreciate that riverine values may exhibit a constant positive relationship with flow—no 'threshold' reduction in values may be obvious as flow declines. It follows that defining a CLF may be relatively arbitrary and based on the magnitude of value-loss that a council—in consultation with stakeholders and mana whenua—deems (un)acceptable.

1.3 Project background

Gisborne District Council (GDC) require information to support the design of EFRs. Te Arai and the Waipaoa Rivers are of particular concern, as these two rivers account for the majority of consented water takes in the district, either directly from surface flows or from associated aquifers.

During 2009–2010, GDC contracted NIWA to determine how alternative CLFs may affect availability of physical habitat for aquatic organisms within Te Arai and Waipaoa Rivers (Booker et al., 2010; hereafter referred to as the '2010 report'). Availability of suitable physical habitat as a function of river flow was estimated using physical habitat simulation models (RHYHABSIM; Jowett, 1989). These models were then used to assess the effects of three CTTF options on habitat availability of fishes, *Deleatidium* mayflies and periphyton (Table 1-1).

- Option 1 was based on CTTFs applied by GDC in existing consent conditions at the time, which stated that abstraction below these CLFs is to be at the discretion of the District Conservator.
- Option 2 was based on a default CTTF of either 80% (Waipaoa) or 90% (Te Arai) of the mean annual (7-day), observed[5] low flow (MALF) as set in the National Environmental

[5] In this report we differentiate 'observed' MALF from 'naturalised' MALF. Observed MALF is estimated using a monitored discharge series that has been affected by water abstraction. Naturalised MALF is estimated from a monitored discharge series that is unimpacted by water abstraction or from a modelled discharge series, in which the potential effects of water abstraction have been removed.

Standard (NES) on Ecological Flows and Levels[6]. The MALF used for Option 2 in the 2010 report was estimated from observed flow data, so would have been influenced by historical trends in water abstraction. As such, the MALF of the 2010 report does not reflect MALF under natural flow conditions, and would likely have been an underestimate of naturalised MALF.

- Option 3 was based on maintaining instream ecological values at a higher level, given the data collected, and the models used in the 2010 report.

The 2010 report assessed the relative effect of each CTTF option on instream ecological value using a five-point relative scale: 'Low', 'Low-moderate', 'Moderate', 'Moderate-High' and 'High' level of maintenance of instream habitat for ecological values. Relative maintenance of values was based on (a) the assumption that Option 3 maintained 'high' ecological value; and (b) the relative difference between modelled habitat availabilities under Options 1, 2 and 3.

Table 1-1: Cease-to-take flow (CTTF) options considered in the 2010 report. Cease-to-take flows presented in units of litres per second (L/s). Relative maintenance of instream values provided in brackets after each CTTF.

	Option 1 (status quo)	Option 2 (NES default)	Option 3 (instream values)
Waipaoa @ Kanakanaia	1,300 (moderate)	1,600 (moderate-high)	2,000 (high)
Waipaoa @ Ford Road	1,300 (moderate)	1,600 (moderate-high)	2,000 (high)
Te Arai @ Water Works	No minimum flow (low)	60 (moderate)	150 (high)
Te Arai @ Reays Bridge	15 (low-moderate)	60 (moderate)	150 (high)

Table 1-2: Current cease-to-take flows (CTTFs) and allocation caps for the Waipaoa and Te Arai Rivers. 'Blocks' refer to different subsets of water use consents within the Gisborne District. Of all the water allocation blocks applying to a river, Block A consents have the lowest CTTFs. Permitted Takes include, for example, stock watering. Discretionary activities are water takes where no catchment plan and water quantity limits are in place.

Freshwater management unit	Water quantity zone	Monitoring location	Block A minimum flow	Block A allocation cap	Block B minimum flow	Block B allocation cap
Poverty Bay Flats	Waipaoa surface water	Kanakanaia	1,300 L/s	2,000 L/s	4,000 L/s	2,000 L/s
Waipaoa Hill Country	Waipaoa Hill Country	Kanakanaia	No A block. Permitted Takes only. Discretionary Activity.		4,000 L/s	2,000 L/s
Te Arai	Upper Te Arai	Water supply intake	Restricted Discretionary Activity – City Municipal Supply. All Other takes Discretionary Activity			
Te Arai	Lower Te Arai	Pykes Weir	60 L/s	70 L/s	220 L/s	100 L/s

[6] Ministry for the Environment (2008) Proposed National Environmental Standard on ecological flows and water levels, Discussion document. Wellington: Ministry for the Environment, 868. 61 p. This National Environmental Standard was never ratified. According to the proposed NES 80% of MALF defines minimum flow of 'large rivers' (mean flow ≥ 5 cumecs) while 90% of MALF defines minimum flow of 'small rivers' (mean flow < 5 cumecs).

Following the 2010 report, GDC set the CTTFs and allocation caps (maximum take rates) presented in Table 1-2. The Option 3 'instream values' CTTFs were not adopted by GDC due to economic values being prioritised when the Waipaoa Catchment Plan was developed and notified in 2015[7]. Block A is the block of consents that includes most run-of-river takes (mostly for irrigation purposes) but excludes takes under permitted and/or discretionary activities.

1.4 Objectives, report structure and scope

Gisborne District Council required a review of the current CTTF rules for the Waipaoa and Te Arai rivers (Table 1-2) within the context of the NPSFM 2020. Prior to assessment of the extent to which river flows affect values, GDC requested we collaborate with GDC staff to review flow data from the Waipaoa and Te Arai rivers, and the processes used to monitor flows of those rivers. The objectives of this project were, therefore:

1. Review the analysis of Waipaoa and Te Arai hydrology data recently completed by GDC[8], focusing on:

    1.1 potential inaccuracies in the hydrology data and, if present, how such inaccuracies might be remedied; and

    1.2 estimates of flow gains and losses downstream of key flow monitoring gauges, such that GDC may better understand how minimum flow rules set and monitored at gauging sites are translated downstream.

2. Review options for updating and extending (e.g., new taxa/values) the flow-response model outputs of the 2010 report, based on recent developments presented in the System for Environmental Flow Analysis (SEFA[9]).

3. Either:

    3.1 Update and extend the flow-response model predictions of the 2010 report using the extended capabilities of SEFA; OR

    3.2 if the capabilities of SEFA are unlikely to change the information presented in the 2010 report, then reproduce the flow-response outputs of the 2010 report.

4. Use spatially-coupled river flow, air temperature and water temperature data to analyse the relationship between river discharge, air temperature and water temperature within the Waipaoa River.

5. Present an analysis of the extent to which alternative critical low flow (CLF) choices provide habitat for instream values of the Waipaoa and Te Arai Rivers, especially within the context of the NPSFM 2020.

6. Recommend future work streams to strengthen evidence-based flow allocation rules for rivers of the Gisborne District.

[7] Regional Freshwater & Waipaoa Catchment Plan Review | Gisborne District Council (gdc.govt.nz)
[8] During 2022-2023 GDC undertook an internal review of river flow data monitored within the Waipaoa River at Kanakanaia and Te Arai River at Pykes Weir, as well as river flow monitoring processes and protocols.
[9] sefa.co.nz

Output of Objective 1 comprises Section 2 of this report (**Flow data for the Waipaoa and Te Arai Rivers**). The outputs of Objectives 2-4 comprise Section 3, **Flow-habitat relationships**. The outputs of Objectives 5 and 6 correspond respectively to Sections 4 (**Assessment of alternative critical low flows**) and 5 (**Improving evidence-based take limits in the Gisborne District**) of this report.

Below we list noteworthy elements of scope:

- The hydrology review involved attendance of several online meetings and ad hoc reviews of the outputs and outcomes of the GDC-led hydrology analysis. It follows that a significant component of this work was for NIWA scientist Lawrence Kees to act as an advisor to GDC.
- In this report we present flow-habitat relationships to facilitate CTTF-setting by the GDC. We present an example assessment of alternative CLF choices using the flow-habitat relationships. We do not, however, recommend CLFs or CTTFs for Te Arai and Waipaoa Rivers. We recognise that the GDC is responsible for considering the information presented in this report and setting take limits that balance the numerous—and conflicting—uses of freshwater, in consultation with tangata whenua and other stakeholders.
- Flow-response modelling for trout was out of scope as trout are not a notable value of the Waipaoa and Te Arai Rivers.
- Mechanistic modelling of relationships between flow and native aquatic animal/plant populations was out of scope as such models are currently not available.
- Flow-water temperature modelling for Te Arai River was out of scope as we had no water temperature data from Te Arai River.
- Modelling joint effects of climate change and river flow on instream values was out of scope.

2 Flow data for the Waipaoa and Te Arai Rivers

2.1 Potential inaccuracies in the hydrology data.

2.1.1 Specific aims and approach

The aims of this analysis were:

1. Contribute advice to facilitate GDC's collation and review of river flow data for their fit for river flow management purposes from three sites:
   1.1 Waipaoa River at Kanakanaia;
   1.2 Te Arai River at the Bush Intake Above Weir; and
   1.3 Te Arai River at Pykes Weir.
2. In collaboration with GDC identify periods of flow time series deemed most robust for estimating hydrological statistics, including 7-day observed MALF and flow duration curves (FDCs) for each monitoring site.
3. Using the reliable subsets of flow data from Aim 2, estimate FDCs and observed MALFs for the three monitoring sites listed above.
4. Offer recommendations for how monitoring of river flow data could be improved in the future to inform river flow management, including recommendations for how flow monitoring site infrastructure could be improved.

To meet **Aim 1** a NIWA hydrologist[10] attended nine meetings to discuss data and approaches to GDC's flow data review. Following those meetings NIWA reviewed 10 GDC documents that presented the outcomes and outputs of the GDC-led hydrology review. River flow data are often generated by converting water levels to flows using a level-to-flow rating curve. Rating curves are fitted to paired direct observations of water level and gauged flows measured during site visits. Rating curves can change through time due to changes in river geomorphology at the gauging station. Changes to rating curves are likely to be more frequent in river channels with highly mobile beds such as the Waipaoa River at Kanakanaia (Figure 2-1).

The process of data review undertaken by GDC included the assessment of systematic deviations in the hydrological record, which are indicative of a rating curve change, incorrect rating curve shape or measurement bias. An **outcome of Aim 1** was a set of specific concerns that GDC had about river flow monitoring on Te Arai and Waipaoa Rivers—concerns that influenced subsequent steps in the process of identifying environmental flow regimes and associated take limits.

[10] Lawrence Kees

Figure 2-1: Waipaoa River near Kanakanaia in April 2010. Source: Doug Booker, NIWA.

Meeting **Aim 2** involved completing three ad hoc tasks in response to the outcomes of Aim 1:

- For the Waipaoa River at Kanakanaia, compare and contrast (a) FDCs estimated using data from two different flow recorders at this site (GDC vs. NIWA gauge), and (b) the number of gaugings that contribute to flow records coming from each gauge. This comparison shed light on the relative reliability of flow data coming from the GDC and NIWA flow recorders.
- An analysis of stage measurement error for the Waipaoa River at Kanakanaia (GDC data) and Te Arai River at Pykes Weir sites.

The **output of Aim 2** was a set of recommendations concerning which data subsets should be used for hydrological statistics, including the flow assessments in Section 4 of this report.

To complete **Aim 3** the reliable subsets of river data (from Aim 2) were used to estimate FDCs and observed MALFs for all three river flow monitoring sites considered in this report.

Meeting **Aim 4** was straightforward and involved collating several potential problems with flow monitoring noted while completing Aims 1–3, then offering recommendations to help remedy those problems.

2.1.2 Flow data reliability

Comparison of the Waipaoa River flow data from the GDC and NIWA gauges at Kanakanaia

Both NIWA and GDC maintain a flow recorder on the Waipaoa River at Kanakanaia. Flow duration curve comparisons were used to infer whether there were systemic differences in the development of river stage versus flow relationships derived by NIWA and GDC, and at what flows any such differences occur. In the assessment of the reliability of each record at a particular flow, consideration was given to the number of streamflow measurements (gaugings) at each site. A comparison of gaugings applied by NIWA and GDC at the two sites may elucidate what stream flow record is more reliable, and where any differences between flow records may occur. Deviation in flow time-series is important as it may lead to variation in the number of days that irrigation is available to water users, or that habitat is impacted at the higher end of permitted limits.

GDC reviewed flow rating curves estimated using data from their recorder at Kanakanaia from 2003. There is extensive commentary on the gauging data and updated ratings within the spreadsheets supplied to NIWA by GDC and this informed NIWA's analysis. Resources available for the current work did not permit a detailed commentary on every rating curve in the record. To aid the comparison of GDC and NIWA flow data, GDC provided cumulative runoff plots, preliminary FDCs, river streamflow gauging data and the river flow and level relationships (flow ratings) for the GDC Waipaoa at Kanakanaia site and Te Arai River at Pykes Weir.

Comparison between the GDC and NIWA flow duration curves show the greatest deviation at lower flows (3.5 $m^3 s^{-1}$; Figure 2-3), and equates to ~13% at the 95th exceedance percentile and grows to ~18% at the 99th percentile. The period of flow with least differences between NIWA and GDC flow time-series for each site was from 2015 until present. To determine the cause of differences between NIWA and GDC flow time-series, the number of gaugings and the temporal spread of those gaugings was investigated to determine the relationship between measured water level and flow.

There are 1397 gaugings from Waipaoa River at Kanakanaia collected by GDC and NIWA. This number of gaugings reflects the length of record, and the number of gaugings necessary to develop a stage/discharge relationship in a highly mobile stream bed. Of note is the number of gaugings that are made during the period for which a particular rating curve is applied before transitioning to application of a new rating curve (Table 2-1). The higher number of gaugings associated with GDC and the distribution of flow measured by those gaugings suggests that the lower end of the flow record is better characterised by the GDC record (Table 2-1 and Figure 2-3).

GDC has a higher frequency of gauging in summertime and at low flows (Figure 2-4). The gauging frequency reflects the need for accurate flow data to maintain flow by managing water abstractions both upstream and downstream of the Kanakanaia site (Figure 2-4). Consequently the 7-day MALF is better characterised in the GDC data set, although the GDC data does not have the temporal coverage or frequency of higher flow measurements that the NIWA data set has.

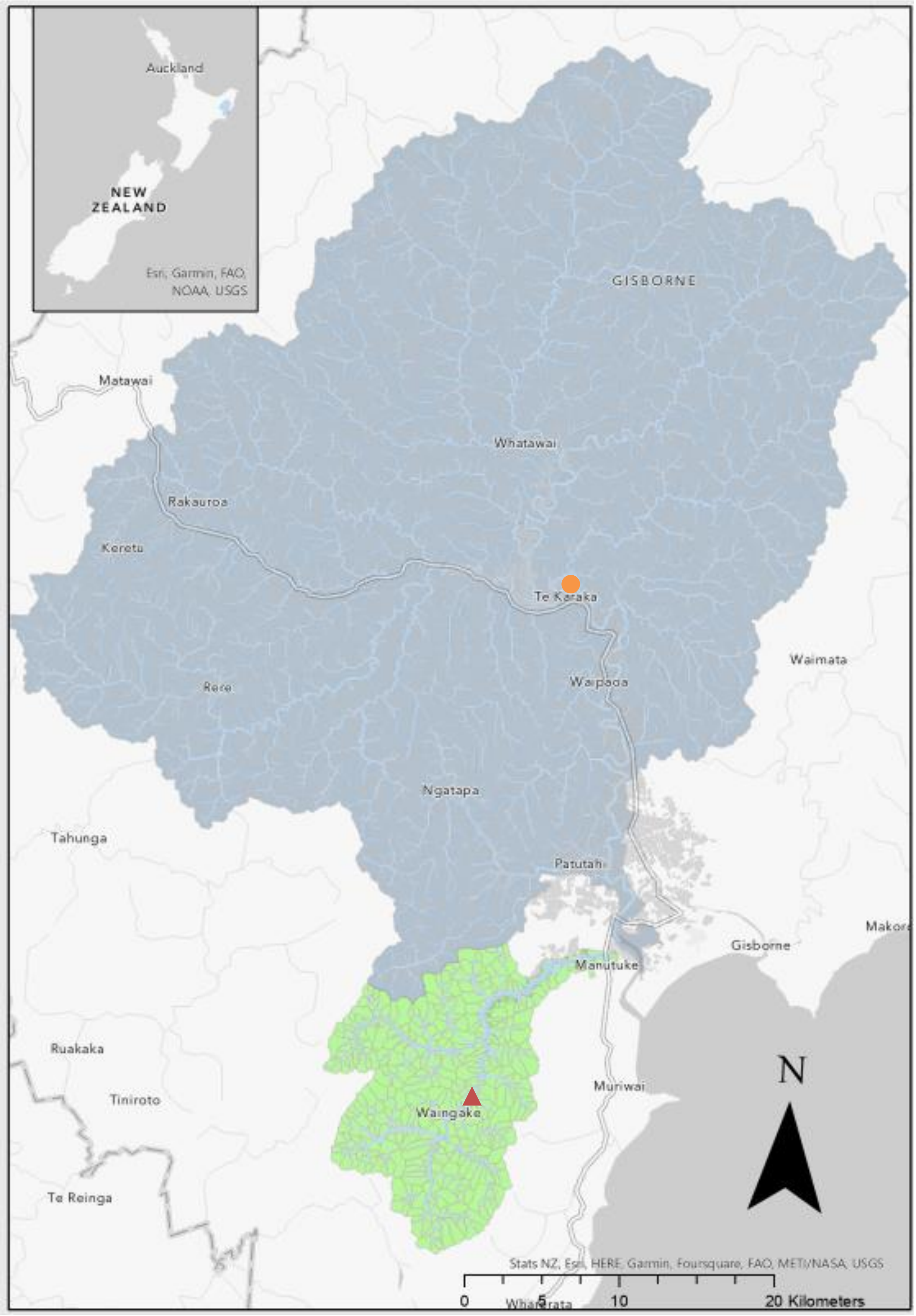


Figure 2-2: Catchments of the Waipaoa River (blue; 1,900 km^2) and Te Arai River (green; 187 km^2). The Waipaoa River at Kanakanaia and Te Arai at Pykes Weir gauges are shown by an orange circle and red triangle respectively.

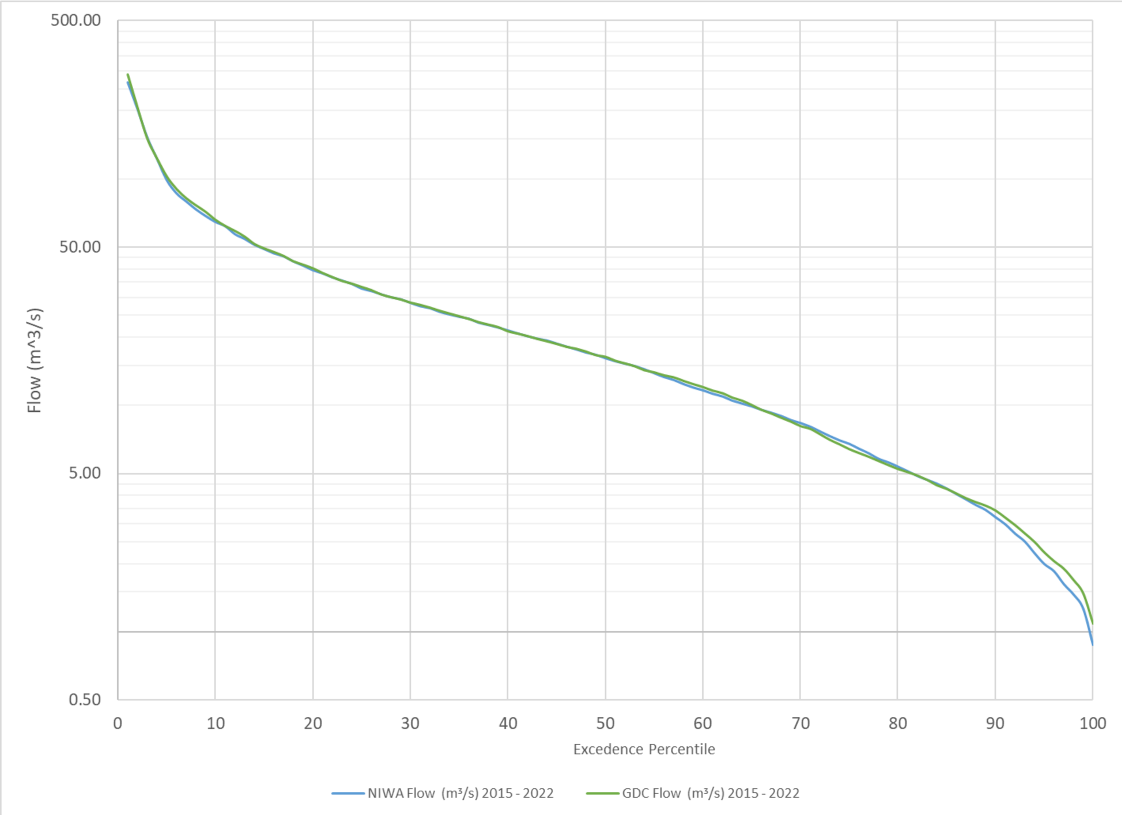


Figure 2-3: Flow duration curves for the Waipaoa River at Kanakanaia estimated using data from both the GDC and NIWA flow recorders.

Table 2-1: Summary of stream flow gaugings per rating change for both GDC's and NIWA's stream flow sites for the Waipaoa River at Kanakanaia.

	GDC	NIWA
From 1980		
No. of rating curves	75	156
No. of gaugings	945	452
Average gaugings per rating change	13	3
From 2010		
No. of rating curves	26	41
No. of gaugings	229	82
Average gaugings per rating change	9	2

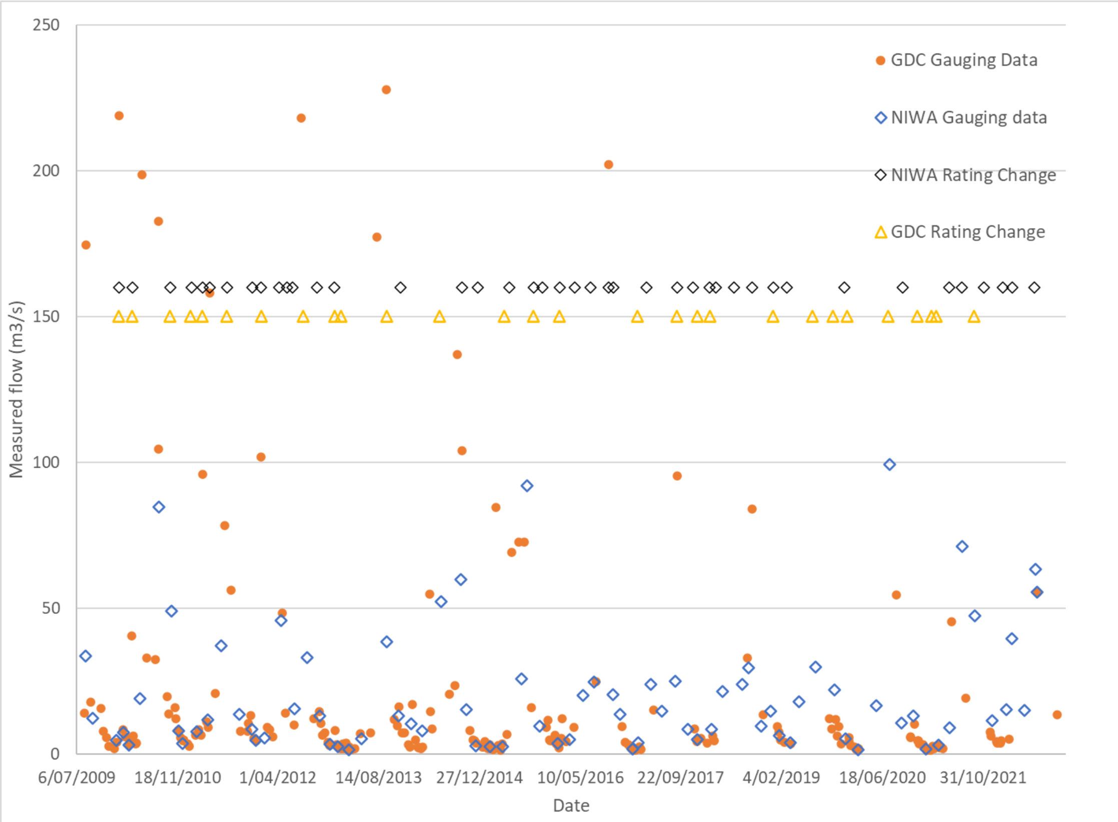


Figure 2-4: The sequences of manual stream flow gaugings and rating changes for the NIWA and GDC flow recorders on the Waipaoa River at Kanakanaia.

A point of interest is the frequency with which each rating period was changed. More frequent changes in rating curves may be needed to reflect frequent changes in river geomorphology. However, more frequent changes in rating curves often means that each curve is less well characterised because fewer gaugings are available to create each rating curve. NIWA changed ratings more often throughout the year. GDC changed ratings associated with the seasonal nature of their streamflow measurement program. In summer this may result in NIWA changing the rating period too often to produce well characterised rating curves, and in winter, GDC not changing the rating period often enough to reflect changes in geomorphology.

Differences between flow records may result in higher MALF estimates derived from GDC's data than NIWA's data during the 1990's and early 2000's (Figure 2-5). This period coincides with the management of the site by an external contractor, with a reduction in deviation between the records since GDC took control of the monitoring site from a contractor in 2015 (Figure 2-5). Observations associated with this assessment are:

- GDC has a reliable flow record from 2015.
- At the same time, there is a reduction in the number of higher flow gaugings, which may be the source of uncertainty in the mid-flow range on GDC data, although this error appears small in the aggregated data of a flow duration curve.
- The GDC flow record is likely more reliable at low flows due to a higher gauging frequency at such flows.

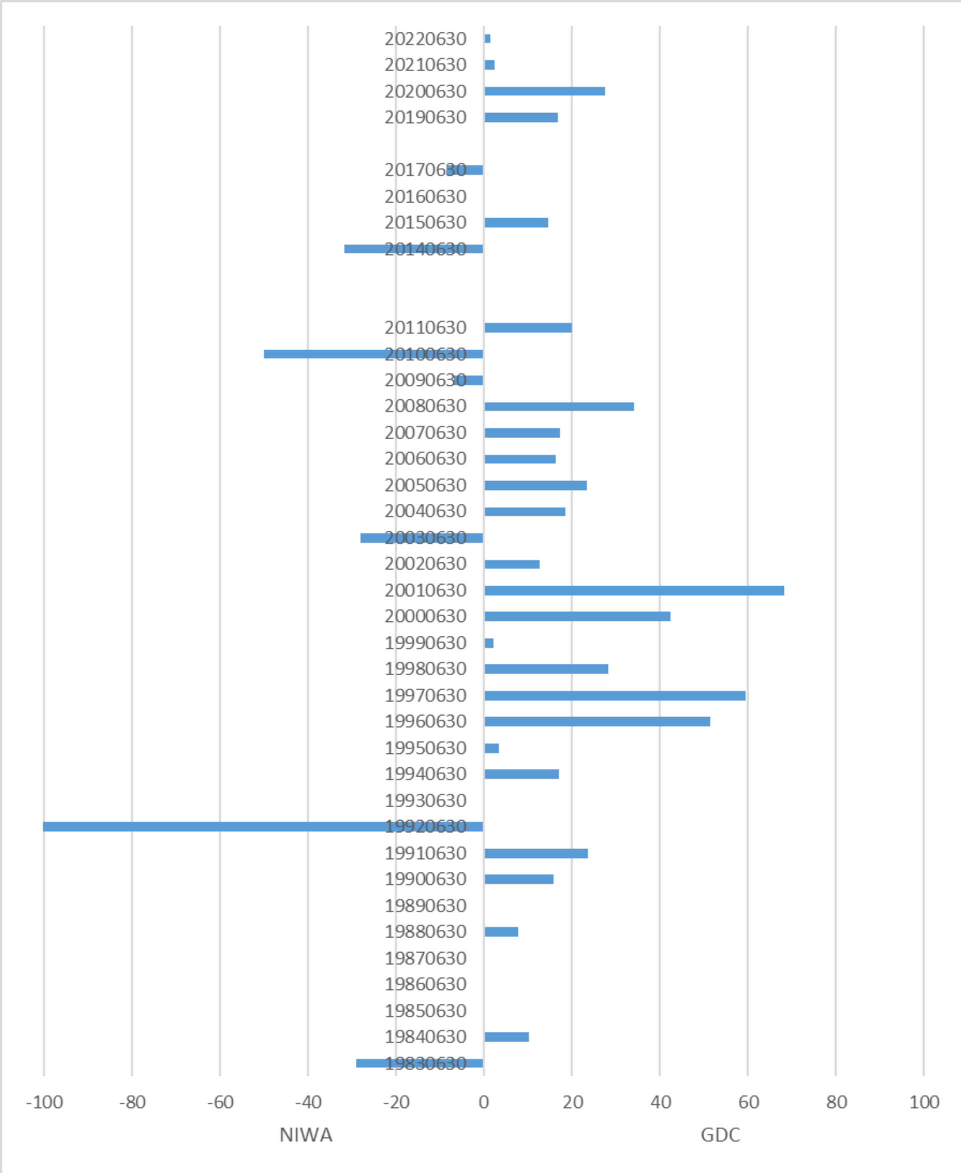


Figure 2-5: Comparison of percent difference of 7-day Annual Low Flow estimated from NIWA and GDC records for the Waipaoa River at Kanakanaia. The hydrological year ending is on the Y-axis. Negative deviation on the x-axis indicates a larger NIWA value, deviation on the positive axis shows a comparatively larger value derived from GDC data.

The difference between 7-day MALF estimates from NIWA and GDC flow records are provided in Table 2-2 and 2-3. To infer changes in data processing procedures over different time periods, the mean annual low flow estimates for the entire record - 1982 – 2003, the reviewed record 2003 to 2022, and the period post 2015 when GDC regained control over data collection and processing from external parties (Table 2-2) are compared. There was a reduction in the difference between the flow records from each organisation from July 2003. GDC have reviewed the flow ratings and record between 2003 and 2023, which has improved the understanding of uncertainties related to the flow record. The 20-year time-period (2003-2022) at Waipaoa River at Kanakanaia provides a good basis for the development of water take limits. The 'like for like' comparison of statistics (Table 2-2) excludes three hydrological years of GDC data (2011-2013, 2017-2018) on the basis that the corresponding NIWA data was not sufficient to form hydrological statistics.

Table 2-2: GDC & NIWA Mean Annual Low Flow (MALF) for the Waipaoa River at Kanakanaia, excluding years with no/limited data. Years not included are 1984–1985, 1985–1986, 1986–1987, 1988–1989, 1992–1993, 2011–2012, 2012–2013, and 2017-2018.

Hydrological year	GDC 7d MALF (m^3/s)	NIWA TIDEDA 7d MALF (m^3/s)	% difference
Jul 1982 – Jun 2022	2.579	2.225	-16
Jul 1982 – Jun 2003	2.748	2.151	-18
Jul 2003 – Jun 2022	2.409	2.192	-9
Jul 2015 – Jun 2022	2.300	2.102	-9

Developing relevant flow statistics from flow record prior to 2003 may be done upon review of the GDC flow data. For certainty of decision making, the inclusion of further years of data would require the data record to have any error associated with data processing and rating development checked and understood in a similar way to the post 2003 data set. However, the entire 20-year record available from 2003, produces a similar value of the 7-day MALF statistic to the entire flow record (Table 2-3). The values in the table below are similar to the 7-day MALF produced for the 1982 – 2022 period (Table 2-2).

Table 2-3: Observed mean annual low flows (MALFs) for the Waipaoa River at Kanakanaia estimated over two different periods / from two organisations.

Hydrological year	GDC 7d MALF (m^3/s)
Jul 1982 – Jun 2022	2.649
Jul 2003 – Jun 2022	2.566

Comparison of the flow records from the two hydrological organisations has been useful in informing the understanding of differences in data processing procedure and reliability of the flow record from NIWA and GDC. For the Waipaoa River at Kanakanaia we recommend using low flow statistics derived from the GDC data presented in Figure 2-3 and Table 2-3. Improvement of the flow record could be made by combining the development of a composite flow record incorporating the discreet flow and stage measurements where gaps in data coverage occur (see recommendations in Section 2.1.4).

2.1.3 Flow data for Te Arai River

GDC supplied flow data for the entire flow record at Te Arai River at Pykes Weir, and for a shorter time period (Nov-2016 to Nov-2022) at Te Arai River Bush Intake Above Weir (also referred to as the 'water works' site in the 2010 report and in Section 3 onwards) and Te Arai River Bush Intake Below Weir.

Flow duration curves and observed MALF

Te Arai River at Bush Intake

Summary data for Te Arai at Bush Creek at sites above and below the weir are presented in this report, The flow at the Bush Intake weir reach is significantly affected by the municipal water supply (Figure 2-6; Figure 2-7). Understanding the effects of the water supply in the Bush Creek reach, and the downstream flow at Pykes Weir are made difficult by the quality of the flow record as a consequence of monitoring frequency, site maintenance and aggregated water abstraction data. Concerns around the supplied flow time series, outlined by GDC, are presented below:

1) Gravel can build up around the water level sensor; when this happens it could artificially raise the water level at the sensor location. As flow is inferred from water level, this could lead to flows which are not representative, particularly at the lower flows (i.e., the actual flow may be lower). The gravel is then cleared out by higher flows.
2) There were gaps in the water level data or the data were very poor from:

   • 3-Jan-2020 to 3-Feb-2020;

   • 24-Aug-2020 to 2-Dec-2020 (issues with the sensor); and

   • 7-Jul-2021 to 23-Feb-2022 (issues with the sensor).

   These water level data were deleted and the gaps filled using regression analysis and water level data from Te Arai River at Pykes Weir.

   There is a gap of two days (24-25 Jun 2019) which has not yet been filled.

   There are also issues with the water level data from Nov-2016 to Feb-2017. These will be reviewed again at a later date.

Some other issues and observations include:

3) The mean daily flow data show that ~30% of flows are higher at the downstream site compared to the upstream site. This is not realistic as there are no tributaries joining Te Arai River between the two sites. It suggests that there could be issues with the water levels and/or rating curves.

4) The flow duration curves at the sites suggest that at the higher flows (from around Q25 to Q0, i.e., when flows are exceeded between 25% and 0% of the time), flows are consistently higher at the downstream site. This could again be related to the rating curves. Gaugings tend to be focused on the medium to lower flows, so there will be uncertainties at the higher flows (Figure 2-6).

5) Using the flow data from 2016-2022, there is no flow below the weir 8 % of the time. This may not be realistic. It also varies according to the years selected (Figure 2-6).

6) There appear to be some errors in the Intake Weir Extraction Rate (e.g., abstraction rates which are unrealistically high), but there are also issues with the flows.

7) The same-day gaugings at Te Arai River Bush Intake Above Weir and Below Weir show that the margin of error in flow measurement can be up to 10% (or greater).

8) The Intake Weir abstraction rates are an average over the day, and may not reflect abstraction rates at the time of the gauging (Table 2-4).

The compounding nature of some of these observations of data quality means that the absolute values of flow from the time series may not be accurate, so it is incumbent on GDC to improve the monitoring at the site to make recommendations of the effect of water takes in Te Arai more reliably. The GDC water level monitoring and flow rating development may not produce a hydrograph well throughout the flow range, time period and difference of aggregated flow data give an indication of the length of time that flow downstream of the weir is affected by abstraction (Figure 2-6). The provided point measurement data (Table 2-4) show that the daily aggregated water take data and measured instantaneous flow can replicate upstream flow data with reasonable accuracy, as well as highlighting some of the concerns listed above, for instance the reduction in flows on the 22/2/2017 and 21/3/2017) does not correspond with water take data. It is also not unreasonable to expect the structure to convey a ~123 L/s abstraction.

Table 2-4: Discharge above and below the Bush Intake Weir, daily mean abstraction rate, and difference between 'extraction + below-weir flows' and above-weir flow. Table supplied by GDC.

	Flow (m³/s)			
Date	Te Arai River Bush Intake Above Weir	Te Arai River Bush Intake Below Weir	Intake Weir Extraction Rate (m³/s)*	% Difference of abstraction plus downstream flow to upstream flow
4/11/2016	0.350	0.192	0.123	90
10/11/2016	0.334	0.124	0.113	71
20/02/2017	0.202	0.187	0.000	93
22/02/2017	0.070	0.008	0.015	32
21/03/2017	0.165	0.022	0.000	13
9/03/2018	0.263	0.241	0.048	110
14/12/2018	0.217	0.171	0.044	99
25/06/2019	0.375	0.327	0.056	102
10/09/2021	0.124	0.088	0.055	115
15/06/2022	0.187	0.138	0.041	96
26/08/2022	0.246	0.156	0.073	93
10/10/2022	0.348	0.357	0.052	118
21/10/2022	0.327	0.289	0.064	108

*N.B. This is an average rate for the day.

It is not unreasonable to expect that low flows could be halved from the natural flow by the Bush Intake at a daily scale (Table 2-4 and Figure 2-6), but the sub-daily abstraction effects could well have a greater impact for a shorter period. This statement in no way discounts the real concerns around the flow time series quality and site maintenance at Te Arai upper catchment flow sites.

Flow in the upper catchment can be reduced to zero or near zero flow for approximately 10% of the observation period. The extraction of around 55 L/s for municipal supply in the upper catchment effectively halves the natural flow that might otherwise flow through the Pykes Weir flow station and cause the stream to cease to flow (Figure 2-6). It is likely that the amount of time that flow is that flow ceases below the weir will vary annually.

A comparison of flow upstream and downstream of the weir was made by subtracting the water take data at the weir from the upstream flow record. This comparison shows that the effect of the abstraction is negligible (~10% of flow) at flows above the ~25th exceedance percentile (Figure 2-6). It also shows that the synthetic data set can well reproduce the flow record downstream of the weir between the 25th and 80th flow exceedance percentile, and that error in rating curve shape is in this flow range is at its least significant effect. The comparison also suggests that that low flows may be affected by reduction to zero or near zero flow between the 85th and 100th flow exceedance percentile. It should be reinforced that any error associated with the development of the flow rating above the weir is carried through in this comparison, which adds to the ambiguity of the period of time that stream flow is affected. Although, the mechanical control of the weir affords a reasonable estimate of flow in the mid-range despite the observed concerns with the data record and measurement error. Assessment of the effects of abstraction on instream ecology do weight the importance of good low flow measurement highly, highlighting the need for improved monitoring in this reach given the scale of effects on flow, and of fish passage.

It may be useful for GDC undertake concurrent gaugings from above the intake and the reach above Pykes weir to add to the concurrent data set to see how significant the impact weir abstraction is along the reach. From the one concurrent gauging data point available between the above Bush Intake and Pykes Weir, it appears that there is the ~ 40 L/s being extracted from a 47 L/s +/- stream gauging. This suggests a ~40 L/s gain from the catchment between the Bush Intake and Pykes Weir (Figure 2-11, 13/2/2017).

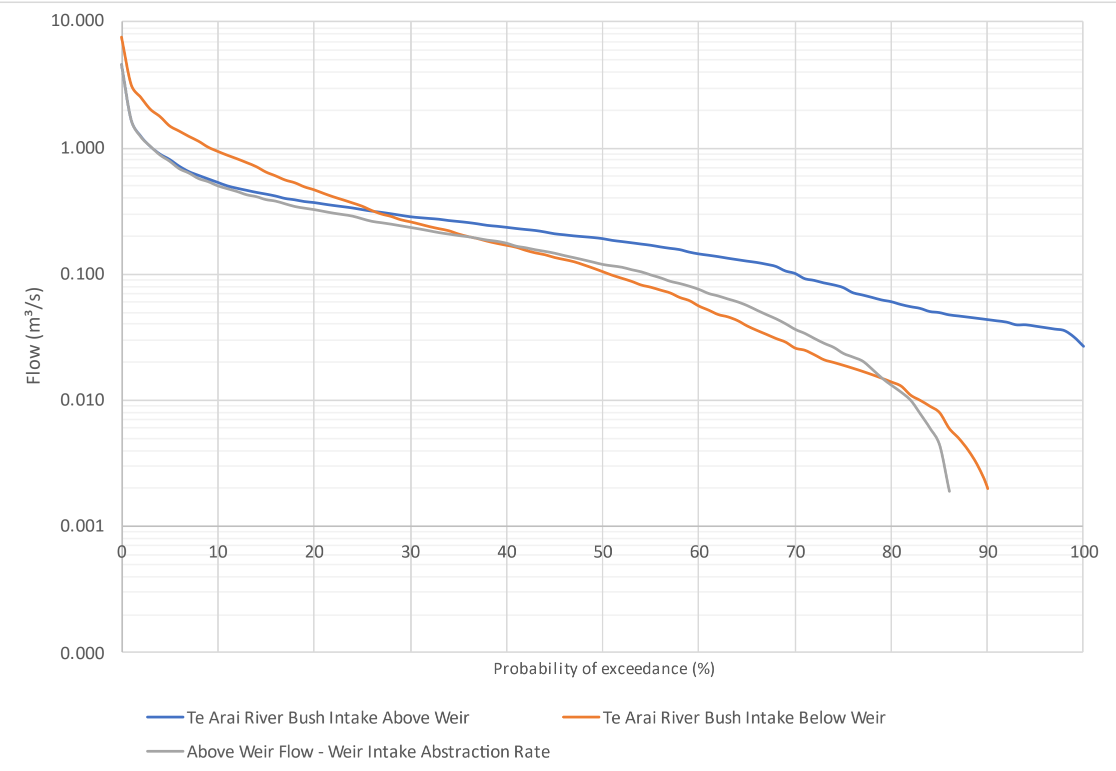


Figure 2-6: Flow duration curves for Te Arai River Bush Intake, above and below the weir/intake (gauge also referred to as water works).

Figure 2-7: Te Arai at Bush Creek intake in April 2010. Source: Doug Booker, NIWA.

Te Arai River at Pykes Weir

With respect to Pykes Weir, 75% of the 642 stream flow measurements have been collected at or below the 7 Day MALF (95th percentile). Measurements are taken throughout the flow range and up to the 99th percentile of flow. Considering the stream flow data alone, Te Arai at Pykes weir could be considered well characterised. The FDC for Te Arai River at Pykes Weir is present in Figure 2-8.

The observed MALF values for each of the three focal sites are presented in Table 2-5. These MALF estimates are based on flow data deemed most reliable for river flow management purposes following the hydrology review.

Table 2-5: Estimates of observed MALF for three sites on the Waipaoa and Te Arai Rivers. Estimates of MALF are calculated from 7-day rolling, daily average discharge. For Te Arai River at the Bush Creek intake, the MALF presented may be a reasonable approximation of naturalised MALF (see Section 4).

Site	MALF	
Waipaoa River at Kanakanaia	2,550 L/s	From GDC (2023)
Te Arai River at the water works / Bush Creek intake	40 L/s	Limited data (2016–2023). Site characteristics result in a flow record with a high degree of uncertainty.
Te Arai River at Pykes Weir	60 L/s	GDC data from 1984 to 2022

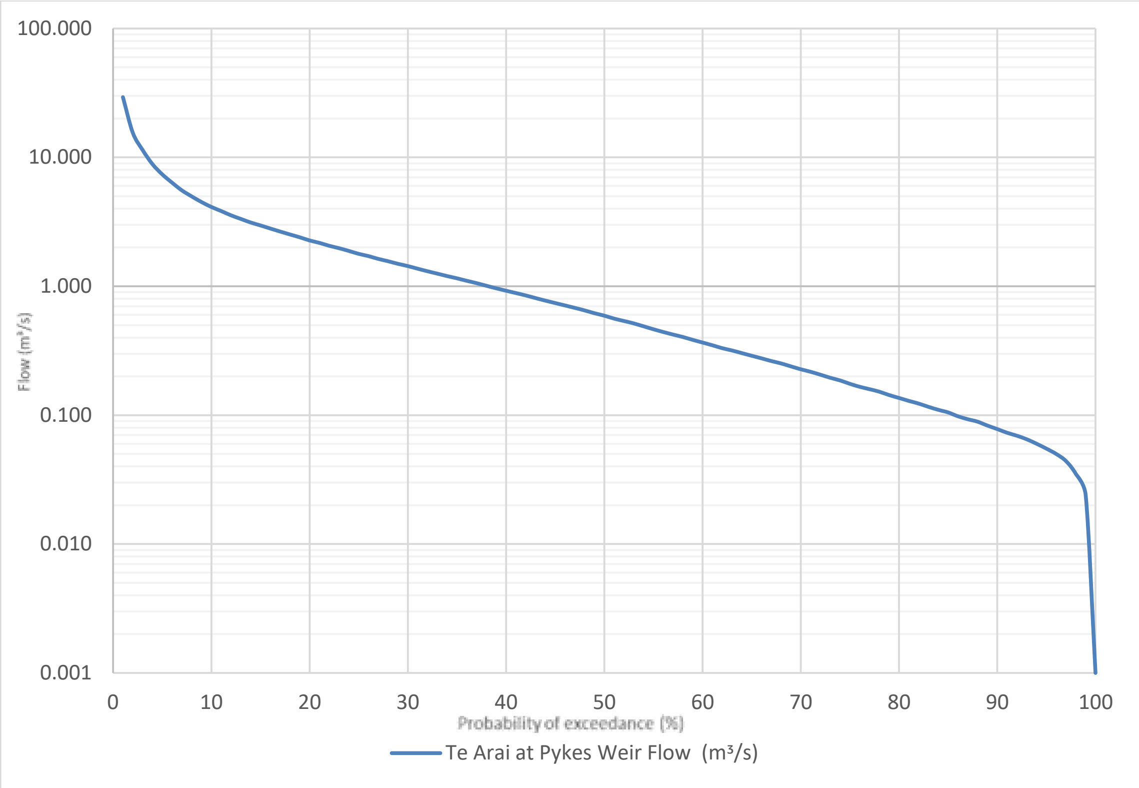


Figure 2-8: Flow duration curve for Te Arai River at Pykes Weir for the period of 1984 to 2022.

2.1.4 Improving river flow monitoring at existing sites on the Waipaoa and Te Arai Rivers

Te Arai River at Pykes Weir represents a stable flow control that can provide a good quality record assuming the appropriate channel maintenance is undertaken.

The comments below relating to the Pykes Weir flow site are valid up until late 2022. Cyclone Gabrielle significantly affected the site, requiring significant remediation works.

Te Arai River at Pikes weir is a shallow v-notch style weir constructed in a concrete channel. Engineered river controls are useful for providing a standard control for flow when estimating streamflow and can be used to estimate flow using theoretical stage to discharge relationships (ratings) for the weir. The shallow weir is useful for controlling river discharge at mid-range flows and low flows, but care must be taken with stage measurement and site maintenance.

Consistency in cross-sectional area is another factor that can affect the performance of theoretical or constructed rating curves. National Environmental Monitoring Standards guidelines suggest that the dimensions of control structures must be measured and recorded:

- at installation and five-yearly intervals thereafter;
- if no significant change is observed in the interim then again at time of site closure; and
- any time the structure is modified.

Channel modification includes the effect of natural processes. The upstream segment of a weir serves the purpose of reducing the velocity of the stream and inducing laminar flow before spilling over the edge of the weir. This process can reduce the ability of the stream to maintain entrainment of sediment and other instream debris, resulting in deposition in the upstream channel altering the cross-sectional area of the weir.

GDC have performed an analysis on the quality of rating curves in a spreadsheet provided to NIWA by GDC titled 'Summary_Rating Curves_Gaugings_&_MALF_Te Arai River at Pykes Weir_V4.xlsx'. In this workbook the following observation was noted:

'The low flow gaugings from 27-Nov-2008 to 5-Feb-2009 all have positive deviations. There seem to be two groups of low flow gaugings which would sit better on different rating curves (these are from 13-Nov-2008 to 22-Dec-2008 & from 7-Jan-2009 to 19-Jan-2009). There are rain events after 22-Dec-2009 which could have caused changes to the channel (and a change in rating) at these lower flows.'

Figure 2-9: Te Arai River at Pykes Weir in December 2008. Source: Mistry and Bosworth (2023)[11].

A potential cause of the deviations in the low flow gaugings is presented in Figure 2-9. In this photograph we see a reduction in cross sectional area upstream of the weir, and deposited branches downstream of the weir which may induce tail water effects at mid-range flows.

Site hydrology data could be maintained or improved by consistent maintenance throughout the year, which should be possible given the (on average) 14 stream flow measurements per year. The quality of data at the site may also be improved by increased monitoring of the stage and discharge relationship, as affected by changes in the cross section of the stream flow control. This can be done

[11] Mistry and Bosworth (2023) Review of low flow data for the Waipaoa River at Kanakanaia and Te Arai River at Pykes Weir. GDC report for NIWA (20/03/2023).

by comparing the rated flow time-series at the Pykes Weir site with one or a combination of the alternative methods of flow measurement suggestions below:

- Real-time flow measurement using acoustic doppler velocity or current profilers to continuously monitor stage and velocity relationships at low flows could help detect change in channel shape.
- Space Time Image Velocity methods may be useful to estimate flows, and the upper portion of the rating curve when sediment loads impede acoustic doppler measurements. This method also has the benefit of providing a visual representation of any change in channel shape.
- Plotting the theoretical rating-based flow time-series over constructed time series may assist with the timing of rating changes.
- Development of a correlation of stream flow measurement at Pykes Weir with another time series from a catchment with similar hydrological characteristics.

With respect to the Waipaoa River at Kanakanaia site:

- It is recommended that a composite stream gauging data set is formed combining the most reliable data subsets of the NIWA and GDC records. Ratings should be reviewed in light of this composite record to better constrain stage-discharge relationships, and to reduce the ambiguity associated with the application period of each stage-discharge relationship.
- The timing of rating changes should be reviewed to cross-check decisions for the timing of rating changes between NIWA and GDC.

2.2 Spatial distribution of river flow data

2.2.1 Specific aims and approach

CTTFs set with respect to a gauging station should operate to be protective of instream values locally, and both upstream and downstream. The minimum flow set with respect to a gauging station may not have a consistent level of effectiveness in terms of protection of instream values along the reach of the river. Additions of flow from tributaries, changes in river channel shape along the length of the river, downstream water takes and exchanges between surface water and groundwater can influence the effectiveness of spatial extrapolation of CTTFs.

When managing water takes at low flows it is important to consider the spatial distribution of natural gains and losses between surface and groundwater, and their associated seasonal variation. Natural gains to streamflow during low-flow periods result from the inputs of tributaries and groundwater. Gains to streamflows during low flow conditions can also be derived from the drainage of near surface valley bottom (or near channel) storages such as more permanently wetted channel bank soils, alluvial valley fills and wetland areas. The Waipaoa and Te Arai catchments include significant portions of each catchment confined in valleys before flowing through alluvial plains where groundwater losses and gains may be substantial. Both catchments considered in this report display evidence of transmission potential transmission losses outside of the confined valley flow.

Groundwater abstraction within the sub-surface drainage area affects the level of phreatic surfaces and therefore the potential for groundwater re-emergence in stream channels. Localised reductions in the level of the water table may affect either hydraulic gradients or the length of channel that intersects the phreatic surface. The effects of groundwater pumping near the head of a perennial river may result in groundwater table depletion through interception of recharge water and induced recharge of the aquifer from the river itself.

The **aims of this analysis** were:

1. Collate available data describing longitudinal patterns in flow for the Waipaoa and Te Arai Rivers and examine longitudinal losses and gains in flow below:

    1.1 the Waipaoa River at Kanakanaia;

    1.2 Te Arai River at the water work /Bush Creek; and

    1.3 Te Arai River at Pykes Weir.

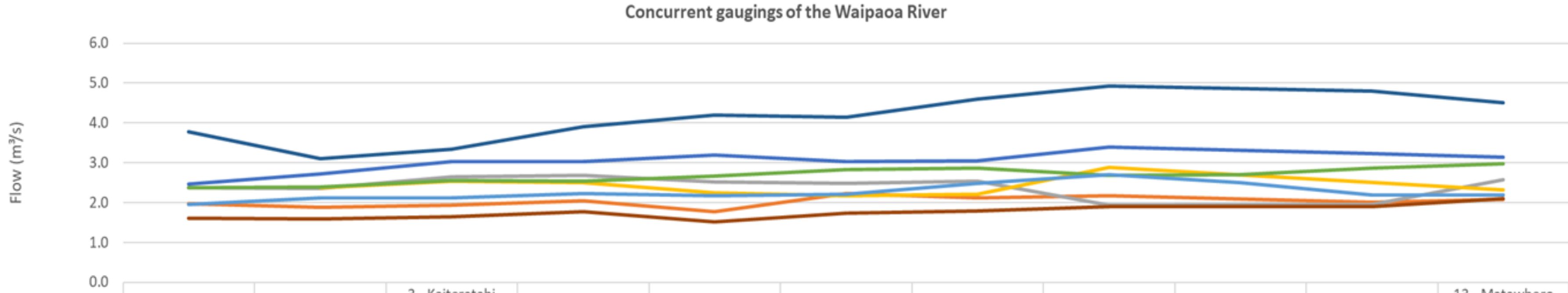
2. Provide recommendations for improving our understanding and monitoring of longitudinal patterns in flow in the Waipaoa and Te Arai Rivers.

To meet Aim 1, we collated GDC data that presented multiple estimates of river flow on the same day, along the courses of Te Arai and Waipaoa Rivers, then plotted discharge as a function of distance downstream. Concurrent estimates of discharge were available for 11 sites along the Waipaoa River between Kanakanaia and Matawhero Bridge. For Te Arai River, concurrent estimates of discharge were available for eight sites between the Water Works and Whakatere Road. For both rivers concurrent discharge estimates were only available for a subset of the sites during each day of measurement.

2.2.2 Longitudinal changes in river flow

Within the Waipaoa River transmission losses occur between Whitmore Road and Ford Road, and between Brown and Tietjens Road (Figure 2-10). These reaches are downstream of the confines of the valley-bound mid-catchment and on the productive plains. Observed losses and gains in flow along the Waipaoa River can be as great as ca. 600 L/s (Figure 2-10; see series from 22/03/2013) and such losses can extend for over 10 km of river length (Figure 2-10). This magnitude of loss is approximately 30% of the current A-Block allocation. It must be noted that the cause and frequency of losses of this magnitude are unknown. The observed losses occurred when surface flow at Kanakanaia was ca. 1000 L/s above the Block A minimum flow (1300 L/s) and ca. 300 L/s over the Block A allocation cap (2000 L/s). (Figure 2-10). When flow at Kanakanaia is close to the CTTF (26/2/13; 6/3/15; 14/2/17) flows downstream tends to be either generally stable or generally increasing. Further investigation should be made to help determine anthropogenic or geomorphic causes of the reduction in surface flows.

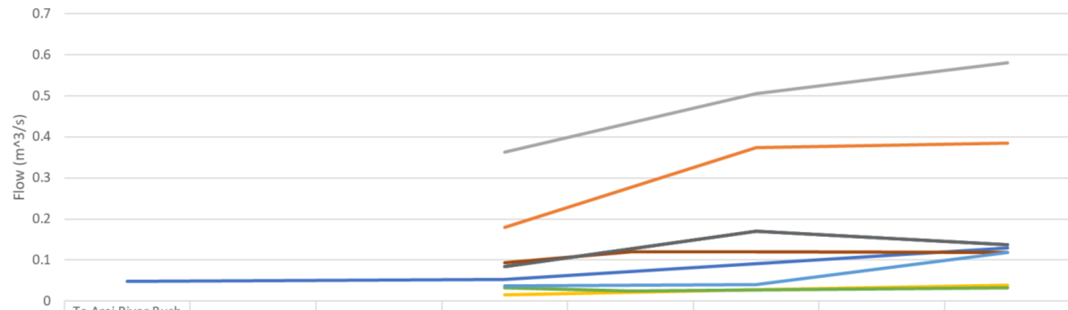
Stream flow measurements taken along Te Arai River on the same day show variable gains and losses along the length of the river (Figure 2-11). These gains and losses are most pronounced downstream of the SH61 bridge where the stream is less bound by hill country and through an area of irrigated land. Gains in river flow are common below Pykes Weir, with flow between Pykes Weir and Whakatere Road (ca. 17 km of river) often doubling (Figure 2-11).



	1 - Kanakanaia	2 - J Clarke	3 - Kaiteratahi Bridge	4 - Whitmore Rd	5 - Ford Rd	6 - Bruce Rd	7 - Brown Rd	9 - Teitjens	10 - Bolitho Rd	12 - Bloomfield Rd	13 - Matawhero Bridge
	0.0	8.8	13.0	21.0	26.5	27.5	28.0	33.0	33.5	37.0	40.0
26/02/2013	1.976	1.877	1.926	2.042	1.766	2.220	2.108	2.178		2.000	2.084
22/03/2013	2.370	2.357	2.649	2.690	2.522	2.488	2.544	1.943		1.953	2.574
26/02/2014		2.378	2.531	2.501	2.239	2.164	2.216	2.875			2.314
16/01/2015	2.456	2.710	3.025	3.027	3.197	3.035	3.054	3.400		3.236	3.146
17/01/2014	2.366	2.384	2.561	2.538	2.671	2.837	2.860	2.691	2.696	2.872	2.981
23/01/2015	3.781	3.095	3.332	3.904	4.201	4.143	4.592	4.932		4.806	4.515
6/03/2015	1.604	1.585	1.642	1.771	1.521	1.731	1.791	1.902		1.902	2.098
14/02/2017	1.955	2.116	2.122	2.231	2.178	2.204	2.474	2.692	2.494	2.183	2.185

Gauging site and distance downstream from Kanakania Bridge

Figure 2-10: Concurrent flow estimates showing longitudinal gains and losses from the Waipaoa River between Kanakanaia and Matawhero Bridge. Numbers directly under site names denote distance downstream; sites span 40 km of river length.



	Te Arai River Bush Intake Above Weir	Te Arai River Bush Intake Below Weir	Te Arai River at Waingake	Te Arai River at Pykes Weir	Te Arai River at Reays Br	Te Arai River at Site 61	Te Arai River at 304 Waingake Rd	Te Arai River at Whakatere Rd
	0	0.025	4.4	7.7	14.2	14.5	24.5	24.8
13/02/2017	0.049			0.053				0.129
5/02/2009				0.016		0.028		0.039
10/02/2009				0.033	0.025			0.033
13/01/2010				0.084		0.171		0.138
21/01/2013				0.094	0.12	0.12		0.118
25/03/2013				0.037		0.041		0.119
26/11/2013				0.179		0.373		0.384
15/11/2013				0.363		0.505		0.58
13/01/2010				0.084		0.171		0.138

Figure 2-11: Concurrent flow estimates showing longitudinal gains and losses from Te Arai River between the water works and Whakatere Road. Numbers directly under site names denote distance downstream; sites span 24.8 km of river length.

2.2.3 Improving understanding and monitoring of longitudinal patterns in river flow

To enhance the utility of flow management sites upstream of water allocations, it is possible to develop correlations between flow series at management sites and streamflow gauging sites downstream. Doing so can provide a time-series of expected flows at other sites of interest that can be used to assess the influence of water take rules at monitored sites on downstream locations. In developing stream-flow correlations, the data used should represent natural flow conditions in the catchments. It is important to undertake data collection under hydrologically similar conditions.

Along the Waipaoa River there are three stream flow gauging sites on the Waipaoa river that have sufficient data to develop stream flow correlations: Kaiteratahi Bridge (22 measurements), Bolitho Rd (16 measurements) and Matawhero Bridge (23 measurements). Along Te Arai River there are two stream flow gauging sites that have sufficient data to develop stream flow correlations: at Site 61 (37) and Whakatere Rd (149).

The magnitude, extent and duration of flow gains and losses need to be better understood to address the relative influence of natural and anthropogenic gains and losses on the water body.

If we are to better understand the influence of interactions between groundwater and surface water on stream flows:

- Undertake sufficient streamflow gaugings during winter (when there should be little to no irrigation) and in summer during periods of low to no irrigation to develop correlated flow estimates at sites with variable flow.
- Determine the fraction of stream depleting groundwater and surface water takes at each REC segment in the catchment.
- Collect, collate, and analyse water take data to aid streamflow depletion estimation.

3 Flow-habitat relationships

3.1 Effects of low river flows on ecology

Before describing the approaches we used to determine how river flows affect instream values, it is useful to clarify (a) how water abstraction during summer-autumn affects river hydrology; and (b) how altered hydrology may then affect physical and ecological patterns and processes. This conceptual understanding of the problem is essential to understand the strengths and weaknesses of the models used in this report. This material was recently presented by Stoffels et al. (2022), so it is convenient to reproduce that material below.

Hydrological stressors resulting from low flows are well studied (Smakhtin, 2001) and include the following:

1. *Duration of a low flow event*. The number of days during which discharge is below the *low flow threshold*[12] (Figure 3-1).
2. The *within-year frequency of low flow events*. The frequency with which discharge drops below the low flow threshold (Figure 3-1).
3. The *magnitude of a low flow event*. The difference between the low flow threshold and the minimum discharge observed during a low flow event (Figure 3-1).
4. The *rate of decline in discharge* during a low flow event. The per-day rate at which discharge declines during a low flow event (Figure 3-1).

Water takes during dry periods exacerbate all four of the above hydrological stressors (Figure 3-1).

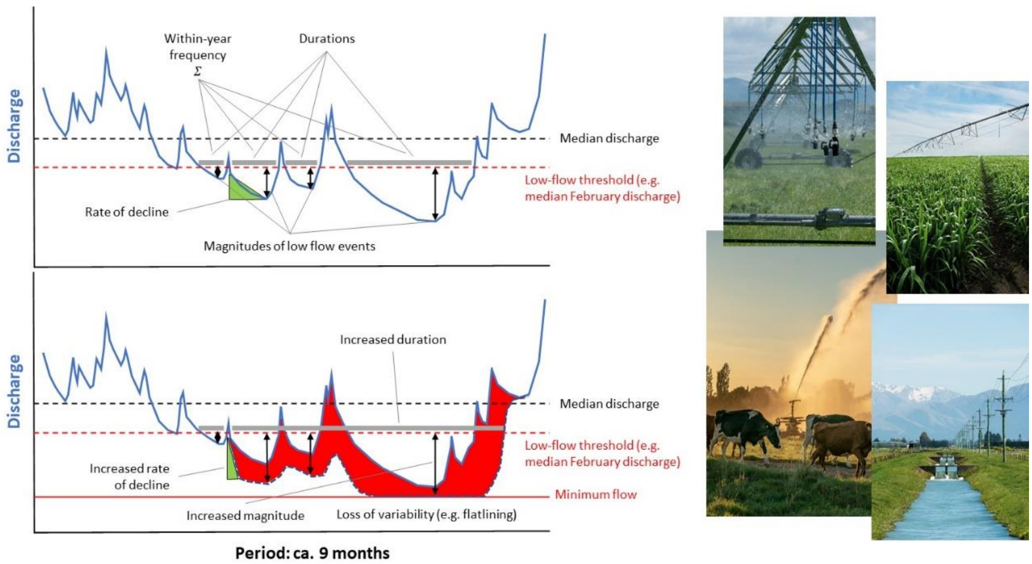


Figure 3-1: Conceptualisation of the impact of water takes during dry periods on a hydrograph and resultant hydrological stressors. Solid and dashed lines indicate hydrographs without and with water takes, respectively. Red filled region indicates volume of water taken away from natural hydrograph.

[12] The level of discharge that defines the low-flow threshold is arbitrary. That is, the low-flow threshold could be defined in several ways (e.g., median February discharge, or perhaps MALF) and is a convenient construct to operationalise the concepts of low-flow hydrology and ecology.

A conceptualisation of the effects of low flows on metrics within runoff-fed rivers is presented in Figure 3-2, which is structured by the NPSFM components of ecosystem health (water quantity, water quality, habitat, aquatic life and ecological processes). The conceptual model was based on research summarised in Smakhtin (2001), Dewson et al. (2007b), Rolls et al. (2012) and King et al. (2015).

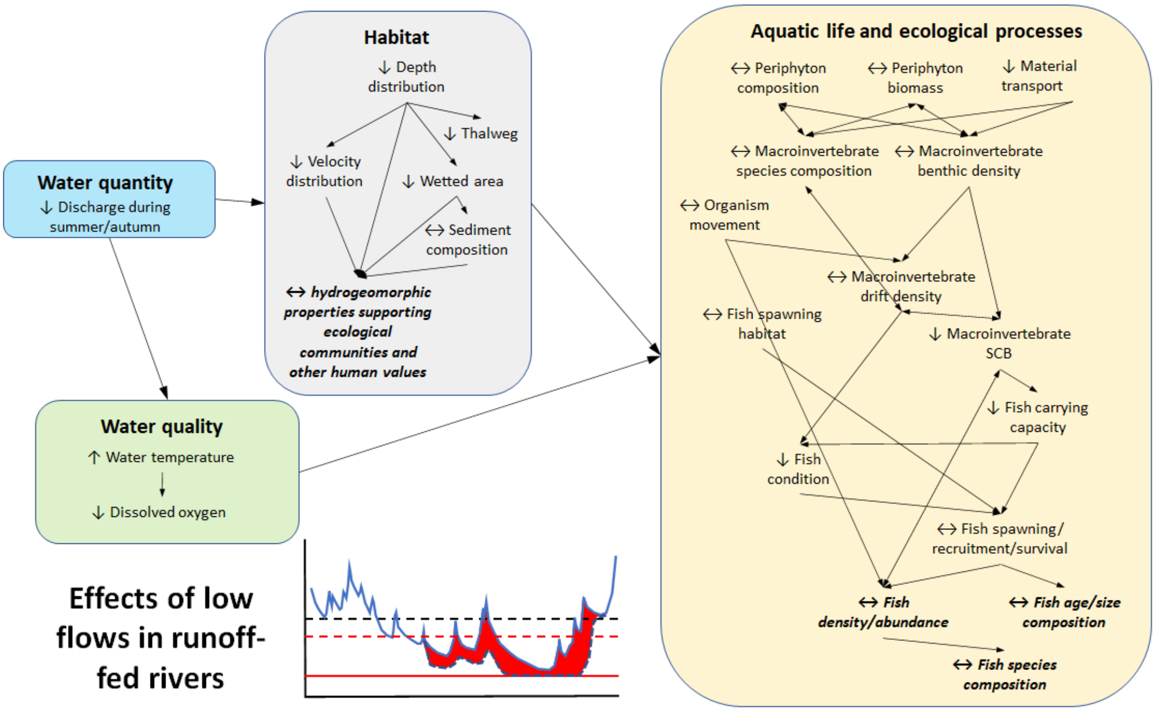


Figure 3-2: Conceptual model of the effects of low river flows on metrics within runoff-fed rivers grouped by water quality, physical habitat, and aquatic life and ecological processes. Up- and down-arrows denote increasing and decreasing respectively. Bidirectional lateral arrows denote change; either increase or decrease, depending on the specific low-flow hydrological stressor considered, its timing, duration and magnitude. Arrows between metrics in different components (boxes) were not included; including them resulted in a very high density of arrows throughout the diagram that did more to obfuscate than clarify.

Low flows may have the following effects on **physical habitat,** resulting in changes in the hydrogeomorphic properties of a river reach that directly (e.g., swimming; boating) and indirectly (support of aquatic life and ecological processes) support focal values (Figure 3-2):

- Reduced discharge will reduce mean depth of the water column throughout a river reach, and may change other statistical properties of the depth distribution of a reach (maximum depth, range, variance, etc.).
- Reduced mean depth may change the thalweg[13] of a river reach.
- Reduced depth will generally reduce reach wetted area. As flow decreases, the magnitude of reduction in wetted area will depend on reach morphometry; the

[13] The thalweg of a river reach is the longitudinal profile of maximum depth along a river reach.

shallower the gradient of the stream bottom, the greater the reduction in wetted area per unit change in depth.

- Mean water velocity of a river reach generally decreases as discharge is reduced.
- As mean water depth and wetted area decline, the sediment size composition of the benthos may also change (Hakala and Hartman, 2004).

Low flows may have the following effects on **water quality** (Figure 3-2):

- Reduced river discharge can increase water temperature (Booker and Whitehead, 2022; Caissie, 2006).
- Higher water temperatures and reduced mixing of the water column may decrease dissolved oxygen in specific rivers where/when ecosystem respiration is high (e.g., in rivers with lots of organic matter, hence high rates of microbial decomposition) (Diaz and Breitburg, 2009).

Flow-mediated effects on physical habitat and water quality will interact to affect **aquatic life and ecological processes** supporting fish populations (Figure 3-2):

- Broad periphyton types (such as thin films or long filaments) tend to be associated with specific depths and velocities (Biggs and Hickey, 1994; Biggs and Stockseth, 1996), so changed hydraulics during low flows may also change the periphyton composition of a river reach, as well as the biomass (mass per unit area) of periphyton as measured by Chl-*a* concentration (Suren et al., 2003b). Increased water temperature during low flows will also interact with changed hydraulics to affect periphyton composition and biomass (Miller et al., 2007).
- Reduced velocity and discharge will reduce rates of organic matter transport downstream, increasing retention of organic matter (Boulton and Lake, 1992; Dewson et al., 2007a).
- Changes in periphyton composition and biomass, organic matter retention and water quality will affect macroinvertebrate species composition and biomass (per unit area) (Brooks et al., 2011; Haxton and Findlay, 2008; Suren et al., 2003a).
- Reductions in wetted area may change the composition of benthic sediment/ substrata. Macroinvertebrates and types of periphyton have specific substrate preferences, hence a change in substrate composition is likely to change the composition of the benthic community (Biggs et al., 1999; Hoyle et al., 2017; Quinn and Hickey, 1990; Shearer et al., 2015). A change in the size composition of benthic sediment may also affect the availability of spawning and refuge habitat of fishes, in turn affecting population survival rates and, ultimately, population size (Davey et al., 2006; Magoulick and Kobza, 2003).
- Changes in the macroinvertebrate community, as well as reduced velocity and discharge will also change the composition and density of drifting macroinvertebrates (Sotiropoulos et al., 2006).
- Although we know that magnitude and duration of low flows affect periphyton and macroinvertebrate species composition and biomass, the direction and magnitude of

effects depends on the spatial context of the river reach (land-use, riparian habitat, etc), and the states of the four low flow hydrological stressors identified earlier in Section 3.1. The states of the four low flow stressors will vary in time, throughout the summer-autumn period. It follows that the directions and magnitudes of effects on periphyton and macroinvertebrates will be dynamic during low flow events (Rolls et al., 2012).

- Despite the dynamic effects of low flows on macroinvertebrate density and species composition at relatively small scales (e.g., within particular channel units (riffles, runs, etc.) and microhabitats (e.g., patches within riffles) (Fausch et al., 2002)), at larger spatial scales we can expect a reduction reach-wide, total standing crop biomass of macroinvertebrates, as a consequence of the reduction in wetted area of the reach (Walters and Post, 2011).
- The effects outlined above combine to reduce fish carrying capacity at the reach scale (Hakala and Hartman, 2004), with the greatest reductions in carrying capacity occurring for large-bodied fishes at higher trophic levels (McCann et al., 2005). Reduced fish carrying capacity will lower condition of individuals in fish populations and in turn lead to reduced survival and recruitment (Cowx et al., 1984), with the end result being reduced fish abundance and changed fish population/community structure (Figure 3-2).
- Increased water temperatures during low flows can affect fish populations via direct and indirect mechanisms, with the direction of the effects (positive/negative) dependent on the magnitude of heating relative to the species' thermal tolerances.

3.2 Approach

3.2.1 Flow-response models, transparent decision-making and best information

The use of models to determine how alternative flow management decisions affect environmental outcomes is considered best practice in flow management (Poff et al., 2010). Models are encoded in computer scripts and functions and accept data as input. These features of models can increase the transparency of decision-making processes in several ways:

- The assumptions that were made when designing a model and/or generating predictions are made explicit[14].
- Model design and assumptions—both explicit and hidden—can be interrogated by independent parties.
- The data that serves as input to the models can be reviewed and analysed for potential biases and imprecisions.
- The output of models can be reproduced.

Given models can increase the transparency of decision-making, use of models to inform decision-making is **consistent with NPSFM Clause 3.6 (Transparent decision-making)**.

[14] We acknowledge that many scientists fail to disclose assumptions, leaving them 'hidden', but that is not consistent with best practice in mathematical modelling.

Ideally, models used to support flow management decisions should be mechanistic, in that they explicitly represent the mechanisms that link environmental outcomes to hydrology (Poff et al., 2010). In the context of low flow management, models should be designed to capture the biophysical mechanistic pathways outlined in Section 3.1, above. When mechanistic models are used to predict environmental responses to flows, the chances of spurious predictions—hence ineffective flow management decisions—is reduced[15] (Lancaster and Downes, 2010b).

When validated mechanistic models are not available, other forms of information should be used to guide flow management decisions (Poff et al., 2010). Correlational models capture associations between environmental responses and hydrological variation in space and/or time, and are not designed to account for variation in the response variable due to known or hypothesised mechanisms[16]. Correlational models may be used to support transparent decision making. However, two variables that are correlated with each other may not be causally linked. Because correlation can not be equated with causation, correlational models have the potential to yield inaccurate information. Table 3-1 presents a very brief comparison of mechanistic and correlational models in terms of their strengths and weaknesses for setting EFRs.

Table 3-1: Strengths and weaknesses of alternative modelling approaches used for designing environmental flow regimes. Footnote 16 applies here.

	Strengths	Weakness
Mechanistic	**Potentially higher accuracy.** Because the models are designed to capture known or hypothesised mechanisms linking hydrology to ecology, there is a lower chance of spurious relationships, hence false predictions. Mechanistic models may be particularly useful when extrapolations outside of the observed bounds are required.	**Development is resource-intensive.** Estimating the parameters of mechanistic models is usually more laborious and takes longer. This increases cost of model development, and delays model implementation. Development of mechanistic models requires more advanced model-building and analysis capabilities; capabilities that are often in short supply. Mechanistic flow-ecology models are rarely available in an easy-to-use software package.
Correlational	**Development is less resource-intensive.** When compared with mechanistic models, parameter estimation is relatively straightforward and less time consuming. Software packages are available for implementing correlational flow-ecology models.	**Potentially lower accuracy.** Correlations between response variables (e.g., fish abundance) and hydrological variables may be confounded by other environmental variables that covary with hydrology. Correlations may be an artefact of sampling methodology and/or strongly biased by choice of sampling method. If correlations between response and hydrology are not consistent with our mechanistic understanding of the system, stakeholder[17] confidence in the model will be low. In short, correlational models may be misleading, and not accurately reflect effects of flow on environmental values.

[15] For a fuller and more general discussion of the need to understand mechanisms to avoid drawing false inferences and/or making false predictions see McElreath, R., 2016. Statstical Rethinking: A Bayesian Course with Examples in R and Stan. CRC Press, Boca Raton, Florida.
[16] Our characterisation of the differences between mechanistic and correlational models as a dichotomy is convenient in that it facilitates explanation but it is, in truth, artificial—environmental models fall along a continuum of types, with highly detailed, dynamical-system, process-based models at one end, and very coarse correlations at the other end.
[17] Including scientists.

Few mechanistic flow-ecology models are available to support flow management decisions in New Zealand. Hayes (2019; 2016) has developed mechanistic flow-ecology models for trout, but no mechanistic flow-ecology models are currently available to support decisions focused on native species. Nevertheless, **Clause 1.6 of the NPSFM (Best information)** requires councils to advance decision-making despite not having ideal decision-support tools. In the absence of mechanistic models, therefore, use of correlational models to support decision making is consistent with Clause 1.6 of the NPSFM.

3.2.2 Weighted usable area (WUA) models

We used models of weighted usable area (WUA) to determine how variation in flow affected availability of habitat for native fish, the mayfly *Deleatidium* and periphyton. WUA models are correlational models that predict changes in the availability of habitat as a function of flow-induced changes in depth, velocity and substrate composition. Our review of the SEFA software revealed that it would not extend the WUA capabilities beyond those used in the 2010 report. Accordingly, the WUA models used here are exactly the same as those used in the 2010 report. Further, because there has been no further collection of data since the 2010 report, the WUA results presented here are a copy of those presented in the 2010 report.

All details of the WUA methods can be found in Booker et al. (2010). Results from physical habitat modelling are provided in units of square metres of available suitable habitat per metre of river length (m^2/m). Graphs showing relationships between flow and river hydraulics variables (i.e., river width, wetted perimeter, average depth and average velocity) are also presented.

3.2.3 Habitat suitability criteria

Weighted usable area models combine two sub-models to predict how flow affects habitat availability of a taxon:

1. a hydraulic model that is used to predict how a change in discharge affects the spatial distribution and abundance of depths, velocities and substrates within a river reach; and

2. habitat suitability criteria, which are correlations between a taxon's relative abundance[18] and velocity, depth and substrate size.

Table 3-2: Habitat suitability criteria (HSC) used in this study.

Species	HSC name	HSC source
Fish		
Shortfin eel	Shortfin eel < 300mm	Jowett and Richardson (2008)
	Shortfin eel > 300mm	Jowett and Richardson (2008)
Longfin eel	Longfin eel < 300mm	Jowett and Richardson (2008)
	Longfin eel > 300mm	Jowett and Richardson (2008)
Torrentfish	Torrentfish	Jowett and Richardson (2008)
Crans bully	Crans bully	Jowett and Richardson (2008)

[18] Density, relative abundance (e.g., catch per unit area), or occupancy (presence-absence).

Species	HSC name	HSC source
Upland bully	Upland bully	Jowett and Richardson (2008)
Common bully	Common bully	Jowett and Richardson (2008)
Bluegill bully	Bluegill bully	Jowett and Richardson (2008)
Redfin bully	Redfin bully	Jowett and Richardson (2008)
Benthic invertebrates		
All	Food producing	Waters (1976)
Deleatidium	*Deleatidium* mayfly nymphs	Jowett et al. (1991)
Periphyton		
	Short filamentous	unpublished NIWA data
	Long filamentous	unpublished NIWA data
	Thin films	unpublished NIWA data

Some of the most **notable assumptions of habitat suitability criteria** are as follows:

- Habitat suitability criteria are assumed to capture causal relationships between the fundamental processes that shape population dynamics (reproduction, recruitment, growth, survival, maturation) and the microhabitat around them measured at the time and place of sampling.
- It is assumed that the primary mechanism by which flow affects populations is by affecting availability of suitable physical microhabitat.
- They most often assume that the habitat requirements of a species do not vary across life-stages, nor across processes within life-stages (e.g., feeding, hence growth, vs reproduction).
- It is assumed that abundance-microhabitat associations are sampled without bias.

The habitat suitability criteria used in the present analysis are summarised in Table 3-2.

3.2.4 Information used at each site

Two sites were the focus of our WUA modelling: the Waipaoa River at Kanakanaia and Te Arai at Reays Bridge / Pykes Weir (Reays Bridge data are assumed to be representative of flow-response relationships just upstream at Pykes Weir; Figure 3-3). These sites are the key hydrological monitoring sites within our two study catchments.

We did not undertake WUA modelling at the water works site on Te Arai River because naturalised flow series were available for that site which, we argue (in Section 4.4), may be a more defensible basis for CLF setting than application and interpretation of WUA models.

A short water temperature time-series was available for the Waipaoa River at Kanakanaia, so we developed a flow-water temperature model to inform assessment of CLFs at this site.

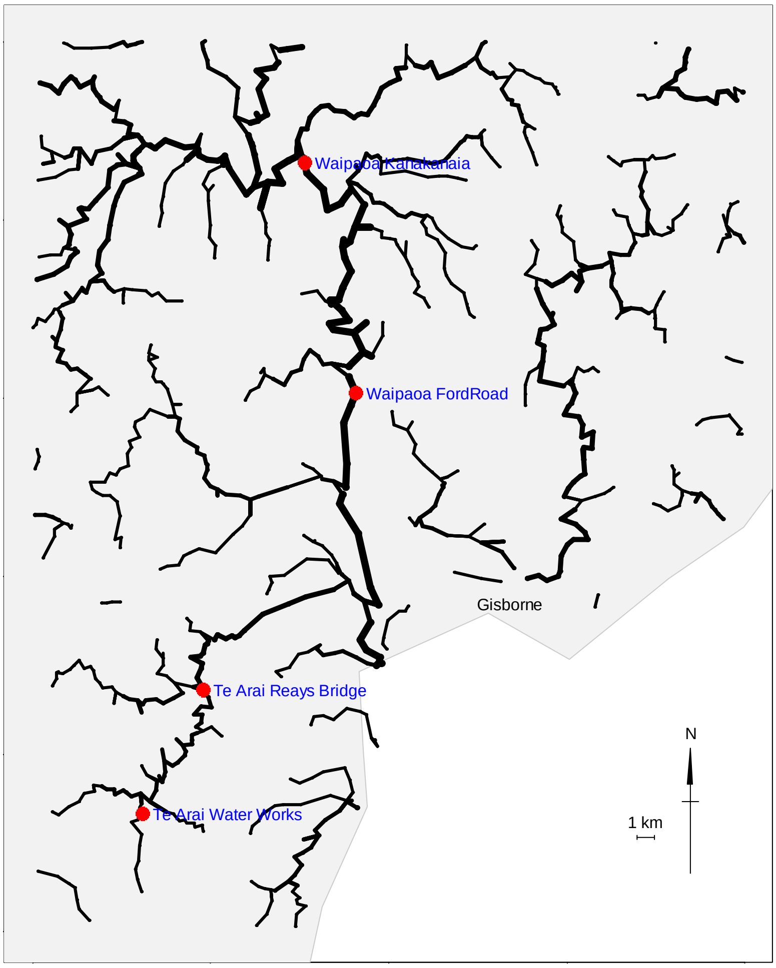


Figure 3-3: Map showing locations of sites from which data were obtained. We did not assess CTTFs or CLFs at the Waipaoa at Ford Rd site – no flow recorded is installed at Ford Rd, so it currently cannot be used for monitoring and enforcing CTTFs.

3.2.5 Water temperature modelling

Low river flows may increase water temperature (Caissie, 2006), which in turn has well-studied, direct and indirect effects on the physiological performance and behaviour of aquatic organisms (Portner and Farrell, 2008), hence on instream values. Thus, models of water temperature as a function of river flow—irrespective of the mathematic approach used—are "building blocks" of mechanistic models of flow-ecology relationships. Both mean and maximum daily water temperature are biologically important. Mean daily water temperature has a strong influence on the metabolic rate of freshwater organisms, which in turn affects growth efficiency and, therefore, maturation, reproduction and survival. Maximum daily water temperature causes mortality when it exceeds the upper thermal limit of a species or life-stage. Both mean and maximum daily water temperature are considered in this report.

As discussed in a more general context above (Section 3.2.1) approaches to modelling water temperature vary along the correlational-mechanistic continuum (Benyahya et al., 2007). Mechanistic models tend to be mathematical depictions of the underlying physics. Correlational models capture relationships between water temperature and predictor variables, usually including air temperature (Caissie, 2006), but do not include terms that account for the physical mechanisms that link ultimate drivers to water temperature.

Here we employed simple correlational approaches to model the relationship between water temperature, air temperature and river discharge in the Waipaoa River. A range of correlational models has been applied to modelling water temperature, including linear regression (Pilgrim et al., 1998), non-linear regression (Mohseni et al., 1998), GAMs (Booker and Whitehead, 2022) and machine learning models (Feigl et al., 2021). These models have shown a close association of water temperature with meteorological variables, particularly air temperature, alongside solar radiation and ground temperature in addition to hydrological variables, such as flow (Booker and Whitehead, 2022; Feigl et al., 2021; Laanaya et al., 2017).

Gisborne District Council provided water temperature & flow data for the Waipaoa River at Kanakanaia (2015-2018). Meteorological data came from the National Climate Database (https://cliflo.niwa.co.nz/[19]). The water data was measured at 10-minute intervals and daily for the meteorological observations.

Before modelling the relationship between water temperature and predictors, the data was split into train and test sets (James et al., 2021). The first two years of data were assigned to a training set, and the third year's data to the test set to evaluate the performance of the models. An exploratory data analysis was carried out on the training set to identify patterns to inform the modelling. A limited amount of analysis was also carried out on the training set to ensure the data was clean, there were no major data gaps, and the training and test datasets appeared to display similar characteristics following a visual comparison.

Five regression approaches were tested with the aim of estimating the mean daily water temperatures: random forests, multiple linear regression, logistic regression, generalised additive models (GAM) and weighted multiple linear regression. The idea of using weighting was to emphasise the more extreme temperature, which only makes up a small fraction of the observed values but is of particular ecological importance. More advanced models using deep learning and autoregressive time series models were not explored given the very small amount of data available. Exploratory data analyses are described in Appendix A. Covariates/predictors of water temperature that we considered were mean air temperature and log-transformed mean daily discharge (Appendix A).

The “best model” was selected on the basis of root mean squared error (RMSE) and predictive bias between the testing data and model predictions. Root mean square error is an estimation of the average absolute error between predictions and observed data (either training or testing data). An RMSE of, for example, 2 would indicate that model predictions are, on the average, out by 2 degrees Celsius. To calculate the direction and magnitude of predictive bias, we estimated “PBIAS” (Moriasi et al., 2015). A PBIAS value of zero indicates that the model fits the testing data perfectly on average although variability between predictions and observations may remain. Positive values of PBIAS indicate that model predictions are, on the average, below the observed values in the testing data, while negative values indicate model predictions are, on the average, higher than observed values in the testing set (Moriasi et al., 2015). Once the best model was identified, the effects of discharge on mean and maximum water temperature were estimated under different air temperature scenarios, including assessment of uncertainty.

[19] Station data from CliFlo: 24976 D87697 30-Nov-2012 04-Apr-2023 100 Gisborne Ews -38.62747 177.9218

The analysis was called out using R version 4.2.2 (R Core Team, 2022) and used the tidyverse (Wickham et al., 2019), GAM (Hastie, 2023), Partial Least Squares (Bjørn-Helge Mevik et al., 2020) and Random Forest (Liaw and Wiener, 2002).

3.3 Results

Much of the results are presented here as figures only, then discussed in Section 4.

3.3.1 Waipaoa River at Kanakanaia

Hydraulics

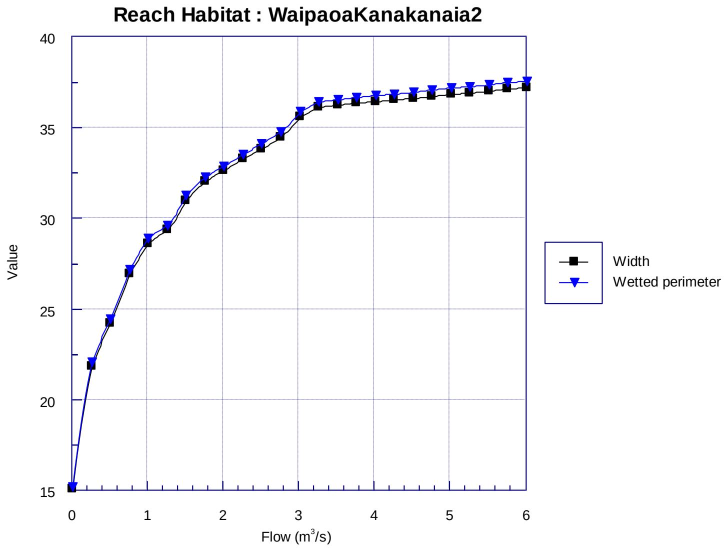


Figure 3-4: Relationships between wetted width (m) and perimeter (m) and flow of the Waipaoa River at Kanakanaia.

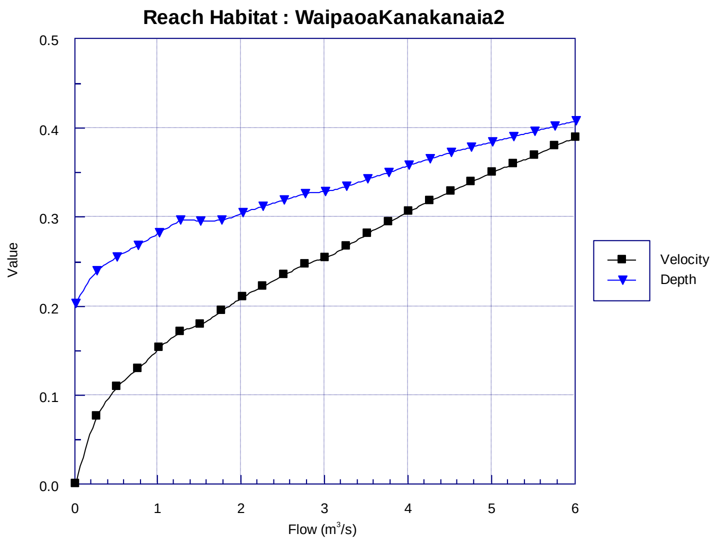


Figure 3-5: Relationships between velocity (m/s) and depth (m) and flow of the Waipaoa River at Kanakanaia.

Fish

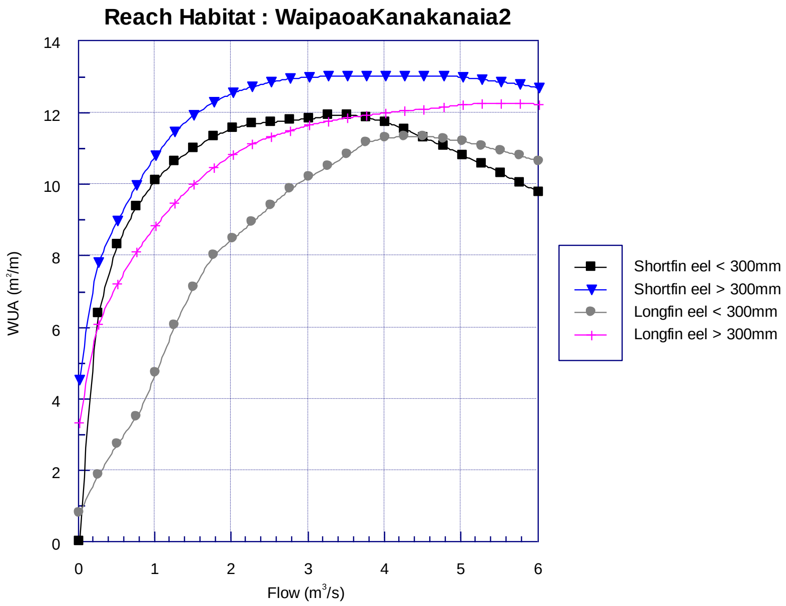


Figure 3-6: Modelled weighted usable area (WUA) for eels in the Waipaoa River at Kanakanaia.

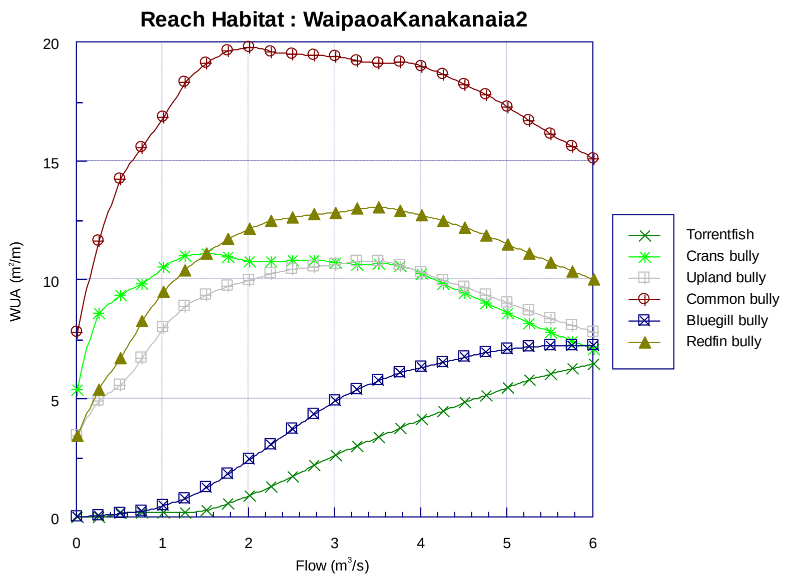


Figure 3-7: Modelled weighted usable area (WUA) for small-bodied native fishes in the Waipaoa River at Kanakanaia.

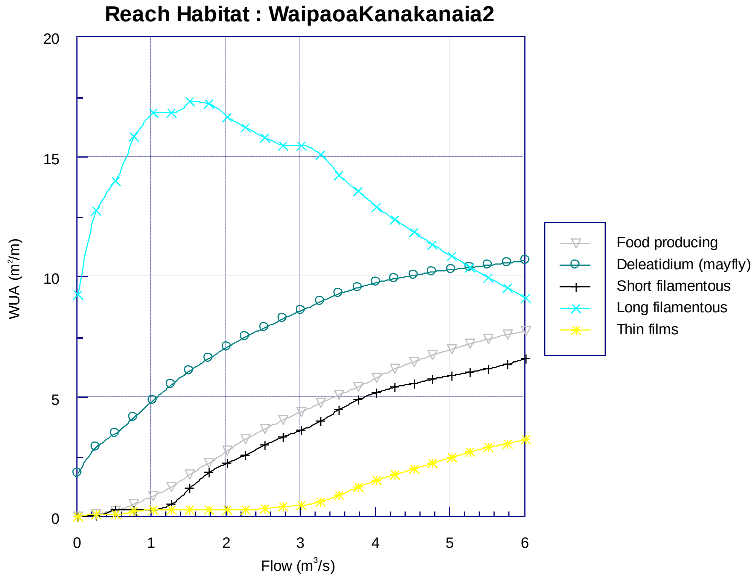


Figure 3-8: Modelled weighted usable area (WUA) for invertebrates and periphyton in the Waipaoa River at Kanakanaia.

Water temperature

Daily mean and daily maximum water temperature showed a strong seasonal pattern (Figure 3-9), with higher values in the summer and lower in the winter. Generally, the maximum daily water temperature was one degree higher than the mean water temperature; however, in the hot summer of 2016, the difference was up to 5 degrees. The training set had a higher maximum water temperature than the test set (Figure 3-9). Except for missing flow data between 26 March 2016 and

7 April 2016, the dataset had no gaps and few apparent outliers. Some additional results from the exploratory analyses are presented in Appendix A.

With respect to mean daily water temperature, the model with the best predictive accuracy, lowest test RMSE and PBIAS was a weighted linear regression (Table 3-3). The predictive performance of the models was similar to those reported by Feigl et al. (2021). Inspection of the residuals showed high levels of autocorrelation. The presence of autocorrelation cast doubt on the reliability of using the testing RMSE to estimate the model's predictive accuracy. Therefore, a heuristic, two times the test RMSE (Table 3-3; Table 3-4), should be used as an indicator of the prediction error.

With respect to maximum daily water temperature, only one model parameterisation was fitted to the data—the weighted multiple linear regression parameterisation shown to be the best model for mean water temperature. The decision to fit and test the performance of this single model was made due to the very high correlation between mean and maximum daily water temperature (Appendix 1). The fit and prediction statistics are presented in Table 3-4.

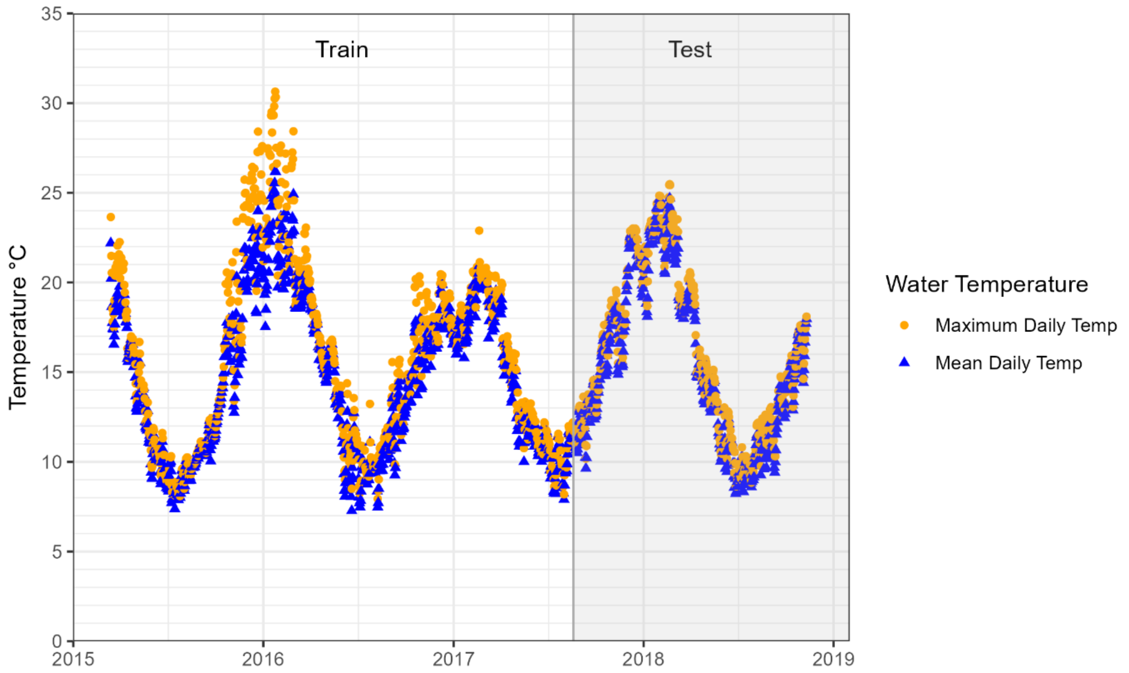


Figure 3-9: Time series of mean and maximum daily water temperatures within the Waipaoa River at Kanakanaia.

Table 3-3: Performance statistics of five different models of mean daily water temperature as a function of air temperature and river discharge.

Model	r^2	RMSE (°C)	PBIAS
Random Forest	0.922	1.51	5.04
Multiple Linear Regression	0.939	1.47	5.32
Logistic Regression	0.942	1.47	5.42
GAM	0.944	1.37	5.15
Weighted Multiple Linear Regression	0.942	1.20	3.18

Table 3-4: Performance statistics of the single model of maximum daily water temperature as a function of air temperature and river discharge.

Model	r^2	RMSE	PBIAS
Weighted Multiple Linear Regression	0.937	1.42	-1.31

Predicted water temperatures (means and maxima) were often higher than air temperatures (Figure 3-10; Figure 3-11). This paradoxical result may be due to the air temperature data being sourced from a station < 10 km from the coast, hence experiencing a cooler microclimate not reflective of the air temperatures driving water temperature in the mid- to upper-catchment of the Waipaoa River at Kanakanaia.

Mean daily water temperature increases as discharge drops below 3000 L/s (Figure 3-10). Mean water temperature increases particularly strongly as discharge declines below 2000 L/s. The shape of the relationship water temperature has with discharge is constant across different air temperature scenarios, but the curve is strongly elevated as air temperature increases.

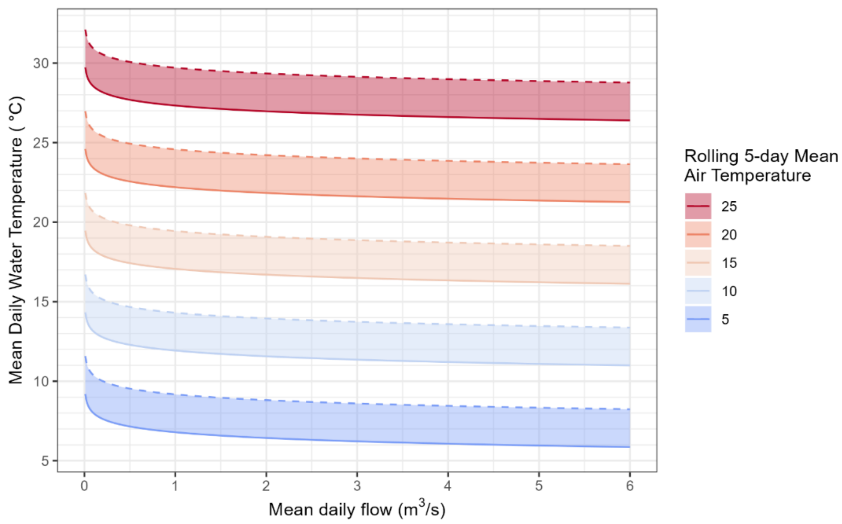


Figure 3-10: Mean daily water temperature of the Waipaoa River as a function of river discharge and air temperature. Solid lines are the predictions of the fitted model, with the dashed lines indicating the upper 95% confidence interval of model predictions.

Maximum daily water temperature generally exhibits the same responses to air temperature and river discharge as mean daily water temperature, with two exceptions: Relative to mean water temperature, maximum water temperature increases more rapidly, first, as a function of air temperature and, second, as river discharge declines below 3000 L/s (Figure 3-11).

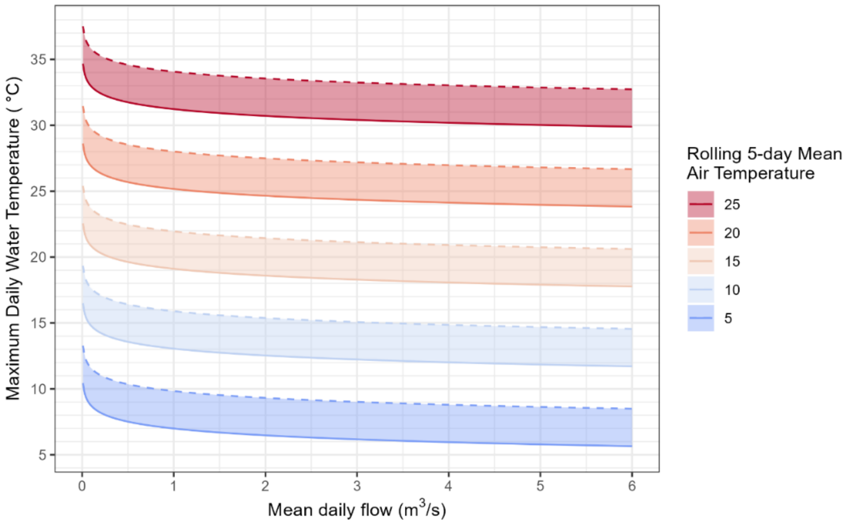


Figure 3-11: Maximum daily water temperature of the Waipaoa River as a function of river discharge and air temperature. Solid lines are the predictions of the fitted model, with the dashed lines indicating the upper 95% confidence interval of model predictions.

3.3.2 Te Arai River at Reays Bridge / Pykes Weir

Hydraulics

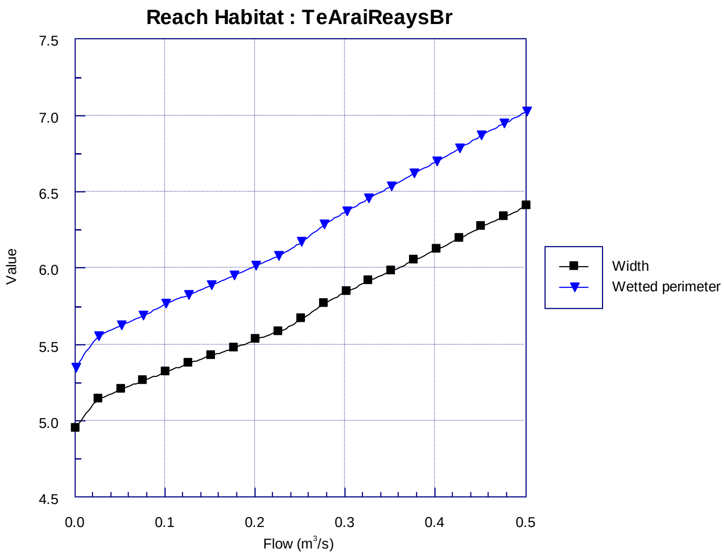


Figure 3-12: Wetted width (m) and perimeter (m) of Te Arai River at Reays Bridge as a function of flow.

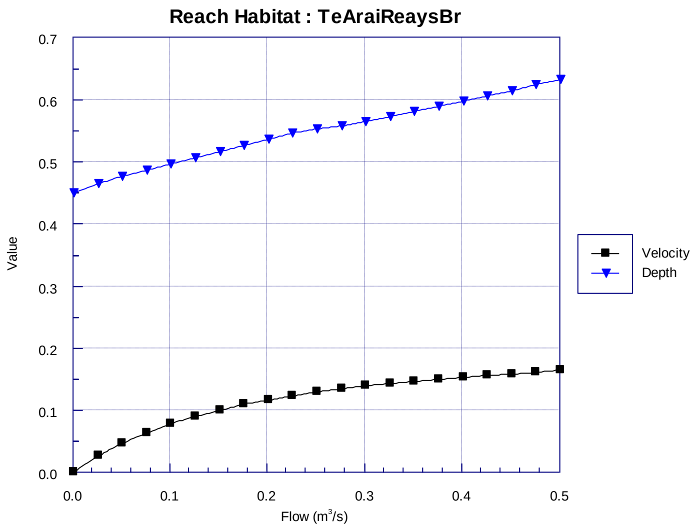


Figure 3-13: Velocity (m/s) and depth (m) of Te Arai River at Reays Bridge as a function of flow.

Fish

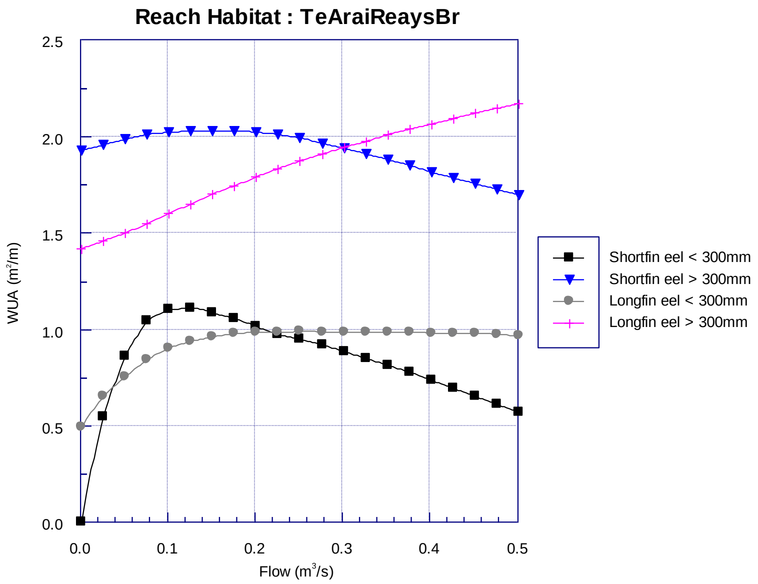


Figure 3-14: Modelled weighted usable area (WUA) of eels as a function of flow in Te Arai River at Reays Bridge.

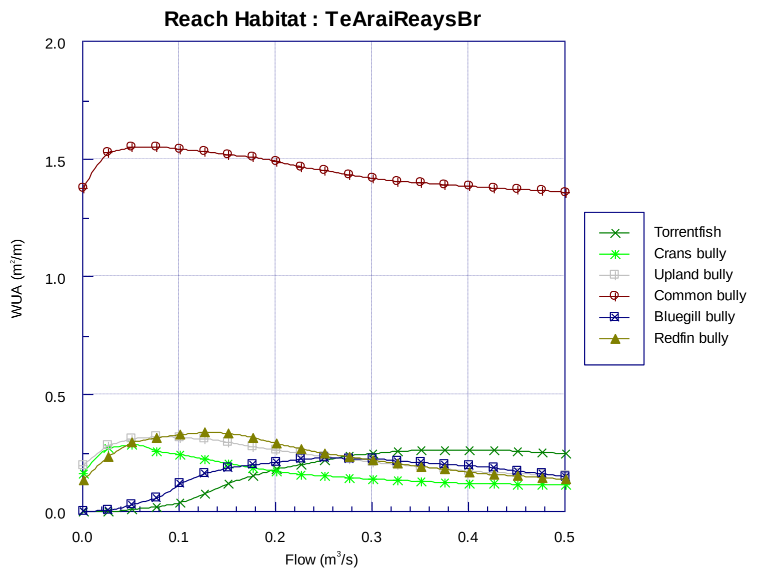


Figure 3-15: Modelled weighted usable area (WUA) of small-bodied fishes as a function of flow in Te Arai River at Reays Bridge.

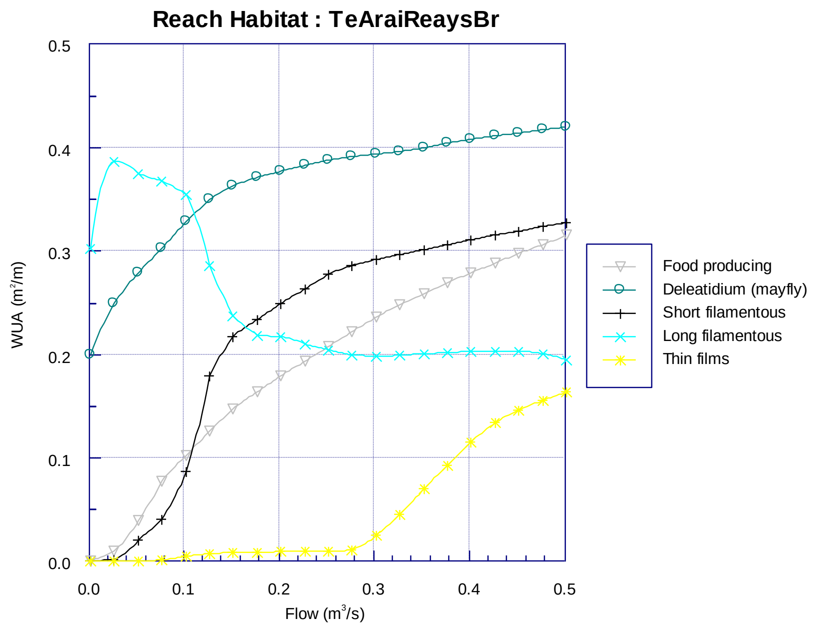


Figure 3-16: Modelled weighted usable area (WUA) of invertebrates and periphyton as a function of flow in Te Arai River at Reays Bridge.

4 Assessment of alternative critical low flows

4.1 Approach

4.1.1 Critical low flow scenarios considered

Here we offer an assessment of the relative environmental outcomes of three alternative CLFs. Cease-to-take flows, which are the limits GDC ultimately require, are set in light of CLFs (see Section 1.2). Later, in Section 5, we discuss some factors that must be considered when using CLFs to set CTTFs. This CLF assessment was undertaken to illustrate how the information presented in the preceding section may be used for river flow management purposes. We do not 'recommend' any particular CLF and understand that the choice made by GDC will represent a balance among the competing objectives of maintaining/improving freshwater values and maintaining agricultural outcomes whilst recognising the requirements of the NPSFM and giving effect to Te Mana o Te Wai three tiers.

We assessed potential outcomes of CLFs within three water quantity zones (WQZs) of two freshwater management units (FMUs):

1. The Waipaoa surface WQZ within the Poverty Bay Flats FMU.
2. The Upper Te Arai WQZ within Te Arai FMU.
3. The Lower Te Arai WQZ within Te Arai FMU.

Data used for our assessments come from the Waipaoa River at Kanakanaia, Te Arai at the water supply intake (water works) and Te Arai at Reays Bridge, which respectively correspond to the above three WQZs. Reays Bridge is ca. 3 km downstream of Pykes Weir flow recorder.

Three CLFs were considered for the Waipaoa River at Kanakanaia and the Lower Te Arai River. By contrast we offer assessment of a single CLF scenario for Te Arai at the water works. The Upper Te Arai at the water works was treated differently to the Waipaoa River at Kanakanaia because (a) a natural flow record was available, enabling what is arguably a more defensible approach to CLF setting; (b) there are no substantial water takes above the water works; and (c) the major take below the water works is for domestic water supply and so there is currently no Block A CTTF or allocation cap at the water works. Further details concerning the somewhat unique nature of Te Arai at the water works are provided in sections below.

Methods used to derive CLFs for the Waipaoa River at Kanakanaia and the Lower Te Arai River were similar to Booker et al. (2010) and included assessment of the following options:

1. *Instream values*.
2. Observed mean annual low flow *(Observed MALF)*.
3. *Status quo*.

For the *status quo* option the CLFs and allocation caps for Block A and Block B bands are presented in Table 1-2.

Ideally, Option 2 (Observed MALF) would have been consistent with the recommendations of Hayes et al. (2021), who recommended the CTTF and allocation rates presented in Table 4-1, which are based on percentages of *naturalised* MALF. Naturalised flow data were not, however, available for any rivers in the FMUs considered here and so naturalised MALF is unknown. In the absence of naturalised MALF we used observed MALF under the assumption that it is a close approximation of naturalised MALF[20].

Note that Hayes et al. (2021) did not distinguish between CLF and CTTF. They presented 'minimum flows' which were essentially operational take limits equivalent to our CTTFs. However, we hereafter equate the 'minimum flows' of Hayes et al. (2021) with our CLFs. Equating the minimum flows of Hayes et al. (2021) with our CLFs (cf. CTTF) is more consistent with the logic presented below concerning the Natural Flow Paradigm as a heuristic for CLF setting.

Table 4-1: Proposed default cease-to-take flow (CTTF) and primary allocation limits, expressed as % of naturalised 7-d mean annual low flow (MALF).

Limit	River with mean daily flow ≤ 5 m^3/s	River with mean daily flow > 5 m^3/s
CTTF	90% of naturalised 7-day MALF	80% of naturalised 7-day MALF
Allocation rate	20% of naturalised 7-day MALF	30% of naturalised 7-day MALF

Observed (100% of) MALF is used for Option 2. Arguably, setting CLFs as a reasonably high percentage of *naturalised* MALF is scientifically defensible. Traits of aquatic populations have evolved to the natural flow regime (following the 'Natural Flow Paradigm'; Lytle and Poff 2004), and so populations should have evolved some degree of resistance and resilience to naturalised flow-driven stress associated with low flow events with the same magnitude, frequency, and duration as naturalised MALF. It follows that the same populations are likely resistant and resilient to flow-driven stress associated with flow conditions that are associated with a flow that is very close to—a high percentage of—naturalised MALF[21]. The same argument cannot, however, be made for observed MALF, which may already be well below a percentage of naturalised MALF as a consequence of historical water takes.

The observed MALFs for Waipaoa River at Kanakanaia, Te Arai at the water supply intake (water works) and Te Arai at Reays Bridge are presented in Table 2-5.

Option 1—instream values—presents take limits that, given the limited data and models available, correspond with high levels of protection to instream values as would be consistent with the requirements of the NPSFM, including all aspects of ecosystem health, threatened species and mahinga kai (see Appendix 1A of the NPSFM 2020). Option 1 is used as the point of reference for Options 2 and 3. The potential outcomes from Options 2 and 3 are summarised using a five-point categorical scale relative to Option 1 and under the assumption that Option 1 supports a '*high*' level of protection of values. Relative to '*high'* the other four levels of value maintenance were '*moderate-high*', '*moderate*', '*moderate-low*' and '*low*'.

4.1.2 Relative influence of flow-response curves on assessment

The flow-response curves presented in Section 3.3 had unequal influences on our assessment. Flow-response curves had either a 'primary' or a 'secondary' influence on our assessment (we may refer to

[20] We comment on the validity of this assumption in the next section of this report.
[21] Under specific assumptions such as: contemporary, within-year frequency of MALF is not significantly greater than naturalised within-year frequency of MALF.

each class of curve as 'primary' and 'secondary flow-response curves', respectively). Curves that had a primary influence

- reflected the potential responses of particularly highly valued assets (i.e., eels);
- were based on sampling methods of relatively low bias; or
- explicitly captured potential mechanisms outlined in Section 3.1.

Longfin and shortfin eels are high-value species within the Waipaoa and Te Arai catchments (following Booker et al. 2010). Maintenance and/or rehabilitation of eel populations may, therefore, be 'fundamental objectives[22]' of the GDC regional plan. Consequently, **eel flow-response curves had a primary influence on our assessment**.

Flow-response curves for *Deleatidium* mayflies, water temperature and mean wetted width also had a primary influence on our assessment. Although these flow-response curves may not represent variables of high, direct value, they were selected for two reasons:

- they can be estimated with relatively little bias, when compared with the flow-response curves of other variables/species presented in Section 3; and
- they capture relationships between variables in conceptual models of the mechanisms linking low river flows to ecological outcomes. Specifically
  - *Deleatidium* mayflies are an important part of food chains and represent a source of food for fish;
  - water temperature can represent a stressor to various ecosystem functions during low flow periods; and
  - wetted width represent the total area of aquatic habitat available in river ecosystems.

Because these curves can be estimated with relatively little bias, we can be more confident that they accurately represent true response-environment patterns, rather than response-environment relationships that may be an artefact of biased sampling methods (as is the case for observations of fish to create habitat suitability criteria). Consider, for example, *Deleatidium*: Sampling benthic invertebrates like *Deleatidium* typically involves use of a Hess or Surber sampler, which is placed on the bottom of a river at a point to remove the invertebrates from a fixed area. These sampling devices can be deployed with near equal efficiency across the range of velocities, depths and substrate compositions relevant to low-flow assessment.

Further, with a careful approach, the act of macroinvertebrate sampling *in situ* is unlikely to significantly displace macroinvertebrates. If the act of sampling significantly displaced organisms, then the resultant abundance-environment relationships may be an artefact of the sampling process itself, and not reflect potential underlying mechanisms.

[22] Decision scientists and natural resource management experts distinguish between 'fundamental' and 'means' objectives. Fundamental objectives are what matter most to stakeholders and represent the things that we really must achieve. Means objectives are useful in that they help us achieve fundamental objectives, but are not endpoints in and of themselves. See: Conroy, M.J., Peterson, J.T., 2013. Decision Making in Natural Resource Management: A Structured, Adaptive Approach. John Wiley & Sons, Ltd.

The above advantages do not apply to, for example, electrofishing. The efficiency of electrofishing varies enormously across species, life-stages within species, and across microhabitats within rivers (e.g., Peterson et al., 2004; Price and Peterson, 2010; Reyjol et al., 2005). Fish are relatively mobile organisms with well-developed senses. Their distribution across microhabitats—the resolution at which HSCs are estimated—is likely affected by electrofishers walking through a river reach as well as the disturbance caused by electric-shocking the water. These features of electrofishing lowers confidence in their accuracy, in that abundance-environment relationships may reflect sampling biases. This is important because data derived via electrofishing is often used to construct habitat suitability criteria that are input to physical habitat models.

In addition to having relatively little bias, flow-response curves for *Deleatidium* mayflies, water temperature and wetted width capture mechanisms in the conceptual models presented in Section 3.1 (refer to that section for details). By contrast, low flows are not hypothesised to influence fishes directly through their affects on the availability of microhabitat. When microhabitat preferences of fishes are estimated accurately, they have been shown to vary:

- across life-stages within species (e.g., adults are associated with different microhabitats than juveniles); and
- across processes of individuals (e.g., adult fish may feed in one microhabitat but rest and/or digest food in another; microhabitats used for spawning may differ strongly from those used for feeding and refuge).

As a result of the poor fit with the conceptual models in Section 3.1, potential biases, and lower direct value relative to eels, **flow-response curves of small-bodied native fishes (non-eel fishes) had a secondary influence on our assessment**. Small-bodied native fishes are nevertheless critical species supporting ecosystem health and mahinga kai, and so may represent 'means objectives'[22] in plans. Reduction of nuisance periphyton (long filamentous periphyton) may also be a planning objective, so flow-response curves of periphyton also had a secondary influence on our assessment.

4.1.3 Use of flow-response curves

The primary and secondary flow-response curves presented in Section 3 represent the response to flow by *variables* that contribute to NPSFM compulsory values. They do not, in the strict sense, represent the response of NPSFM *attributes* to flow. Consequently, the flow-response curves presented herein cannot be used to identify CLFs that correspond with quantitative, NPSFM attribute targets.

Flow-response curves of the form presented in Section 3 of this report usually exhibit a positive relationship between an ecological value (e.g., WUA of a fish) and flow at low-to-medium flows. The typical observation is—over the range of flows that we may consider as potential CLFs—the higher the discharge, the higher the ecological values supported. In the absence of specific targets, therefore, interpretation of flow-response curves to identify potential CLFs is influenced by a subjective decision, and the CLF selected represents a somewhat arbitrarily selected level of protection for the ecological value in question.

In the present study flow-response curves were subjectively examined by eye to identify potential discontinuities in the gradient of the relationship between response and flow. Specifically, we identified discharge levels below which ecological values decline particularly rapidly. Not all flow-response curves exhibited such discontinuities. Those curves had a lower influence on assessments.

4.1.4 The influence of downstream losses and gains in discharge

As shown in Section 2.2 there may be losses in surface flow below flow recording sites, where flow allocation rules may be designed and monitored, but that there was little to no evidence for significant losses below flow monitoring sites when flow at those sites was close to the current CTTF. Accordingly, we assume that CTTFs set and monitored at the three focal sites of this study are transmitted well downstream, with negligible losses after the CTTF has been reached. To be clear, this is an assumption we have made given very limited data, to advance our assessments. This assumption would have to be tested with improved flow monitoring in the future.

4.2 Waipaoa River at Kanakanaia

4.2.1 Option 1 - 'Instream values' critical low flow

There is little change to wetted width of the Waipaoa River at Kanakanaia as flow declines from 6000 L/s to 3000 L/s. Once flow drops below 3000 L/s, wetted width declines rapidly. Weighted usable areas of small and large longfin eel change relatively little between 6000 – 3000 L/s, but decline sharply once flow drops below 3000 L/s. Weighted usable areas of small and large shortfin eel decline steeply once flow drops below 2000 L/s. Unlike eels and wetted width, the slope of the relationship between *Deleatidium* WUA and flow is more constant. The more we decrease flow the more we reduce WUA of *Deleatidium*—there is no obvious flow at which the slope changes abruptly.

The partial[23] warming effect of discharge on water temperature was noticeable as discharge dropped below 3000 L/s, but became stronger as discharge dropped below 2000 L/s. As discharge drops below 2000 L/s, mean water temperature may increase by as much as ca. 3-4 °C (Figure 3-10). As discharge drops below 2000 L/s maximum water temperature may increase by as much as ca. 4–5 °C, and—given the model and (limited) data—is predicted to exceed 35 °C under the 25 °C air temperature scenario (Figure 3-11). Temperatures of that magnitude can be lethal for native aquatic animals in New Zealand (Olsen et al., 2012).

Based on the primary flow-response curves, instream values of the Waipaoa River at Kanakanaia decline relatively quickly once flow drops below 3000-2000 L/s. Te Mana o te Wai directs councils to set water take limits that prioritise river health over non-environmental uses of water, hence limits that are 'environmentally conservative.' It follows that **an environmentally conservative CLF for the Waipaoa River at Kanakanaia that maintains *high* levels of instream values is 3000 L/s**.

A CLF of 3000 L/s at Kanakanaia is above the observed MALF of 2300 L/s (Table 2-5) considered under Option 2. A CLF of 3000 L/s should also support high small-bodied native fish values, as the WUA of such species declines relatively quickly as flow drops below 4000–2000 L/s (depending on the species). At 3000 L/s WUA of nuisance, long-filamentous periphyton is ca. 86% of the maximum WUA of long-filamentous periphyton, which occurs at ca. 1600 L/s.

A CLF of 3000 L/s for the Waipaoa River at Kanakanaia is 1000 L/s greater than the CLF supporting *instream values* suggested in the 2010 report (Booker et al., 2010, who suggested 2000 L/s). The reasons for this difference are as follows:

- For the present assessment we did not give all flow-response curves equal weight. What we called primary flow-response curves had a stronger influence on our assessment, and these curves happen to exhibit relatively clear and rapid declines in

[23] The 'partial' effect of discharge is the modelled/isolated effect of discharge after controlling for the effect of air temperature.

value once flow dropped below 3000 L/s. The 2010 report did not use the same relative weighting system that we have used here. Section 4.2 presents the rationale for the unequal weighting of flow-response curves used herein.

- The hydrology data and MALF estimates for the Waipaoa River have been revised as part of this study (Section 2). The revised estimate of observed MALF for the Waipaoa River at Kanakanaia is 2550 L/s; 550 L/s greater than the *instream values* CLF suggested in the 2010 report. Best available general information[24] indicates that a CLF that is 22% below the observed MALF (not the naturalised MALF) will not support *high* levels of instream values (Hayes et al., 2021; Lytle and Poff, 2004; Poff et al., 2010). Use of best available information is consistent with Clause 1.6 of the NPSFM.
- The overarching NPSFM concept of Te Mana o te Wai directs councils to set environmentally conservative limits. Our assessment has been carried out with this requirement in mind.
- The information presented in Section 3.3 comprises output of quantitative models whose parameters have been estimated as a result of data collected within the Waipaoa River at Kanakanaia. As such, the information presented in Section 3.3 is relatively objective. However, use of that information in CLF assessment involves numerous subjective elements, including relative weighting of flow-response curves and—in this assessment and that of the 2010 report—choice of flow values at which slopes of WUA curves change abruptly. Subjective elements of assessments such as these are common in resource management (Conroy and Peterson, 2013), but they may result in variation in assessments across assessors.

4.2.2 Options 2 and 3

If we were to select the observed MALF of the Waipaoa River at Kanakanaia as our CLF (2550 L/s; Option 2), then we may observe the following changes to the values supported, relative to the *instream values* option (Option 1):

- Reductions in WUA of ca. 5% and 8% for small and large longfin eel respectively.
- A ca. 5% reduction in wetted width and a 12% reduction in *Deleatidium* WUA.
- A negligible increase in mean and maximum water temperature (by ca. 0.5 °C).

With respect to the secondary flow-response curves, Option 2 may result in the following changes to the small-bodied fish community and periphyton:

- Reductions in WUA of torrentfish and bluegill bully of 20% and 30% respectively.
- Generally small (< 10%) reductions in WUA of Crans bully, upland bully, common bully and redfin bully.
- Small (< 10%) increases in WUA of nuisance periphyton.

[24] By 'general information' we mean information about setting minimum flows in New Zealand (and international) rivers in general, not just within Gisborne.

Therefore, **relative to the *high* levels of values supported by the *instream values* option, the *observed MALF* option may support *moderate-high* values**.

Relative to the *instream values* option, the *status quo* CLF may support:

- Reductions in WUA of ca. 48% and 25% for small and large longfin eel respectively.
- Reductions in WUA of ca. 13% and 15% for small and large shortfin eel respectively.
- A ca. 30% reduction in wetted width and a 29% reduction *Deleatidium* WUA.
- A small increase in mean and maximum water temperature (by ca. 1 °C).

With respect to the secondary flow-response curves, Option 3 may result in the following changes to the small-bodied fish community and periphyton, relative to the *instream values* CLF:

- Reductions in WUA of torrentfish and bluegill bully of 96% and 80% respectively.
- Generally moderate (< 25%) reductions in WUA of Crans bully, upland bully, common bully and redfin bully.
- Small (13%) increases in WUA of nuisance periphyton.

Therefore, **relative to the *high* levels of values supported by the *instream values* option, the *status quo* option may support *moderate* values**.

4.3 Te Arai River at Reays Bridge / Pykes Weir

4.3.1 Option 1 - 'Instream values' critical low flow

Wetted width of Te Arai at Reays Bridge declines with flow at an approximately constant rate at flows from 40 L/s to 500 L/s (Figure 3-12). Below 40 L/s there is a rapid decline in wetted width (Figure 3-12). Weighted usable areas of small eels (both species) decline relatively quickly once flow drops below 100 L/s (Figure 3-14). According to the models, WUA of large longfin eels increases ca. constantly with flow, while WUA of large shortfin eels appears less affected by flow (Figure 3-14). The slope of the relationship between *Deleatidium* WUA and flow is constant over flows from 140 – 500 L/s, with a more rapid decline evident when flow drops below 140 L/s (Figure 3-16).

With respect to the secondary flow-response curves, there is some evidence for rapid declines in WUA of the more flow-sensitive small-bodied fishes[25] as flow drops below ca. 150 L/s (Figure 3-15). Weighted usable area of nuisance periphyton increases rapidly as flow decreases below ca. 150 L/s (Figure 3-16).

Based on the flow-response curves summarised above, instream values of Te Arai River at Reays Bridge may decline relatively quickly once flow drops below ca. 150 L/s. One could suggest that **an environmentally conservative CLF for Te Arai River at Reays Bridge / Pykes Weir that maintains *high* levels of instream values is 150 L/s**.

A CLF of 150 L/s at Reays Bridge is above the observed MALF of 60 L/s (Table 2-5) considered under Option 2 and is the same '*high* instream values' flow identified in the 2010 report. The current CLF for this site is 60 L/s—equal to the revised estimate of observed MALF.

[25] E.g., torrentfish and bluegill bully

4.3.2 Options 2 and 3

If we were to select the observed MALF of Te Arai at Reays Bridge / Pykes Weir as our CLF (60 L/s; Option 2), then we may observe the following changes to the values supported, relative to the *instream values* option (Option 1):

- Reductions in WUA of ca. 9% and 11% for small and large longfin eel respectively.
- Reductions in WUA of ca. 18% and 0% for small and large shortfin eel respectively.
- A ca. 3% reduction in wetted width and a 22% reduction *Deleatidium* WUA.

With respect to the secondary flow-response curves, Option 2 may result in the following changes to the small-bodied fish community and periphyton, relative to the *instream values* CLF:

- Reductions in WUA of torrentfish, bluegill bully and redfin of 100%, 50% and 21% respectively. The models indicate torrentifish may be extirpated under Option 2.
- No change in WUA of upland bully.
- Generally small (< 10%) increases in WUA of Crans bully and common bully.
- A large, 70% increase in WUA of nuisance periphyton.

Therefore, **relative to the *high* levels of values supported by the *instream values* option, the *observed MALF* option may support *low-moderate* values**.

We predict the same outcomes from the *status quo* CLF, given the current CLF for Te Arai at Reays Bridge / Pykes Weir is the same the revised observed MALF.

Therefore, **relative to the *high* levels of values supported by the *instream values* option, the *status quo* option may support *low-moderate* values**.

4.4 Te Arai River at the water works

4.4.1 Estimated naturalised MALF

As noted in Section 2 the municipal water take from Te Arai River may be 100% of surface flow at the water works—leaving the river with zero flow—10% of the time. Without the water take, flow of Te Arai at the water works is below MALF (40 L/s; Table 2-5) approximately 5% of the time, but after the water take that flow is less than MALF approximately 35% of the time (Figure 2-6).

The current magnitude of water take from Te Arai at the water works is not consistent with the requirements of the NPSFM. We note, however, that this water take is important as it is for domestic use and there is currently no Block A CTTF or allocation cap for Te Arai at the water works. If there are alternative water sources for municipal supply that can be utilised in a cost-effective fashion and GDC would like to better maintain/rehabilitate instream values of Te Arai between the water works and Pykes Weir, a Block A CTTF may be set at the water works.

Unlike the Waipaoa River at Kanakanaia and Te Arai River at Pykes Weir, the default CLF recommendation of Hayes et al. (2021), presented in Table 4-1, is a scientifically-defensible option for Te Arai River at the water works. The flow recorder for Te Arai at the water works is just above the municipal water supply intake. There are no notable abstractions above the water works. As such, one may assume that the flow record of Te Arai River at the water works is approximately naturalised[26]. In turn, we assume that the MALF of 40 L/s presented in Table 2-5 is a reasonable approximation of naturalised MALF, and can be used to implement the default CLF of Hayes et al. (2021). **A CLF for Te Arai (water works) of 90% of naturalised MALF (ie. 36 L/s) may maintain relatively high instream values.**

In Section 4.1.1 we briefly discussed why naturalised MALF—or a high percentage of naturalised MALF—may be a scientifically-defensible CLF. Internationally, there is a growing body of evidence supporting the general applicability of the Natural Flow Paradigm. The Natural Flow Paradigm generally states that the physiological, behavioural and life-history traits of riverine species have evolved within the context of natural flow regimes and, consequently, those traits are—to varying degrees—adapted to the natural flow regime (Lytle and Poff, 2004). The Natural Flow Paradigm does not suggest that riverine species have no resistance or resilience to departures from the natural flow regime, nor does it suggest that all species have equal levels of adaptation to the natural flow regime. In the context of minimum flow management, the Natural Flow Paradigm implies that species have evolved some degree of resistance and resilience to the natural frequency distribution of annual low flows, of which naturalised MALF is a summary statistic.

Arguably, basing CLFs on naturalised MALF is more scientifically-defensible than use of WUA models—like the ones presented in this report and the 2010 report. Application of WUA models to flow management have been criticised on several bases (see Section 4.1.2, and as examples, Hayes et al. (2016) and Lancaster and Downes (2010a, b)). By contrast, the large literature in support of the Natural Flow Paradigm comprises strong evidence in support of basing default flow rules of naturalised regimes when a strong, mechanistic understanding of flow-ecology relationships is deficient (Poff et al., 2010).

[26] We note the flow record for Te Arai at the water works is not a long one. As such, even though the flow record is natural, its statistical properties—including MALF—are uncertain.

5 Translating critical low flows into cease-to-take flows

Our assessments above present potential CLFs for the Waipaoa and Te Arai Rivers. These CLFs are summarised in Table 5-1.

Table 5-1: Example CLFs for the Waipaoa and Te Arai Rivers. CLFs are presented in units of litres per second (L/s). Relative maintenance of instream values provided in brackets after each CLF.

	Option 3 (status quo)	Option 2 (Observed MALF)	Option 1 (instream values)
Waipaoa @ Kanakanaia	1,300 (moderate)	2,550 (moderate-high)	3,000 (high)
Te Arai @ Reays Bridge	60 (low-moderate)	60 (low-moderate)	150 (high)
			Option 1 (instream values; naturalised MALF default)
Te Arai @ water works			36 (high)

As explained in Section 1.2, Block A CTTFs must be greater than CLFs to reduce the risk of undesirable environmental outcomes and to ensure take rules are consistent with the NPSFM 2020. Cease-to-take flows must be based on the CLF as well as the maximum take rate ('allocation cap' in GDC plans) under Block A. Consider, for example, the following hypothetical case (also see Figure 1-1):

- River A has a CLF of 2000 ML/day.
- The council chooses to equate CTTF with the CLF with an allocation cap of 2000 ML/day—the allocation cap equals the CTTF.
- During a low flow event, River A drops to 2000 ML/day and irrigators are notified that CTTF has been reached and takes must cease. At this point in time irrigators are abstracting at the maximum rate, hence at the allocation cap.
- Irrigators take 24 hours to respond to the CTTF notification, during which time they continue to take at the allocation cap.
- Given the allocation cap is the same as the CTTF, the 24-hour response time, and the abstraction at the maximum rate, the flow in River A is reduced to zero before taking ceases.

To reduce the risk of dropping below the CLF, CTTFs may be set using a simple rule:

CTTF = CLF + Block A allocation cap (Eqn. 1)

This very simple equation highlights a planning trade-off: a larger Block A allocation cap increases Block A water availability up until the CTTF is reached, but it also increases the CTTF, so results in cessation of supply at higher flows.

Essentially, Equation 1 applies two assumptions. The first assumption is a worst-case scenario for streamflow depletion akin to "all allowable water is taken all the time (and all abstractions instantaneously deplete flows)". Application of that assumption is consistent with the precautionary approach required by the NPSFM. The second assumption is that all abstractions are subject to the CTTF. Given these two assumptions, application of Equation 1 would eliminate flow dropping below

CLF because of abstraction. However, neither assumption is likely to be 100% correct. If all allowable water is not taken all the time, then Equation 1 will produce a CTTF that is too high (overly environmentally-conservative). If some abstractions are not controlled by the CTTF because they are not assigned to Block A, then Equation 1 will produce a CTTF that is too low (insufficiently environmentally-conservative). Planners should consider these assumptions when applying Equation 1.

A lag in irrigator responses to CTTF notifications[27] will likely result in some fluctuations in flow about the CTTF. For any fixed period of lag, the magnitude of these fluctuations will be a positive function of the ratio *(Block A allocation cap) / CTTF*. That is, the larger the allocation cap relative to the CTTF the larger the potential magnitude of fluctuations of flow around CTTF. These fluctuations may have a detrimental effect on instream values (Blinn et al., 1995; Kjærstad et al., 2018). One way to keep the magnitude of potential fluctuations low is by using a Block A allocation cap that is a relatively low percentage of the CLF (say, 33% of CLF). This is consistent with the recommendations of Hayes et al. (2021). For illustrative purposes only, in Table 5-2 we have translated the CLFs of Table 5-1 into allocation caps and CTTFs.

Table 5-2: Translation of the example CLFs for the Waipaoa and Te Arai Rivers (in Table 5-1) into allocation caps and CTTFs. Allocation caps and CTTFs are presented in units of litres per second (L/s). Here, allocation caps are set at 33% of the CLFs in Table 5-1. CTTFs are then determined using Eqn. 1.

	Option 3 (status quo)		**Option 2 (Observed MALF)**		**Option 1 (instream values)**	
	CTTF	Cap	CTTF	Cap	CTTF	Cap
Waipaoa @ Kanakanaia	1,733	433	3,400	850	4,000	1,000
Te Arai @ Reays Bridge	80	20	80	20	200	50
					Option 1 (instream values; naturalised MALF default)	
Te Arai @ water works					48	12

We appreciate that these CTTFs and allocation caps represent a substantial change to those currently implemented in Gisborne. A potential way to increase water security for irrigators while still protecting riverine values from over-abstraction is to implement a multi-band allocation system, such as the one explored by Booker and Rajanayaka (2023).

[27] Both when flow drops below the CTTF, as well as when it rises above the CTTF

6 Improving evidence-based take limits in the Gisborne District

To improve evidence-based take limits we recommend the following, in addition to the recommendations offered in Section 2 of this report:

6.1 Explore alternative approaches to minimum-flow setting 2024–2025

NIWA is currently investing in the development of mechanistic flow-ecology models to support design of water take rules. These models will be ready for trial application during the summer-autumn of 2024-2025. **We recommend GDC collaborate with NIWA to apply these models to the Waipaoa and Te Arai Rivers to cross-check CLFs for these rivers.**

We contend that these models will produce forecasts of response to flow that are more accurate and scientifically-defensible than those arising from traditional WUA models (similar to the arguments of Hayes et al. 2016). The mechanistic models NIWA is developing are ecosystem models designed for forecasting the carrying capacity of a river reach as a function of how low flows affect benthic[28] food webs.

Development of the models has been funded by NIWA, but applying these models to the GDC district would require some collection of local habitat and ecological data, such that we may calibrate the model for use in the Waipaoa and Te Arai Rivers. Accordingly, this workstream would require additional funding. The Envirolink Fund is a possible source of the additional funds required for this workstream.

6.2 Naturalise flow series for the Waipaoa and Te Arai Rivers

It is difficult to complete a robust assessment of the impacts of water takes without estimates of naturalised flow series. Naturalised flow series serve as a benchmark against which to compare modified flow regimes and proposed flow targets (like CLFs). Furthermore, water accounting is a requirement of the NPSFM. **We recommend investing in the development of naturalised flow series for the Waipaoa and Te Arai Rivers**. Using naturalised flow series GDC would be estimate naturalised MALF for sites of interest, operationalising the default minimum values of Hayes et al. (2021) within the Waipaoa and Te Arai catchments. These default CLFs would serve as a very useful corroboration of any model-derived CLFs (like the ones presented in this report), thereby increasing the credibility of water take rules in the district.

6.3 Begin monitoring for adaptive management of river flows

The CLF assessment carried out herein was constrained by lack of data. **We recommend implementing some monitoring consistent with the plan of Stoffels et al. (2022), which GDC helped develop**. Monitoring activities need to be developed in light of the conceptual models of Section 3.1. NIWA would be glad to work with GDC to help prioritise monitoring activities from Stoffels et al. (2022) to suit local needs and budget. This could be done through a one day in-person or online workshop.

6.4 Consider a banded water allocation system

A banded water allocation system, similar to the one explored by Booker and Rajanayaka (2023), may help balance the need to ensure water security for irrigators as well as the need to meet the requirements of the NPSFM. Recommendation 6.2, above, is a prerequisite for this workstream. **We**

[28] River bottom

recommend undertaking an analysis of how alternative banded systems affect the naturalised flow duration curves of Te Arai and Waipaoa Rivers. Analysis of how banded water take limits affect hydrology should be extended to analyses of those hydrological impacts go on to affect riverine values, including instream ecology.

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Appendix A Exploratory analysis of water temperature

The water temperature showed a bimodal distribution as temperature switched from summer to winter (Figure A-1).

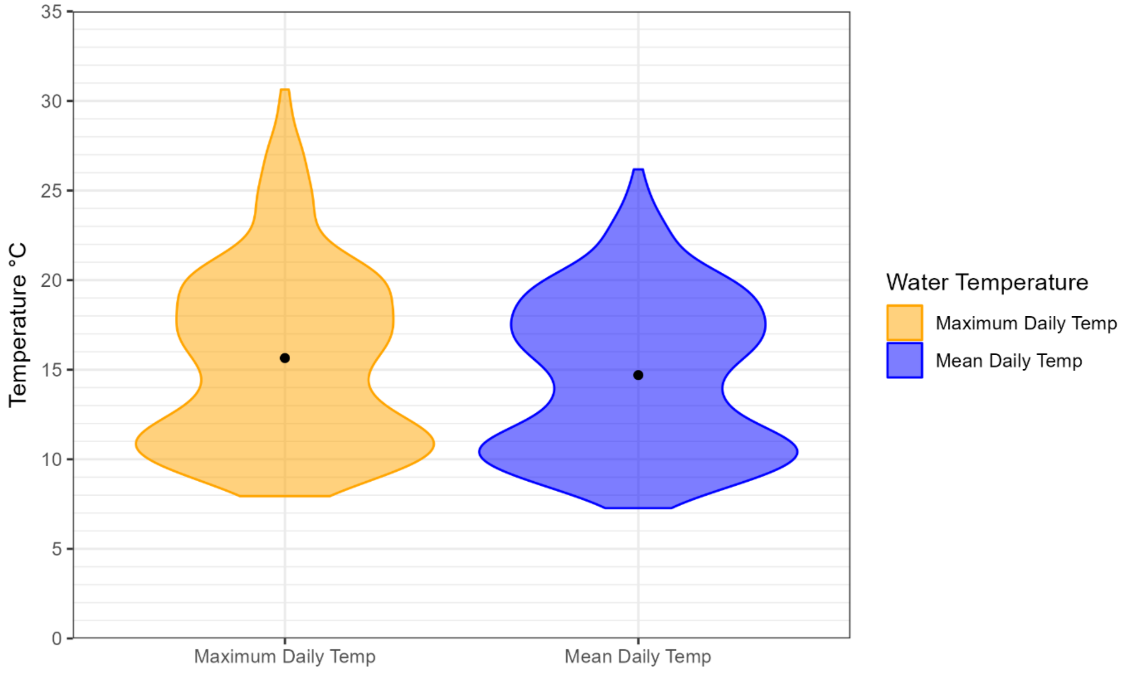

Figure A-1: The mean and maximum daily water temperature show a bimodal distribution related to summer and winter conditions. Data plotted are from the training data. The black dot is the mean of the distribution.

Principal component analysis revealed a strong association between mean and maximum water temperatures, loading negatively onto PC1 (principal component 1; Figure A-2). In addition, mean air temperature, maximum air temperature and solar radiation also loading negatively onto PC1, was mean air temperature having a close association with the water temperature parameters. This indicates that air and water temperature are associated with one another, plus higher levels of solar radiation are also associated with higher temperatures. The flow was positively associated with PC1 (Figure A-2). It was noted that higher flows are associated with lower temperatures. Conversely, rainfall loaded onto PC2, loading in the opposite sense to solar radiation but similar overall direction as flow (Figure A-2). So as rainfall goes up, the amount of solar radiation (and sunshine) would be expected to decrease.

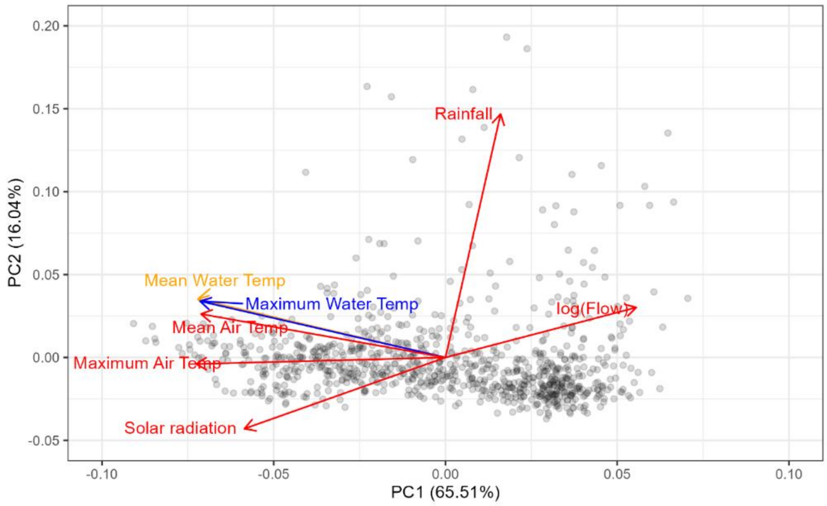

Figure A-2: Principal components plot showing the relationships between water temperature observations and potential driving variables.

We focused on the key variables: water temperature (mean and maximum), flow and air temperature. The general trend was that the flow tends to go down as air and water temperature rise, as the black line in Figure A-3 indicates. On top of the trend, there is quite a lot of variability from day to day. The flow figures have been log-transformed, which better represents the variation in flow relative to temperature.

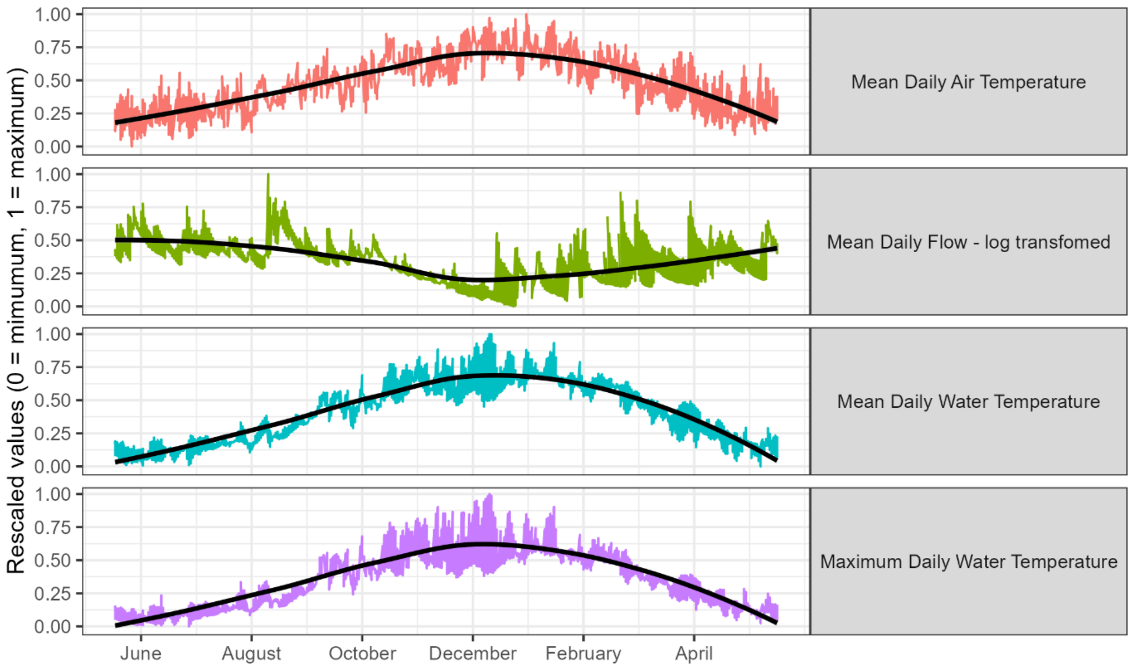

Figure A-3: Rescaled daily mean air and water temperature and log transformed flow from two years of training data. The black line is best fit of a GAM.

Various statistical models were trialled on the raw training data and with new variables created by introducing lagged and rolling averages of meteorological and hydrological parameters. The use of shrinking and dimensional reduction methods, such as elastic net and partial least squares (James et al., 2021) pointed towards air temperature as a critical variable, particularly the rolling average air temperature. However, these methods did not produce more accurate models, compared with simpler models such as multiple linear regression with only two predictors (air temperature and flow), so they were not pursued in detail. Various models with different degrees of flexibility were tested with the flow and rolling 5-day mean of air temperature as the predictor variables.

WALLBRIDGE GILBERT AZTEC

Gisborne District Council

Poverty Bay Flats Groundwater Modelling Programme Summary Report

TECHNICAL REPORT

Project No. WGA210398
Doc No. WGA210398-RP-HG-0008
Rev. F
21 November 2023

EXECUTIVE SUMMARY

Introduction

A numerical groundwater model of the Poverty Bay Flats/Tūranganui-a-Kiwa has been developed based on a geological model using Gisborne District Council (GDC) bore lithological data. A number of exploratory scenarios were run in the model to provide guidance on potential groundwater management measures. This report summarises the findings of the scenario modelling.[1]

Conceptual Groundwater Model

A conceptual model of the groundwater system of the Poverty Bay Flats was built that incorporates five primary aquifers. The shallow and predominantly unconfined Te Hapara Sands and Shallow Fluviatile Gravel Aquifers are highly connected to each other and to surface water bodies within the catchment, including the ocean. The deeper Waipaoa, Makauri and Matokitoki Aquifers are predominantly confined. The Makauri Aquifer, which is the water source most utilised for horticultural purposes, is considered to extend offshore but the southern and western extents of this aquifer are uncertain.

The primary sources of natural recharge to the groundwater system are rainfall and flow losses from the Waipaoa River to underlying aquifers at the northern end of the Poverty Bay Flats. There is evidence to indicate some recharge to the confined aquifers is occurring in localised areas along the eastern and southeastern edges of the flats. However, as the mechanisms, seepage paths and rates of these recharges are poorly understood, they have not been incorporated in the numerical model. Groundwater discharges are distributed between the ocean, the Waipaoa River, streams, wetlands drains and bores.

Exploratory Model Scenario Results

Exploratory Scenarios were designed to enable a better understanding of existing and future groundwater issues and to provide guidance on potential management measures. The Exploratory Scenarios, together with model scenarios to be developed in the future by GDC, can be used to investigate combinations of management and mitigations measures to address the community concerns. Responses to specific questions raised by the community in consultation workshops are summarised below, based on Exploratory Scenario model results (Table A).

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[1] GDC commissioned Wallbridge Gilbert Aztec (WGA) and AQUASOIL Ingenieure & Geologen GmbH (AQUASOIL) to develop a groundwater model including; a 3D geological model, a conceptual groundwater model and a numerical FeFlow groundwater model. The model incorporates a wide range of climatic, hydrological, hydrogeological, groundwater abstraction and water quality data. Detailed descriptions of the numerical geological and groundwater models are documented in separate technical reports that should be considered in conjunction with this report. These separate reports include model input parameters and input derivations, technical assumptions and limitations.

Is there a decline in the aquifers?

A review of the groundwater levels in the Makauri Aquifer, which is by far the largest source of water for horticultural purposes, indicates that both summer pumped groundwater levels and recovered winter peak levels are declining. These declines are due to increasing groundwater pumping over time. In addition, analysis showed that the time required for groundwater level to recover following droughts is increasing. As the frequency and severity of droughts are predicted to worsen, it will take longer for the Makauri Aquifer to recover in the future. The cumulative modelling results indicate that additional abstraction during droughts could potentially be accommodated by increased downward flows from overlying aquifers and increased inflows to the northern end of the aquifer. However, additional abstraction resulted in increased surface water depletion and groundwater level recovery after drought periods may take years.

What is the current status of the aquifers?

As detailed above, the review of historical monitored groundwater levels indicated a decline in the Makauri and Matokitoki aquifers. Shallower aquifers showed stable groundwater level trends. However, coastal groundwater levels temporarily dropped below sea level in the Te Hapara Aquifer.

The model was used to assess the ongoing groundwater level trends under various scenarios. The baseline Model Scenario 1.1 was used to determine if levels would stabilise if groundwater abstraction was held at the current rates. Model Scenario 1.1 represents a continuation of the current climate conditions, with no allowances made for climate change, droughts or increases in groundwater demand above the current metered rate. Modelling results indicated that with abstraction held at the current rates groundwater levels are dynamically stable. Therefore, observed declines are considered to be due to increasing abstraction rates over time. However, the model outcomes also indicate local trends of increasing groundwater salinity are likely to continue. This implies, management measures may need to be implemented to address increases in groundwater salinity even if the projected climate change impacts do not eventuate. In reality, the modelled Baseline Scenario 1.1 will not occur as demand for groundwater abstraction will increase. This is covered in the modelling under Scenario 2.1.

What effects would climate change have?

Model Scenario 2.1 incorporates a continuation of existing groundwater allocation and abstraction (1,188,000 m^3/year), in addition to climate change effects. These effects include reduced natural recharge, progressive sea level rise, increased groundwater pumping to offset decreasing summer rainfall and extreme drought events. Scenario 2.1 is considered to be a **baseline** reference, against which the other model scenarios are compared. The model results indicate that aquifer conditions will progressively worsen for all values considered under this project: aquifer status (groundwater pressures and levels), cultural values, surface ecosystems, and groundwater salinity (Table A).

What effects would occur when Te Mana O Te Wai is placed above commercial use?

Model Scenario 3.1 represents a ‘no-pumping’ or ‘natural state’ projection. Groundwater abstraction is reduced from 1,188,000 m^3/year to zero across all five aquifers, but the other aspects of climate change projections are incorporated as represented in Scenario 2.1. If groundwater abstraction were to cease completely, the model indicates groundwater levels and baseflows in the surface water ecosystems would increase (Table A). However, even under this extreme scenario groundwater salinity trends are unlikely to be reversed compared to the baseline scenario (and therefore are considered to stay the same). The impacts of climate change on the agreed cultural indicators are still likely to worsen, mainly due to projected sea level rise. Turning off all groundwater pumping would have substantial economic and social impacts on the region.

What effects arise if existing allocations are used to full entitlement?

Model Scenario 4.1 explores the consequences of increasing pumping up to the full 2021 groundwater allocation limit of 3,980,908 m^3/year distributed across all five aquifers. This abstraction is increased to allow for the need for further progressive increases in abstraction in response to climate change stresses. The overall model results indicate increased pumping up to the currently consented allocation limit draws down the groundwater levels, but the system subsequently stabilises in a dynamic equilibrium at a lower level. However, the lower groundwater levels within each aquifer could cause issues such as reduced groundwater availability in bores and increased salinity. Increased groundwater usage acts to worsen the outcomes for all values against which the model has been evaluated (Table A). Model results indicate that there would be increased pressures on surface water baseflows and progressive degradation of groundwater quality in the form of increasing salinity, particularly along western side of the Makauri Aquifer. However, the maximum volumes allocated under individual groundwater abstraction consents are designed to provide irrigators with water security through drought periods. In reality, the regular year-to-year use of all allocated water is not considered a likely scenario.

What effects would replenishment have on groundwater levels?

Model Scenario 5.1 explores the benefits of incorporating a focused managed groundwater replenishment programme to actively recharge groundwater supplies. Under this scenario replenishment was initiated at 600,000 m^3/year, increasing over time to 780,000 m^3/year as an offset to increasing water demand driven by climate change. Model results indicated that clear benefits could be achieved in the form of increased groundwater pressures within the targeted Makauri Aquifer. The enhanced recharge helped offset the effects of climate change and helped maintain current surface water conditions (Table A). In addition, the model outcomes indicate the application of managed aquifer recharge could provide a first line of defence in reducing and reversing the spread of saline water within the Makauri Aquifer. This modelled scenario did not result in improved outcomes for cultural values because these values were measured for coastal sites with links to shallow groundwater whereas the simulated replenishment targeted the Makauri Aquifer at an inland site.

Table A: Groundwater Model Results for Selected Community Outcomes.

Summary Community Questions	Investigation Exploratory Scenarios (1)		Human Usage	Aquifer Status	Cultural	Surface Water Ecosystems	Salinity
	Baseline	1.1	Current	Stay the Same	Stay the Same	Stay the Same	Worsen
	Baseline + Climate Change	2.1	Current	Worsen	Worsen	Worsen	Worsen
What effects would occur if Te Mana O Te Wai was placed above commercial use?	Natural State	3.1	Zero	Improve	Worsen	Improve	Stay the Same
What happens if allocations are used to full entitlement?	Entitled Allocation	4.1	Full 2021 Allocation	Worsen	Worsen	Worsen	Worsen
What effect would replenishment have on groundwater levels?	Groundwater Replenishment	5.1	Current	Improve	Worsen	Stay the Same	Improve
What is a sustainable allocation rate?	Sustainable Allocation	7.1	*Variable*	Stay the Same	Worsen	Improve	Worsen

What is a sustainable allocation rate?

Defining a 'sustainable' pumping rate from a groundwater system requires a thorough definition of what is to be protected and what changes are considered sustainable, derived through community/stakeholder consultation. Model Scenario 7.1 explores one concept for a potential 'sustainable groundwater allocation' in response to projected climate change effects. Under this scenario the model objective was to maintain groundwater levels within the currently observed ranges through to 2050. This was achieved through a 15% reduction in pumping from the 2021 actual groundwater use. Then through time the modelled abstraction was increased to account for increasing demand with climate change to meet crop requirements, under the same irrigated area. The modelled increased abstraction steps in response to potential evapotranspiration deficit requirements were; no increase until 2029, 5% increase from 2030 and 15% increase from 2045.

The results indicate that the modelled pumping during both normal and drought years increases progressively in response to increasing water demand driven by climate change. In addition to groundwater levels being maintained in the Makauri Aquifer within the currently observed ranges through to 2050, improvements were modelled in surface water flows. However, outcomes for both cultural values and increasing groundwater salinity both worsened (Table A).

The concept of 'sustainability' used as a measure for Scenario 7.1 is limited to groundwater levels and pressures. To achieve improvements in all community set outcomes for 'sustainability' a combination of setting an allocation limit combined with groundwater replenishment would be needed.

Overall Model Results

None of the modelled scenarios led directly to improved outcomes for the agreed cultural indicators developed through the project (Table A). The main reason for the consistently worsening outcomes are the overriding impacts of climate change rather than the impacts of groundwater abstraction. There is limited groundwater abstraction close to the coast, which means shutting down this pumping did not effectively offset the projected negative impacts of sea level rise. Also, possible changes to surface water drainage systems were not included in any of the simulated scenarios, further limiting any potential benefits of groundwater management.

The modelled scenarios provide guidance on measures that may be considered for future investigation and modelling to achieve improved outcomes for culturally valued features. These include, for example, using targeted enhanced recharge to prevent or reverse saline water intrusion to aquifers along the coast.

Summary and Recommendations

The model results indicate that the combined application of both groundwater replenishment and abstraction allocation management can provide options to enable improved quality and quantity outcomes, even in the context of climate change.

WGA recommends that GDC model a set of Solution Scenarios that investigate the options for how these two levers (**groundwater replenishment** and **allocation limits**) may be used in tandem to achieve as many of the desired outcomes as possible.

The calibrated groundwater model provided to GDC is a tool that can be used to test groundwater management options and thereby support the development of a progressive set of policies and management goals to inform climate change adaptation planning and further community engagement.

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Figures

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Revision History

Rev	Date	Issue	Originator	Checker	Approver
A	12/09/2022	Draft for review	BAS/RJB	CHO	RJB
B	10/11/2022	Final draft	BAS/RJB	CHO	RJB
C	19/05/2023	Final	BAS/RJB	CHO	RJB
D	20/07/2023	Final revised Exec Sum	BAS/RJB	CHO	CHO
E	27/09/2023	Final revised Exec Sum	BAS/RJB	CHO	CHO
F	21/11/2023	Final revised Exec Sum	BAS/RJB	GDC	CHO

1 INTRODUCTION

1.1 OVERVIEW OF THE MODELLING PROGRAMME

Starting in 2021, Gisborne District Council (GDC) commissioned Wallbridge Gilbert Aztec New Zealand (WGA) and its project partner AQUASOIL Ingenieure & Geologen GmbH (AQUASOIL) to provide technical support for the development of a definitive and defensible groundwater model for Poverty Bay Flats/Tūranganui-a-Kiwa (Poverty Bay Flats). The model would be designed to simulate the behaviour of groundwater flows and water quality changes within the aquifers underlying the Poverty Bay Flats. The modelling programme that GDC established was more comprehensive than is typically developed for numerical groundwater model building processes (Figure 1).

Firstly, a comprehensive understanding of the geology beneath the Poverty Bay Flats was established. This process clarified the spatial distribution and extent of the five primary aquifers based on the available geologic information. This process helped to clarify areas where data was sparse or even unavailable, which in turn will help GDC decide where to prioritise future data collection efforts. The information generated in this assessment was then used to construct a geologic framework inside a specialised 3D modelling software package named **GeoModeller.** A completed geological model for the Poverty Bay Flats groundwater system formed the structural foundation on which the numerical groundwater model was constructed (Figure 1).

The second important step in this process, was the development of a **FEFLOW** numerical groundwater model for the area. This model incorporates a wide range of hydrologic, climatic, abstraction, hydrogeology and geochemical data that has been collected by GDC over several decades. The model was also developed to help evaluate the effects of climate change model through model scenario comparisons. Outcomes from national climate change modelling completed by the National Institute of Water and Atmosphere (NIWA) were also incorporated to help simulate the climate effects in our scenario modelling process.

When the model was calibrated, validated and ready for use, a series of model scenarios were generated to evaluate a range of groundwater management questions about the Poverty Bay Flats. For the Poverty Bay Flats model scenarios, the model was set up to estimate current groundwater conditions as well as the predicted effects of climate change. The combination of current conditions with the influence of climate change were used as the basis to which all modelled management scenarios were compared.

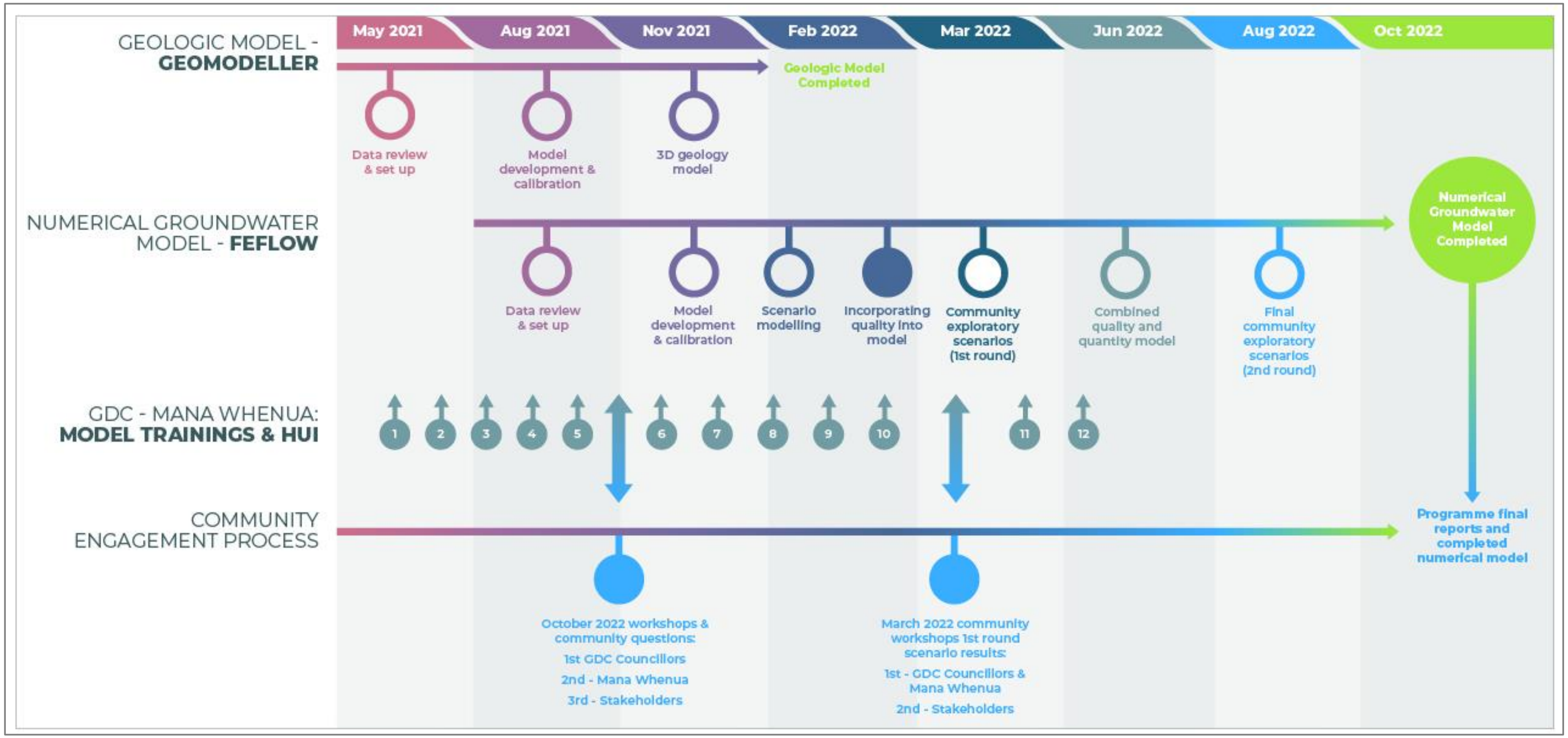


Figure 1: Poverty Bay Flats Numerical Groundwater Model and Community Engagement Process (May 2021 to October 2022)

In addition to the numerical model development process, GDC established a parallel community engagement strategy to help incorporate the wider community's input and answer questions about the model development process. As part of the engagement with GDC treaty partners, key representatives from **Mana Whenua**[2] were invited to and participated in the twelve online FEFLOW technical trainings (Figure 1). During these trainings, technical aspects of the modelling process were shared and discussed.

During these hui, the technical team was fortunate to have Mana Whenua also share learnings about surface and groundwater in the project area from a cultural history perspective. As a means to help ingrain a cultural perspective in the modelling process, the technical team worked with Mana Whenua to identify a series of culturally important locations. The effects at these sites were assessed qualitatively through each of the groundwater management scenarios being evaluated using the numerical model (e.g., likely to improve, likely to stay the same, likely to worsen). These indicators provided the project team a means by which to start to connect identified cultural values with possible future management decision making alongside the anticipated effects of climate change including sea level rise and the increased frequencies of extreme weather events. Similarly, measurements of other environmental indicators such as changes in groundwater salinity and the effects of groundwater management on environmental surface flows were linked using some key qualitative statements.

In addition to the Mana Whenua hui, GDC technical staff worked with the GDC councillors and wider community stakeholders in a series of **workshops** (Figure 1). These workshops were designed to inform the participants as well as incorporate various perspectives into the model development process. The first set of these workshops in October 2021, helped inform the participants on the overall hydrogeology of the area as well as the construction and capabilities of the numerical groundwater model. During the workshops, GDC lead an interactive process by which the various stakeholder groups were asked to pose specific 'big picture' questions relative to the current and future management of the Poverty Bay Flats groundwater system. These questions were related to resource sustainability, climate change, groundwater replenishment, and various levels of allocated groundwater usage. From a compiled list of these community questions, a series of 'first cut' exploratory scenarios were quantified numerically and incorporated as tests of the newly calibrated and validated groundwater model. The scenarios sought to provide projections of groundwater flow and levels under a range of management options over a period from present (2022) through to the end of the climate forecast modelling period (2090). After completion of the first round of exploratory scenario modelling the results were presented and discussed in a series of community workshops in April 2022 (Figure 1).

During the engagement process, the quality of groundwater in the Poverty Bay Flats was raised as an issue of particular concern to the Mana Whenua and the wider community. These concerns covered a number of parameters, but in particular the issue of salinity intrusion along the coast and in the western portion of the Makauri Aquifer, where the poor quality of available groundwater restricts its use. GDC instructed the modelling team to review and compile all groundwater quality data and then work to incorporate salinity modelling into the community scenario development process. For the purposes of the groundwater quality modelling and this report, the term salinity is taken to specifically mean chloride concentration. As the modelling and community workshops progressed, GDC, Mana Whenua and community stakeholders developed a series of questions on the current and future management of the Poverty Bay Flats groundwater system. The modelling team transcribed the technical essence of the questions into the context of numerical modelling scenarios.

[2] Gisborne District Council is developing a treaty partnership with representatives from the local iwi groups as part of a co-governance model approach to resource management.

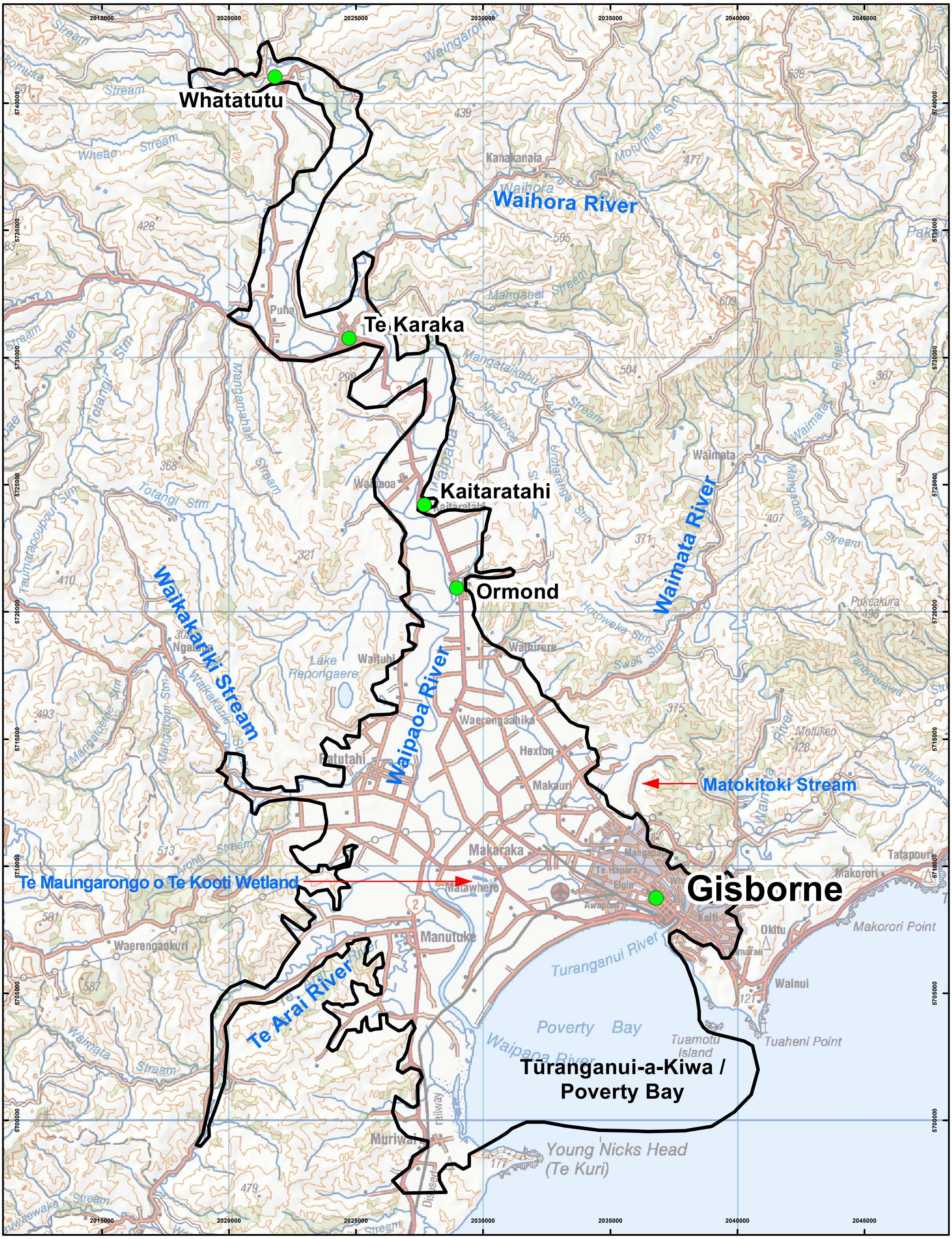
Informed by the community workshop process and after further consideration of the technical results from the first round of **exploratory scenarios**, a second and final round of scenarios was commissioned by GDC. The major changes in the second round of scenarios were to refine and better represent the likely effects of climate change. This included combining three separately modelled issues (anticipated sea level rise, increased severity of droughts, and increasing irrigation water demands resulting in increased groundwater pumping) into a combined comprehensive baseline with the influence of climate-change modelling scenario. With the incorporation of the water quality function into the FEFLOW model, this second round of modelling scenarios also incorporated the expected changes in chloride concentrations into the various scenarios results. This second round of community exploratory scenarios is considered the final outputs from the project and is presented in this final Poverty Bay Flats groundwater modelling programme report.

1.2 POVERTY BAY FLATS GROUNDWATER SYSTEM

The Poverty Bay Flats covers an area of about 200 km^2 comprising the coastal alluvial floodplains in the Gisborne Region/Te Tai Rāwhiti, on the Northeast Coast of the North Island of New Zealand. The Poverty Bay Flats extend inland for approximately 20 km to Ormond, which lies at an elevation of about 20 m above mean sea level (Figure 2).

The Waipaoa River, which is the primary surface waterbody, flows southward for over 80 kilometres from its headwaters in the Raukumara Range capturing flow from a total catchment area of approximately 2,165 km^2. Smaller rivers and streams flowing into the Poverty Bay Flats modelling area include the Te Arai, Waimata and Wahiora Rivers as well as Matokitoki and Waikakariki Streams. Other water features include the Te Maungarongo o Te Kooti Rikirangi wetland (also known as the Matawhero wetland), which formed in a former oxbow of the Waipaoa River and is one of the largest remaining wetlands on the Poverty Bay Flats. This wetland holds culture significance to local iwi as well as terrestrial and aquatic environmental values.

The Gisborne district has approximately 1,000 mm annual precipitation at the coast to 1,400 mm in the upper parts of the Waipaoa River catchment (Chappell, 2016). Monthly rainfall (Gisborne AWS) ranges a low of 57 mm (December) through a high of 131 mm in July (Table 1). Average monthly potential evapotranspiration substantially exceeds monthly rainfall from October through to February (Figure 3) which drives the need for groundwater pumping to help support agriculture on the Poverty Bay Flats. Spatially distributed rainfall recharge to the Poverty Bay Flats aquifers is considered to predominantly occur through the period March to August annually. Although irrigated areas have increased over time as the horticultural industry in the region has expanded, most of the irrigation is designed to maintain soil moisture levels through the main summer crop production period. Irrigation practices on the horticultural areas of the Poverty Bay Flats are relatively efficient and do not appear to lead to widespread and frequent exceedance of the soil water holding capacity.



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Scale 1:200,000 @ A4

Coordinate System: NZGD 2000 New Zealand Transverse Mercator

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Note: The information shown on this map is a copyright of WGA 2022

LEGEND

- City
- Model Extent

WGA
WALLBRIDGE GILBERT AZTEC

Figure 2

Gisborne MAR Model

Poverty Bay Flats Project Area and Topography

Table 1: Monthly Average Rainfall and Potential Evapotranspiration

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Waipaoa Rainfall (1)	98	116	130	130	127	156	186	123	98	93	66	73	1,395
Gisborne AWS rainfall (2)	59	68	93	97	96	105	131	78	72	70	63	57	987
Gisborne EWS ET (3)	161	119	97	59	40	29	31	47	73	110	132	147	1,045

Notes: 1) 1981 – 2010 (Chappell 2012)

2) Metservice dataset from NIWA CLIFLOW database, Gisborne monitoring stations 2809 and 2810, Period 1982 – 2021

3) Metservice dataset from NIWA CLIFLOW database, Gisborne monitoring station 2810, Period 1992 – 2021

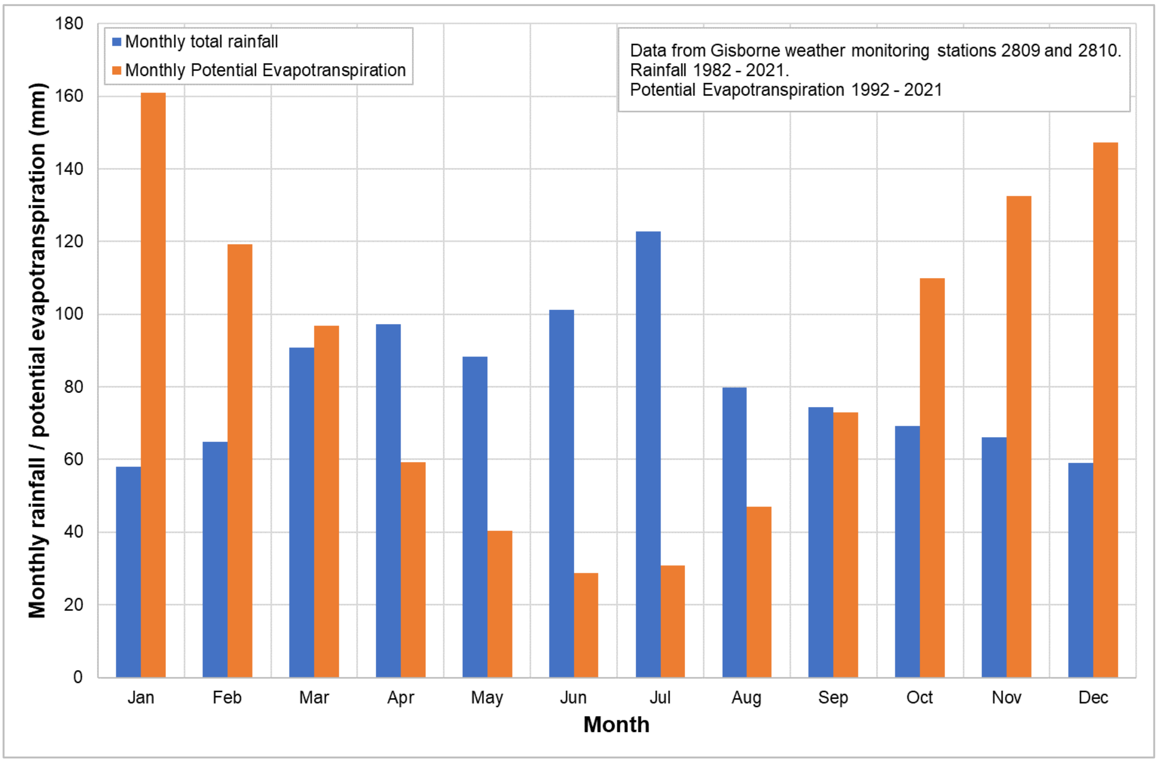


Figure 3: Average Monthly Rainfall and Potential Evapotranspiration at Gisborne

For the purposes of the groundwater modelling, it is assumed that distributed groundwater recharge to the unconfined aquifers is predominantly limited to the period March to August annually. Monthly recharge is calculated for the numerical model by subtracting potential evapotranspiration from rainfall on a monthly basis.

Average high air temperatures for the area range from over 20˚C during the summer months (December to March) down to below 0˚C during the winter months (June to August). The Gisborne district is one of New Zealand's sunniest regions with western areas receiving between 1,800 and 2,100 hours of bright sunshine per year. The prevailing winds for the Poverty Bay Flats are from the west, where various mountain ranges provide some protection against more severe wind and weather events.

Gisborne is the major municipal centre of the region with a population of approximately 47,517 in 2018. The Poverty Bay Flats is a nationally recognised horticultural area covering approximately 18,500 hectares (ha) of highly productive soils suitable for arable farming, market gardening, horticulture, and viticulture. Irrigation for horticultural purposes is one of the main uses of water across the Poverty Bay Flats with a substantial proportion of the water used for irrigation being derived from groundwater. Within the entire Tairawhiti region resource consents have been granted authorising surface and groundwater takes enabling the irrigation of 7,120 ha, 96% of which is on the Poverty Bay Flats.

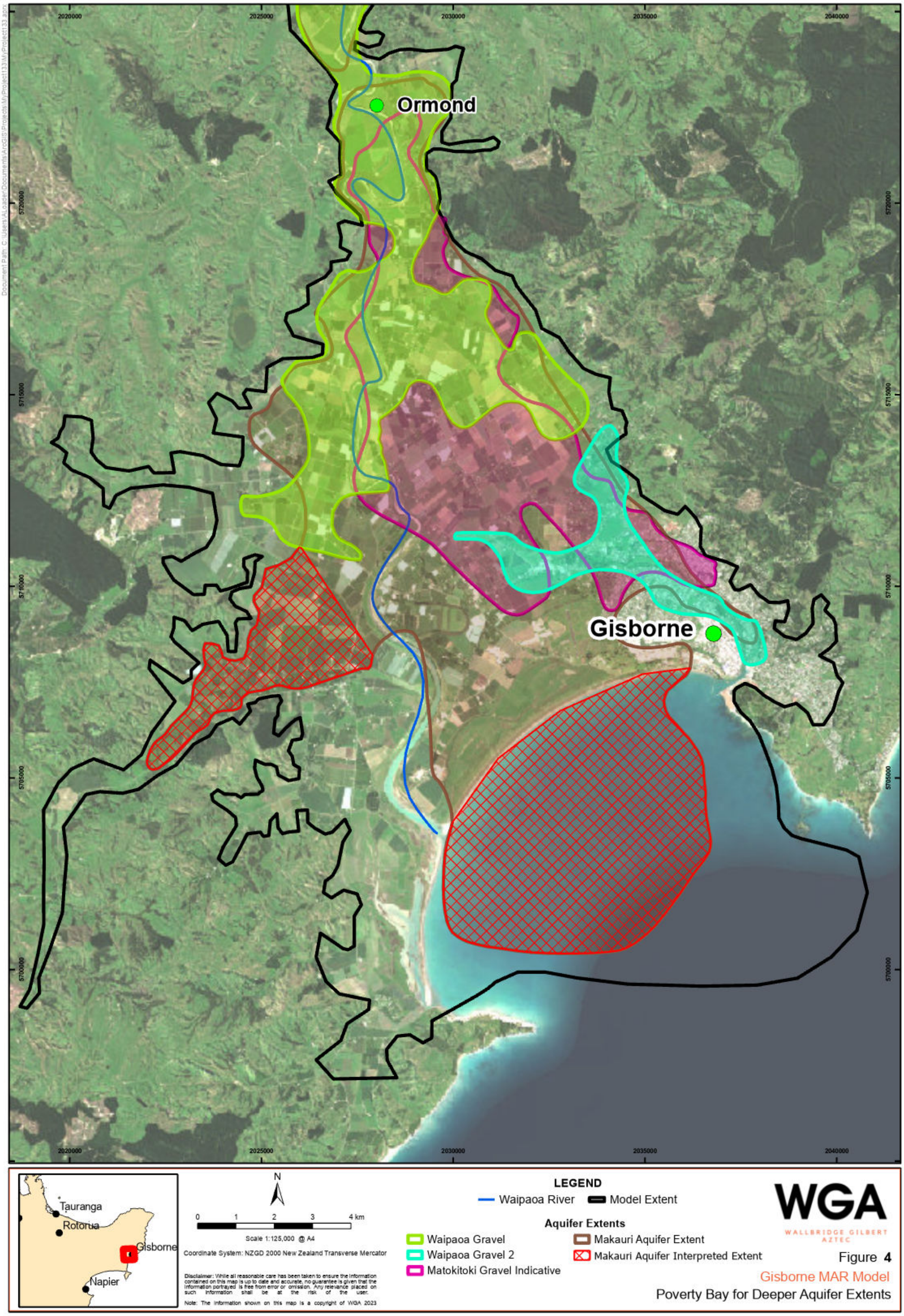
Water use in the Poverty Bay Flats is sourced from both from both surface and groundwater sources with a reported 85% of all groundwater takes for the Gisborne District located in this area. Relative to groundwater use, currently there is nearly 4 million m^3/year of consented allocation between the five aquifers which are the Makauri (48%), the Te Hapara Sands (23%), the Shallow Fluviatile (16%), the Waipaoa Gravels (11%) and the Matokitoki (2%) aquifers. GDC's operative 2018 Resource Management Plan[3] outlined a "paper-based" reduction in the allocation to horticulturists from the Makauri Aquifer has been implemented by GDC. The first stage was to reduce the groundwater allocation from approximately 8,000,000 m^3/year to approximately 1,800,000 m^3/year which is currently consented. A further reduction is planned to occur in 2023, with the allocation limit being set at 1,700,000 m^3/year.

A Managed Aquifer Recharge (MAR) trial targeting the Makauri Aquifer has been operating at Kaiaponi since 2017 and represents New Zealand's first Aquifer Storage Transfer Recovery (ASTR) bore. Outcomes from the trial to date indicate MAR can be a viable tool to help slow and reverse the declining groundwater level trends in the Makauri Aquifer. Further discussions with the community on the application of groundwater replenishment techniques are ongoing. Use of these techniques is being considered as one of the groundwater management options in this modelling programme.

Hydrogeologically, from the ground surface through to the basement bedrock, there are 10 unique units of aquifers and aquitards which form the Poverty Bay Flats groundwater system. The aquifers tend to be composed of riverine deposited alluvium while the aquitards tend to be formed from geologic sources of silts and mudstones or from marine sediments or swamp deposits. There are five main aquifers which underlie the Poverty Bay Flats (from shallower to deeper): Te Hapara Sand, Shallow Fluviatile, Waipaoa, Makauri and Matokitoki Aquifers. None of the aquifers are continuous across the full extent of the Poverty Bay Flats. The aquifers range in confinement from shallow unconfined aquifers to the deeper semi to fully confined aquifers. The spatial distribution of the three deeper and more productive aquifers are shown in Figure 4. The extent to which the Makauri Aquifer extends offshore is somewhat speculative, although it is supported by an understanding of sea levels at the time of deposition and the current gradient of the aquifer beneath the Poverty Bay Flats (WGA 2022a).

The largest groundwater abstraction by volume is from the Makauri Aquifer, with approximately 900,000 m^3 being abstracted during a typical irrigation season. Previous studies and reviews of groundwater levels in the Poverty Bay Flats aquifers have identified declining groundwater pressure trends (e.g., Moreau et al 2020). These trends are linked to increasing groundwater abstraction for irrigation purposes. Continuation or exacerbation of these trends has been identified by the GDC as presenting environmental, economic, cultural, and social risks linked to water flow and supply reliability issues. GDC considers most of the aquifers to be either fully allocated or over-allocated and no new resource consents for groundwater abstraction currently being issued.

[3] https://www.gdc.govt.nz/council/tairawhiti-plan/tairawhiti-plan#heading-1


Ormond
Gisborne
2020000
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Tauranga
Rotorua
Gisborne
Napier
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Coordinate System: NZGD 2000 New Zealand Transverse Mercator
Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any relevance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2023
LEGEND
Waipaoa River
Model Extent
Aquifer Extents
Waipaoa Gravel
Waipaoa Gravel 2
Matokitoki Gravel Indicative
Makauri Aquifer Extent
Makauri Aquifer Interpreted Extent
WGA
WALLBRIDGE GILBERT AZTEC
Figure 4
Gisborne MAR Model
Poverty Bay for Deeper Aquifer Extents

Groundwater quality for the Poverty Bay Flats is highly variable between the various aquifers and in relation to their proximity to the ocean. The shallow, unconfined aquifer is susceptible to land use activities and contamination sources in the form of nutrients for agriculture fertilisers and faecal bacteria from livestock. The interaction with the rivers also means that these shallow systems are higher in oxygen levels and nearer the coast, increased levels of salts from windblown ocean spray as well as the tidal fluctuations.

The deeper, confined aquifers are more disconnected from these surface activities. The confinement means that natural recharge from the surface water bodies takes longer, and the groundwater quality changes with increased residence time. Oxygen depletion results in higher levels of dissolved metals such as iron and manganese in the deeper aquifers, which makes the water less potable for drinking water and has resulted in some ongoing issues for irrigation systems.

The interpreted western section of the Makauri Aquifer is characterised by elevated groundwater salinity, with few bores having been drilled there over the past few decades. The reasons for this inland saline condition are yet to be determined. However, it is hypothesised that paleo marine sediments deposited in this area when the ocean levels were higher may be a continued source of salts. Concerns raised during the groundwater modelling process include the threats of saline water intrusion to the shallow aquifer from climate change (e.g., rising sea levels) and saline intrusion issues caused by continued declines in groundwater pressures from over pumping.

1.3 TECHNICAL SUPPORTING INFORMATION

The Poverty Bay Flats Groundwater Modelling programme has resourced information from a wide range of GDC databases, reports, and journal articles. A comprehensive list of these formal references can be found in the References Section 7. In addition to this document, the following reports directly support the modelling programme:

- Poverty Bay Flats Geological and Conceptual Hydrogeological Models (WGA, 2022a)
- Poverty Bay Flats Conceptual Groundwater Quality Model – Salinity (WGA, 2022b)
- Groundwater Modelling of the Poverty Bay Flats – Turanganui a Kiwa (Gisborne): 3D FEFLOW Groundwater Model (AQUASOIL, 2022)

This report is intended to provide a high-level overview of the technical information and biophysical settings in which this modelling programme was developed. It also provides an overview of the community engagement process and the exploratory scenario modelling results. At the conclusion of this programme, GDC has a fully developed FEFLOW numerical groundwater model for the Poverty Bay Flats which is intended for use in future science and regional planning processes.

2 MODELLING PROCESS

2.1 INTRODUCTION

The primary objective of the Poverty Bay Flats modelling programme was to develop a fit-for-purpose numerical model to improve GDC's scientific understanding of the groundwater system as well as inform the regional management planning processes. The programme has delivered a calibrated numerical model which has been used to evaluate a series of exploratory groundwater management scenarios. These scenarios were used to test the capabilities of the model as well as provide indicative information on some of the major water management issues facing the system.

Two numerical models were developed during this process: a 3-D geological model (Geomodeller) which formed the structural foundation for the FEFLOW groundwater model. The FEFLOW model provides computational assessment of both groundwater quantity and quality parameters. A series of comprehensive reports documented specifics of the construction of these models, with references to these documents provided in Section 7. This section of the report summarises the key features and design criteria for these models as an introduction to the use of the model in the Exploratory Scenario results and discussion found in Section 4.

2.2 MODELLING OBJECTIVES

The objectives of this programme were primarily to develop a functioning set of geologic and numerical groundwater models to service GDC's future needs. Specific to this modelling and community engagement programme, the key objectives that the team worked toward were:

- Develop a robust numerical model as a tool to better understand the Poverty Bay Flats aquifer system's groundwater quantity and quality characteristics.
- Enable the model to be fit-for-purpose for future Tūranganui-a-Kiwa regional planning to support regulatory decision making.
- Develop an engagement process where the model and understanding of the Poverty Bay Flats is developed through a co-design philosophy partnership, with Mana Whenua (treaty partners) providing insights from their local knowledge as well as learnings into the technical model build process.
- Develop a wider community consultation process to help inform and educate area stakeholders on the hydrogeology of the Poverty Bay Flats groundwater system and the computational capabilities of this newly developed numerical tool.
- Develop the model structure to enable the modelling of a series of Exploratory Scenarios designed to ask specific questions from Mana Whenua and the wider Gisborne community about this groundwater system.

- Develop the capability to provide 3D visualisation of this complex Poverty Bay Aquifer system for both a better science understanding as well as sharing with the community.

The following sections provide an overview of conceptual and numerical models relative to their development steps. It also provides a summary of the completed models that have been used to investigate the Exploratory Scenarios discussed in this report.

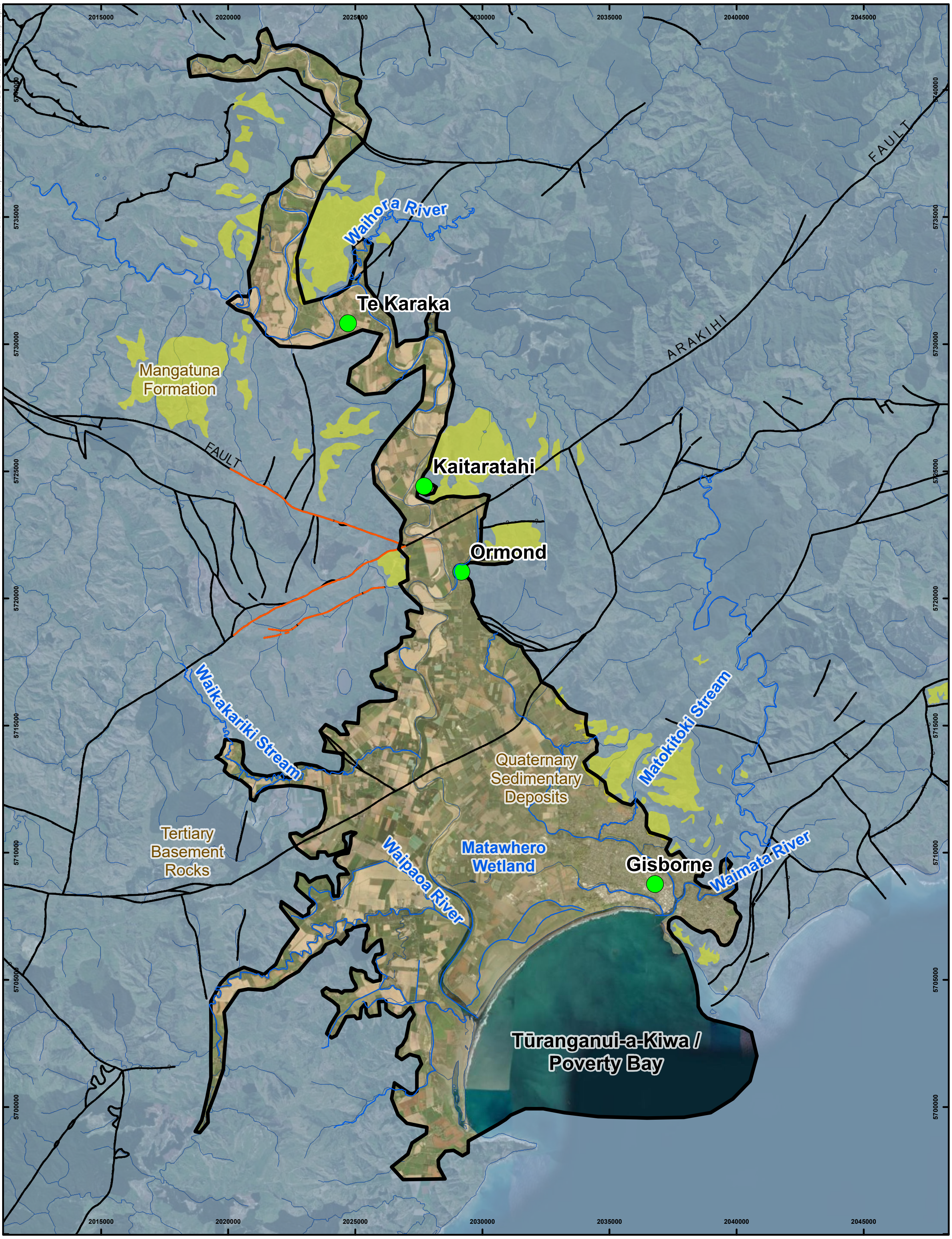
2.3 CONCEPTUAL GEOLOGICAL MODEL DEVELOPMENT

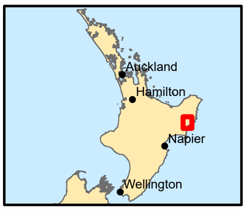
The initial step in the development of any numerical groundwater model is to develop a conceptualisation of how the overall hydrogeologic system is laid out and how it functions. Draft concept models of the geology and hydrogeology were set up based on a review of the available physical data and various geology reports about this area. As the numerical modelling process progressed, these conceptual models were revised and adapted based on our improved understanding of the system. The final hydrogeological conceptual model was different from the one with which the process started.

The Poverty Bay Flats geology can be conceptually represented as a triangular 3-dimensional sedimentary prism, expanding from north (narrow top) to south (wide bottom), of thick silt and clay deposits alternating with substantially thinner gravel and sand deposits (WGA, 2022A). This prism is underlain by Tertiary (> 2.6 million years) aged bedrock (Figure 5). This depositional prism is bounded laterally to the east and west by Tertiary and Quaternary (< 2.6 million years old) siltstones and sandstones. The sedimentary prism has its greatest thickness at the coastline marking the southern end of the flats.

The internal area of the prism consists of Quaternary aged sediments deposited through geologic time by the rivers and streams that flow into Poverty Bay Flats. The youngest deposits, representing the coastal Te Hapara Sands and the Waipaoa River’s Shallow Fluviatile Gravels, are shallow and close to the surface. At the north end of the prism, where the Waipaoa River system enters the Flats, these gravel beds merge. As we move deeper in this prism, older buried river deposits of gravels and sandy gravels make up the Waipaoa, Makauri and Matokitoki gravel beds. The gravel beds generally increase in depth from north to south across this prism and as they deepen, they become increasing separated by thickening silt deposits. The silt deposits act as barriers (aquitards) which were thought to have formed as overbank riverine, swamp, and estuary deposits. Nearest the coast, the shallower Te Hapara Sand and the deeper Makauri gravel deposits both appear to extend offshore.

A branch of the Matokitoki Gravel deposit, which appears to represent an ancient, buried river channel, extends underneath Gisborne. This branch becomes shallower toward the southeast and is likely to consist of sediments derived from the Waimata River catchment. An interpreted branch of the Makauri Gravel, which extends westward under the Te Arai River terrace, is similarly thought to consists of sediments derived from the Te Arai River catchment (Figure 5).





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Coordinate System: NZGD 2000 New Zealand Transverse Mercator

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LEGEND

- Waterways
- Fault - Active
- Fault - Inactive
- Mangatuna Formation
- Quaternary Sedimentary Deposits
- Tertiary Basement Rocks

WGA
WALLBRIDGE GILBERT AZTEC

Figure **5**

Gisborne MAR Model

Surficial Geology Map

2.4 NUMERICAL GEOLOGICAL MODEL

Based on the geologic data available and this geologic conceptualisation, a geologic model of the Poverty Bay Flats was built using the GeoModeller software package. A detailed technical summary of this process is presented in the conceptual hydrogeology report by WGA (2022a).

Generally, the geological model was developed through creating a grid of cross sections between a series of exiting well's drillholes. The available lithological information was correlated between drillholes, and sedimentary layers defined. Once the cross sections were completed, the layers were connected between the cross sections to create the 3D geologic model. This was an iterative process, with numerous reinterpretations of the sedimentary layers. The completed numerical geologic model was provided to GDC in February 2022. The geological modelling report (WGA 2022A) provides maps and visualisations of geological model layers, which can be used by GDC in future scientific projects. Figure 6 provides an example of the 3-D visualisation capability of the model as presented to Mana Whenua during one the model training sessions in September 2021. Figure 7 provides an example of a north-south cross-section across the Poverty Bay Flats showing the interpreted geological deposits (WGA 2022A).

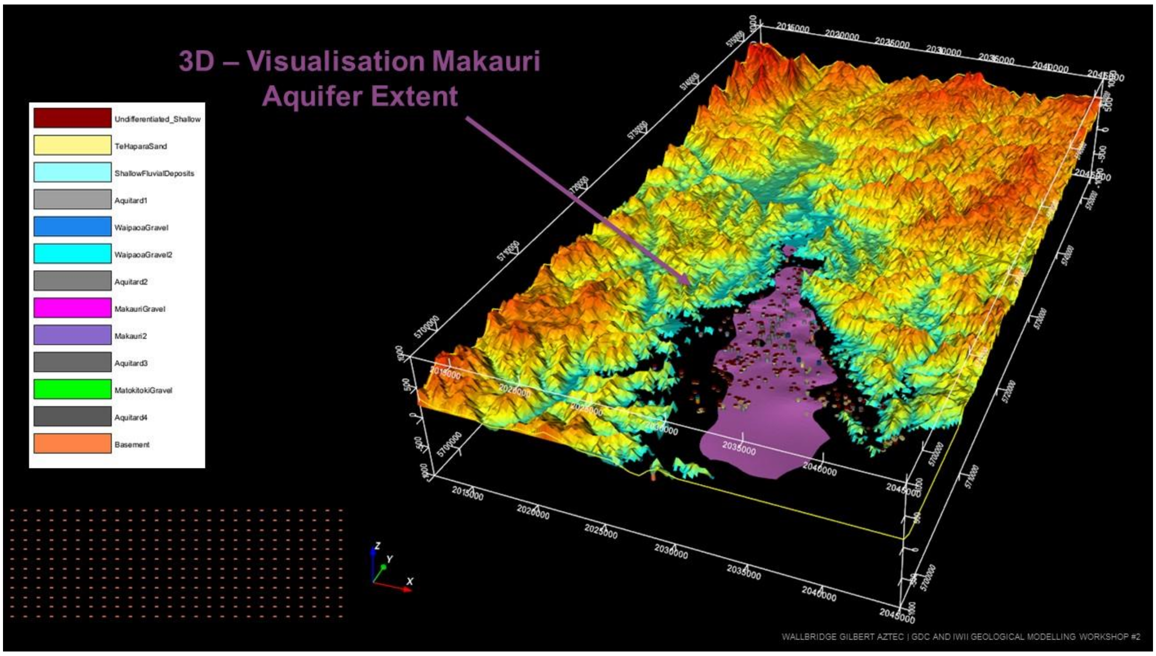


Figure 6: Example of 3D Visualisation using Poverty Bay Flats Geological Model – GDC – Mana Whenua Training Workshop (7/0/2021)

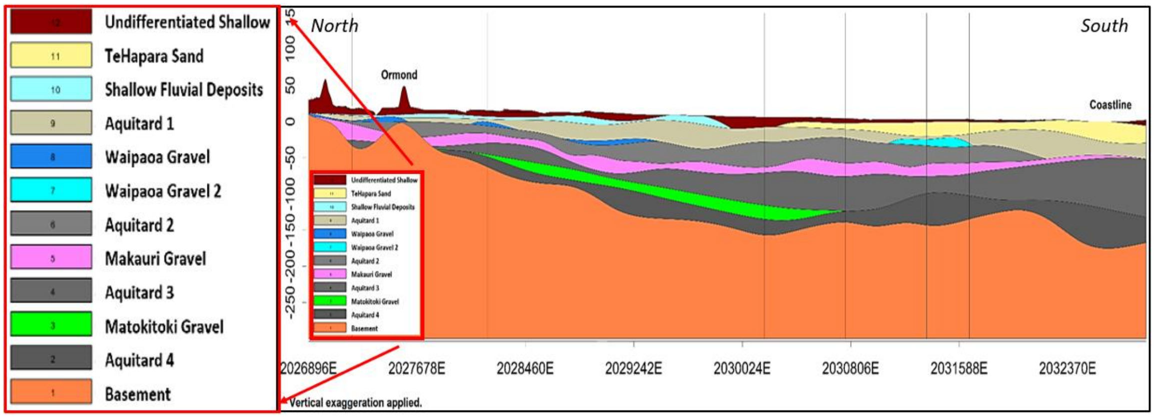


Figure 7: Example of North – South Geologic Cross Section of Poverty Bay Flats (WGA 2022a)

2.5 CONCEPTUAL HYDROGEOLOGIC QUANTITY AND QUALITY MODEL

With the completion of the geologic model framework, the next step in the process was the development of the hydrogeologic numerical model in the FEFLOW modelling software package. A detailed summary of that model development process can be found in the WGA (2022A, 2022B) and in AquaSoil (2022) reports.

The hydrogeological conceptualisation of the groundwater system underlying the Poverty Bay Flats utilised the geologic framework and essentially ‘added water’ to the conceptualisation process. Large amounts of GDC groundwater monitoring data and hydraulic tests performed Poverty Bay Flats bores helped build a picture of how water behaves in this system.

Natural recharge is driven by rainfall and river loss recharge, groundwater flows through this system are primarily through the shallower fluviatile gravel and sand aquifers. The shallowest aquifers extend northward from the Poverty Bay Flats as components of the valley fill alluvium within the Waipaoa River valley. As groundwater moves southward into the deeper parts of the system, spatially extensive thick silt beds act to hydraulically separate the aquifers, acting as efficient aquitards limiting the vertical leakage and natural recharge processes.

The shallowest of the aquifers are the Shallow Fluviatile Gravel and the Te Hapara Sands, which are generally unconfined[4] but can be locally confined[5] by surficial silt deposits. Both shallow aquifers are generally highly connected with the rivers, streams, and wetlands of the Poverty Bay Flats. Based on our conceptualisation, toward the coast, these same aquifers tend to discharge baseflows to the Waipaoa River and other surface water bodies such as wetlands and artificial drains. Along the coastline the Te Hapara Sand Aquifer also discharges freshwater directly to the ocean and receives saline water inflows from the ocean.

The deeper river gravel deposits constitute the Waipaoa, Makauri and Matokitoki Aquifers. These aquifers are predominantly confined and hydraulically separated from each other, although they merge at the northern end of the Poverty Bay Flats. There is also evidence that southeastern branches of these aquifers are hydraulically connected under Gisborne City. These aquifers are not known to directly interact with surface waterbodies except at their northern end where the Waipaoa River enters the Flats. Recharge to these aquifers occurs at this northern end from incipient rainfall and losses from the Waipaoa River. There is evidence to indicate some focused recharge to the confined aquifers may be occurring along the eastern edge of the Poverty Bay Flats and to the southeast of Gisborne. However, the exact mechanism, locations, pathways and potential rates for this recharge are unknown. Consequently, focused recharge in these areas has not been incorporated in the numerical FEFLOW model.

Groundwater flows through each of these confined aquifers tend to follow elevation gradients from north to the south. The notable exceptions to this are the southeastern branches of the Matokitoki, Makauri and Waipaoa Aquifers, which appear to contain groundwater flowing toward the northwest away from the eastern hills near Gisborne. Flow rates through the aquifers vary depending on the aquifer’s degree of confinement and depth. Groundwater in the shallower confined aquifers tends to move faster than the deeper aquifers, which is reflected in the groundwater quality and age information used to support the model conceptualisation. However, ‘fast’ is a relative term in groundwater movement and should be noted as being much slower than flows visually apparent in surface water bodies such as rivers and streams.

---

[4] Water table open to the infiltration of water from the surface including rainfall and river losses.
[5] Surficial silt beds may locally partially isolate the shallow aquifers from direct rainfall recharge and hydraulically separate the aquifer from overlying shallow drains.

Groundwater quality conditions in the various aquifers of this system are highly dependent on their location, confinement, and depth. The shallow unconfined aquifers have a stronger connection with surface land use activities, tend to have higher levels of nutrients from farming and enteric bacteria from animal sources are more often detected in groundwater samples. The deeper confined aquifers tend to demonstrate reducing redox or low oxygen conditions. Groundwater in these deeper aquifers tends to contain higher concentrations of dissolved metals such as iron.

Salinity was selected as a focus point for this numerical modelling process based mainly on the prevalence in the Poverty Bay Flats as well as concerns over increasing coastal saline intrusion related to the effects of changing climate. Salinity measured as chloride is another feature of this coastal groundwater system and can be found distributed throughout all the aquifers. Additionally, the reducing conditions and the presence of organic material in the silt aquitards has led to high dissolved gas loads including methane in the deeper groundwater.

Salinity in the Poverty Bay Flats groundwater system is conceptualised to be from several potential sources and processes. In the deeper parts of the system, fine-grained sediments deposited under marine conditions likely contain elevated salt levels representing relic sea water from the deposition process. These marine sediments constitute the various aquitards that separate the deeper aquifers (Waipaoa, Makauri and Matokitoki). The limited seepage flows through the thicker aquitards means salts may be retained in the geologic matrix for very long periods of time.

The western section of the Makauri Aquifer is characterised by high chloride concentrations. This has resulted in few water bores being installed in this area. The geological, hydraulic and groundwater quality information from this area is limited. Although the salt in the groundwater of this area may be a relic of the depositional period, insufficient information is available to be confident in this interpretation.

The shallower parts of the groundwater system, which are highly connected to the freshwater recharge from rivers and rainfall, have low concentrations of chloride. In the Te Hapara Sand and Shallow Fluviatile aquifers, groundwater salt concentrations are likely influenced by other processes. Rainfall recharge closer to the coast is interpreted to be influenced by onshore winds carrying chloride in ocean spray. Shallow groundwater chloride conditions along the coast indicate that this effect decreases with increasing distance from the coast.

The coastline presents as a sharp saline water intrusion interface within the Te Hapara Sand Aquifer. Sea water is seeping through the coastal sands toward the drained low-lying Awapuni Moana area, which was historically an estuary. Relic salts may still be present in the fine-grained estuary deposits. The lack of coastal monitoring wells limits understanding of potential saline intrusion effects to the deeper Makauri aquifer, which is thought to extend some distance offshore. However, any future drawdown of groundwater pressures in the coastal Makauri Aquifer below sea level would clearly represent a risk of saline water intrusion to this aquifer.

2.6 NUMERICAL GROUNDWATER MODEL

The numerical groundwater flow model was developed through a comprehensive process outlined in detail in the AQUASOIL (2022) report. This process started with the construction of FEFLOW model mesh both horizontally and vertically forming the foundation of the computational structure. Several iterations of the mesh were tested and revised as a combination of model results, new information and new requirements placed on the model helped to guide improvements as the project progressed. A total of 10 primary hydrogeological layers were constructed into the model based on the numerical geological model, with 6 aquifer units and 4 aquitards. Figure 8 shows the Makauri Aquifer as it is represented in the FEFLOW numerical model. Figure 9 provides a 2D cross section of how all the hydrogeologic units are situated inside the FEFLOW model.

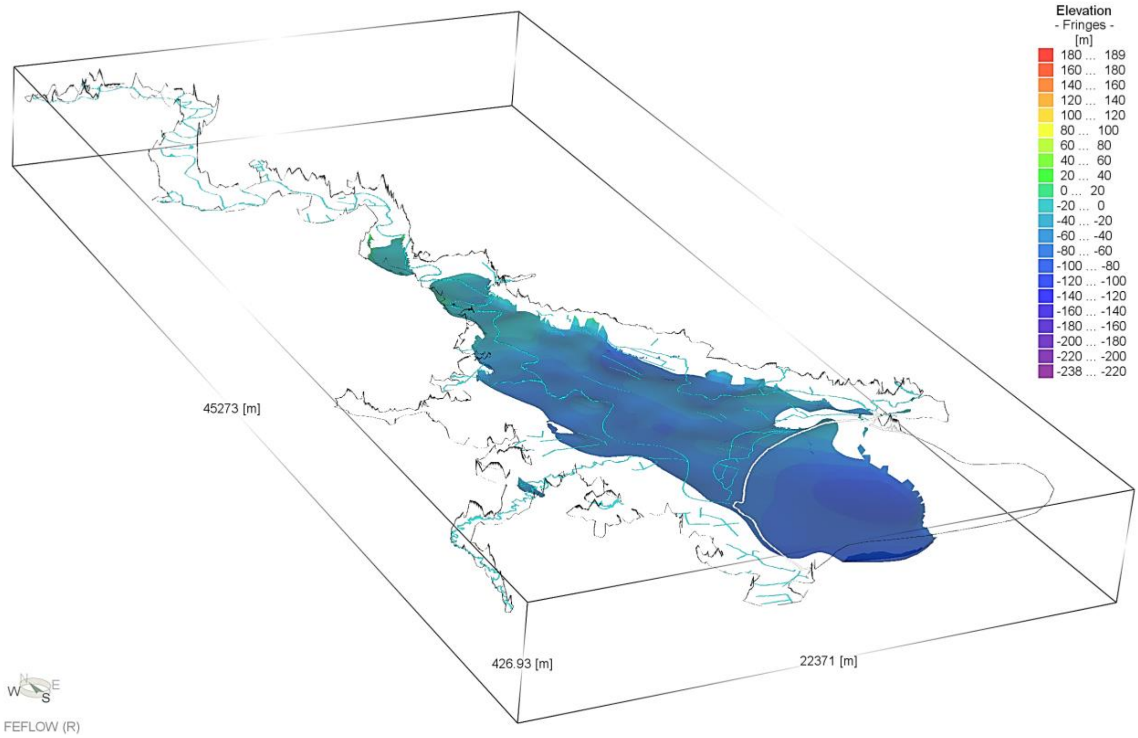


Figure 8: 3D View of Makauri Aquifer in FEFLOW Model (AQUASOIL, 2022)

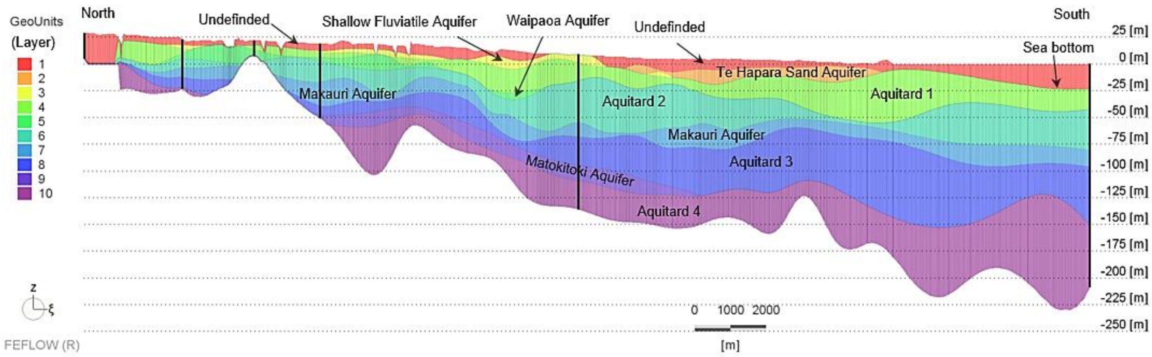


Figure 9: Vertical 2D Cross Section of Poverty Bay Flats FEFLOW Model showing various Hydrogeologic layers: North – South (AQUASOIL, 2022)

Following the construction of the model mesh, the hydraulic properties and boundary conditions of all the model were defined based on a combination of available data as well as according to the conceptual hydrogeological model (WGA 2022a). Key elements to this process included incorporating spatially distributed rainfall-recharge into the model based in land use types and measured seasonal climate information. All known monitoring bores were also incorporated into the model in order to be able to extract and compare results during the calibration/validate as well as the scenario generation process.

The next phase of the model was to calibrate, validate and verify the 3D model. This started with a steady calibration with used simulations and sensitivity analysis to establish the calibration. A transient calibration of the model followed that included simulations and comparison with time-series surface and groundwater data, groundwater age (residence times) and electrical conductivity simulations through mass-transport verification. The calibration and validation process for both the steady state and the transient state models was successful.

At this time, the community workshop establishing the Exploratory Scenarios was completed, and the modelling team developed the first Round of scenarios for FEFLOW simulation testing. During this community process, it was determined that groundwater quality (salinity) would be incorporated into the FEFLOW model. The main purpose of the salinity scenario to discern the possible transport processes or/and behaviour of salinity characterised by chloride concentrations in the Poverty Bay Flats groundwater system based on the assumptions of the conceptual groundwater quality model (WGA 2022B). Similar to the quantity model, the salinity transport simulation needed to be parameterised and tested through simulations until it was ready for scenario modelling. It required two rounds of conceptualisation and model changes in order to get this function in the model working to represent the likely salinity changes in our Exploratory Scenarios. The groundwater quality conceptualisation and numerical quality modelling is described in detail in both the WGA (2022B) and the in AQUASOIL (2022) reports.

At the conclusion of the numerical groundwater quantity and quality model build process, the WGA, GDC and AQUASOIL team deemed the model to be fit-for-purpose for incorporation into the predictive Exploratory Scenario simulations to evaluate potential future groundwater quantity and quality trends. The remaining sections of this report present a summary of the Exploratory Scenario results from the FEFLOW numerical model and a discussion of their results relative to potential use for future groundwater management planning efforts.

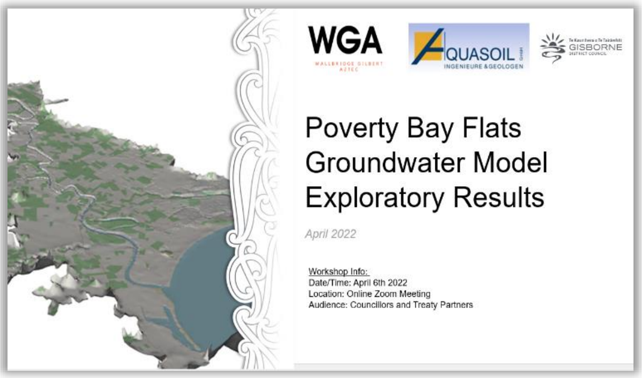
3 COMMUNITY ENGAGEMENT AND EXPLORATORY SCENARIOS

3.1 OVERVIEW

GDC developed an interactive engagement process in order to proactively involve the GDC Councillors, Mana Whenua, and the wider community in the groundwater modelling process. This was conducted in two forums, the first being twelve **GDC staff - Mana Whenua Model Trainings** (hui) which were hosted online over the course of the model development process (Figure 1). During each training session details of the environmental data being used and the way in which this information was being incorporated into the groundwater model were shared and discussed with GDC staff and Mana Whenua. During this process, Mana Whenua shared culturally and environmentally relevant insights on various waterbodies and landmarks of the Poverty Bay Flats. This information had a direct influence on the model's development, as well as the establishment of a series of qualitative cultural and environmental indicators for modelling scenario process. These GDC – Mana Whenua Trainings are discussed in detail in **Section 3.2**.

The other primary engagement process that GDC established for this project, was a series of **modelling workshops** to educate and inform the wider community on the Poverty Bay Flats groundwater system, the development of numerical model, and its capabilities. The first set of separate workshops was held in October 2021 with GDC Councilors, Mana Whenua – Treaty Partner representatives, and the wider Gisborne stakeholder community. During these workshops, a set of community questions were developed about the Poverty Bay Flats groundwater system. The questions were centered around the current and potential future management of this groundwater system as it related to climate change and human usage. These questions were used to form the basis for the numerical modelling predictive scenarios. These Exploratory Scenarios were used to compare the various single management change future states of this aquifers system. The results from these workshops are discussed further in **Section 3.3**.

After the Exploratory Scenarios were processed through the Poverty Bay Flats numerical model, a second set of workshops were held in April 2022 (see inset cover slide) to share the results of these Exploratory Scenarios. The two separate workshops were firstly a combined workshop for GDC councilors and Mana Whenua, and a second workshop for the wider Gisborne community. The results from these workshops are discussed further in **Section 3.4.**



3.2 GDC – MANA WHENUA TRAINING (HUI)

GDC commissioned WGA and AQUASOIL to build a numerical model but requested that GDC staff be upskilled on the modelling as the model was built. As the programme progressed, GDC also invited Mana Whenua to the training sessions. This was both to help inform the Treaty Partners Representatives on the groundwater model's inner workings as well as share the learnings that the model provides about how the Poverty Bay Flats groundwater system behaves scientifically. In turn, the technical modelling staff were able to learn from Mana Whenua about natural and cultural history of the area and incorporate some of this knowledge into a refined modelling process. In total there were twelve trainings that took place from May 2021 to June 2022 as summarised in Table 2.

As a means to attempt to try and capture the concept of 'cultural indicators' in the modelling process, a series of qualitative indicators were also developed for key water features. Whilst the cultural values of the Poverty Bay Flats are understood to be much more than simply groundwater levels and quality measures, the training – hui format provided a unique opportunity to combine scientific and cultural knowledge sources into a more representative modelling process. It is understood that this represents only a start of the partnership between GDC and Mana Whenua which is the focus on the co-governance and management model being pursued in the region.

3.3 COMMUNITY WORKSHOPS – INTRODUCTORY AND COMMUNITY QUESTIONS

3.3.1 Introduction

Three separate workshops were held in the GDC offices in late October 2021. The workshop focused on introducing the conceptual understandings of the Poverty Bay Flats groundwater system as well as how the numerical model was being constructed and used for water management decision making. The workshops also worked on gathering specific questions from the stakeholders that could then be addressed either with existing information or through running scenarios in the numerical groundwater model.

3.3.2 Predictive Scenario Development

During the workshops, the modelling team provided an overview of the process by which the model was being developed and the use of firstly Exploratory Scenarios and then subsequently Solutions Scenarios to help inform water management decision making (Figure 10). Whilst the Exploratory Scenarios are designed to ask specific standalone questions such as '*what happens if all the wells get turned off?*', the Solutions Scenarios would be used to combine various management options into a final suite of solutions which work to better manage the resource. This is an approach that is used in various regions throughout New Zealand when working to develop water management plans that include community consultation as part of the process. Environment Canterbury used a similar approach to numerical modelling and scenario development in its sub-regional Canterbury Water Management Strategy process (Bower, 2014).

Table 2: Community Engagement, Internal Workshops and Trainings

INTERNAL/ COMMUNITY WORKSHOPS AND TRAININGS (hui)	DATE(s)
Internal Workshop #1: Project start-up. Geologic modelling update, and data compilation summary. Attend scoping, trainings, workshops. Provide overview of GeoModeller (geological) / FEFLOW (groundwater) models.	26/05/2021
Training #1. Geological model draft structure, data input, cross sections and interpretation discussion.	15/6/2021
Training #2. Geological unit interpolation and interpretation process. Interpretation discussion.	7/7/2021
Training #3. Additional training for discussion on the geologic model as requested by GDC staff.	20/7/2021
Internal Workshop #2: Draft geological model handover with documentation, GDC peer review and discussions	13/08/2021 Workshop
Training #4. FEFLOW model mesh generation of Poverty Bay Flats area.	15/09/2021
Training #5.1. FEFLOW Models build and hydrogeological conceptualisation. Also work through review on the draft geological model in Geomodeller.	22/09/2021
Training #5.2. FEFLOW model parameterisation and set up.	06/10/2021
Training #6. FEFLOW Model Run training – using FEFLOW to run various management scenarios.	13/10/2021
Training #7. FEFLOW model calibration and validation results and discussion	10/11/2021
Community Workshop #1: Introduction of Geomodeller and FEFLOW Models, introduction on modelling scenarios, generation of community groundwater questions.	26 & 27 October 2021 at GDC
Internal Workshop #3: on initial FEFLOW numerical model calibration and validation outcomes. Changes required to facilitate climate change and community questions into scenarios.	24/11/2021
Training #8. FEFLOW - Allocation rate and effects and revised model update on calibration.	8/12/2021
Training #9. FEFLOW Results - Community exploratory scenarios generation in FEFLOW	2/3/2022
Training #10. FEFLOW - Incorporating water quality into model based on 1st conceptualisation of salinity and scenarios.	23/3/2022
Community Workshop #2: summary on FEFLOW model exploratory water quantity/quality scenario outcomes (1st Round Scenarios), draft report, and appendices for external review.	5, 6 and 7/4/2022 at GDC
Training #11. FEFLOW Scenarios: 2nd Round of Water Quantity and Quality Modelling Results from FEFLOW. Final combined training with Mana Whenua, and modelling training completion.	29/6/2022

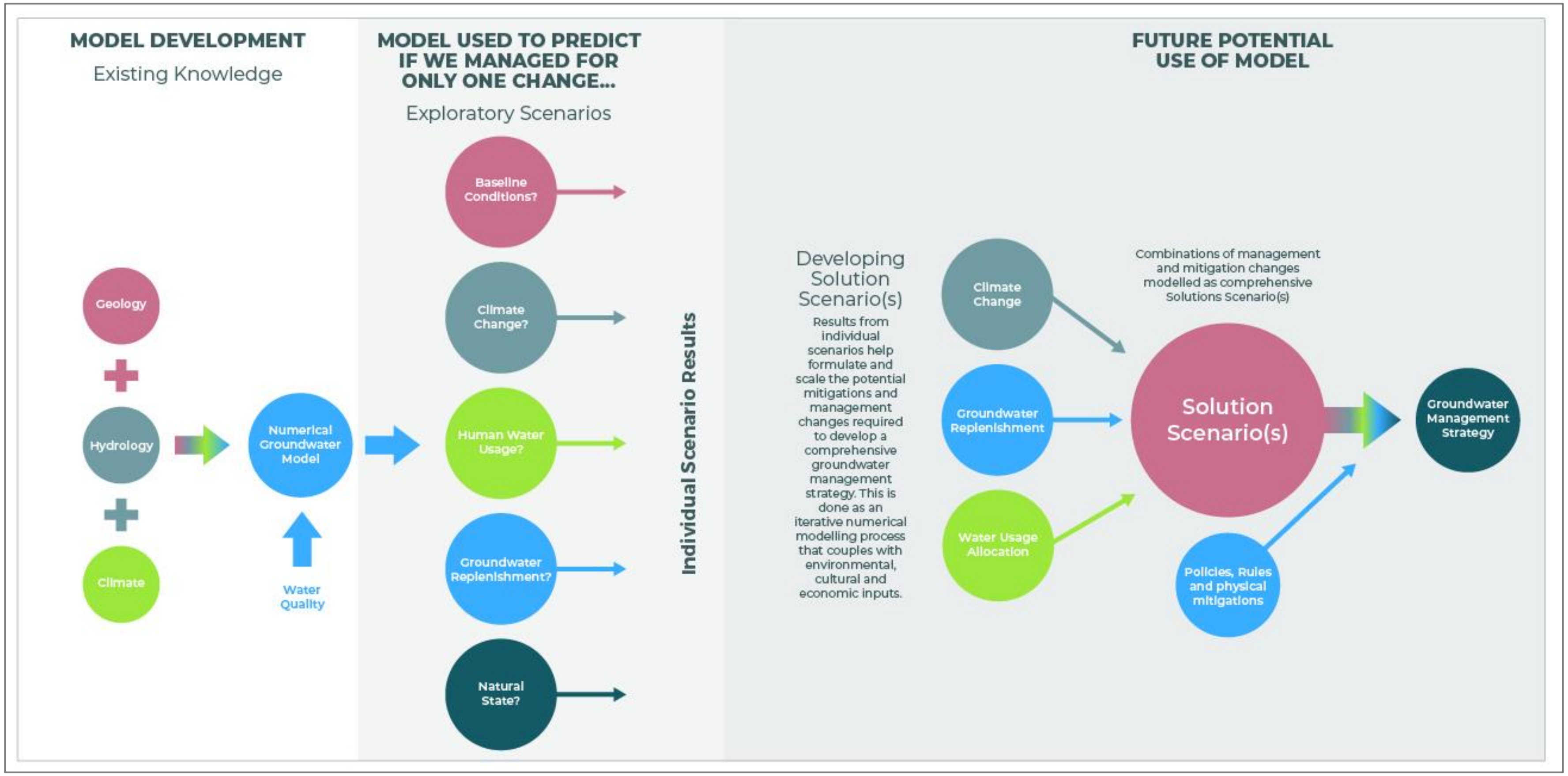


Figure 10: Poverty Bay Modelling Programme – Model and Scenario Development Steps

The general approach to using a model to develop water management plan is outlined in the following steps.

- From the basis of a fully functional numerical model with scenario capability, a set of Exploratory Scenarios based on community input are developed. The community engagement process helps to socialise the model, its capabilities and what it tells us about the behaviour of groundwater flow and quality. The community questions about the current state of the groundwater system and the various management options are compiled into numerical changes to the model inputs to best reflect changes to the physical environment and water management.

- The results from the round of Exploratory Scenarios helps to frame the overall groundwater management context and often used as 'bookend' type scenarios to define the boundaries of possibility for water management decisions. The results also inform the measurable changes to the groundwater system which are then used as part of an iterative process to refine and improve the scenarios as they are formulated for use in the model.

- Based on the learnings from the Exploratory Scenario process the development of potential changes in water management policies and the enabling of various physical mitigations, a combined suite of changes are developed into a round of Solution Scenario modelling. Consistent with the community engagement during the Exploratory Scenario process, an iterative process to fine tune the scaling and timing of the various mitigations are combined with other key factors like environmental, cultural, and economic values to work toward a final Solutions Scenario package. This final Solution Scenario forms the basis of a groundwater resource management plan leading into the regional planning process.

It is important to note that the Poverty Bay Flats groundwater modelling programme has completed the Exploratory Scenario stage of this process. Upon completion of this project, GDC will determine how best to proceed with the use of the numerical groundwater model platform and scenario results to develop regional water management goals.

3.3.3 Community Questions

GDC led the workshops to facilitate discussions predicated on having stakeholders scope their specific big picture questions about the Poverty Bay Flats groundwater system from a current, historical, or future state perspective. The questions were then consolidated into key themes from all three workshop groups and compiled in the questions presented in Table 3. It is important to note that there were great number of questions raised at the workshops that were not directly relevant to kinds of scenarios that could be generated using a regional groundwater model. Examples of these questions included changes in specific reach of rivers or specific spring flows, and questions on specific bores which were of interest to participants. Whilst these are all valid resource management questions, the ability to model some of these localised effects is beyond the design of the regional scale groundwater numerical model. The description of the modelling methodology used to represent the key questions shown in Table 3 is discussed in Section 3.5.

It is also important to note that there was a total of two rounds of Exploratory Scenarios generated for this final report (Table 3). The first round included a number of climate change scenarios (modelled separately) which were then combined and incorporated into the final climate modelling used. Water Quality in the form of salinity was also incorporated into the modelling capability along with the ability to provide qualitative results for the cultural indicators identified in the discussions with Mana Whenua. The 2nd round of Exploratory Scenarios represent the final outcomes of the scenario modelling process and what are presented in this report. Only one scenario scoped in the first round was not continued in the 2nd round (scenario 6.0) which had higher replenishment recharge volume.

The compiled final list of questions was transformed into specific changes to the numerical groundwater model and used to generate scenario results. As noted in Figure 10, each of the scenarios were "single issue" or 'book end' scenarios which provided a general sense of the boundaries of possibly for future management options. These Exploratory Scenarios were not considered in context to cultural, environmental, social and/or economic values but rather as numerical model possibilities.

Table 3: Community Groundwater Questions Leading to Exploratory Scenarios (1st and 2nd Rounds)

COMMUNITY QUESTIONS	1st Round SCENARIOS: NAME AND NUMBER	2nd Round SCENARIOS: NAME AND NUMBER	MODELLING ASSUMPTIONS -REPORT SECTION
What is the current status of the different aquifers? **Is there a decline in the aquifers?**	Baseline only (1.0)	Baseline only (1.1)	Section 3.6.1
What effect would extreme dry weather have?	Baseline + Climate Change (2.0)	Baseline + Climate Change (2.1)	Section 3.6.2
What effects would occur if Te Mana O Te Wai was placed above commercial groundwater use? **Would there be a change in wetland and spring persistence?** **Would there be a change in groundwater salinity?**	Natural State (3.0)	Natural State (3.1)	Section 3.6.3
What happens if current paper allocations are used to full entitlement?	2021 Current Paper Allocation (4.0)	2021 Current Paper Allocation (4.1)	Section 3.6.4
What effect would replenishment have on groundwater levels?	Groundwater Replenishment (MAR) – +600,000 m^3 recharge (5.0)	Groundwater Replenishment (MAR) - +600,000 m^3 up to +780,000 m^3 (5.1)	Section 3.6.5
	Groundwater Replenishment (MAR) – +1.2 Million m^3 recharge (6.0)	*Not modelled in 2nd round*	
What is a 'sustainable allocation rate'? **Can we understand aquifer recovery rates?**	Sustainable Allocation (7.0)	Sustainable Allocation (7.1)	Section 3.6.6

3.4 COMMUNITY WORKSHOPS – EXPLORATORY SCENARIO RESULTS AND DISCUSSIONS

Following the calibration and validation of the Poverty Bay Flats Groundwater Model, the community question based Exploratory Scenarios were run and the first round of results compiled into a summary workshop format. In April 2022, two workshops were hosted with GDC Councillors – Mana Whenua first and the wider community stakeholders in the second. The format of the workshop was to cover the results of these exploratory scenarios and discuss the general implications and next steps for the overall groundwater management strategy process. GDC and WGA staff co-presented the outputs and addressed a range of questions about the modelling.

Whilst some of the model-scenario outputs were easily quantifiable based on measured model outputs, a number of specific cultural and environmental indicators were more difficult to quantify. These indicators were determined to be best captured as **qualitative indicators** and measured as resulting in one of the following terms: '*generally improve'*, '*stay the same'*, or 'likely to *worsen*' relative to the baseline + climate change scenario (Scenario 2.1). The specific quantitative and qualitative model indicators are detailed fully in Section 4.

At the time of this workshop, only the water quantity aspect (e.g., levels and flows) was ready for use in scenario modelling. The conceptualisation and incorporation of the water quality (i.e., salinity) into the model required additional data and a variety of modelling changes in order to be ready to evaluate scenarios for changes in salinity. The first round of Exploratory Scenarios also tested three different 'climate change' scenarios based on NIWA climate modelling for the Gisborne area. A comparison of these climate scenarios helped refine and finalise the climate change settings for the FEFLOW model. Based on the quality modelling changes and final climate change scenario settings were then incorporated into a second round of Exploratory Scenario results which are presented in this report.

Following the April workshop, the numerical outcomes from the results led to the numerical modelling team refining and improving both the numerical model as well as the scenarios. In addition to changes to the model structure (e.g., coastal mesh refinement) and scenario input data, the water quality modelling component was added to the FEFLOW model. The results particularly brought into focus that a combination of the climate change drivers (e.g., rainfall recharge, extreme events, sea level rise and increased water demands) should all be encompassed into the scenario modelling process. The specific question around the degree of salinity effect in coastal areas with the anticipated sea level rise was identified as both culturally and environmentally valuable to better understand.

Section 4 provides a detailed summary of the community based Exploratory Scenarios as part of the completion of this stage of the groundwater modelling programme. These results have not yet been presented in a community workshop format.

3.5 EXPLORATORY SCENARIO MODELLING ASSUMPTIONS

The development of the Exploratory Scenarios based on the community questions required a combination of changing the input parameters to the model as well as understanding what climate change related issues may influence future groundwater management decisions. As outlined in the previous sections as well as is highlighted in Table 2, the Exploratory Scenarios were founded on community workshop questions. WGA and AQUASOIL worked collaboratively with GDC guidance on determining how the scenarios would be set up and run through the model period.

There are few key guidance notes on the scenario designs:

- Incorporating climate change predictions in the model was completed based on climate modelling done by NIWA for the Gisborne Regional area. The numerical groundwater model provides projections out to 2090 as it models long term changes in climate and sea levels. All scenario runs were modelled out to the end of this period and were presented in the first workshop.
- The Exploratory Scenarios focus on results for the shorter-term timeframes as set out by GDC for the following dates: 2025, 2035, and 2045. This is based on GDC district council's 10-year regional planning cycle and are required to be completed under the Resource Management Act. The current regional plan covers up to 2024, with a new regional plan being developed in 2023 and 2024 that will cover the period from 2025 to 2035.
- The Poverty Bay Flats Groundwater model provides results for all the aquifers in this groundwater system, but for the purpose of sharing the most relevant, WGA has generally focused on the Makauri Aquifer, Shallow Fluviatile and Te Hapara Sand aquifers. The Makauri Aquifer has the vast majority of the groundwater abstraction whilst the two shallower aquifers have a direct link to surface waterbodies including the coast, rivers, streams, and wetlands of Poverty Bay Flats.

The following sections cover the methodology and rationale behind each of the scenarios. A more technical summary of the specific inputs to the scenario modelling can be found in Appendix B.

3.5.1 Baseline Conditions

The two primary community questions relative to the baseline and/or current conditions of the groundwater system were:

- **What is the current status of the different aquifers?**
- **Is there a water level decline in the aquifers?**

The answers to these questions can be generated both from an analytical summary of the existing historical data, as well as through running a simulated baseline groundwater scenario into the future (2090).

As part of the groundwater modelling programme, WGA conducted analytical review of the available data for the various aquifers in order to help answer this question for the workshop. A review of the groundwater levels in the Makauri Aquifer, which has the vast majority of groundwater usage, indicates that both summer pumped groundwater levels as well recovered winter peak levels are declining (Figure 11). Current allocation used in this scenario was modelled at 1,188,000 m^3/year combined from all five aquifers. The data also shows that droughts are becoming more difficult for the groundwater levels to recover from (Figure 11– Points A, B, C). As the frequency and severity of droughts are predicated to worsen, it will take longer for the Makauri Aquifer to recover.

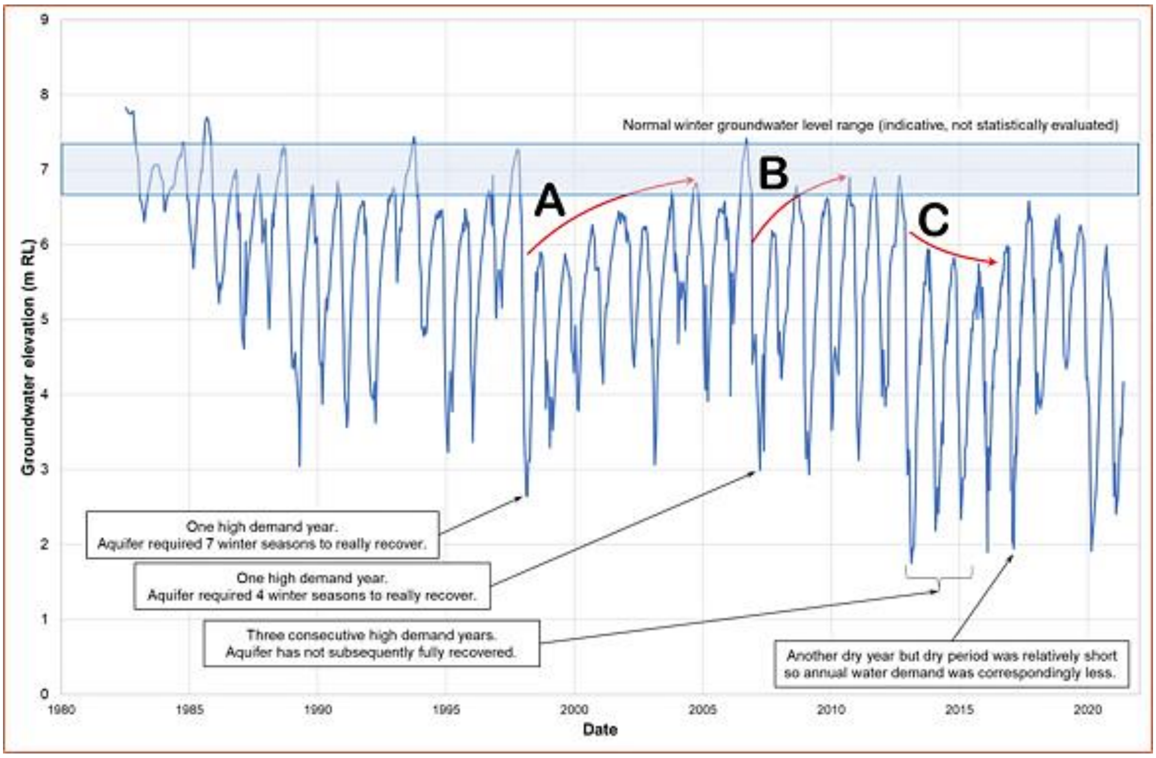


Figure 11: Historical Trends in Makauri Aquifer Indicating Declining Levels and Drought Recovery Issues (Bore GPJ040)

The Te Hapara Sand Aquifer is a coastal aquifer (bounded by the coastline) and is directly interactive with surface waterbodies including some key cultural and environmental wetland areas. Groundwater level data from a GDC monitoring bore in the Te Hapara Sand Aquifer shows similar responses to droughts periods with groundwater levels falling below mean sea level at times (Figure 13). Similarly, WGA's review of groundwater level trends in the Matokitoki Aquifer indicates potential declines in water level as shown in (Figure 13). The downward trends are consistent with GDC groundwater reports and regional planning changes which have been designed to help to resolve the groundwater abstraction pressure. The ASTR MAR pilot site has been in operation since 2017, and therefore MAR is a mitigation option being explored further during the groundwater numerical modelling process.

As the Poverty Bay Flats FEFLOW model was calibrated, validated, and set up to mimic the current aquifer conditions, it provides a baseline scenario.

Table 4 provides an overview of the FEFLOW modelling settings for the baseline condition including current metered usage, and current or actual levels of rainfall recharge rate and groundwater demand. These parameters are changed for each of the scenarios in order to evaluate the community questions through the Exploratory Scenario modelling process. Current seasonal usage based on metered takes were used in combination current climate conditions. The technical results from this scenario are presented and discussed in Section 5.

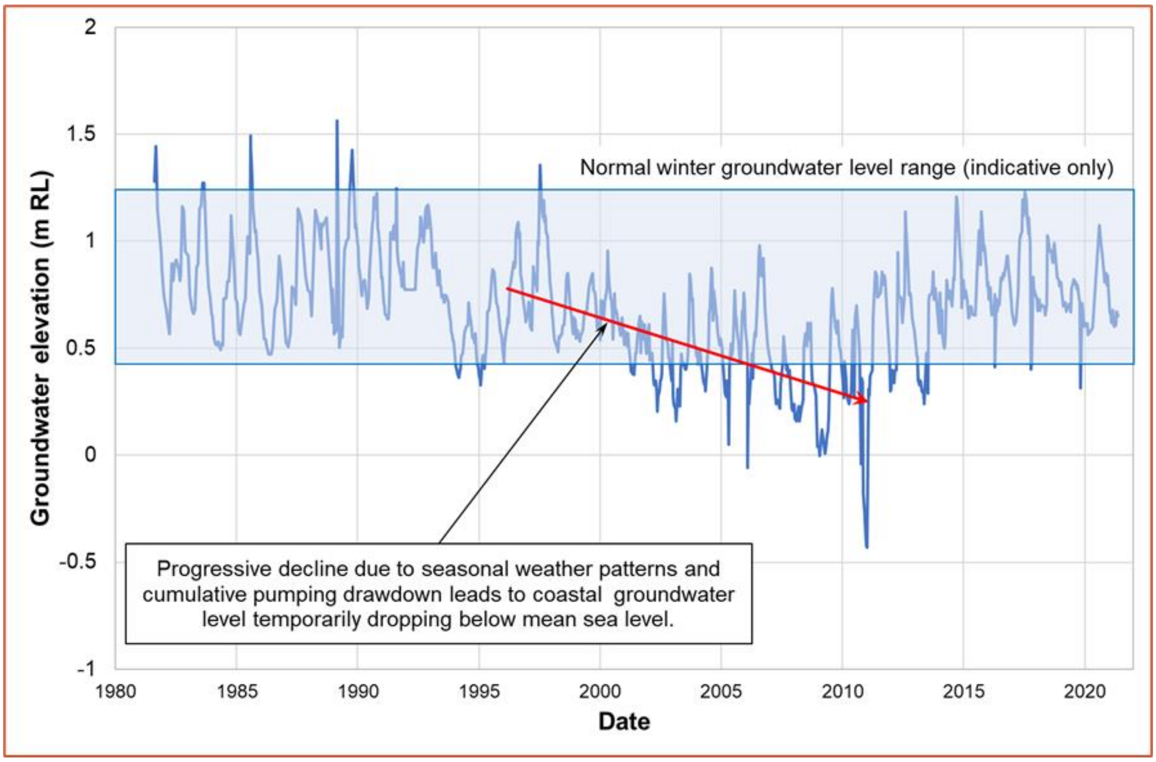


Figure 12: Te Hapara Sand Aquifer Analysis of Longer-Term Historical Data Trends (GPA003)

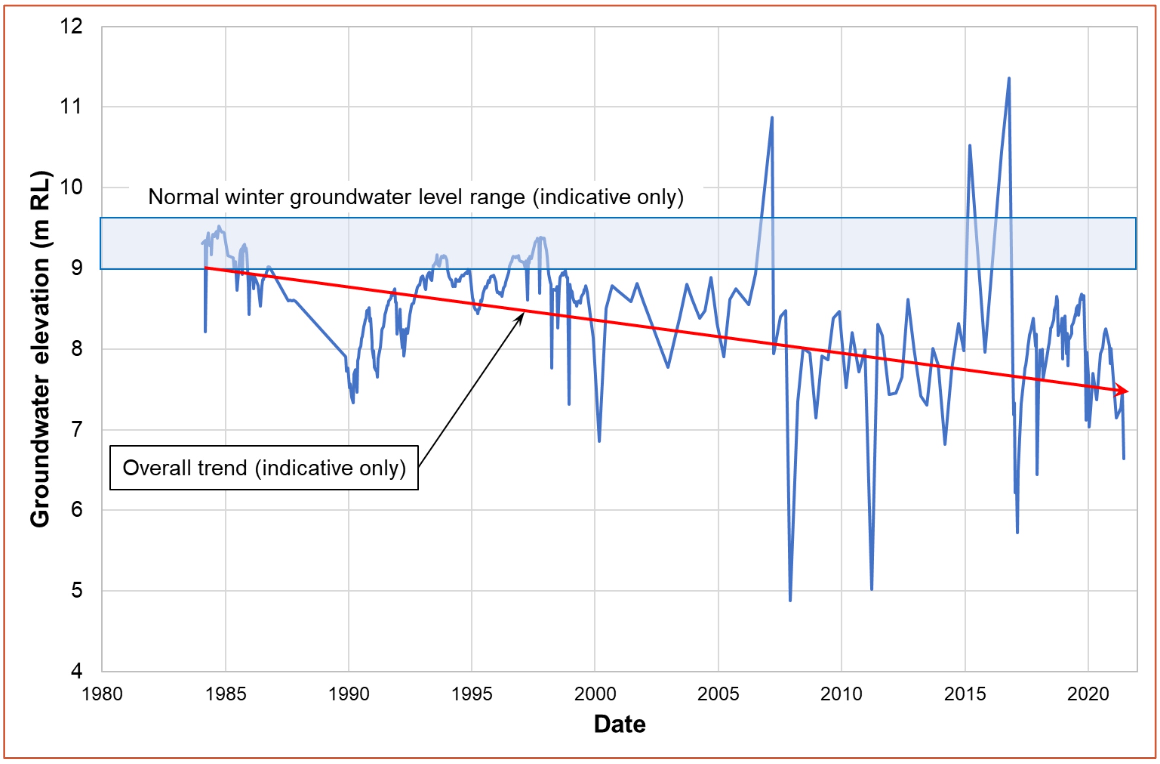


Figure 13: Analytical Assessment of Historical Trends in Matokitoki Aquifer (GPB102)

Table 4: Baseline Scenario Model Settings (Scenario 1.0)

SCENARIO NAME (#)	DESCRIPTION	CLIMATE CHANGE	METERED CURRENT USAGE	2021 PAPER ALLOCATION	MANAGED GROUNDWATER REPLENISHMENT
Baseline (1)	Current seasonal metered usage, no MAR, no climate change	Yes	Yes (1)	No	No

Note: 1) - **Metered Usage (- m³/year)** - Usage by aquifer Makauri @ 847,000 m³, Matokitoki @ 62,000 m³, Te Hapara Sands @ 103,000 m³, Waipaoa Gravel @ 69,000 m³, and Shallow Fluviatile @ 107,000 m³. Data sourced from GDC metered usage data.

3.5.2 Baseline + Climate Change Scenario

As climate change influences projections of the future baseline (current management) scenario, the community workshop question around climate change were amalgamated into two general questions:

- **How is climate change including extreme dry weather (droughts) expected to impact groundwater?**

For New Zealand's coastal communities, climate change impacts are important to consider for developing sustainable management strategies for groundwater resources. The primary drivers of hydrologic change under climate change include decreasing amounts of natural groundwater recharge directly related to changing rainfall patterns as well as flow in surface waterbodies (Figure 14). Increasing soil temperatures directly relate to increased soil moisture deficits resulting in additional water being required to irrigate the same crop yields. This in turn drives up the water demands resulting in increased groundwater pumping. These are compounded further when droughts are longer and drier as the frequency and duration of extreme weather events increase. For coastal aquifer systems increasing sea level rise coupled with storm surges will work to put additional pressures on freshwater aquifer supplies both in the shallow and deeper aquifers. Saline intrusion related to increased and prolonged groundwater pumping has been shown globally to be a challenging issue for coastal communities.

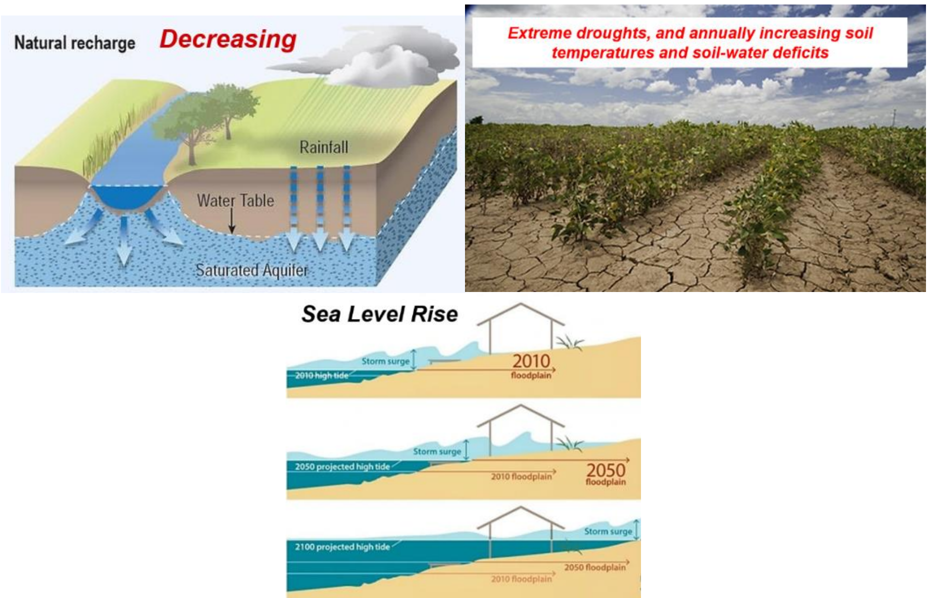


Figure 14: Examples of Climate Change Drivers Influencing Coastal Groundwater Systems

For the Poverty Bay Flats an important factor is that climate change will have implications that mean that the 'current' conditions will change even while maintaining the current irrigation area. WGA notes that that when planning for the future sustainable management, climate change should be factored in so as to develop the polices, rules and mitigations that work to adjust to these issues. For the purposes of adding the effects of climate change to our current or baseline scenario for this modelling programme, WGA worked with GDC staff to develop a set of climate change drivers that were incorporated into the modelling process. This was done through the two rounds of scenario modelling in order to arrive on the baseline + climate change scenario presented in this report in Section 3.5.

3.5.2.1 Technical Foundations for Climate Change Model Drivers

During the first round of Exploratory Scenarios, three different climate change scenarios were modelled to provide a sense of how the aquifer conditions changed. Information used for these scenarios was based on a combination of GDC database information as well as several NIWA technical reports. The assessments of historical drought events in the Gisborne area (NIWA 2013) were coupled with NIWA national report on coastal hazards as they relate to climate change to provide the reference information required. The primary climate related information was drawn from NIWA (2020) which provided water resource specific impacts for the Gisborne/Tairawhiti area. The NIWA climate change modelling report refers to a number of possible modelled climate change predictions relative to certain input parameters with the nomenclature of RCP 4.5 and RCP 8.5 (NIWA, 2020). RCP 4.5 represents a more conservative prediction (less change) than does the RCP 8.5 predictions (highest level of change).

WGA notes that GDC prepared a technical memorandum on the climate change decision making process which is included in Appendix B of this document.

During the first round of scenarios, three climate scenarios were developed to test the influence of three ranges of climate effects. These trial testing climate scenarios were as follows:

a) **Baseline + Climate Change (RCP 4.5):** Only rainfall was reduced due to climate change (NIWA 2020, RCP4.5). This influenced the natural groundwater recharge and was incorporated into every first-round scenario.
b) **Baseline + Climate Change (RCP 8.5):** A second round of baseline + climate change was modelled based on the more intensive predictions for rainfall and changes in natural recharge.
c) **Baseline + Extreme Events (RCP 8.5 + Droughts):** This scenario incorporated extreme drought events based on direct examples from GDC historical database into the model. These events were combined with baseline usage and added the more severe of the climate change predictions (NIWA 2020, RCP 8.5) for changes in rainfall, and increased irrigation demands from soil temperatures and moisture deficits.

Sea level rise was also incorporated into the overall FEFLOW modelling process, but not on a scenario comparison basis. Sea level rise was included by changing ocean boundary conditions as the model ran from 2022 to 2090. The amount of rise incorporated is documented in Section 3.5.2.5.

All of these first-round models were evaluated to the full extent of the NIWA predictive modelling timeline (current to 2090). The following sections provide an overview of the settings for the various climate related groundwater model inputs.

3.5.2.2 Changes in Rainfall (NIWA, 2020)

Changes in rainfall related to climate change were evaluated in all three of the first-round climate scenarios. The rainfall changes are sourced from the NIWA (2020) climate change report for Tairawhiti. The percentage decreases in rainfall were chosen by GDC for both RCP 4.5 and RCP 8.5. The projected rainfall changes from NIWA (2020) are as follows:

RCP 4.5

- Decrease of <5 % of actual until 2040 (RCP4.5)
- Decrease Summer 5-15% of actual until 2040 (RCP4.5)
- Decrease Spring and Summer 5-15% of actual 2040-2090 (RCP4.5)

RCP 8.5

- Decrease <10 % of actual until 2040 (RCP8.5)
- Decrease Spring and Summer 5-15% of actual until 2040 (RCP8.5)
- Decrease 5-15 % of actual 2040-2090 (RCP8.5)

For the purpose of setting a specific step change value for the FEFLOW scenario modelling, AQUASOIL assumed the upper limits for each of these RCP ranges of:

- **RCP 4.5** = -5% in 2040, -15% in Sept in 2090
- **RCP 8.5** = -10% in 2040, -15% in Sept 2040 and -15% in 2040-2090.

3.5.2.3 Extreme Weather - Droughts

Climate change is expected to increase the severity and frequency of severe weather events including flooding events and extended droughts. It was decided as part of modelling process, that increased severity of droughts would not be implicitly modelled as it would mostly likely mean changes in rainfall and/or river recharge which is difficult to simulate in a regional context. However, the predicted increased severity and frequency of droughts were incorporated into the Baseline + Extreme Events scenario.

The Baseline + Extreme Events scenario is based on GDC historical drought information as well as a drought report done by NIWA (2013) for the Gisborne area. A review of the GDC historical drought information indicates that two droughts were of recent mention, the El Nino period of 1997 -1998 was one of the highest on records, whilst the more recent 2012 – 2013 drought was ranked 5th most severe since 1940. A review of the data indicates that the frequency of droughts appears on average about every 7 years, however for the purposes of numerical testing the effects of these droughts in the scenario process, it was determined that three individual drought periods would be simulated. This was done by using a ratio of the measured increased abstractions (GDC metered flow data) from the recorded drought event in 2012-2015 and applying it as a three-year drought period occurring from 2035-2038, 2050-2053 and 2070-2073. For more information on these extreme droughts and the scenario modelling see Section 4 in the AQUASOIL (2022) report. The inclusion of droughts based on the NIWA reports and historical records is discussed in more detail in Appendix B.

3.5.2.4 Increased Water Demands (PED)

Determining how to model climate related increases in water demand required the use of the readily available estimates of changes in Potential Evaporative Demand (PED) predictions from the NIWA climate modelling report (2020). The use of PED as a surrogate for water demands for irrigation was determined in part due to the FEFLOW model's inability to capture PED from a surface water exchange. The relationship between PED and usage was determined by applying the relative percentage difference in climate change increases in PED (mm/year) against the total annual metered groundwater usage, resulting in a proportionate increase in groundwater usage related to climate change (Figure 15).

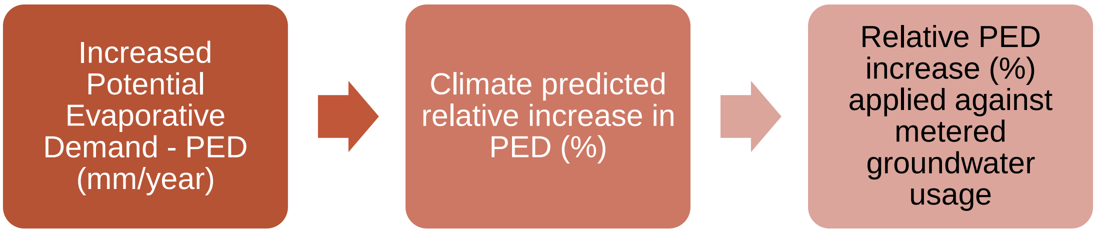


Figure 15: Relationship Applied to Utilise Climate Predictions for Changes in PED to Changes in Irrigation Demands

Changes in groundwater usage (as PED) were chosen by GDC staff for both RCP 4.5 and RCP 8.5 as follows:

For **RCP 4.5** scenarios GDC worked back in 15-year increments from 2090 for the 42% increase and used a linear relationship to fill in the previous years.

- Average (2008-2021) Takes to increase:
- 5% in 2030
- 15% at 2045
- 24% at 2060
- 33% at 2090

For **RCP 8.5** scenarios NIWA provided two sets of incremental changes which for the purpose of these scenarios GDC assumed a median value be applied.

- Average (2008- 2021) Takes to increase:
- 21% in 2030
- 42% at 2040
- 53% at 2065 to 2090

For more information on these extreme droughts and the scenario modelling see Section 4 in AQUASOIL (2022) report.

3.5.2.5 Sea Level Rise

Coastal New Zealand is expected to experience changes in sea level rise, increasing severity of storm surges, and a range of other factors. For the purposes of a numerical groundwater model, only sea level rise could be incorporated into the scenario development process.

Sea level rise was also included in the climate scenario changes based on information from two sources. The progressive scenario information for all of New Zealand from NIWA (2017, Table 10) and more specifically from the for RCP 4.5 and RCP 8.5 model predictions provided in NIWA (2020) which are only considered marginally different. For the purposes of the FEFLOW scenario modelling the sea level rises were as follows:

For **RCP 4.5,** a total incremental sea level rises of 0.41 m from 2020 to 2090, with step increases every decade (2030, 2040, 2050, etc).

For **RCP 8.5** a total incremental sea level rise of 0.58 m from current to 2090, with step increases every decade (2030, 2040, 2050, etc).

For more information on these extreme droughts and the scenario modelling see Section 4 in the AQUASOIL (2022) report.

3.5.2.6 Second Round Exploratory Climate Model Settings

The Exploratory Scenario testing of several climate change settings allowed the modelling team the opportunity to evaluate how the model responded to a range of climate predictions. As climate change was to be embedded in all final Exploratory Scenarios, it was important to select a combination that was suited to the goals of testing the model capabilities as well as provide a preliminary answer to the questions posed by the community. Appendix B provides an overview of GDC's decision-making process around selecting the most appropriate climate change scenario inputs, as well as the logic behind the final decisions made to progress to the final climate change settings used in this reports scenario's results.

Generally, the decision was made to use the more conservative NIWA predicted model settings (RCP 4.5) for changes in rainfall, increases in water usage and changes in sea level rise. Extreme weather events droughts based on historic GDC data was also added to the final Baseline + Climate Change scenario. After the results from the three first round climate scenarios were completed, the modelling team finalise the climate scenario settings as follows:

Rainfall Recharge Rates[6] - Decrease <5 % of actual until 2040 (RCP4.5), Decrease Summer 5-15% of actual until 2040 (RCP4.5), and Decrease Spring and Summer 5-15% of actual 2040-2090 (RCP4.5).

Potential Evaporation Demand (PED)[7] - PED to increase +125 mm. Utilised mid-range of NIWA prediction, +100-150 mm until 2090. RCP 4.5). The modelling team utilised PED as a surrogate to represent increases in groundwater usage. Increasing soil temperatures and soil moisture deficits are assumed to result in increasing water demands. Relative PED changes converted to increased groundwater takes to increase: 5% at 2030, 15% at 2045, 24% at 2060, 33% at 2075, 42% at 2090.

Droughts – Actual observed 3 Year drought periods from historical Poverty Bay Flats records from 2013, 2014, 2015 replicated generally in their severity and longevity. Applied to model years 2036, 2051, and 2071. Data sourced from GDC groundwater and climate data.

Sea Level Rise[8] **-** Applied projected sea level rise from NIWA scenario RCP4.5 (mid-range). Table 10 of NIWA (2020) indicating; +0.13m by 2030, +0.19m by 2040, +0.24m by 2050, +0.30m by 2060, +0.36m by 2070, +042m by 2080, and +0.49m by 2090.

Table 5: Baseline + Climate Change Scenario Model Settings (Scenario 2.1)

SCENARIO NAME (#)	DESCRIPTION	CLIMATE CHANGE	METERED CURRENT USAGE	2021 PAPER ALLOCATION	MANAGED GROUNDWATER REPLENISHMENT
Baseline + Climate Change (2.1)	Current seasonal metered usage, baseline conditions with Climate Change	**Yes**	**Yes 1,188,000 m^3/year**	No	No

[6] Section 5.1 NIWA 2020
[7] Section 6.1 NIWA 2020
[8] Table 10 of NIWA 2020

3.5.3 Natural State

As part of the community workshops there was specific interest in understanding how the Poverty Bay Flats groundwater system may respond if the influence of groundwater abstraction (usage) was removed. The specific questions that led to the Natural State scenario from the community were as follows:

- **What effects would occur if Te Mana O Te Wai was placed above commercial groundwater use?**
- **Would there be a change in wetland and spring persistence?**
- **Would there be a change in groundwater salinity?**

This Natural State scenario was reasonably easy to simulate in the model, which simply required that all simulated groundwater abstraction was ceased from 2020 to 2090. Of course, the scenario still has the imbedded human-caused influence of climate change which will continue to influence and change all of New Zealand's freshwater systems. In the context of climate change, perhaps 'natural state' is better described as 'no abstraction' which has other social and economic implications which will be covered in the results section (Section 4.5.4). For more information on the modelling settings for Natural State scenario modelling see Section 4 in the AQUASOIL (2022) report.

Table 6: Natural State Scenario Model Parameters (Scenario 3.1)

SCENARIO NAME (#)	DESCRIPTION	CLIMATE CHANGE	METERED CURRENT USAGE	2021 PAPER ALLOCATION	MANAGED GROUNDWATER REPLENISHMENT
Natural State (3.1)	All irrigation pumps cease to operate	Yes	**No** (1)	No	No

Note: 1) 2021 Consented Paper Allocation (- m^3/year) - Usage turned off to 0 meters/year for all aquifers. Permitted activity wells (unmetered) for drinking and stock not included in this scenario, all assumed to still be pumping.

3.5.4 2021 Paper Allocation Usage

The primary community questions relative to the effects of currently consented groundwater allocation are:

- **What happens if current paper allocations are used to full entitlement?**
- **Can we understand aquifer recovery rates?**

This scenario provides a view of the potentially extreme situation where the maximum amount of groundwater abstraction is withdrawn every year between 2020 and 2090. GDC reported paper allocation for all five aquifers is 3,980,908 m^3/year. The additional pressures placed on the aquifer from climate change are also imbedded in this scenario. This would mean an increase of metered abstraction of between 100% and 555% when compared to the baseline current usage.

The modelling team understood that this is not a realistic scenario in the sense of actual water demands in a year-to-year basis. However, the scenario provides a test of the bookend or extreme boundary value from which to evaluate how the aquifer system would respond to heavy pumping pressures. Table 7 provides a summary of the modelling settings for this scenario.

Table 7: 2021 Paper Allocation Scenario Modelling Settings (Scenario 4.1)

SCENARIO NAME (#)	DESCRIPTION	CLIMATE CHANGE	METERED CURRENT USAGE	2021 PAPER ALLOCATION	MANAGED GROUNDWATER REPLENISHMENT
2021 Paper Allocation Limit (4.1)	All groundwater consents are utilised representing total consent allocation	**Yes**	No	**Yes (1)** **3,980,908 m³/year**	No

Note: 1) 2021 Consented Paper Allocation (- m³/year) - Usage increased to full paper allocation for each aquifer. Usage by aquifer Makauri @ 1,906,362 m³, Matokitoki @ 343,900 m³, Te Hapara Sands @ 613,346 m³, Waipaoa Gravel @ 535,440 m³*, Shallow Fluviatile @ 581,860 m³*. Data sourced from GDC Consents. * *Based on annual paper allocation of individual bores*.

3.5.5 Groundwater Replenishment (MAR)

From the community workshops there was a general interest in understanding role groundwater replenishment could play as a mitigation in increase recharge to groundwater system. Given that GDC initiated the first ASTR bore in New Zealand and has successfully conducted a MAR trial since 2017, the information required for this scenario was readily available for the modelling process.

This general interest area was formulated into the question:

- **What effect would replenishment have on groundwater levels?**

Similar to other scenarios, the first round of groundwater replenishment scenarios helped to better define application of recharge through a combination of recharge scenarios. The simulation of six aquifer recharge bores was provided by GDC based an assessment of potential locations that were assessed during the GDC-Kaiaponi ASTR MAR trial.

The two first round scenarios were set up as follows:

- **Replenishment Scenario 1** – six bore locations targeting the Makauri Aquifer, recharge occurring during summer season, a total of 600,000 m³ recharged annually (Scenario 5.0 and 5.1).

- **Replenishment Scenario 2** – six bore locations targeting the Makauri Aquifer, recharge occurring during summer season, a total of 1,200,000 m³ recharged annually (Scenario 6.0).

All of the recharge scenarios are designed to directly relate to the quantity of water being abstracted from the Makauri Aquifer. The use of recharge sites to help manage the **salinity issues** in the aquifer had not been a topic of discussions with Mana Whenua and the October 2021 community meetings. Whilst not being part of the community processes, the concern around the effects and management of salinity was clear from the community.

The final scenario modelled used the results from those initial MAR model scenarios as follows:

Final Replenishment (2nd Round) Scenario – six bore locations targeting the Makauri Aquifer, recharge occurring during summer season, a starting recharge rate of 600,000 m³ recharged annually is increased in a stepwise process (to response to groundwater usage driven by climate change) up to an annual recharge rate of 798,000 m³ annually by 2090.

Table 8 provides the FEFLOW numerical modelling changes used to generate this scenario. Specific technical information on the results from this scenario is detailed in the results section (Section 4.5.6). For more information on the modelling settings for Sustainable Allocation scenario modelling see Section 4 in the AQUASOIL (2022) report.

WGA notes here that these two scenarios represented numerical scenario 5.0 and 6.0 in the first round of modelling. Replenishment Scenario 2 was evaluated during the first round of scenarios but not included in the second round leading to the removal of scenario 6 from the scenario numbering process.

Table 8: Groundwater Replenishment (MAR) Scenario Modelling Parameters (Scenario 5.1)

SCENARIO NAME (#)	DESCRIPTION	CLIMATE CHANGE	METERED CURRENT USAGE	2021 PAPER ALLOCATION	MANAGED GROUNDWATER REPLENISHMENT
MAR (5.1)	Managed Aquifer Recharge applied, increased in response to climate change pressures on demand	**Yes**	**Yes** **1,188,000 m^3/year**	No	**Yes (1)** **600,000 m^3/year increasing to 780,000 m^3/year**

Note: 1) Managed Aquifer Recharge (MAR) targeting only Makauri Aquifer starting at 600,000 m^3/year increasing up to 847,000 m^3/year to offset the increasing pumping demands from climate change. Increase recharge relative to climate change water use demands (PED, RCP 4.5): 5% at 2030, 15% at 2045, 24% at 2060, 33% at 2075, 42% at 2090. Recharge values based on MAR trial results.

3.5.6 Sustainable Allocation

From the community workshops there was a general interest in understanding what long term abstraction rates might result in a *sustainable* groundwater system. This general interest area was formulated into the question:

- **What is a 'sustainable' allocation rate of usage for the Poverty Bay Flats aquifers?**

At first glance, using the term 'sustainable' appears to be a reasonable approach to describe managing a resource to some abstraction limit that does not cause any long-term degradation of the resource. However, the term 'sustainable' in the context of the wide range of issues that could be encompassed within the concept of sustainability is problematic. Even more difficult is to determine what indicators could be used to measure 'sustainability'. For example, what is a sustainable allocation rate with background implications of the numerous pressures applied from ongoing climate change? The technical team decided that it was important to clearly define the use of 'sustainable' in the context of this this Exploratory Scenario modelling process which is as follows:

'Sustainable Allocation *is used in the context of this modelling as description text for a particular Exploratory Scenario. This scenario is intended on starting the process to establish a sustainable annual allocation abstraction volume which will decrease current human usage until measured declines in the aquifer potentials are stabilised. As with all the scenarios, this includes the modelled effects of climate change. However, we recognise that the concept of sustainability is measured well beyond just the issue of groundwater potentials and a range of other factors including economics, water quality, cultural values, and groundwater dependent ecosystems all would need to be considered in a full assessment of sustainable groundwater usage.'*

WGA also notes that as all of the Exploratory Scenarios are single resource management changes that are typically only used to provide a reference to evaluate the range of potential groundwater management options relative to changes seen in the modelling. Given that climate change will make 'sustainability' a challenge for all natural freshwater systems, future combinations of policies, rules and mitigations are likely how a well-defined sustainable groundwater allocation level can be achieved.

For the purposes of this modelling project, a simplified numerical definition of sustainability has been used as a guide for the iterative evaluation of a sustainable allocation. The amount of annual groundwater abstraction is reduced to the point whereby groundwater levels do not drop below the current levels (Scenario 2.1) in late summer through to 2050. This Scenario does not specifically seek to maintain current groundwater levels in late winter, following seasonal groundwater level recoveries. Additionally, different aquifers respond to changes in abstraction in different ways. As the percentage changes in abstraction rates are applied equally to all production bores simulated in the model, the results vary on an aquifer-by-aquifer basis when compared to the Scenario objectives. Therefore, the main focus for Scenario 7.1 was to manage groundwater pressures in the Makauri Aquifer, which is the target for the largest groundwater abstractions.

Table 9 provides the FEFLOW numerical modelling changes used to generate this scenario. Specific technical information on the results is provided in Section 4.5.7. For more information on the modelling settings for Sustainable Allocation scenario modelling see Section 4 in the AQUASOIL (2022) report.

Table 9: Sustainable Allocation Scenario Model Parameters (Scenario 7.1)

SCENARIO NAME (#)	DESCRIPTION	CLIMATE CHANGE	METERED CURRENT USAGE	2021 PAPER ALLOCATION	MANAGED GROUNDWATER REPLENISHMENT
Sustainable Allocation (7.1)	Iterative modelling to determine rate of water usage (abstraction) where groundwater levels stablise.	**Yes**	**Variable Rates (1)**	No	No

Note: 1) See Section 4.5.7.

3.6 WATER QUALITY SCENARIOS - SALINITY

As water quality was built into the model after the community scenarios on groundwater quantity were established, salinity modelling was discussed generally during the community Exploratory Scenario process, but the modelling capability was not established after those workshops. The modelling of salinity, specifically chloride, required two rounds of conceptualisation and model simulation testing before it was ready for use in the final round of Exploratory Scenarios, the second-round results are shared in this report. Fundamentally information provided to conduct this modelling was limited and GDC is working toward gathering more field information to help understand this quality issues. This has resulted in the quality modelling focusing mainly on a qualitative comparison of results between scenarios. WGA (2022b) provides a technical summary of the various model inputs and conceptual understandings that were used for the scenario modelling. These qualitative results and discussion of the salinity modelling is included in Section 4. A further discussion of risks and recommendations around salinity and water quality more generally are discussed in Section 5.

4 EXPLORATORY SCENARIOS - RESULTS AND DISCUSSION

4.1 OVERVIEW

This Section provides an overview of the Exploratory Scenario outcomes including a summary of the quantitative and qualitative outputs as well as the individual scenario results with discussion. The results in this section with the exception of the Climate Change Scenarios represent the second (refined) Round of FEFLOW model simulation outputs. The results from the first round presented at the April 2022 community workshops are provided in the Appendices of the AQUASOIL (2022) modelling report.

4.2 INDICATORS OF MODELLED EFFECTS

The numerical model generates wide range of simulation results. These results include text files documenting:

- Water flow budgets for the Poverty Bay Aquifers
- Water budgets for the consented production bores within the modelled area.
- Water budgets for the Waipaoa River and each of the simulated drains within the modelled area.
- Groundwater level hydrographs at all GDC monitoring wells, not only for the aquifer monitored by the well but also for any underlying and overlying aquifers.
- Chloride concentrations over time for all GDC groundwater quality monitoring wells.
- Chloride concentrations over time for a series virtual groundwater quality monitoring wells aligned in transects close to the coastline.
- Chloride mass loads for the Waipaoa River and each of the simulated drains within the modelled area.

The model results also include maps documenting:

- Groundwater levels for each aquifer at a series of times through the model run.
- Changes in groundwater level for each aquifer compared to the baseline scenario at a series of times through the model run.
- Changes in chloride concentration for each aquifer compared to the baseline scenario at a series of times through the model run.

The volume and complexity of the model outputs is very large. Therefore, it has been necessary to define a set of indicators to enable a clear and defensible comparative evaluation of model results from the various scenarios simulated. These indicators are in two forms:

- Quantitative indicators that are supported by graphs or maps showing projected outcomes (Section 4.3).
- Qualitative indicators that represent broader quality, environmental, cultural, and social outcomes (Section 4.4).

The quantitative and qualitative indicators should be considered together when assessing the simulated effects arising from the various modelled scenarios.

4.3 QUANTITATIVE INDICATORS

4.3.1 Hydraulic Head Changes

Through discussions between GDC and WGA, a set of existing groundwater level monitoring wells has been chosen as providing appropriate monitoring points to evaluate the simulated behaviour of the Poverty Bay Flats aquifers. For the Te Hapara Sand Aquifer, five monitoring wells have been chosen reflecting the range of concerns and areas sensitive to the effects of climate change and future groundwater abstraction (Table 10). In contrast, the simulated effects on the confined Waipaoa, Makauri and Matokitoki aquifers are each considered to be adequately represented by the simulated hydrographs from single monitoring wells (Table 10).

Table 10. Groundwater Model Quantitative Monitored Bores

AQUIFER	MONITORED WELL	LINKED SURFACE FEATURE
Te Hapara Sand	GPA003	Te Waiohiharore
	GPB099	Taruheru Stream
	GPC029	Te Maungarongo o Te Kooti Rikirangi Wetland
	GPC080	Awapuni Moana Drains, Waipaoa River
	GPC094	Awapuni Moana Drains
	GPI007	Waipaoa River
Shallow Fluviatile Gravel	GPF068	Waipaoa River
Waipaoa	GPE040	Indirect to Waipaoa River
Makauri	GPJ040	N/A
Matokitoki	GPB102	N/A

The representative monitoring wells have been chosen because they each have a long monitoring history and none of these wells are located close to major water production bores. The hydrographs for these representative wells should not be overly influenced by nearby simulated pumping operations. Consequently, the simulated hydrographs are considered to reasonably represent the effects of climate change and changes to groundwater management regimes for the aquifers as a whole. The simulated effects vary laterally within each aquifer and these representative wells do not reflect the impacts of climate change and changes in water demand or water supply security at specific production bores.

Groundwater levels in the Shallow Fluviatile Gravel Aquifer are not represented by any monitoring well for the purposes of this assessment. This exclusion is because the groundwater levels in this aquifer are strongly tied to water fluctuations in the Waipaoa River. The river has not been modelled in this project, except as a boundary condition for the groundwater model (i.e., reflecting inflow and outflow from the groundwater system to the river during baseflow conditions). Therefore, simulated groundwater level fluctuations in the Shallow Fluviatile Gravel Aquifer are not considered to fully respond to projected climate change effects on the integrated groundwater and surface water system.

For clarity, simulated groundwater level hydrographs are presented on two-time scales: the full model run period from 2021 to 2090 and a five-year extract from 2040 to 2045 (Figure 16). The extracted period was chosen to be relevant to upcoming regional plan development processes and also be within a timeframe where climate change projections are associated with a high degree of confidence.

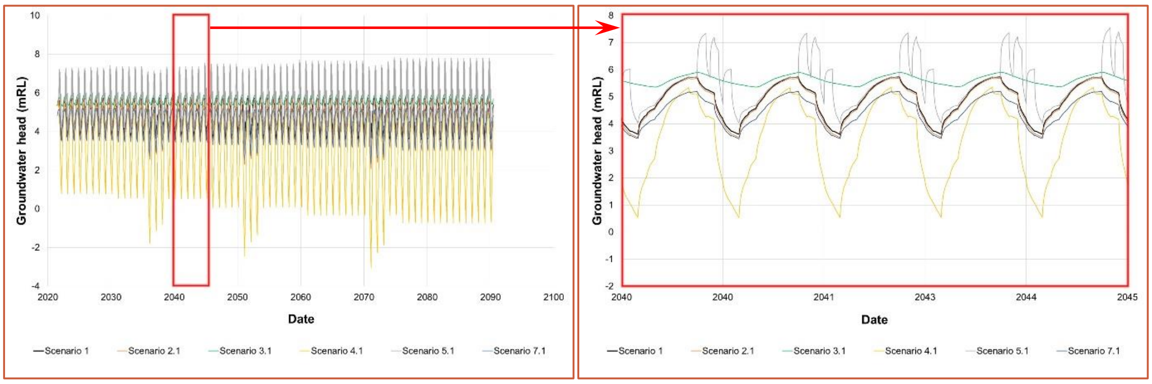


Figure 16: Model Output Full Record Compared to a Five-Year Extract

Comparisons between groundwater hydrographs from different modelled scenarios are presented in two forms:

- Hydrographs presented as absolute groundwater level (mRL) fluctuations over time, with multiple scenarios being presented in a single graph.
- Difference hydrographs which represent the difference between the simulated hydrograph for a specific scenario and the baseline + climate change simulated hydrograph (Figure 17). i.e., Are groundwater levels going to rise or fall compared to the continuing with the status quo abstraction in the face of projected climate change?.

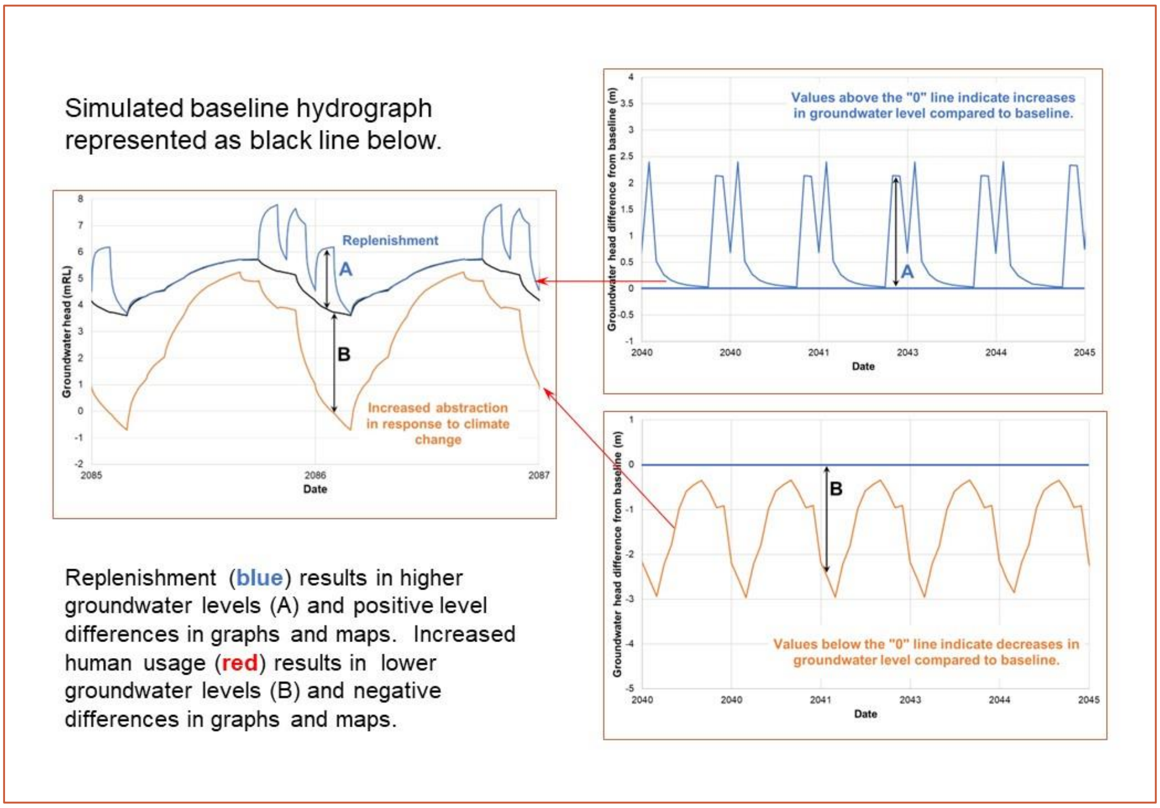


Figure 17: Derivation of Groundwater Difference Graphs

The effects on groundwater levels arising from the different simulated scenarios when compared to the baseline scenario are also presented in map form (Figure 18). In each of these maps the groundwater level at a particular point in time is compared to the groundwater level from the baseline + climate change scenario (Scenario 2.1) at the same point in time. Negative values indicate a drawdown of groundwater level compared to Scenario 2.1. Conversely, positive values indicate groundwater level rises compared to the Scenario 2.1.

4.3.2 Vertical Hydraulic Gradients

An important differentiator between scenario outcomes is the vertical hydraulic gradient between aquifers. Under natural conditions without the influence of pumping vertical groundwater gradients between aquifers have tended to be downward across the northern third of the Poverty Bay Flats. These gradients generally changed to be upward gradients across the southern half of the Poverty Bay Flats. The upward hydraulic gradients have helped to protect the confined aquifers from saline water intrusion close to the coast. Furthermore, these upward gradients also help to reduce the risk of other shallow groundwater contaminants impacting groundwood quality in the confined aquifers.

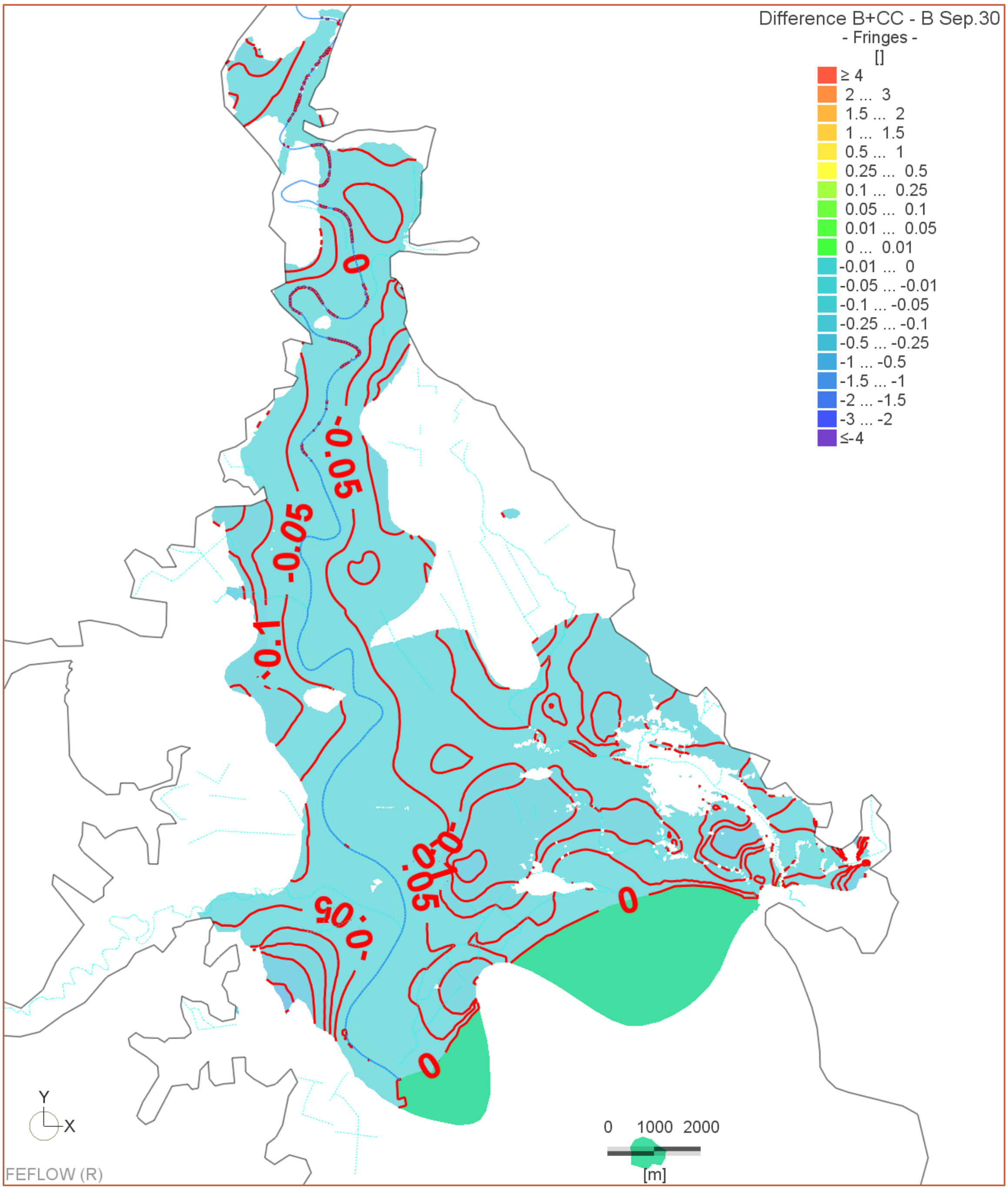


Figure 18: Example of Head Difference Map[9]

[9] Note that head difference maps for all results are available in the AQUASOIL 2022 report. For the remainder of the maps shared in this document, WGA has provided a qualitative range to help the reader understand relative changes (increasing, decreasing, etc).

Over the past three decades, groundwater abstraction from the confined aquifers has resulted in seasonally increased downward hydraulic gradients from the shallow aquifers. These seasonal changes in vertical hydraulic gradients cannot be prevented without reducing groundwater abstraction from the confined aquifers to a negligible amount. However, the effects from the various modelled scenarios can be evaluated in terms of winter vertical hydraulic gradients. Retaining or re-establishing upward hydraulic gradients through the winter periods will help to protect the quality of groundwater in the confined aquifers over the long term. Therefore, graphs summarising winter vertical hydraulic gradients between aquifers are presented in this report.

4.3.3 Salinity Trends

Monitoring of chloride concentrations and electrical conductivity in the ground water across the Poverty Bay Flats has identified a number of trends over time. In many areas, groundwater salinity has remained stable over the past 30 years. In some areas groundwater salinity is increasing over time. GDC has held concerns over the past few years regarding the potential for groundwater abstraction and future sea level rise to lead to increased groundwater salinity.

The groundwater quality modelling to date has successfully simulated these trends in key aquifer areas. However, there are several key input parameters for the groundwater quality modelling that require further clarification through field investigations and testing. Therefore, model outputs documented in this report have focused on expected changes in water quality into the future at key monitoring locations. Graphs showing projected differences in chloride concentrations compared to the baseline are presented in this report. However, the effects arising from the various scenarios on groundwater salinity are summarised as qualitative outcomes from the model (refer Section 4.4).

The effects of projected sea level rise on groundwater salinity within the Te Hapara Sand Aquifer is of concern for cultural, ecological, and social reasons. Increases in salinity have been observed in shallow groundwater monitoring wells and in drains crossing the Awapuni Moana area. However, past work on water quality in this area has shown that changes result from a highly complex combination of factors and are not simply related to groundwater behaviour alone. For this reason, it has proven difficult to replicate salinity trends observed in individual monitoring wells and to generate location-specific projections into the future.

The potential effects of sea level rise on groundwater quality in coastal areas of the Te Hapara Sand Aquifer have been investigated using virtual groundwater monitoring points. Two lines of simulated monitoring points have been added to the model, with these lines running inland from the coast (Figure 19). Simulated changes in chloride concentrations have been recorded along these lines of monitoring points and the relative changes concentration are summarised in this report for each of the modelled scenarios.

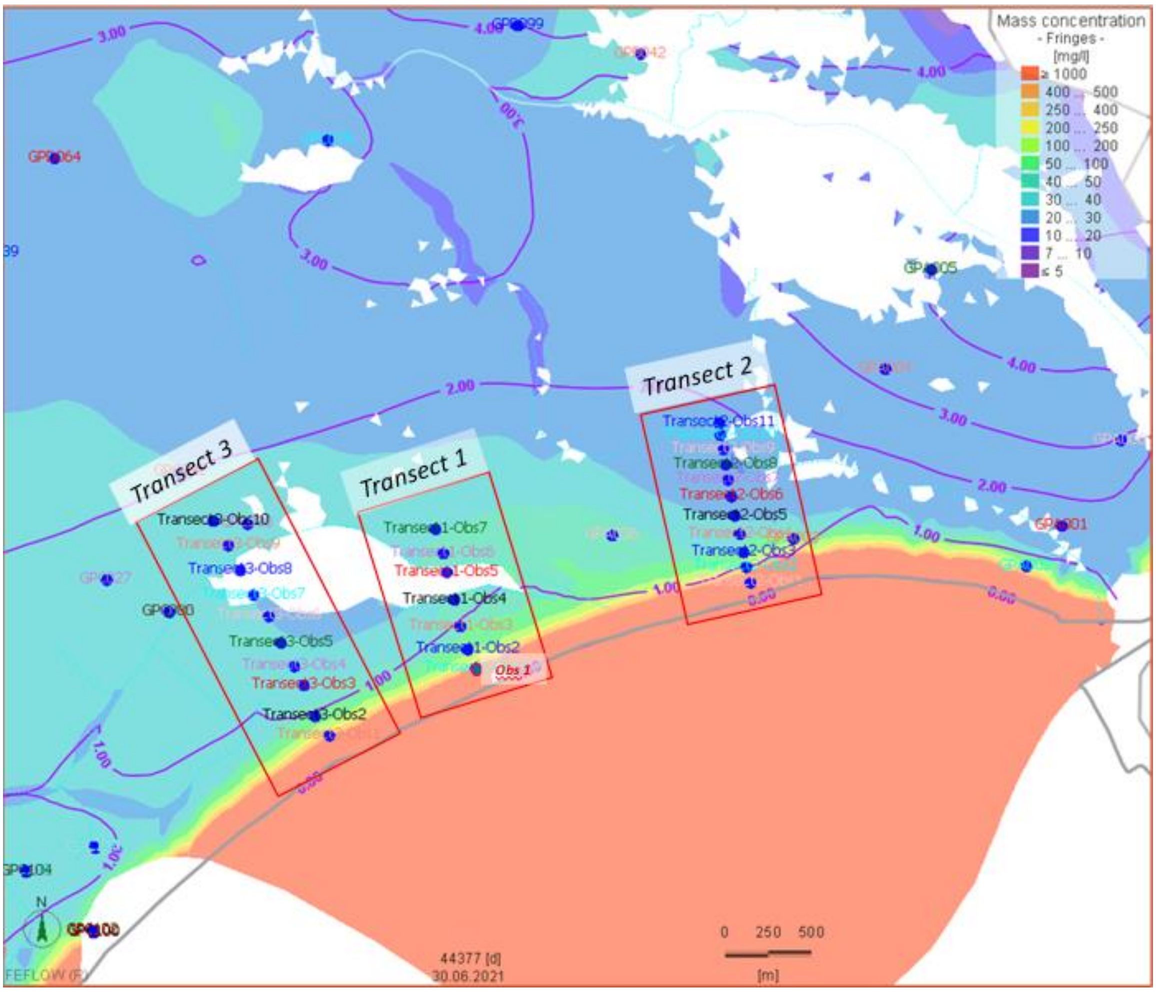


Figure 19: Simulated Chloride Monitoring Points in the Coastal Te Hapara Sand Aquifer from AQUASOIL (2022)

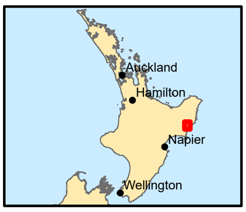
4.4 QUALITATIVE INDICATORS

4.4.1 Introduction

Qualitative indicators referenced to the model outcomes are listed in Table 11. The locations of monitoring stations referred to in Table 11 are presented in Figure 20. The groundwater model does generate quantitative outcomes linked to some of these monitoring sites, such as groundwater flow budgets for the Waipaoa River and the Awapuni Moana drains. However, no corresponding surface water flow model is available at this stage and a detailed assessment of the consequences of changes in groundwater flows or levels on surface water ecology or cultural values is outside the scope of this assessment. The effects of changes in the groundwater system are summarised qualitatively rather than quantitatively. In this sense, the effects arising from each of the modelled Exploratory Scenarios are summarised qualitatively as indicated in the final column in Table 11.

Table 11: Groundwater Model Qualitative Categories, Monitored Features and Outputs

CATEGORIES	SURFACE WATER CONNECTION	AQUIFER CONNECTION	MODEL OUTPUT PARAMETER	OPTIONS FOR STATUS OUTPUT
Cultural	Te Waiohiharore	Te Hapara Sand Aquifer	Has there been a relative change in groundwater levels at GPA003?	Likely to **improve** Likely to **stay the same** Likely to **worsen**
	Awapuni Moana Drains	Te Hapara Sand Aquifer	Has there been a relative change in groundwater levels at GPC080 and GPC094? Has there been a relative change in outflows to the drain?	
Surface water ecosystems	Te Maungarongo o Te Kooti Rikirangi Wetland	Te Hapara Sand Aquifer	Has there been a relative change in groundwater levels at GPC029?	
	Waipaoa River baseflow	Shallow Fluviatile Gravel Aquifer	Has there been a relative change in groundwater levels at GPC080 and GPF068? Has there been a relative change in net outflows to the river?	
	Taruheru baseflow	Te Hapara Sand Aquifer	Has there been a relative change in groundwater levels at GPB099? Has there been a relative change in net outflows to the river?	
Groundwater salinity	No direct connection	Makauri Aquifer	Has there been a relative change in trend for salinity at GPD115 and GPJ040?	
	Ocean Awapuni Moana Drains	Te Hapara Sand Aquifer	Has there been a relative change in trend for salinity at GPC026? What is the relative change in trend for salinity along the monitoring transects?	



N

0 0.5 1 1.5 2 km

Scale 1:125,000 @ A4

Coordinate System: NZGD 2000 New Zealand Transverse Mercator

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any relevance placed on such information shall be at the risk of the user.

LEGEND

Shallow Fluviatile Gravel
- Surface water ecosystem

Te Hapara Monitoring Wells
- Cultural
- Cultural / Surface water ecosystem
- Surface water ecosystem

Makauri Fluviatile Gravel
- Salinity

Matokitoki Monitoring Wells

Model Extent

WGA
WALLBRIDGE GILBERT AZTEC

Figure **20**

Gisborne MAR Model

Qualitative assessment locations of interest

4.4.2 Cultural

A number of surface water features that are at least partially dependent on groundwater discharges have been highlighted by the Mana Whenua as being of great cultural importance (Table 11). These features include:

- The Waipaoa River, especially with respect to protecting flows during summer periods
- The Awapuni Moana area, which was historically a tidal estuary and important kai moana source
- Te Maungarongo o Te Kooti Rikirangi Wetland, which is an oxbow of the Waipaoa River
- Te Waiohiharore spring

The projected effects of the modelled scenarios on these features have been evaluated based on review of a range of model outputs, including flow rates, water levels and salinity trends. The relative importance of these factors has been summarised qualitatively as described above rather than trying to reach value judgements from numerical changes.

4.4.3 Surface Water Ecosystems

In this assessment it has been assumed that increased flows from the groundwater system to surface wetlands, drains and rivers during summer will lead to increased and more stable flows through these surface water features. It has also been assumed that any increases in summer surface water flows will enable a corresponding improvement in the associated surface water ecology. Therefore, increased groundwater flows during summer to simulated surface water bodies has been qualitatively described as a potential improvement in surface water ecosystem outcomes.

4.4.4 Salinity

Groundwater quality model outputs for salinity have focused on the projected change in chloride concentrations into the future at key monitoring points. Additionally, simulated salinity trends in the Te Hapara Sand Aquifer have been monitored along three coastal transects (Figure 19). For reasons presented above (Section 4.3.3) the model indicates general expectations for increasing or decreasing chloride concentrations at these monitoring points. The effects on groundwater salinity arising from the various scenarios are summarised as qualitative outcomes from the model. i.e., The outcomes are presented as potentially improving, stable or potentially getting worse.

4.5 FINAL SCENARIO RESULTS

As discussed in the previous sections, this project incorporated groundwater modelling for two rounds of Exploratory Scenarios. The second round of scenarios was informed by the results from the first round and GDC's feedback and aspirations for the model capability. Changes between the first and second rounds of models focused on:

- Improving the coastal model structure to incorporate sea level rise projections into the model, and
- Applying a consolidated set of 'climate change' settings to produce a final baseline plus climate change scenario (Scenario 2.1) against which the effects of the other scenarios (Scenarios 3.1 through to 7.1) are considered.

The following sections provide a short description of the model stages that led to the development of the Scenario 2.1 model. The rest of Section 4.5 summarises the outcomes of the remaining Round 2 scenarios, which are considered the final exploratory scenarios under this project.

4.5.1 Scenario 1.1 – Round 1 Baseline

The Baseline Scenario (or continuation of the status quo) is the same for model Rounds 1 and 2 because climate change is not considered in this scenario. Examples of hydrographs from bores used to monitor the Te Hapara Sand and Makauri Aquifers (Figure 21) show that seasonal climate variation is considered but no further variability in annual weather patterns or allowance for sea level rise is incorporated. The initial rise in groundwater level shown in both hydrographs covers a model stabilisation period rather than an actual projected change in groundwater level.

4.5.2 Scenario 2.0 – Round 1 Baseline Plus Climate Change

The initial exploratory round of modelling incorporated a climate change scenario (Scenario 2.0) that was little different from the baseline scenario described in Section 4.5.1. As a consequence, the simulated hydrographs for monitored wells showed little change from the baseline scenario (Scenario 1; Figure 22). On review, it was determined that the Round 1 scenario incorporating climate change did not appropriately account for likely additional water demand, drought events or sea level rise. For this reason, an updated scenario for baseline plus climate change was developed for Round 2.1, as described in Section 3.5.

4.5.3 Scenario 2.1 – Round 2 Baseline Plus Climate Change

A Round 2 version of the baseline + climate change scenario (Scenario 2.1) was developed, against which all of the long-term predictive scenarios were to be considered. Scenario 2.1 incorporates a progressive increase in sea level (see GPA003 hydrograph in Figure 23), a progressive increase in groundwater abstraction in response to increasingly dry summer conditions and three drought periods (see GPJ040 hydrograph in Figure 23). Sea level rise also is incorporated into the modelling (See Baseline + Climate Change Scenario 3.5.2 for reference information). Scenario 2.1 has been used for comparison purposes going forward because it is considered to represent a more realistic projection of climate change effects together with a reasonably foreseeable irrigation response to these changes based on existing land use, compared to Scenario 2.

The results documented below are comparing the outcomes from Scenario 2.1 to those from Scenario 2, as described in Section 4.5.1.

<u>Te Hapara / Shallow Fluviatile Aquifers.</u> When compared to Scenario 2, adding climate change to the model results in a small increase in groundwater levels close to the coast over time. This rise results in a minor (<0.2 m) increase in late winter groundwater levels at GPA003 by 2045, linked to projected sea level rise. The Te Hapara Sand Aquifer does not react significantly to additional pumping during major drought events.

<u>Waipaoa Aquifer</u>. When compared to Scenario 2, Scenario 2.1 results in a slight progressive decrease in both late winter and late summer groundwater levels in the main body of the Waipaoa Aquifer. By 2045 this additional late summer drawdown of approximately 0.3 m is relatively minor, as measured at GPE040. However, additional pumping in response to extended droughts results in approximately one metre additional drawdown by 2045.

<u>Makauri Aquifer</u>. When compared to Scenario 2, Scenario 2.1 results in a progressive decrease in late summer groundwater levels. By 2045 this additional drawdown is relatively minor (Figure 23). However, over the longer term the additional drawdown is approximately 0.5 m. Additional pumping in response to droughts results in approximately one metre additional drawdown by 2045.

Matokitoki Aquifer. When compared to Scenario 2, incorporating climate change into the model results in a progressive decrease in late summer groundwater levels over time. The late winter groundwater levels remain similar to Scenario 2 levels. The additional pumping in response to three-year droughts results in an additional metre drawdown at GPB102.

Salinity

Water quality projections for Transects 1 and 3 (Figure 19) between the coast and Awapuni Moana indicate the movement of saline water inland through the Te Hapara Aquifer toward the Awapuni drains will be similar under both Scenario 2 and Scenario 2.1. The chloride projections for these points taking into account climate change show no substantial difference to the baseline projections (Figure 24, Figure 25).

The eastward movement of saline groundwater from the western saline area of the Makauri Aquifer is projected to continue under both Scenario 2 and Scenario 2.1.

Cultural Indicators

Groundwater levels are projected to increase at Te Waiohiharore (GPA003) by 2045, mainly linked to the projected sea level rise incorporated in Scenario 2.1. The model indicates no substantial increase in saline water movement from the ocean toward Te Waiohiharore (Figure 26).

In Scenario 2.1, groundwater levels are projected to increase at Awapuni Moana (GPC080 and GPC094), resulting in increased flows to Awapuni Moana drains. Although these changes appear mainly linked to projected sea level rise, the Scenario 2.1 model indicates no substantial increase in saline water movement from the ocean toward the drains at Awapuni Moana.

Surface Water Ecosystems

Under Scenario 2.1, summer water levels in Te Maungarongo o Te Kooti Rikirangi Wetland (GPC029) are projected to decrease by 20 mm by 2045, with winter water levels being unaffected. It is also shown that the Waipaoa River summer base flow increased due to reduced losses from river to adjacent shallow aquifers. It is also predicted to result in small increases in groundwater levels in Shallow Fluviatile Aquifer.

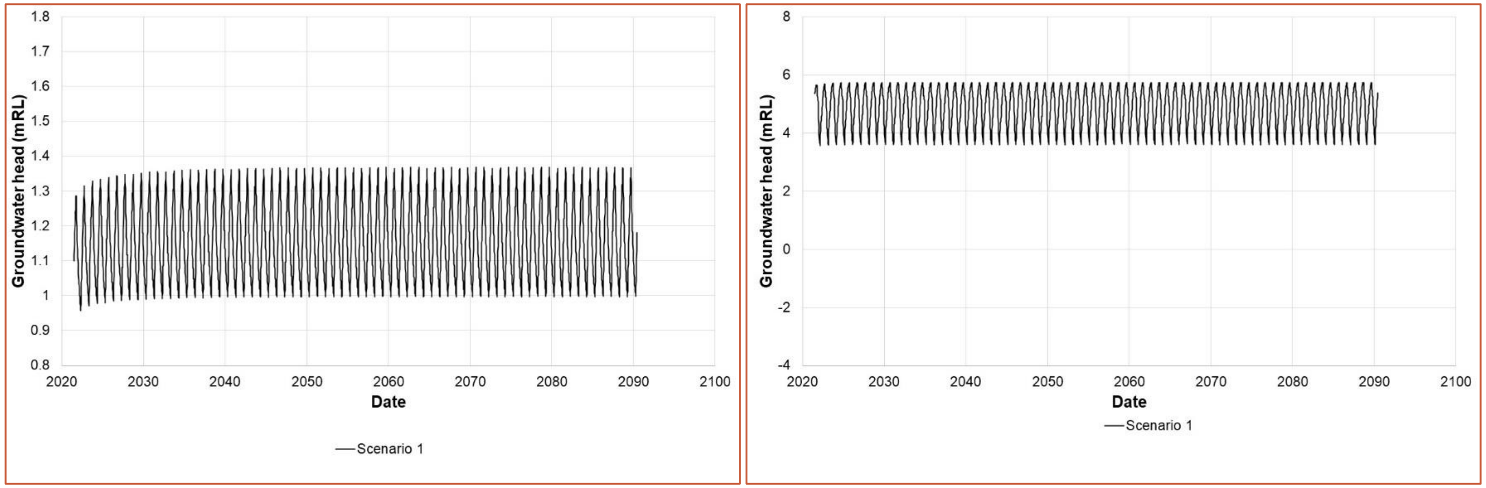


Figure 21: Scenario 1 Hydrographs for Te Hapara Sand (GPA003 left) and Makauri (GPJ040 right) Aquifers

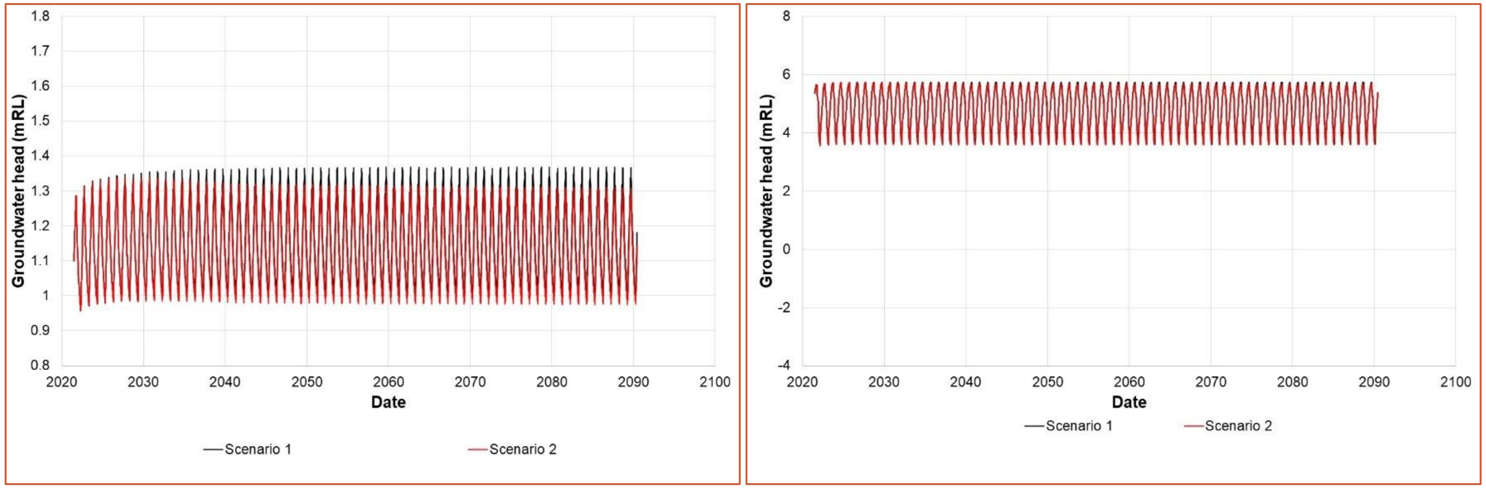


Figure 22: Scenario 2 Hydrographs for Te Hapara Sand (GPA003 left) and Makauri (GPJ040 right) Aquifers

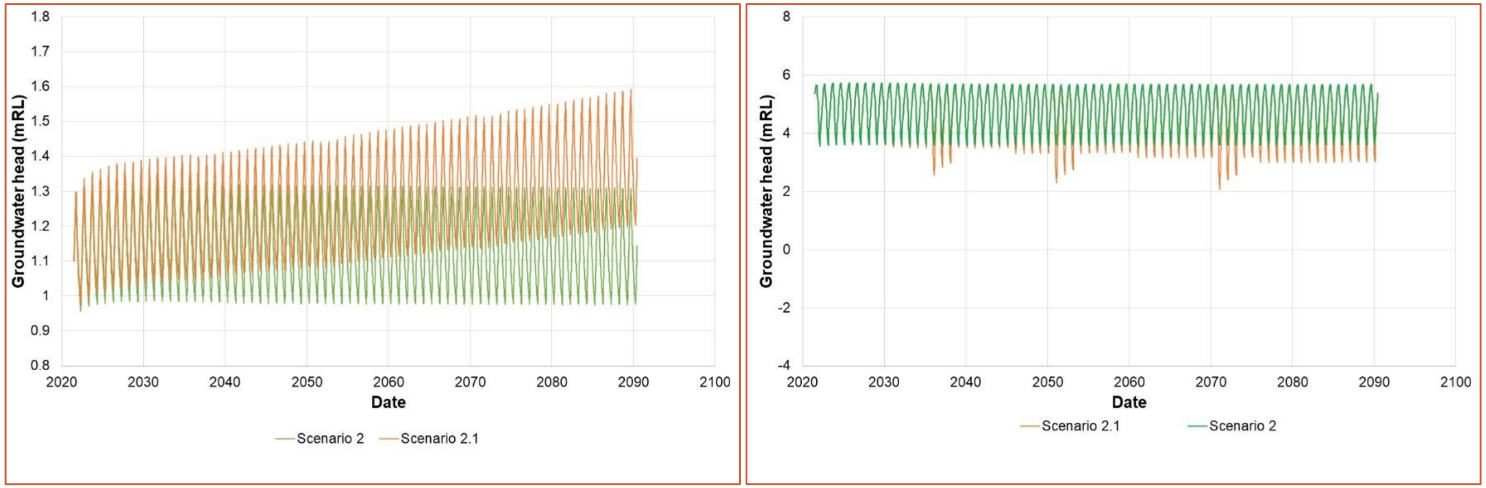


Figure 23: Scenario 2.1 Hydrographs for Te Hapara Sand (GPA003 left) and Makauri (GPJ040 right) Aquifers

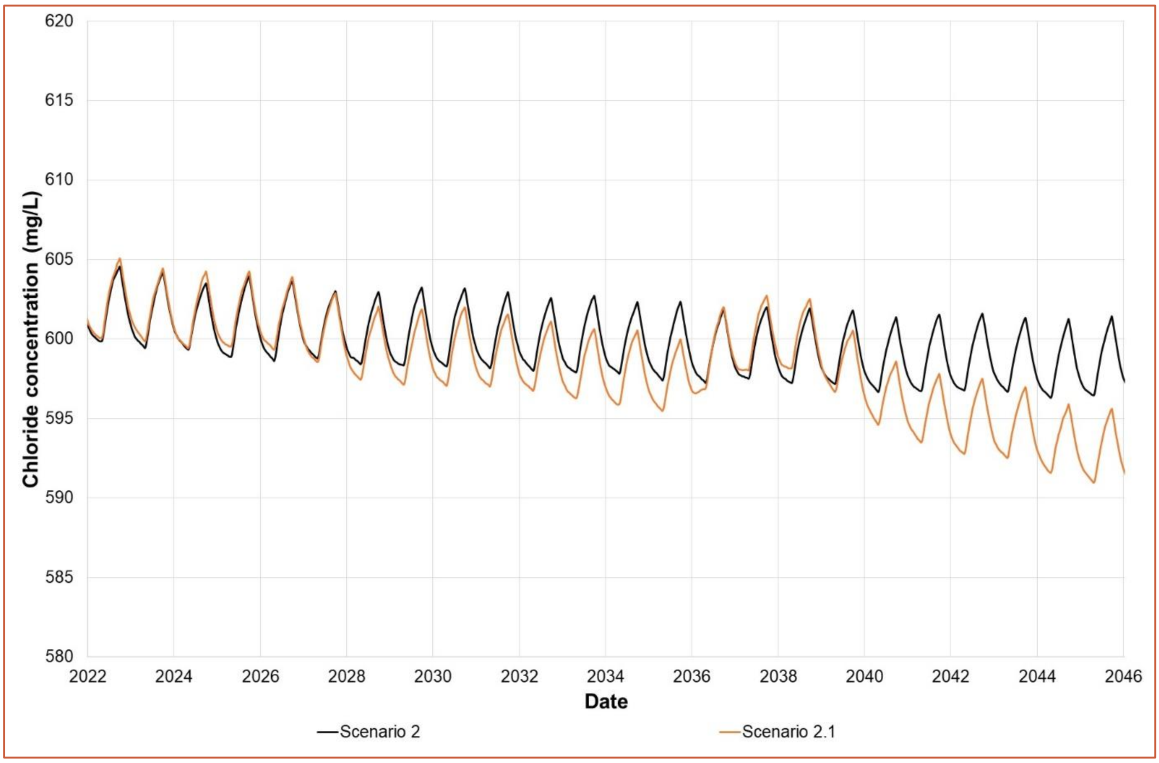


Figure 24: Baseline Chloride Projections, Seaward End (Observation Point 1) of Transect 1, Te Hapara Sand Aquifer

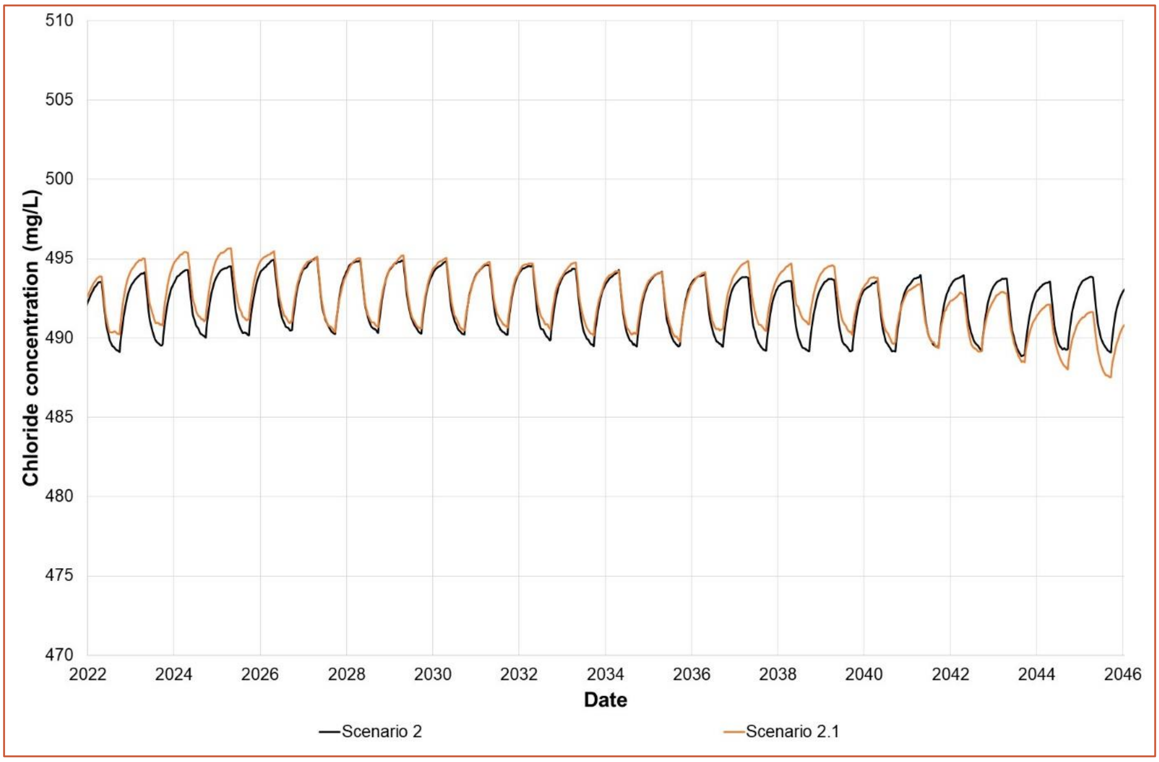


Figure 25: Baseline Chloride Projections, Seaward End (Observation Point 1) of Transect 3, Te Hapara Sand Aquifer

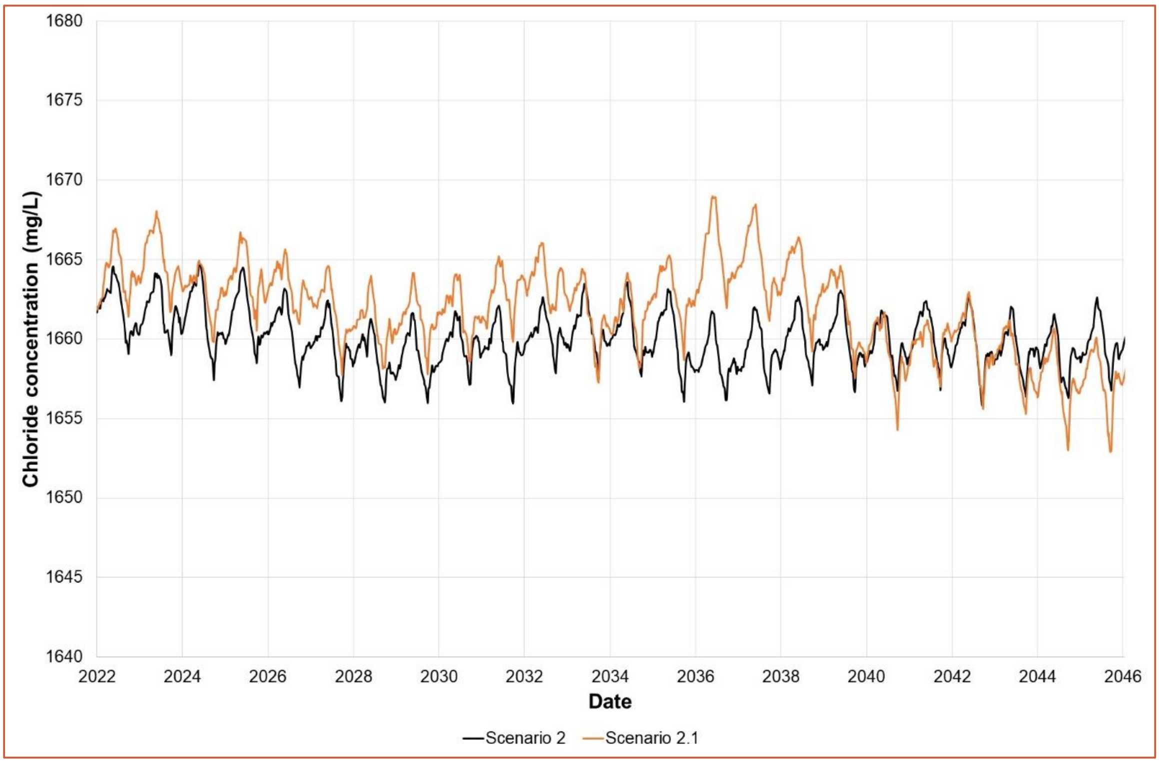


Figure 26: Baseline Chloride Projections, Seaward End (Observation Point 1) of Transect 2, Te Hapara Sand Aquifer

4.5.4 Scenario 3.1 – Natural State (3.1)

The results documented in this section for Scenario 3.1 are compared to the outcomes from Scenario 2.1 as presented in Section 4.5.3.

Drought events under Scenario 3.1 do not have a significant effect on the groundwater levels under Scenario 3.1. Droughts in each of the other modelled scenarios are predominantly expressed through increased groundwater pumping. No groundwater abstraction is simulated in Scenario 3.1, which means drought conditions have no effect on groundwater under this scenario.

Te Hapara / Shallow Fluviatile Aquifers. When compared to Scenario 2.1, ceasing groundwater pumping results in a progressive increase in groundwater level over time. This rise results in a minor (<0.1 m) increase in late winter groundwater levels linked to the projected sea level rise at GPA003 by 2045 (Figure 27).

Waipaoa Aquifer. When compared to Scenario 2.1, Scenario 3.1 results in substantially reduced summer drawdown with late summer groundwater levels being approximately 1.4 m higher at GPE040. Late winter groundwater levels are higher than under Scenario 2.1, with a difference of approximately 0.1 m by 2045.

Makauri Aquifer. When compared to Scenario 2.1, Scenario 3.1 results in greatly reduced summer drawdown with late summer groundwater levels being approximately 2 m higher at GPJ040. Late winter groundwater levels are also higher than under Scenario 2.1, with a difference of approximately 0.2 m by 2045 (Figure 28, Figure 29). The largest improvement in late winter groundwater levels is in the area shaded yellow shown in Figure 29.

Matokitoki Aquifer. When compared to Scenario 2.1, Scenario 3.1 results in a minor increase in late winter groundwater levels at GPB102 in the Matokitoki Aquifer by 2045. Although a seasonal fluctuation is still evident, the lack of pumping leads to groundwater levels being approximately 1.5 m higher in late summer.

Salinity

Water quality projections for Transects 1 and 3 (Figure 19) between the coast and Awapuni Moana indicate the movement of saline water inland toward the Awapuni drains under Scenario 3.1 will continue in response to sea level rise.

The eastward movement of saline water from the western saline area of the Makauri Aquifer is projected to cease under Scenario 3.1. However, there is no indication that observed historical increases in salinity in the aquifer will be reversed.

Cultural Indicators

Under Scenario 3.1, groundwater levels are projected to increase at Te Waiohiharore (GPA003) by 2045 but this appears to be mainly linked to projected sea level rise rather than the close of abstraction. The model indicates no substantial increase in saline water movement from the ocean toward Te Waiohiharore.

Groundwater levels under Scenario 3.1 increased at Awapuni Moana (GPC080 and GPC094), resulting in increased flows to Awapuni Moana drains. Although these changes appear mainly linked to projected sea level rise, the model indicates no substantial increase in saline water movement from the ocean toward the drains at Awapuni Moana.

Surface Water Ecosystems

Waipaoa River summer base flows are projected to increase under Scenario 3.1, due to reduced losses from the river to adjacent shallow aquifers. However, changes in groundwater levels in the adjacent Shallow Fluviatile Aquifer are minimal.

Summer water levels in Te Maungarongo o Te Kooti Rikirangi Wetland (GPC029) are projected to increase by 50 mm by 2045, with winter water levels being unaffected.

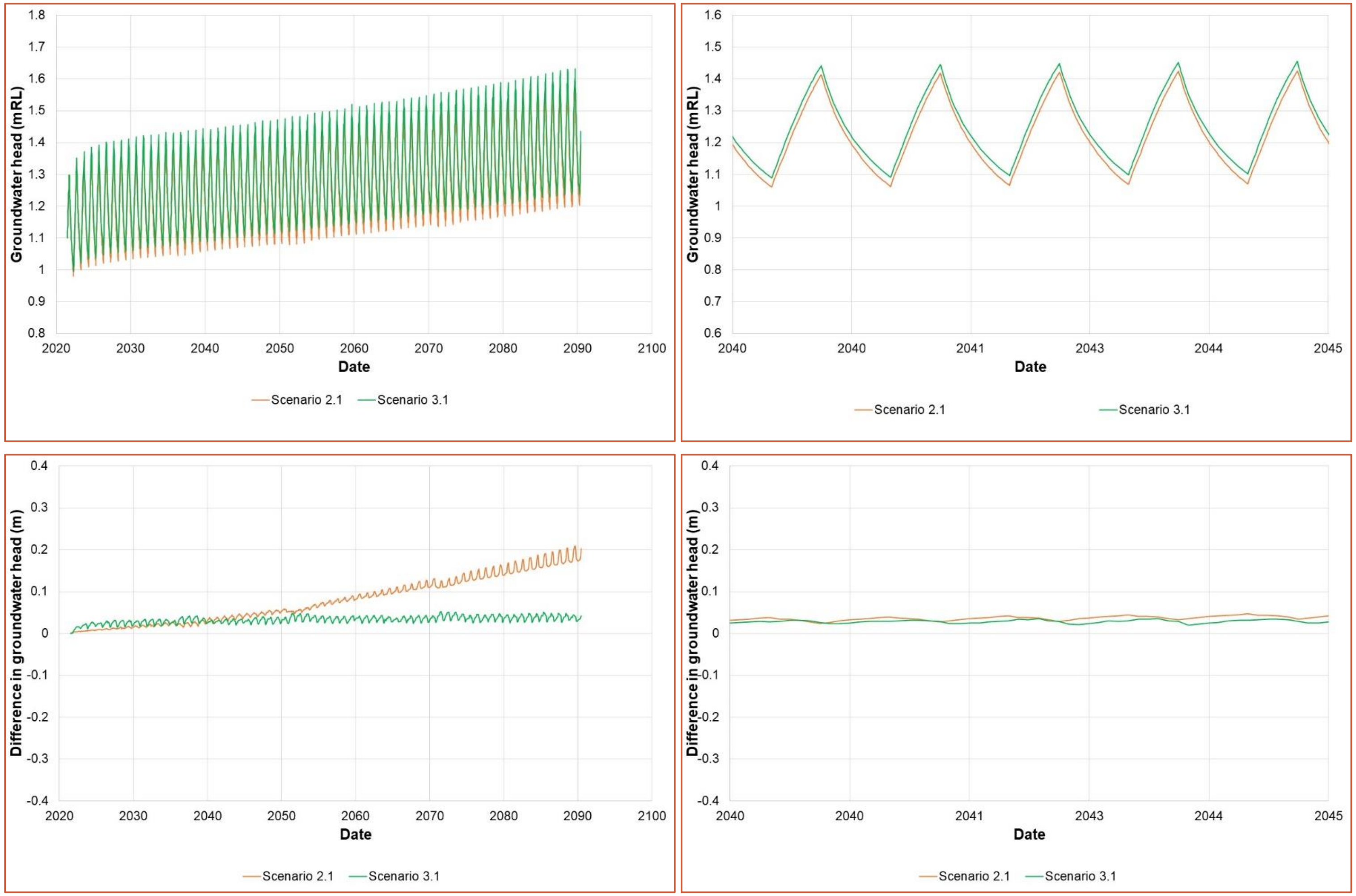


Figure 27: Effects of Scenario 3.1 on Te Hapara Sand Aquifer at GPA003

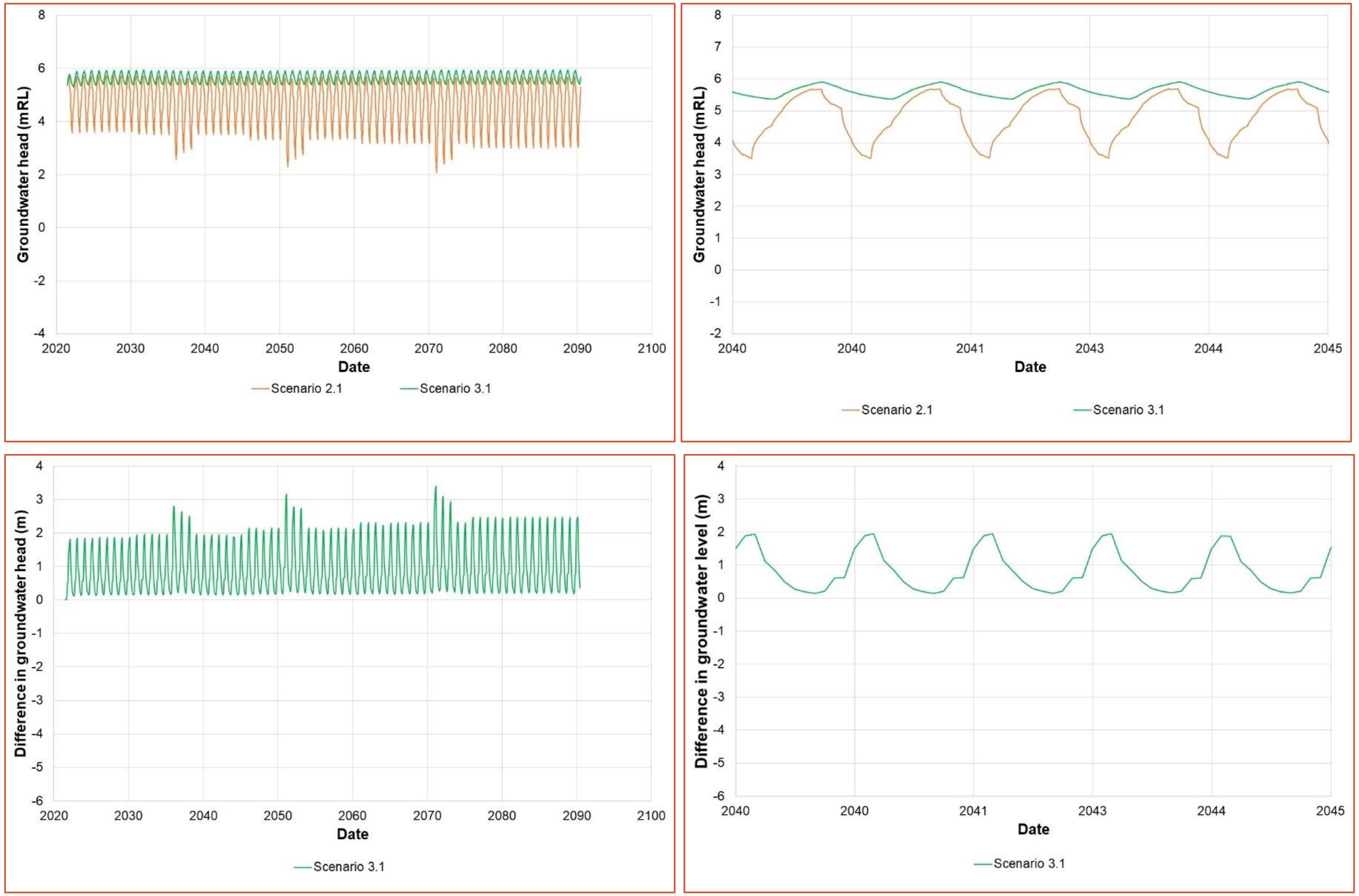


Figure 28: Effects of Scenario 3.1 on Makauri Aquifer at GPJ040

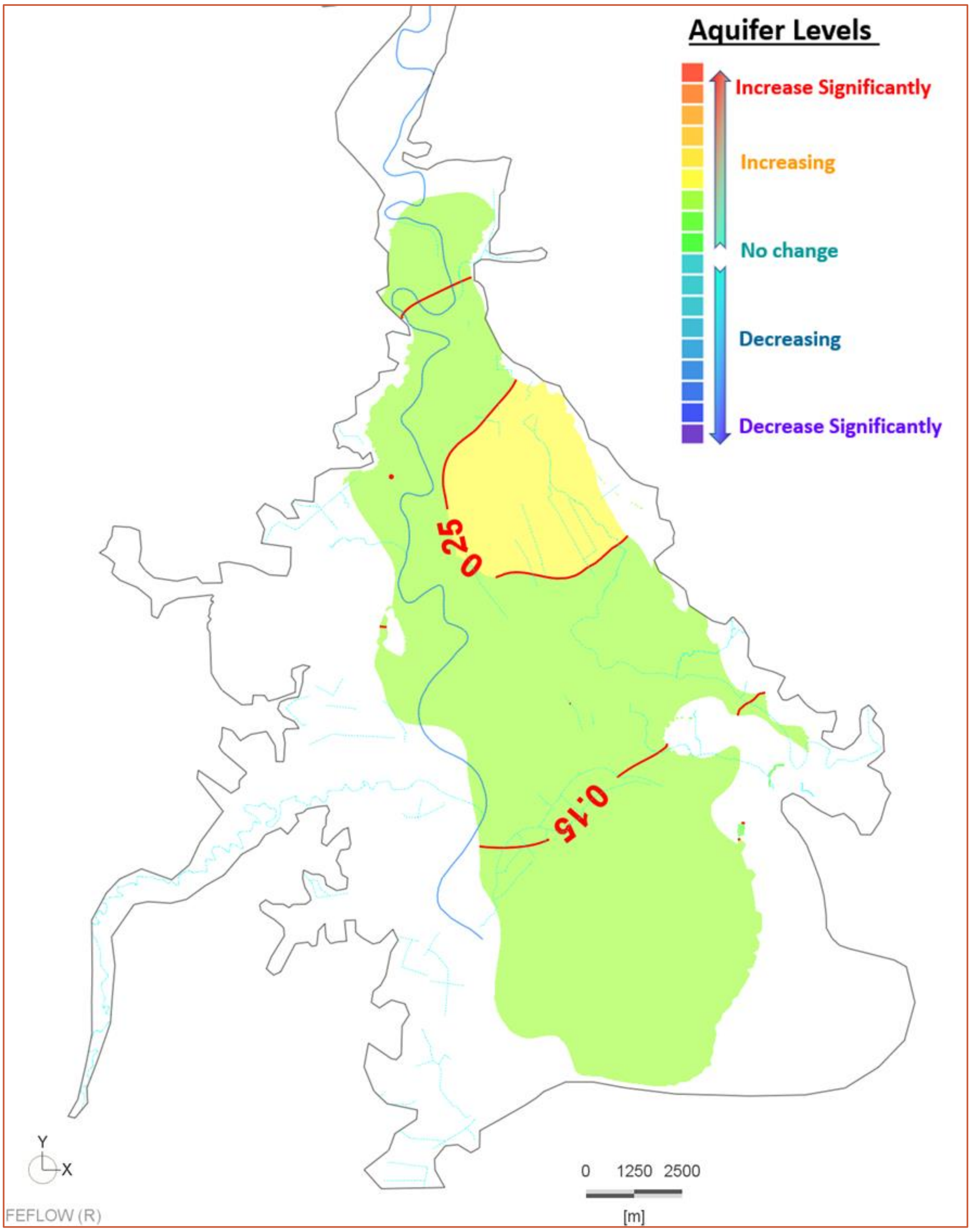


Figure 29: Effects of Scenario 3.1 on Makauri Aquifer – September 2045

4.5.5 Scenario 4.1 – Current Consented Allocation

The results documented in this section are compared to the outcomes from Scenario 2.1 presented in Section 4.5.3.

The effects of droughts are increased under this scenario as the modelled groundwater pumping is increased to offset the drought conditions.

Te Hapara / Shallow Fluviatile Aquifers. When compared to the Scenario 2.1, increasing abstraction to the currently consented limits (Scenario 4.1) initially results in a small additional drawdown in groundwater level. Over time this additional drawdown is offset near the coast (e.g., at GPA003) by the rise in sea level leading to a small long-term increase in groundwater level compared to the baseline. Additional pumping during drought periods results in minor increased drawdown throughout the drought years.

Waipaoa Aquifer. When compared to Scenario 2.1, Scenario 4.1 results in a substantial decrease in late summer groundwater levels in the main body of the Waipaoa Aquifer. By 2045 this additional late summer drawdown is approximately 4.2 m, as measured at GPE040. Increased pumping in response to extended droughts results in additional drawdowns of approximately 7.3 m compared to Scenario 2.1 by 2045. Additional drawdown under late winter conditions is approximately 0.3 m by 2045.

Makauri Aquifer. When compared to Scenario 2.1, Scenario 4.1 results in a substantial increase in drawdown. At GPJ040 there is an increase in drawdown of approximately 3 m by 2045, with additional pumping during drought periods leading to further drawdown of approximately 1.8 m (Figure 30 and Figure 30). The Makauri Aquifer reacts more than the other aquifers under Scenario 4.1 because it is the main focus of groundwater abstraction for horticultural use. Groundwater levels in the Makauri Aquifer already drop below today's mean sea level due to summer pumping and the additional abstraction is projected to worsen that situation.

Matokitoki Aquifer. When compared to the Scenario 2.1, Scenario 4.1 results in groundwater being drawn down by a further 3.1 m at GPB102 in the Matokitoki Aquifer by 2045. Late winter groundwater levels are also drawn down by approximately 0.4 m. In response to the simulated droughts the drawdown of up to 5.2 m means groundwater levels in the Matokitoki Aquifer drop below today's mean sea level.

Salinity

Scenario 4.1 water quality projections for Transects 1 and 3 (Figure 19) between the coast and Awapuni Moana indicate the movement of saline water inland toward the Awapuni drains will increase in response to sea level rise and the increase in groundwater abstraction.

Under Scenario 4.1 the eastward movement of saline water from the western saline area of the Makauri Aquifer is projected to increase in response to increased drawdown in the main areas of horticultural abstraction.

Cultural Indicators

Groundwater levels increased at Te Waiohiharore (GPA003) by 2045 but this is mainly linked to projected sea level rise. Under Scenario 4.1 the model indicates a small increase in saline water movement from the ocean toward Te Waiohiharore.

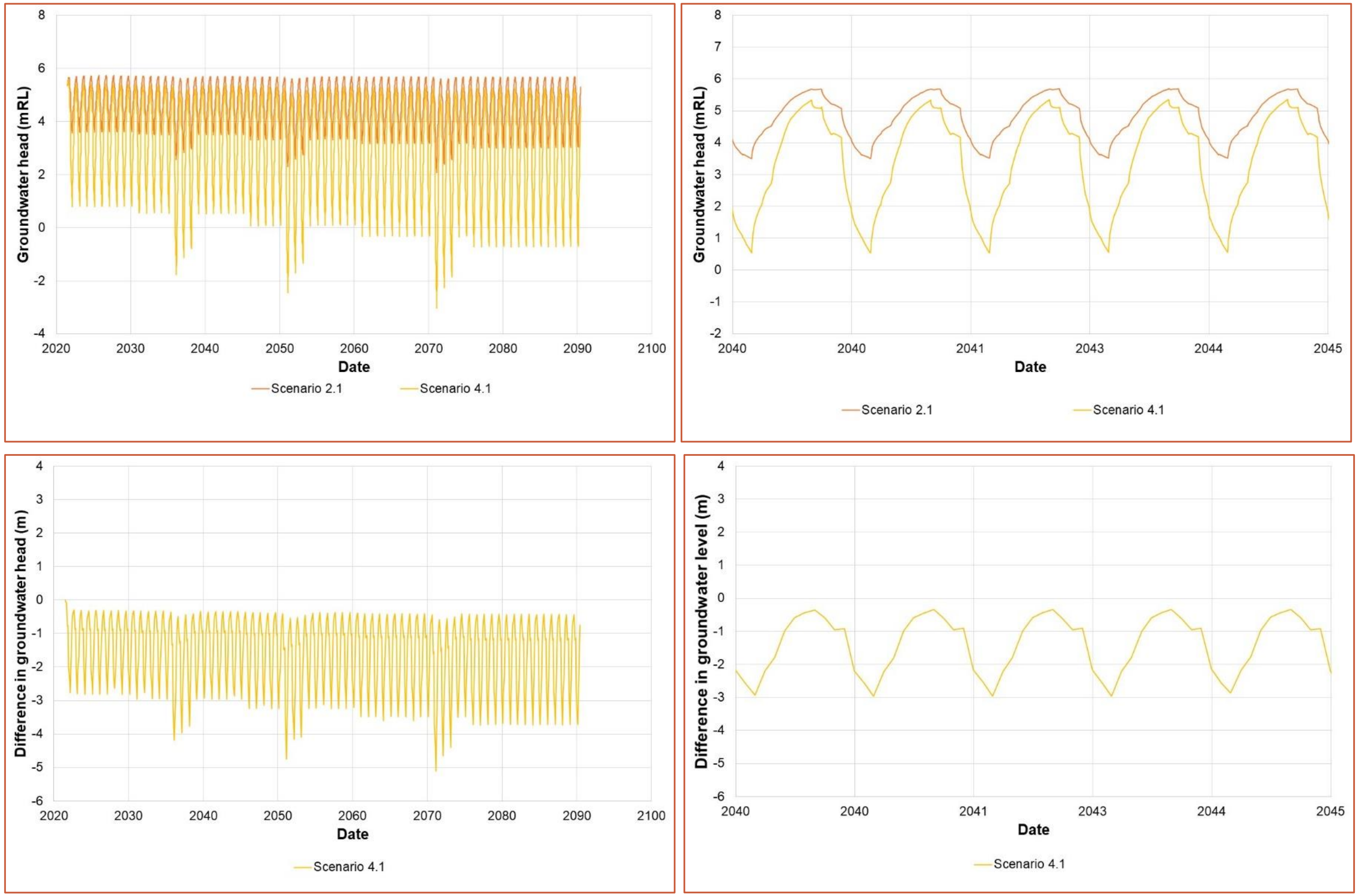


Figure 30: Effects of Scenario 4.1 on Makauri Aquifer at GPJ040

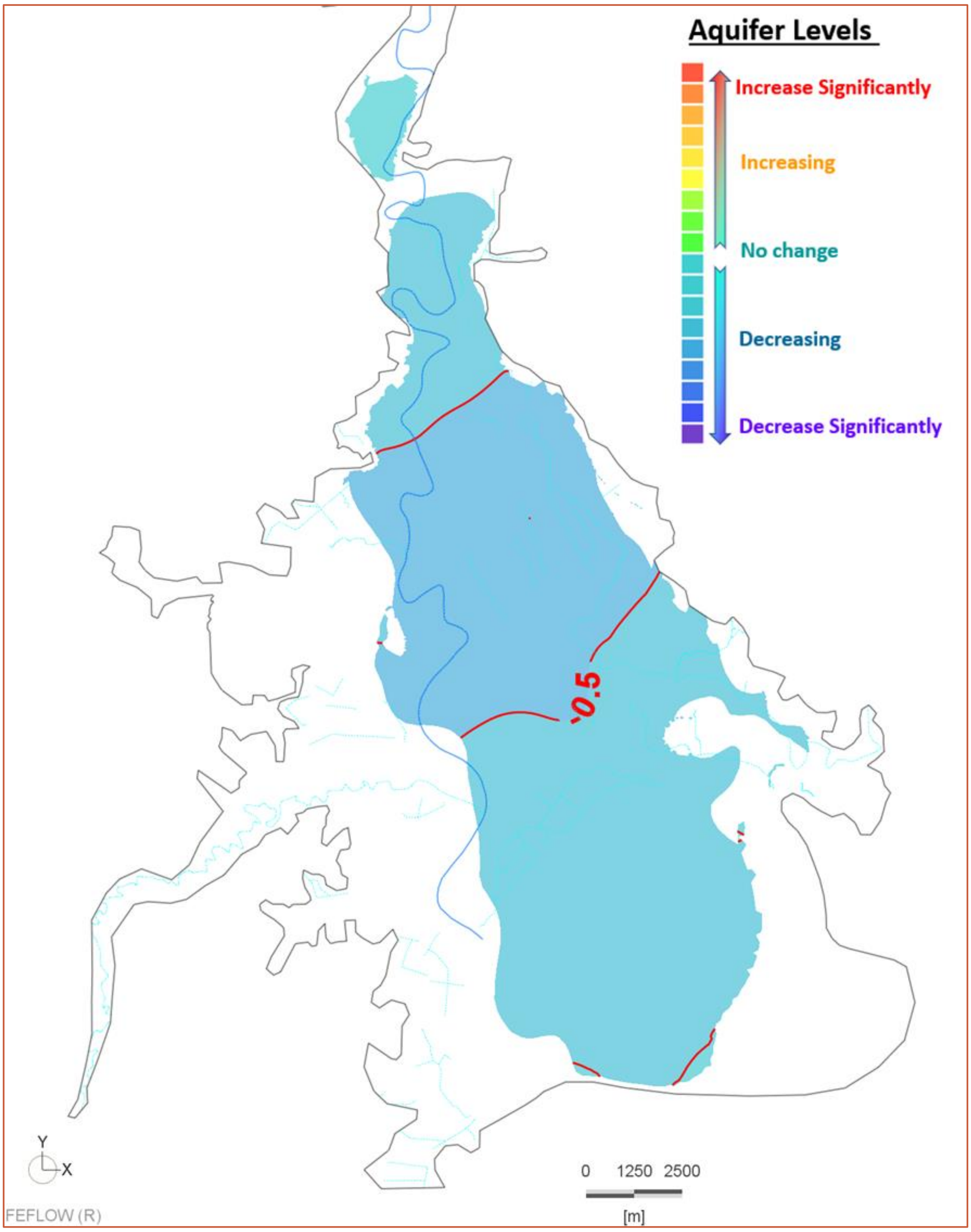


Figure 31: Effects of Scenario 4.1 on Makauri Aquifer – September 2045

Under Scenario 4.1 groundwater levels decreased or showed no change at Awapuni Moana (GPC080 and GPC094) through to 2045. Flows of groundwater to Awapuni Moana drains decreased through the coming five decades although this trend reversed toward the end of the simulated period due to ongoing sea level rise. These changes are mainly linked to projected sea level rise. Sea level rise presents ongoing risk of increased salinity in groundwater and surface drains at Awapuni Moana under this scenario.

Surface Water Ecosystems

Under Scenario 4.1 Waipaoa River summer base flow decreases due to increased losses from the river to adjacent shallow aquifers. Changes in groundwater levels in the adjacent Shallow Fluviatile Aquifer are minimal.

Summer water levels in Te Maungarongo o Te Kooti Rikirangi Wetland (GPC029) decreased by 2045, with winter water levels being unaffected. The projected decrease of approximately 200 mm and the associated decrease in wetland throughflows during summer may have an effect on the wetland ecosystem.

4.5.6 Scenario 5.1 – Groundwater Replenishment (MAR)

The results documented in this section are compared to the outcomes from the Scenario 2.1 presented in Section 4.5.3.

Te Hapara / Shallow Fluviatile Aquifers. When compared to Scenario 2.1, Scenario 5.1 results in no significant change to groundwater levels in the shallow aquifers.

Waipaoa Aquifer. When compared to Scenario 2.1, the application of enhanced replenishment results in small increases in groundwater levels in the main body of the Waipaoa Aquifer during both late summer and late winter months by 2045. These increases are approximately 0.75 m in late winter and 0.4 m in late summer. Similar seasonal increases in groundwater levels compared to Scenario 2.1 occur under drought conditions.

Makauri Aquifer. When compared to Scenario 2.1, Scenario 5.1 results in an increase in groundwater levels exceeding two metres at GPJ040 by 2045. As the simulated replenishment is focused on the irrigation shoulder seasons, there is only a minor increase in the aquifer groundwater levels through the winter (See Figure 31 and Figure 32).

Matokitoki Aquifer. When compared to Scenario 2.1, Scenario 5.1 results in an increase in groundwater levels of approximately 0.9 m during late summer at GPB102 in the Matokitoki Aquifer by 2045. In contrast, the MAR programme does not significantly influence late winter groundwater levels.

Salinity

Under Scenario 5.1, water quality projections for Transects 1 and 3 (Figure 19) between the coast and Awapuni Moana indicate the movement of saline water inland toward the Awapuni drains will continue in response to sea level rise.

The aquifer replenishment scenario is the only scenario whereby a clear improvement (decrease) in chloride concentrations in groundwater along the western side of the Makauri Aquifer is projected through to 2045.

Cultural Indicators

Scenario 5.1 produces no significant difference from Scenario 2.1 when considering the effects on Te Waiohiharore, Te Maungarongo o Te Kooti Rikirangi Wetland and the Awapuni Moana area.

Surface Water Ecosystems

Scenario 5.1 produces no significant difference from Scenario 2.1 when considering the effects on surface water bodies and the associated ecosystems.

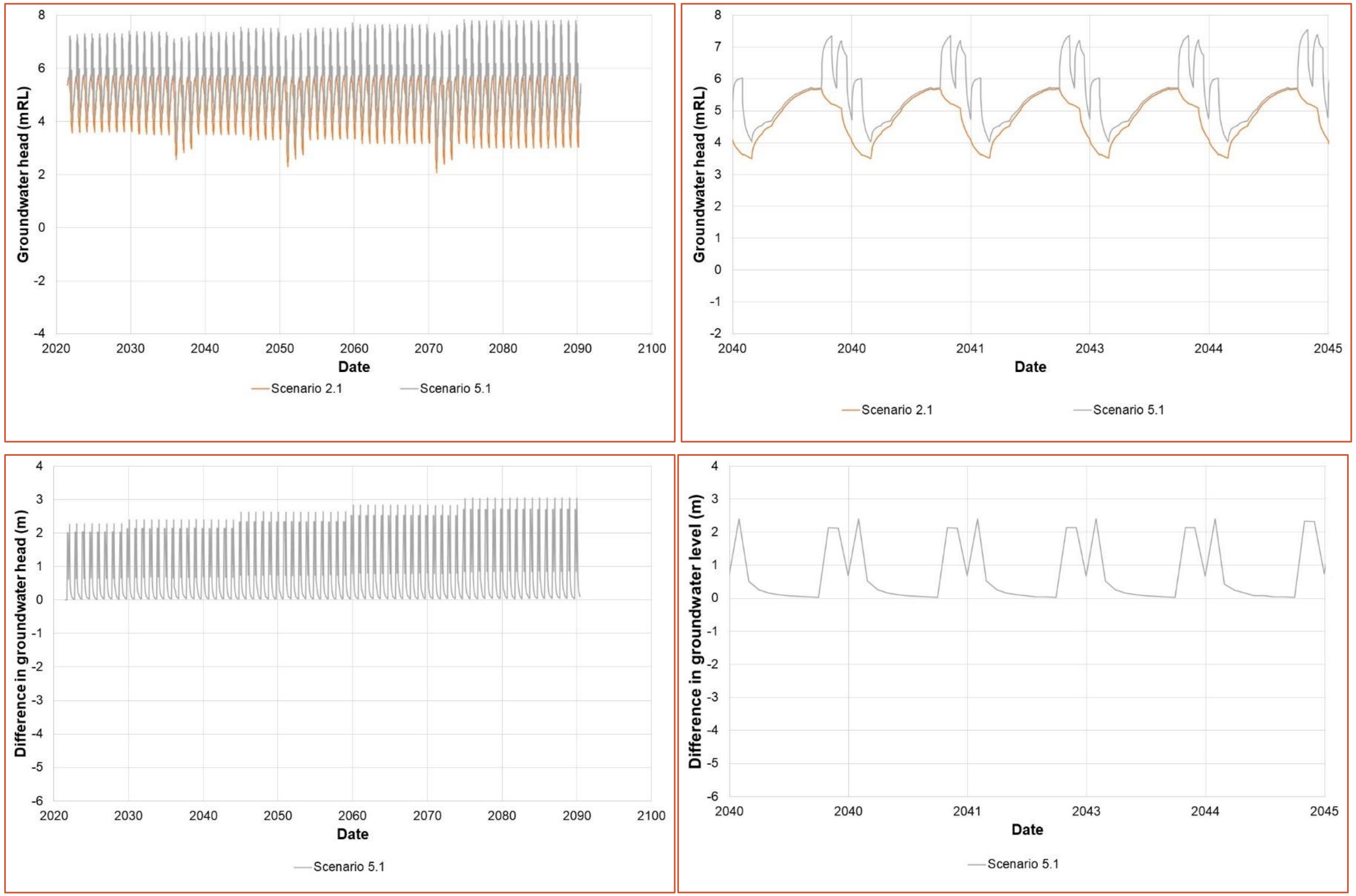


Figure 32: Effects of Groundwater Replenishment Scenario on Makauri Aquifer at GPJ040

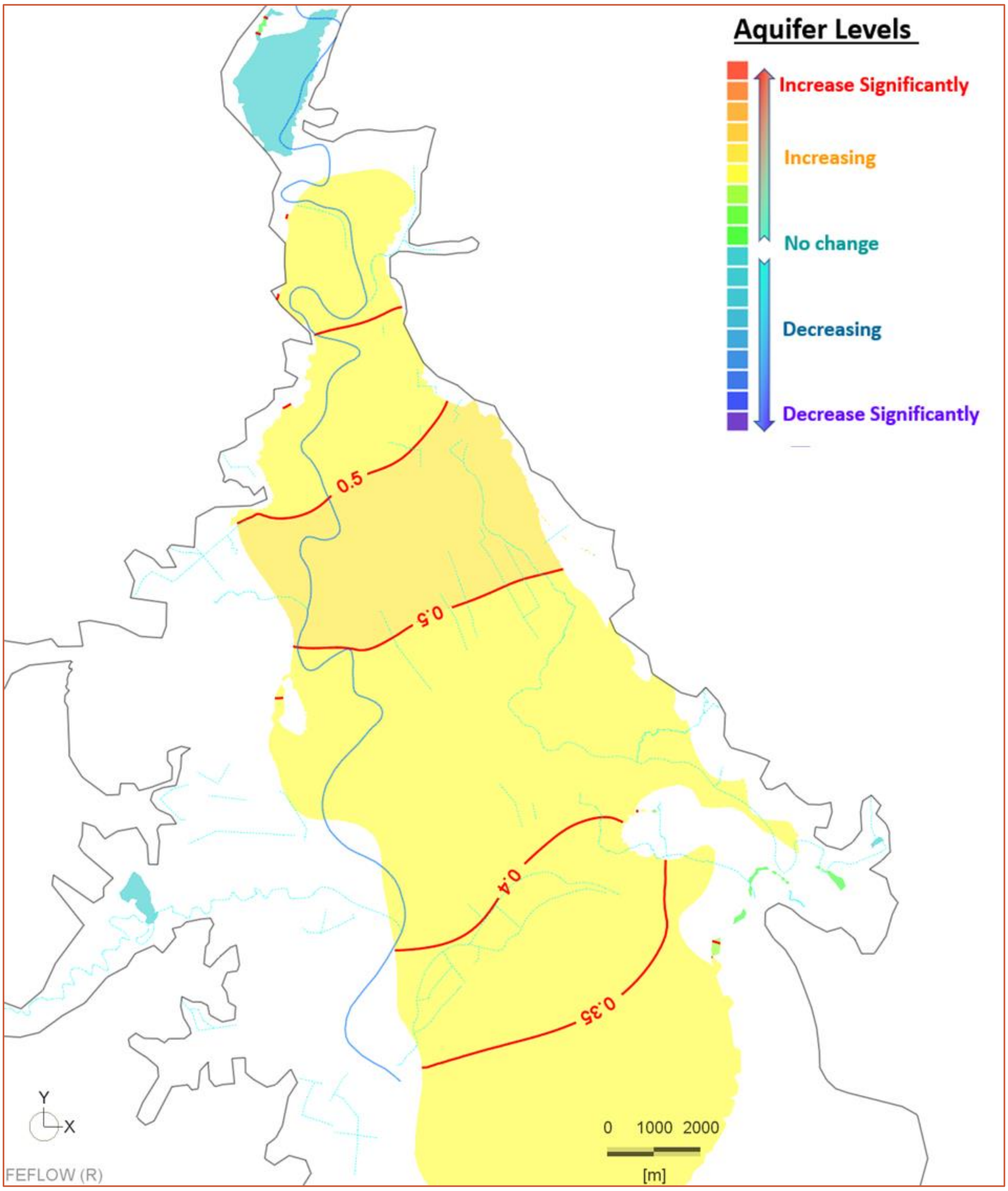


Figure 33: Effects of Groundwater Replenishment (5.1) on Makauri Aquifer – February 2090

4.5.7 Scenario 7.1 – Sustainable Allocation

The modelling undertaken to determine a 'sustainable allocation' scenario was iterative, where abstraction rates were adjusted and the model re-run to establish aquifer responses. The amount of annual groundwater abstraction was reduced to the point whereby groundwater levels do not drop below the Scenario 2.1 levels in late summer through to 2050. Abstraction was adjusted on a percentage basis, applied equally to all production bores simulated in the model. As different aquifers respond to abstraction changes in different ways, the main focus of Scenario 7.1 modelling was to manage groundwater pressures in the Makauri Aquifer, which is currently subject to the greatest abstraction stress.

Climate driven stresses on the groundwater system under 'normal' years are projected to change over time. Furthermore, GDC considered it unreasonable to prevent users from temporarily increasing seasonal abstraction in response to major drought events. Therefore, the model results do not indicate a single 'sustainable allocation' value that applies consistently into the future.

The iterative modelling results indicate that a reduction in total groundwater abstraction of 15% from the amounts allowed for under Scenario 2.1 should enable groundwater levels to be managed without further drawdown in summer levels below those already observed. In effect, the drawdowns simulated during the third drought event do not exceed the groundwater drawdowns that have been observed in response to historical drought events.

For comparison purposes, groundwater abstraction from the Poverty Bay Flats aquifers has been documented for six separate years, as identified in Figure 34. These years are paired, with each pair including the final 'normal' rainfall year before a simulated drought and the first year of the following drought. The total groundwater volumes taken from the aquifers during these years are presented in Table 12.

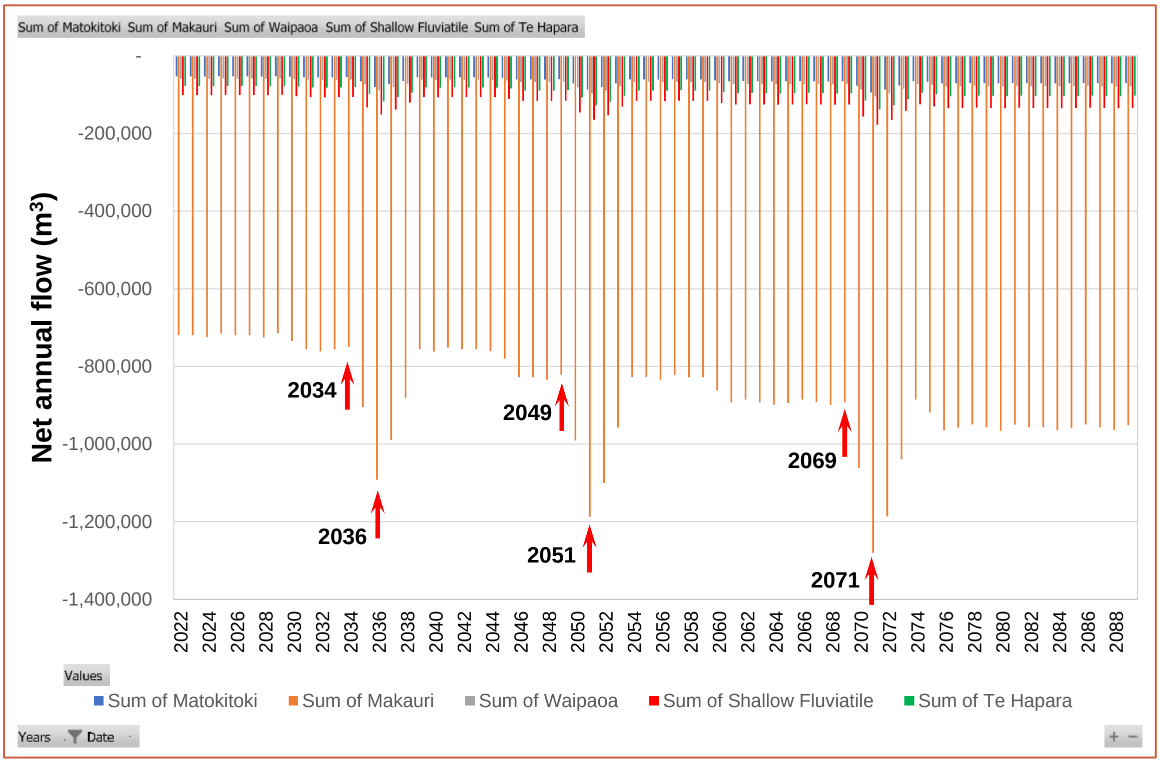


Figure 34. Interrogated for Groundwater Take Volumes Showing Simulated Influence of Increasing Climate Change Effects (All Aquifers)

The annual abstraction volumes presented in Table 12 and Table 13 indicate that the aquifers have the capacity to provide water to deal with exceptional climate events. This conclusion reflects the observed recovery in aquifer pressures following historical droughts, as documented in Section 3.5.1.

Defining a 'sustainable allocation' based on the abstraction rates simulated for 'normal' rainfall years under Scenario 7.1 does not consider the capacity of the aquifers to respond to abnormal events. However, defining a 'sustainable allocation' based on the abstraction calculated as necessary to deal with the simulated drought years under Scenario 7.1 would be equally inappropriate, as full utilisation of such an annual allocation would lead to outcomes like those generated by Scenario 4.1.

Table 12: Groundwater Volumes Taken at Selected Years from Defined Aquifers.

Year	MATOKITOKI AQUIFER	MAKAURI AQUIFER	WAIPAOA AQUIFER	SHALLOW FLUVIATILE GRAVEL AQUIFER	TE HAPARA SAND AQUIFER
2034 (normal)	54,936	749,751	61,039	105,566	80,712
2036 (drought)	80,267	1,092,169	88,997	151,064	117,517
2049 (normal)	60,244	821,680	66,877	115,621	88,438
2051 (drought)	87,318	1,187,168	96,689	164,659	127,707
2069 (normal)	65,407	892,940	72,735	125,256	96,153
2071 (drought)	94,152	1,280,076	104,256	177,546	137,701

Table 13: Total Groundwater Volumes Abstracted Under Scenario 7.1

PERIOD	SCENARIO 2.1 ABSTRACTION (m^3/year) (1)	SCENARIO 7.1 ABSTRACTION (m^3/year) (2)
2029 through to 2044, 'normal' years only.	1,247,400	1,060,290
2035/36 (First simulated drought - Year 1)	1,862,210	1,582,879
2036/37 (First simulated drought - Year 2)	1,680,707	1,428,601
2037/38 (First simulated drought - Year 3)	1,593,709	1,354,653
2044 through to 2059, 'normal' years only.	1,366,200	1,161,270
2050/51 (Second simulated drought - Year 1)	2,199,181	1,869,304
2051/52 (Second simulated drought - Year 2)	1,984,835	1,687,110
2052/53 (Second simulated drought - Year 3)	1,882,094	1,599,780

Note: 1) Model results sourced from AQUASOIL (2022) report, Table 5-5.
2) Model results sourced from AQUASOIL (2022) report, Table 5-9. Totals differ slightly from the sum of aquifer abstractions presented in Table 12 due to differences in the calculation periods.

The results documented in this section are compared to the outcomes from Scenario 2.1 presented in Section 4.5.3.

Te Hapara/Shallow Fluviatile Aquifers. When compared to Scenario 2.1, Scenario 7.1 results in a small progressive increase in groundwater level over time. This increase is practically the same as that resulting from the baseline + climate change scenario (Figure 35).

Waipaoa Aquifer. When compared to Scenario 2.1, Scenario 7.1 results in insignificant changes in groundwater levels during late winter months by 2045. Small increases of approximately 0.3 m occur in groundwater levels in the main body of the Waipaoa Aquifer during late summer months by 2045. Similar increases in late summer groundwater levels compared to Scenario 2.1 occur under drought conditions.

Makauri Aquifer. When compared to Scenario 2.1, Scenario 7.1 results in a small increase in groundwater levels of approximately 0.3 m during the late summer irrigation period at GPJ040 by 2045. Increases during other times of the year are less (Figure 36 and Figure 37).

Matokitoki Aquifer. When compared to Scenario 2.1, Scenario 7.1 results in an increase in groundwater levels of approximately 0.2 m during late summer at GPB102 by 2045. The reduction in pumping does not have a significant effect on late winter groundwater levels.

Salinity

Water quality projections for Transects 1 and 3 (Figure 19) between the coast and Awapuni Moana indicate the movement of saline water inland toward the Awapuni drains shown no significant difference from Scenario 2.1 outcomes.

Under Scenario 7.1 the eastward movement of saline water from the western saline area of the Makauri Aquifer is projected to continue but not increase in the rate of movement.

Cultural Indicators

Under Scenario 7.1 groundwater levels increased at Te Waiohiharore (GPA003) by 2045 but this is mainly linked to projected sea level rise. The model indicates no substantial increase in saline water movement from the ocean toward Te Waiohiharore.

Under Scenario 7.1 groundwater levels increased at Awapuni Moana (GPC080 and GPC094), resulting in increased flows to Awapuni Moana drains. Although these changes appear mainly linked to projected sea level rise, the model indicates no substantial increase in saline water movement from the ocean toward the drains at Awapuni Moana.

Surface Water Ecosystems

Under Scenario 7.1 summer water levels in Te Maungarongo o Te Kooti Rikirangi Wetland (GPC029) only decrease by 2045, with winter water levels being unaffected. The projected change of 20 mm is unlikely to have a significant effect on the wetland ecosystem.

Under Scenario 7.1 Waipaoa River summer base flow increased due to reduced losses from the river to adjacent shallow aquifers. Changes in groundwater levels in the adjacent Shallow Fluviatile Aquifer are minimal.

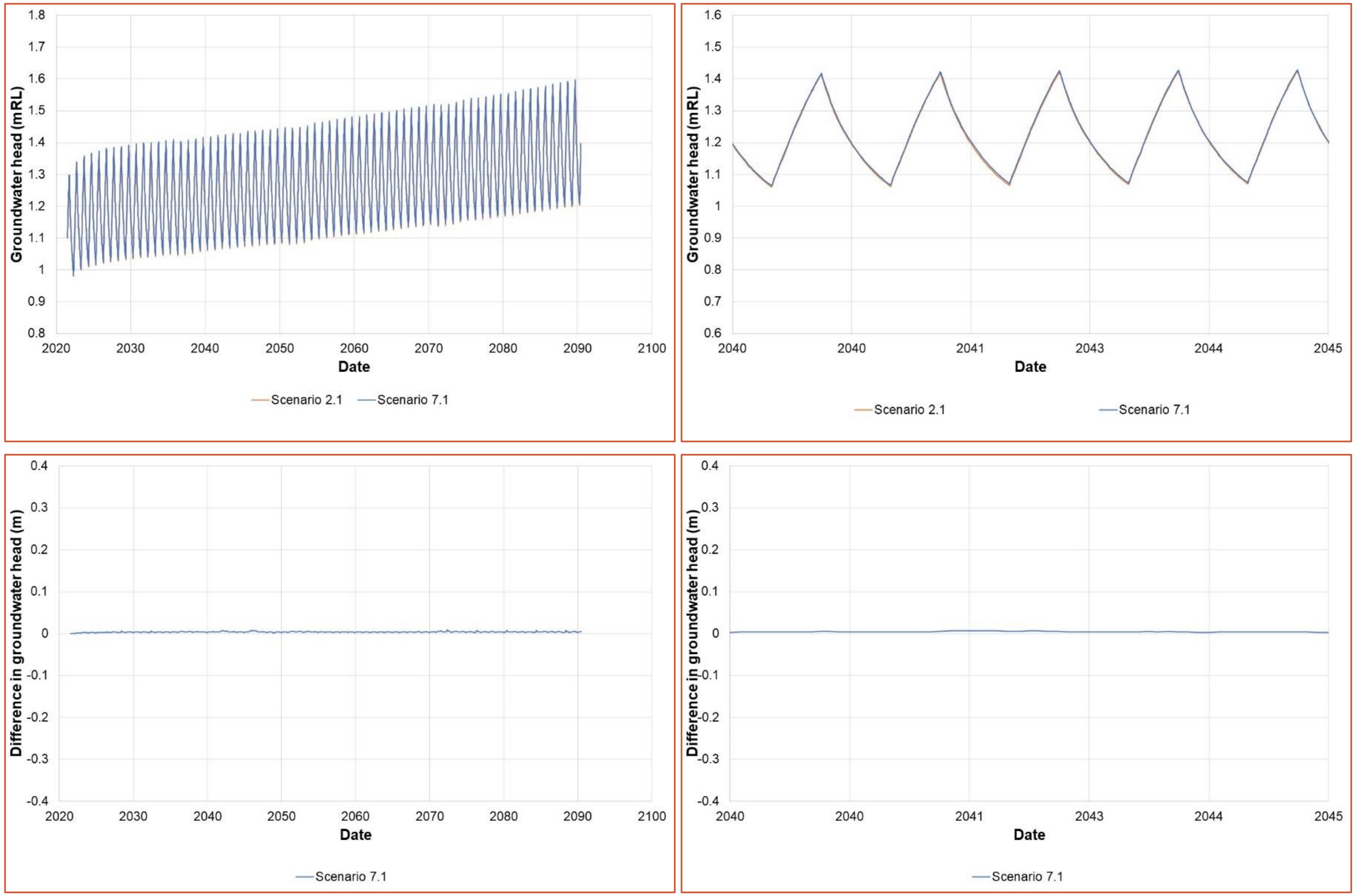


Figure 35: Effects of Sustainable Allocation Scenario on Te Hapara Sand Aquifer at GPA003

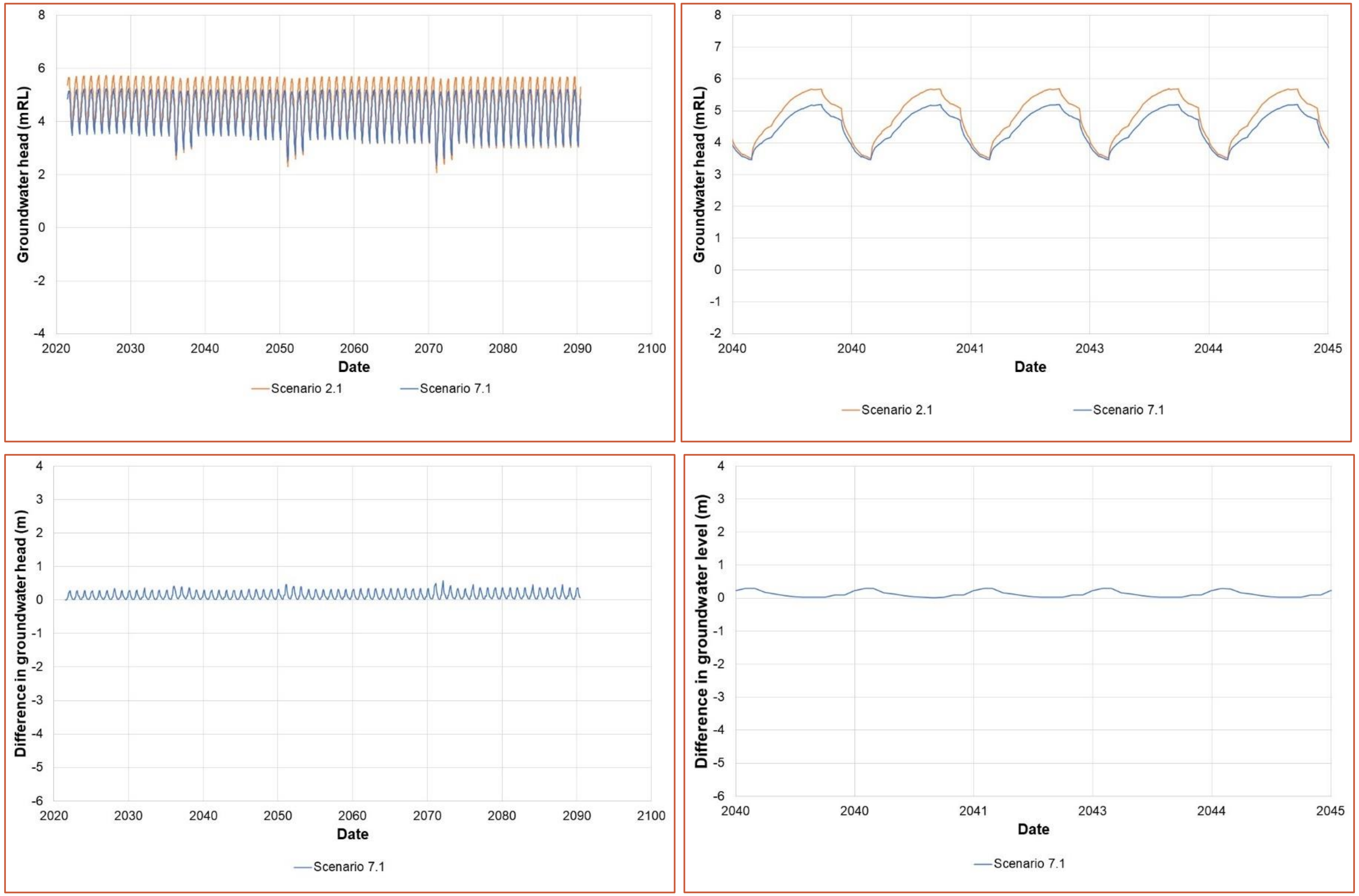


Figure 36: Effects of Sustainable Allocation Scenario on Makauri Aquifer at GPJ040

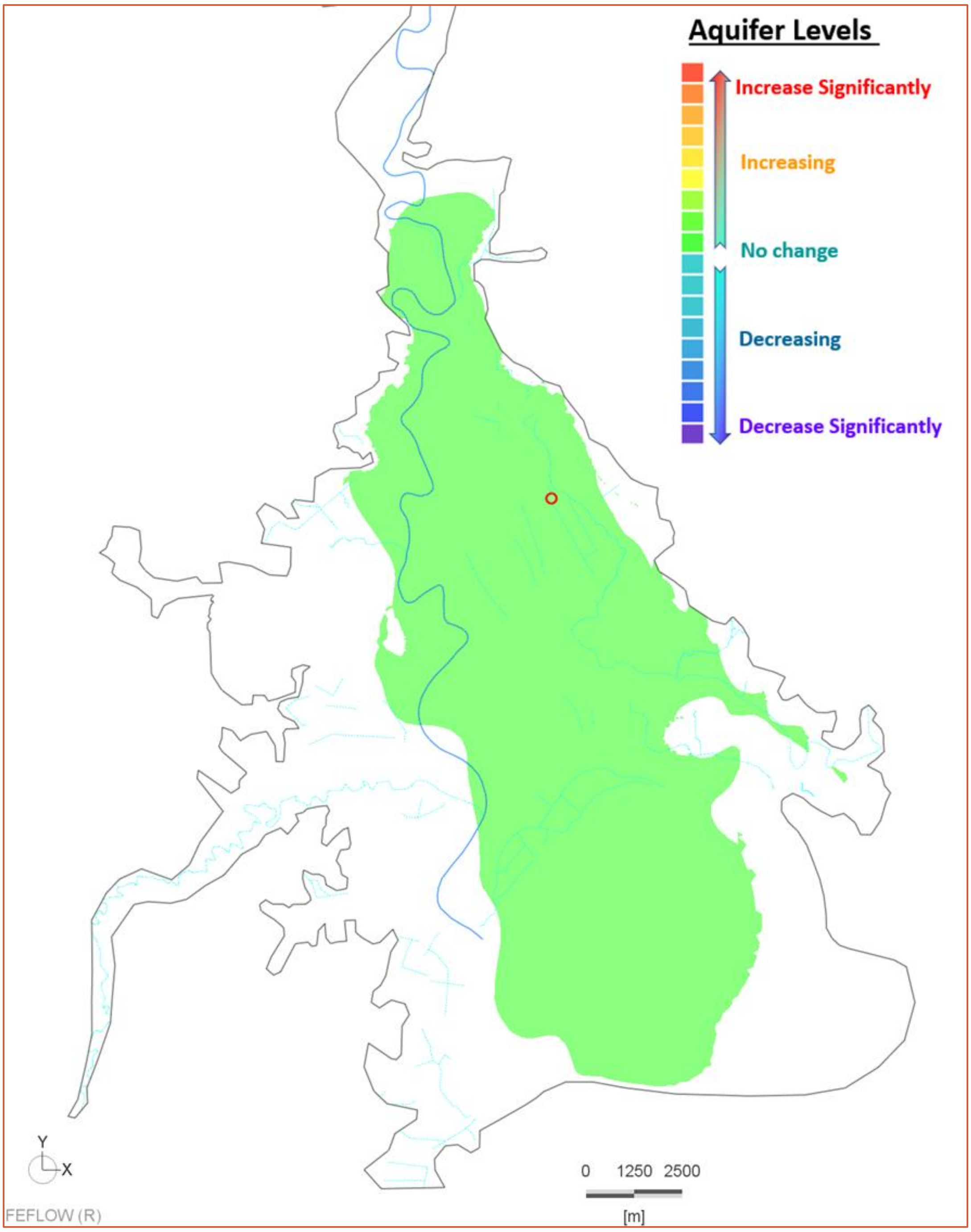


Figure 37: Effects of Scenario 7.1 on Makauri Aquifer – September 2045

4.6 AQUIFER WATER BALANCES

4.6.1 Introduction

Water balances for the aquifers underlying the Poverty Bay Flats for each of the simulated Round 2 scenarios are summarised in tables presented in Appendix C. The water balance outcomes presented in Appendix C focus on total annual inflow and total outflow volumes for individual aquifers and annual pumped MAR and abstraction volumes for the same aquifers.

Spreadsheets providing full model outcomes in terms of aquifer groundwater flow balances for each of the Round 2 simulations have been provided separately to GDC. These spreadsheets provide simulation results for each modelled timestep and compilations of inflows and outflows on an annual basis.

Volumetric groundwater storage has not been tracked in the FEFLOW model, with groundwater levels being used as the key indicator of storage condition. The main reasons groundwater storage has not been tracked for the aquifers are:

1. The confined aquifers have a negligible change in stored water, year on year. Seasonal changes in groundwater storage in the underlying and overlying aquitards may equal or exceed the storage changes in a confined aquifer. Groundwater storage changes in the aquitards are difficult to quantify and to allocate to individual aquifers for water budget purposes.
2. There is substantially less information available on aquifer and aquitard storage characteristics than on the permeability characteristics for the corresponding units. Therefore, the uncertainty attached to any calculated storage is large relative to any potential annual change in annual water storage.
3. The annual changes in groundwater storage in the confined aquifers are likely to be very small compared to the overall volume of groundwater stored in the aquifers and aquitards underlying the Poverty Bay Flats.
4. Operationally, changes in groundwater pressures and levels are far more important and can be more easily monitored than changes in stored water volumes.

For the purposes of calculating aquifer water budgets, it is assumed that annual changes in stored water volumes within each aquifer are negligible.

4.6.2 Reporting Periods

For the purposes of Regional Plan reviews, GDC requested aquifer budgets for the years 2025, 2035 and 2045. However, the agreed model scenario setups do not lend themselves well to reporting aquifer budgets for these precise years. For example, 2035 is impacted by the early stages of a simulated drought season (Figure 38). Additionally, model results vary slightly year on year, even if the model input stresses in terms of rainfall and irrigation demands remain stable for several years. Therefore, ‘normal’ years are better evaluated by averaging the results from periods covering several similar years.

Furthermore, planning groundwater budgets based on ‘normal’ year rainfall and irrigation requirements does not take into account the need to plan for and accommodate significant drought periods. Calculating fixed groundwater allocations based on ‘normal’ years may not provide sufficient flexibility to address short term water supply security issues that may arise out of significant droughts. Therefore, aquifer water budgets for key drought years have also been evaluated.

To better inform GDC on the simulated annual groundwater budgets for each scenario, a series of reporting periods have been designated, as shown in Figure 38. Average annual water budgets for each simulated scenario are calculated for each of the designated reporting periods. In the case of the deepest drought years, identified by arrows in Figure 38, the budgets relate to a single modelled year. Note: the modelled year is the calendar year (Jan to Dec) rather than an irrigation year (Jul to Jun). The tables presented in Appendix C summarising annual water budgets under each model scenario has one column covering each designated reporting period. The groundwater budgets for the Makauri Aquifer presented in Section 4.6.3 are also summarised against these reporting periods. The 'normal' periods and drought years identified in Figure 38 approximately correspond to the reporting years for the assessment of annual flow budgets to surface waters (Figure 34).

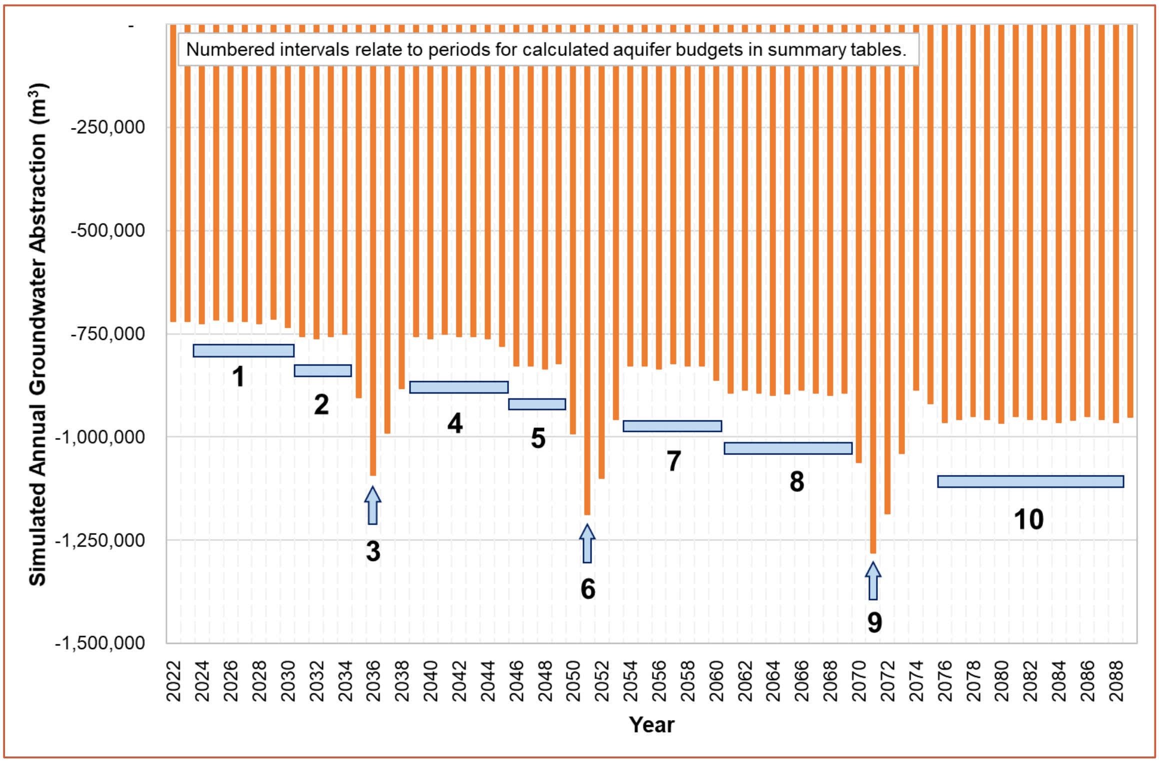


Figure 38: Designated Reporting Periods for Aquifer Water Budgets

4.6.3 Makauri Aquifer Water Budgets

As an example of the aquifer water budget outcomes, the results for the Makauri Aquifer derived from each of the simulated projection scenarios are summarised in Table 14. Presented are total annual inflows and total annual outflows to and from the aquifer, together with annual enhanced recharge amounts and annual groundwater abstraction amounts. Table 14 does not present all components of the aquifer budgets. However, it does represent the total through-flow for the aquifer and the manageable components of the aquifer water budgets (abstraction and enhanced recharge) for the listed scenarios. The key points to be taken from Table 14 relate to the lines of red text in the table. The Periods refer to the modelled time periods and droughts presented in Figure 38.

Table 14: Example Water Budget: Makauri Aquifer Total and Manageable Water Balance Components Under Different Projection Scenarios

Scenario / Parameter	Annual groundwater flows – averages for defined periods / single year result for defined drought years									
	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10
	2024 - 30	2031 - 34	2036	2039 - 45	2046 - 49	2051	2054 - 60	2061 - 69	2071	2076 - 88
Scenario 1.1 Current										
Total inflow	2,494,108	2,494,987	2,504,212	2,494,932	2,494,743	2,494,887	2,495,961	2,493,581	2,494,953	2,495,312
Total outflow	-2,494,088	-2,494,992	-2,504,683	-2,494,940	-2,494,745	-2,494,903	-2,496,029	-2,493,540	-2,494,971	-2,495,349
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-846,909**	**-846,860**	**-853,482**	**-847,130**	**-846,860**	**-846,710**	**-847,902**	**-846,185**	**-846,710**	**-847,447**
Scenario 2.1 Climate Change + Droughts										
Total inflow	2,490,192	2,514,172	2,820,313	2,507,311	2,563,888	2,896,820	2,562,698	2,609,959	2,973,276	2,660,561
Total outflow	-2,490,269	-2,514,180	-2,818,835	-2,507,484	-2,563,879	-2,894,435	-2,562,909	-2,609,883	-2,970,762	-2,660,676
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-849,307	-889,204	-1,284,812	-894,032	-973,833	-1,396,668	-979,256	-1,049,148	-1,505,972	-1,126,868
Scenario 3.1 Natural State										
Total inflow	1,944,269	1,978,778	1,946,260	1,931,345	1,929,473	1,796,652	1,948,212	1,903,661	1,759,470	1,913,493
Total outflow	-1,944,224	-1,979,088	-1,946,489	-1,931,325	-1,929,449	-1,795,506	-1,948,380	-1,903,482	-1,758,204	-1,913,548
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Scenario 4.1 Current Consented Allocation										
Total inflow	3,338,650	3,414,394	4,309,787	3,410,181	3,573,808	4,571,541	3,575,818	3,729,429	4,830,299	3,885,291
Total outflow	-3,338,644	-3,414,166	-4,307,013	-3,410,691	-3,573,397	-4,566,944	-3,576,142	-3,730,010	-4,827,589	-3,885,420
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-1,911,232**	**-2,001,210**	**-2,893,421**	**-2,011,630**	**-2,191,450**	**-3,147,745**	**-2,203,238**	**-2,361,132**	**-3,391,550**	**-2,535,750**
Scenario 5.1 Groundwater Replenishment										
Total inflow	2,771,767	2,806,104	3,066,442	2,809,198	2,884,317	3,165,624	2,892,116	2,956,777	3,262,168	3,031,424
Total outflow	-2,771,810	-2,806,138	-3,065,107	-2,809,284	-2,884,335	-3,163,365	-2,892,294	-2,956,702	-3,259,733	-3,031,492
Wells recharge	**607,435**	**630,230**	**629,568**	**644,692**	**690,216**	**690,000**	**702,949**	**744,354**	**744,000**	**797,878**
Wells abstraction	-849,327	-889,223	-1,284,757	-894,059	-973,819	-1,396,708	-979,275	-1,049,177	-1,506,016	-1,126,802
Scenario 7.1 Sustainable Allocation										
Total inflow	2,400,094	2,418,995	2,669,898	2,411,918	2,457,528	2,729,815	2,455,969	2,493,772	2,791,689	2,533,194
Total outflow	-2,400,161	-2,419,011	-2,668,753	-2,412,080	-2,457,525	-2,727,888	-2,456,149	-2,493,704	-2,789,548	-2,533,209
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-721,933**	**-755,822**	**-1,092,173**	**-760,163**	**-827,734**	**-1,187,168**	**-832,523**	**-891,821**	**-1,280,076**	**-957,962**

Note: Values in red font indicate key differences when compared to Scenario 2.1., Periods refer to Periods shown in Figure 38.

Scenario 1.1, which represents a continuation of the current baseline based on the existing climate and groundwater abstraction conditions, shows no significant change in any of the water budget components into the future. Given the measurable effects being witnessed from climate change, this is not considered a realistic scenario for future prediction purposes. Scenario 2.1, which incorporates the added climate change effects including regular simulated droughts and increasing demands, shows an ongoing increase in groundwater abstraction from the Makauri Aquifer. The total inflows and total outflows for the aquifer remain well balanced into the future, even during drought years. This implies that the additional abstraction is accommodated by increasing downward flows from overlying aquifers and increased in flows from the northern end of the aquifer linked to the Waipaoa River. However, the increased abstraction does then result in decreasing groundwater pressures within the aquifer.

Scenario 3.1, in which all groundwater abstraction has ceased, shows a significant reduction in aquifer through flow. This outcome highlights the effect pumping has on groundwater flows into the aquifer. Increased pumping is associated with both increased pressure drawdown, which then causes increased recharge to the aquifer from surrounding strata and a new dynamic equilibrium is reached. Conversely, reducing the annual volumes of water abstracted does not automatically mean the aquifer inflows and outflows become more balanced. Such a reduction simply leads to a different flow and pressure equilibrium. This aspect of groundwater management for the Poverty Bay is considered further in Section 5.3.

Scenario 5.1, in which groundwater replenishment to the Makauri Aquifer is applied, indicates that enhancing recharge results in a significant increase in outflows to the adjacent strata. Although groundwater abstraction volumes under this scenario are simulated as in Scenario 2.1, the total outflows from the aquifer are substantially higher. These outflows will be partly accommodated in storage within the overlying and underlying strata which would then be available for drawdown during subsequent years. Some of these outflows will also move to overlying and underlying aquifers through diffuse seepage, leading to groundwater pressure increases in these aquifers.

Scenario 7.1, which represents a nominal sustainable allocation scenario, shows reduced abstractions under ‘normal’ years for much of the projected future. However, it does include an allowance for increased pumping in response to drought years in response to climate change effects. The simulations indicate winter high groundwater pressures would recover following these increased drought year abstractions, even though it may take several years for this to occur. This scenario is discussed further in the Section 5.3.

THE Tairāwhiti Resource Management Plan (TRMP) is slated to be prepared and ready for publication consultation in 2024. This plan will include Freshwater Planning chapter which this model is anticipated to provide input for decision making.

4.7 VERTICAL HYDRAULIC GRADIENTS

One of the key concerns with respect to protection of groundwater quality in the confined aquifers is the maintenance of vertical hydraulic gradients between aquifers. Groundwater seepage flows from higher pressure to lower pressure areas, both within aquifers and between aquifers. In natural groundwater recharge areas, the hydraulic gradients tend to be downward, with the shallow aquifer's having a higher groundwater pressure. In areas where the confined aquifers are discharging groundwater toward surface, the deeper aquifer will have a higher pressure than overlying shallow aquifers.

In terms of potential risk to groundwater quality arising from human activity, in most cases contaminants are transported in accordance with groundwater flow patterns.

In the case of the confined aquifers underlying the Poverty Bay Flats, issues of potential concern are:

1. Changes in the distribution of existing contaminants (salt) in the aquifers or adjacent aquitards in response to changes in groundwater flow patterns.
2. Enhanced saline water intrusion to the aquifers along the coastline (salt) in response to projected changes in sea level or drawdown in aquifer hydraulic pressures.
3. Reversal of hydraulic gradients in areas that were formerly relatively protected from contaminant risks due to natural upward groundwater flows.

The first two issues have been addressed elsewhere in this report (Sections 4.4.4 and 4.5). The third issue is considered below.

Vertical hydraulic gradients between the confined aquifers and the shallow unconfined aquifers vary across the Poverty Bay Flats. A detailed description of the distribution of vertical gradients between aquifers under existing and projected conditions is outside the scope of this summary report. Plots of vertical hydraulic gradients have been presented for selected monitored wells to support model documentation in numerous sections of the AQUASOIL (2022) report. However, the concepts and consequences of changes in vertical hydraulic gradients under the different modelled projections can be demonstrated by summarising the model outcomes for one representative bore, GPD129, located in the southern central area of the Poverty Bay Flats.

Under winter conditions the Matokitoki and Makauri aquifers at GPD129 have higher simulated groundwater pressures than the overlying Waipaoa and shallow unconfined aquifers under existing conditions (Figure 39). Groundwater pressure and therefore seepage flows between the deeper and shallower aquifers are upward. This pattern does not change substantially between modelled Scenarios. Scenario 4.1, in which current groundwater allocation is fully utilised, shows the largest impact on winter hydraulic gradients at this location. Even under this scenario the hydraulic gradients remain upward. The main simulated winter groundwater head differential is between the Makauri and Waipaoa Aquifers.

In contrast, the simulated vertical hydraulic gradients at GPD129 during summer (Figure 40) show substantial differences between scenarios, even though this bore is not in the main area of groundwater abstraction. Under Scenario 2.1, in which climate change projections are considered, the simulated pressure at each of the aquifers is similar and the modelled upward hydraulic gradient has effectively disappeared. Under Scenario 4.1, in which current groundwater allocation is fully utilised, the vertical hydraulic gradient between the Waipaoa Aquifer and the Makauri Aquifer has reversed. Although this means that the Makauri Aquifer is now receiving groundwater additional recharge from the overlying aquifers in this area, it also means that any contaminants in the overlying aquifers may be drawn downward toward the Makauri Aquifer.

The consequences of groundwater management measures applied under Scenarios 3.1, 5.1 and 7.1 are also clear to see in Figure 40. Scenario 3.1, which incorporated no groundwater abstraction, shows summer groundwater levels and pressure gradients very similar to the winter conditions. Scenario 7.1 results indicate the upward summer hydraulic gradient at GPD129 has been maintained, although at a somewhat reduced gradient. The application of enhanced recharge under Scenario 5.1 also helps to protect the upward summer hydraulic gradient at GPD129, even though the closest simulated MAR locations are approximately five kilometres northwest from GPD129.

The model results from GPD129, as summarised in Figure 39 and Figure 40, do not represent an extreme range of effects arising from the various scenarios. The seasonal effects of pumping induced drawdown increase to the north of GPD129, as do the effects of the simulated enhanced recharge programme. This section of the report simply indicates the relative effects from the various projection scenarios that may be reasonably expected to apply across much of the southern Poverty Bay Flats.

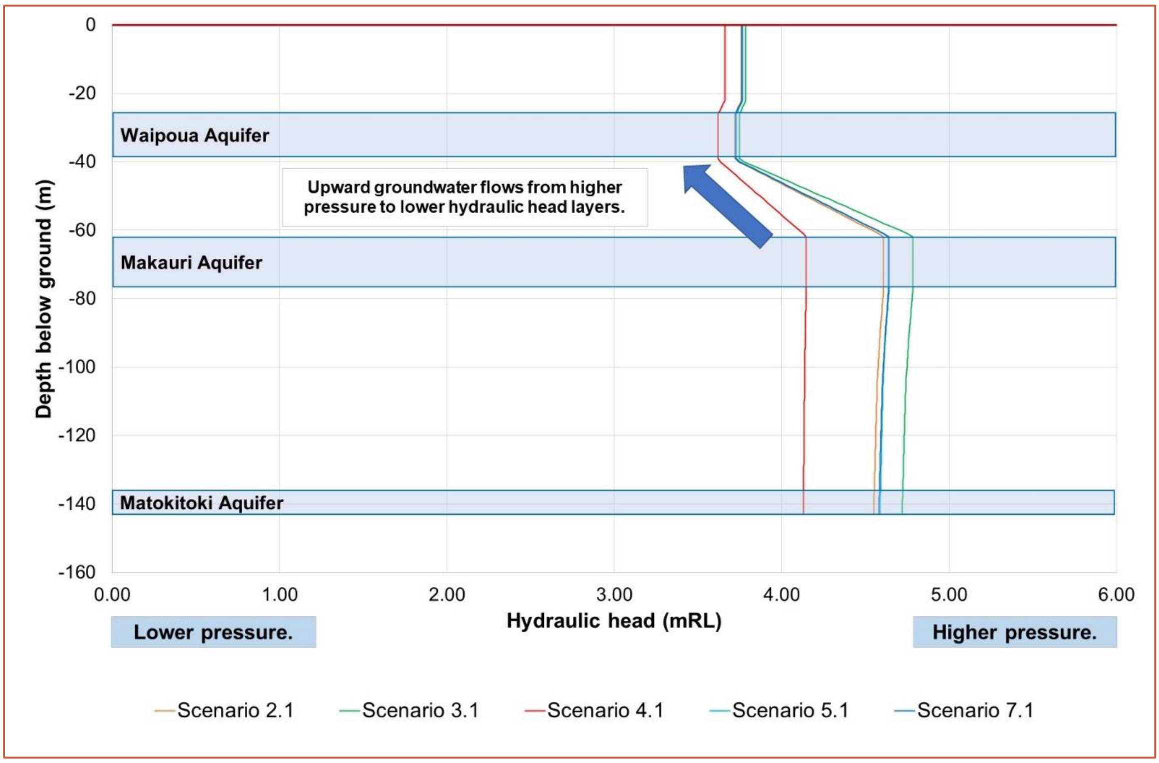


Figure 39: Winter Vertical Hydraulic Gradients at Monitored Well GPD129

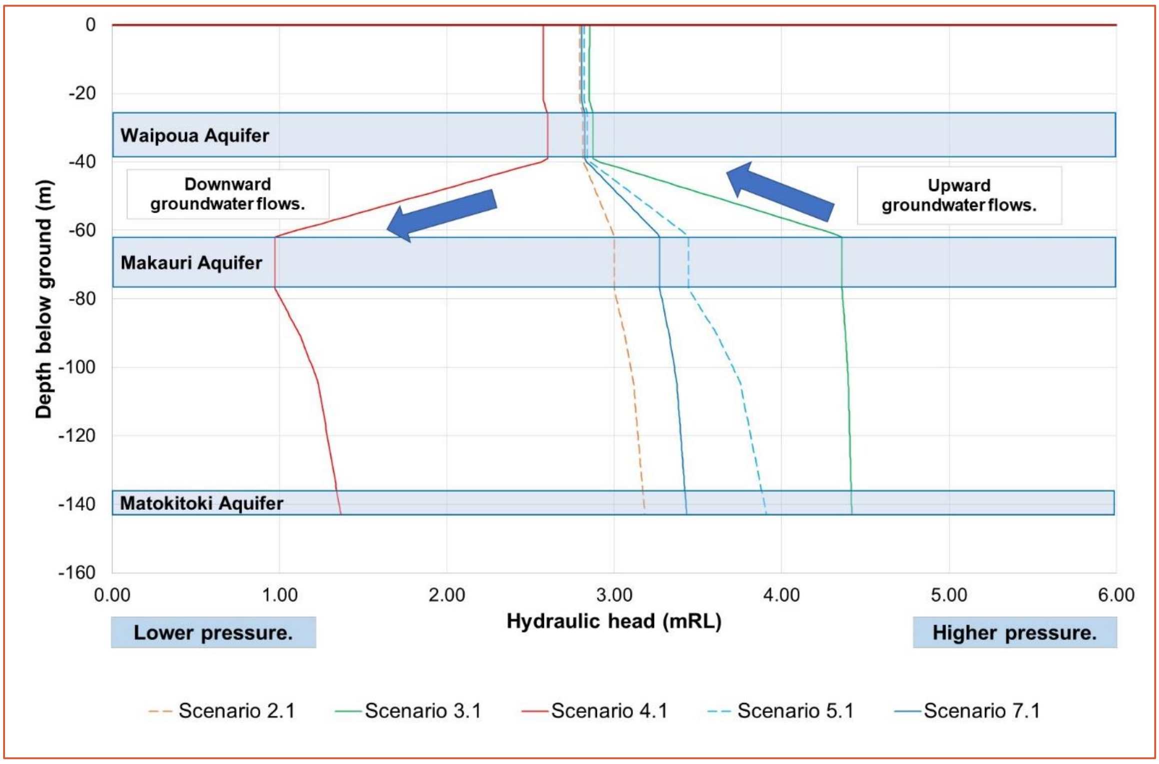


Figure 40: Summer Vertical Hydraulic Gradients at Monitored Well GPD129

4.8 SCENARIO ASSUMPTIONS AND LIMITATIONS

There are several areas where a defensible conceptual groundwater model was unable to be developed that exactly matched the field observations. In some cases, there was more than one reason for a discrepancy for a specific area, but insufficient field data was available to support one concept over another. Collective decisions were made by the team (WGA, GDC and AQUASOIL) regarding how to proceed with the numerical model. In each case the modelling team have taken the more conservative and defensible option when faced with such choices. In making these choices we have:

- Avoided extrapolating aquifer extends beyond what can be reasonably defined from the drillhole geological database, even when we consider that the aquifer very likely extends further based hydraulic behaviour. The one exception to this is the Makauri Aquifer, which is extended offshore for several reasons, with the extent of this extrapolation being evaluated in the conceptualisation report (WGA 2022a).
- Avoided incorporating hydraulic boundary conditions that could improve the statistical “model calibration” but are conceptually indefensible and would potentially lead to an inappropriate addition of water to the aquifers under some of the predictive scenarios.

WGA considers that it is better to know where the model has less than ideal performance and having some understanding of the reasons for the issue than to force the calibration and subsequently produce over-optimistic long-term predictive outcomes.

The main areas that come to mind where these decisions have been made are:

- The western saline area of the Makauri Aquifer
- The eastern edge of the Matokitoki Aquifer
- The southern extents of the Makauri and Matokitoki aquifers toward the coastline and potentially offshore

<u>Western Saline Area of Makauri Aquifer</u>

It is reasonably clear that the Makauri Aquifer extends further to the west than is represented in the numerical model, including under the Te Arai River flats. However, there is a lack of geological information from drilling in this area. Furthermore, the information that does exist on bore structures and groundwater quality appears locally contradictory. No satisfactory conceptualisation of the Makauri Aquifer structure in this area of the model has been achieved. Therefore, rather than incorporating a questionable interpretation of the aquifer layout and behaviour, the simulation of the western saline area of the Makauri Aquifer has been excluded from the numerical groundwater flow model. Chloride is introduced to the western edge of the Makauri Aquifer through applying groundwater quality boundary conditions that support a partial simulation of groundwater quality trends in this area. Although acceptable for the purposes of this modelling programme, we recognise that this area of the model can be significantly improved following further field investigations and testing.

<u>Matokitoki Aquifer</u>

The hydraulic head in the eastern part of the Matokitoki Aquifer is systematically underestimated by the model. The calibration process undertaken on the numerical model has shown that the issue is not related to the hydraulic parameters applied to aquifers and aquitards. This underestimation is caused by a structural deficiency incorporated in the conceptual and numerical models, which in turn is caused by a lack of knowledge of the aquifer structure in the area.

The underestimation of the hydraulic heads could be addressed numerically through providing a source of lateral seepage inflow to the model from the east. However, this addition of groundwater is difficult to support conceptually. There are limited areas of Tertiary age sandstones forming hills to the east of the area affected, just outside the model boundary. If recharge to these Tertiary sandstones was flowing to the Matokitoki Aquifer, this would help to address the head underestimation issue. This possibility was considered and discounted during conceptualisation of the groundwater flow model. Tertiary siltstones underlying the sandstones would act to restrict potential seepage flows down into the confined aquifers. Furthermore, similar inflows should affect groundwater levels in the Makauri Aquifer and there is no evidence of this occurring.

It was decided to accept a poorer groundwater level calibration in this area rather than applying a questionable hydraulic boundary condition to introduce lateral inflows to the aquifer and thereby achieve a "better" calibration. Additional inflow to the model that is not supported by any acceptable conceptual hydrogeological understanding would make the model less conservative because of the additional availability of water. Such a boundary condition would support increased or even almost unlimited groundwater abstraction from this area of the Matokitoki Aquifer. Such an outcome is unlikely to reflect the reality of the Matokitoki Aquifer hydraulic behaviour.

It is important to recognise that a more “statistically accurate” model calibration is not a goal in itself. Furthermore, WGA consider that a model should not be built and calibrated independent of its intended application. In this case, the main application is the testing of the effects of groundwater abstraction and climate change on the groundwater system. Therefore, this “fit for purpose” model is a little conservative in its approach. The calibration process must support a predictive model that is as reliable as possible. Where uncertainties or calibration discrepancies arise, these can provide guidance for further field observations and testing, followed by subsequent improvement of the conceptual and numerical models. This process is referred to in the modelling philosophy presented in the conceptual groundwater modelling report (WGA 2022).

5 MODEL APPLICATIONS AND IMPLICATIONS

5.1 QUALITATIVE SUMMARY OF SCENARIO OUTCOMES

Modelled scenario outcomes have been interpreted to provide qualitative responses to the questions that have arisen out of the community engagement workshops held in 2022 (Table 15). Simulation of the various scenarios described in this report does not provide absolute answers to all of the questions. However, the results do provide guidance on which groundwater management measures can help to begin to develop management options to address key areas of community concern. This information can inform the development of a combination of mitigations and management measures that may be incorporated in the upcoming GDC regional planning process.

In review of qualitative summary results, it is important to note that the baseline Scenario 1.1 model results indicate a 'stay the same' outcome for Poverty Bay aquifers. Whilst WGA acknowledges that the monitoring data indicates 'worsening' trends in groundwater levels, the baseline scenario was established as a steady-state reference condition. The model outcomes indicate that trends of increasing salinity in some aquifer areas can be expected to continue, even if nothing else changes.

The climate change effects incorporated into Scenario 2.1 result in worse outcomes for aquifer groundwater levels, cultural, surface ecosystems and salinity. As the outcomes from all the following scenarios are compared against Scenario 2.1, the increasing water demands and therefore abstraction, coupled with sea level rise and declining natural recharge have an overarching effect across all the scenario qualitative comparisons. Incorporated into this baseline scenario were also evaluation of the community questions were specific to the effects of extreme dry weather and climate change. Whilst the effects of these issues form the basis of all the modelled scenarios, the only scenarios that offer potential long term aquifer status improvements in the face of climate change are linked to substantially reducing the amount of water abstracted or increasing the amount of water being replenished.

The worst model outcomes arise from Scenario 4.1 Entitled Full Allocation, where every year (year in year out) groundwater abstraction is used to the full extent of the current 2021 paper allocation. As individual groundwater abstraction consents are designed to provide enough allocation to provide irrigators with water through drought periods, the year-to-year use of all allocated water is not considered a reasonable expectation. During a particularly wet summer, for example, the pumping of groundwater would not be needed or desired due to the costs of applying water to already wet crops and orchards. Under this scenario the model indicates worse outcomes across all of the assessment categories.

With respect to the cultural indicators assessed, none of the modelled scenarios lead directly to improved outcomes. This does not mean that improvements for culturally important are not achievable as many of the modelled options were not spatially located or conceptually designed to specific benefit cultural values. However, it does provide guidance on the nature of how these envisioned groundwater issues impact on cultural values and provides an opportunity to develop mitigations that potentially could be designed to address these issues. There are four main reasons why improvements against cultural value criteria were not achieved by any of the models:

1. The cultural values, as with the other values considered, have been focused on a narrow range of agreed criteria. Cultural values may indeed have better outcomes if measured against other criteria under some of the simulated scenarios, but the existing models have focused on monitoring the agreed criteria.
2. The effects of climate change have overriding long-term impacts on each of the chosen cultural criteria against which the models have been assessed. In fact, even if groundwater abstraction were to cease (Scenario 3.1) the model indicates sea level rise and changes in rainfall patterns are likely to override any potential positive changes in groundwater levels and flows. For example, a close of groundwater abstraction will not necessarily prevent coastal saline water intrusion and associated water quality impacts on coastal springs.
3. Surface drainage systems which have a direct effect on the cultural values have not been changed in the models. Some of the coastal effects on shallow groundwater are related to drainage rather than groundwater abstraction. Therefore, the effects are consistently worsened simply as a consequence of sea level rise.
4. Enhanced replenishment was applied to one small area under Scenario 5.1. Although this recharge led to positive outcomes for several of the values considered, it was applied in an area distant to any of the cultural values under consideration. If the aquifer replenishment had been applied in different places in order to safeguard particular issues, for example perhaps targeting the key cultural indicators, the outcomes would potentially have been different.

The models indicate likely improvements to some values under the Natural State (3.1), Replenishment (5.1) and Sustainable Rate (7.1) scenarios. Each of these scenarios works to pull one of the two main levers (groundwater replenishment and abstraction allocation management) that GDC have to better manage the Poverty Bay aquifer system: take less water out or recharge more clean water in.

Reducing the rate at which water is taken out of the aquifers (Scenario 7.1) results in improved aquifer and ecosystem outcomes but does not change the outcomes for the chosen cultural criteria or salinity indicators. Turning off all groundwater pumping (Scenario 3.1) would result in groundwater levels and baseflows in the surface water ecosystems increasing. However, salinity issues are unlikely to be reversed (and therefore are considered to stay the same) and cultural indicators are still likely to worsen, as discussed above. The modelled enhanced replenishment into the Makauri Aquifer (Scenario 5.1) would also locally improve aquifer levels and reduce water moving from other aquifers to offset abstraction. But the simulated enhanced recharge is not likely to significantly influence the surface water systems due to its focus on a deep confined aquifer. The model outcomes do suggest that strategically located replenishment is the only scenario variant that offers potential opportunities in saline water intrusion management.

The results of the Exploratory Scenario modelling process have provided a spectrum of possible mitigations and management options that may be used to better inform management planning for the Poverty Bay groundwater system. The FeFlow numerical groundwater model can be used to help bring together aspects of various scenarios into a cohesive set of measures to address the identified issues propagated by climate change.

5.2 KEY RISKS

It is important to keep the following key objectives of the groundwater modelling project in mind when considering the outcomes from the numerical modelling.

1. What are the risks to water supply security, cultural and environmental values arising from the "business as usual" Scenario 2.1?
2. Do the other simulated scenarios address the identified risks to water supply security, cultural and environmental values?
3. Do the other simulated scenarios provide guidance with respect to addressing the identified risks

Based on the outcomes from the "business as usual" Scenario 2.1, the key risks to water supply security, cultural and environmental values are:

1. On-going pumping causing an eastward spread of saline water into the Makauri Aquifer from the Western Saline Aquifer.
2. Pumping causing saltwater from the ocean entering the Makauri Aquifer.
3. Pumping causing reduced flows in the Waipaoa River during summer.
4. Sea level rise causing increased flows from the ocean toward Awapuni Moana, leading to increased salt concentrations in the drains.
5. Ongoing overarching and increasing effects of climate change to the sustainability of this groundwater system.

Monitoring of the groundwater system has shown that some of these effects are already happening. The following sections consider aspects of the risks listed above and summarised in Table 15 and their management options.

Table 15: Qualitative Responses to Community Questions Based on Model Outcomes

Summary Community Questions	Investigation Exploratory Scenarios (1)		Human Usage	Aquifer Status	Cultural	Surface Water Ecosystems	Salinity
What is the current status of the different aquifers and are they declining? How is climate change including extreme dry weather (droughts) expected to impact groundwater?	Baseline	1.1	Current	Stay the Same	Stay the Same	Stay the Same	Worsen
	Baseline + Climate Change	2.1	Current	Worsen	Worsen	Worsen	Worsen
What effects would occur if Te Mana O Te Wai was placed above commercial use?	Natural State	3.1	Zero	Improve	Worsen	Improve	Stay the Same
What happens if allocations are used to full entitlement?	Entitled Allocation	4.1	Full 2021 Allocation	Worsen	Worsen	Worsen	Worsen
What effect would replenishment have on groundwater levels?	Groundwater Replenishment	5.1	Current	Improve	Worsen	Stay the Same	Improve
What is a sustainable allocation rate?	Sustainable Allocation	7.1	*Variable*	Stay the Same	Worsen	Improve	Worsen

Note: 1) A Scenario 6.0 related to groundwater replenishment was generated for the 1st round of model scenarios but was incorporated into Scenario 5.1 in the 2nd round.

5.3 SUSTAINABLE ALLOCATION

In terms of this groundwater modelling process, a general definition of sustainable allocation has been provided in Section 3.5.6. As described in the AquaSoil (2022) report, a simplified numerical definition of sustainable abstraction has been applied when modelling Scenario 7.1. In effect, the amount of simulated abstraction was reduced to a degree that groundwater levels and hydraulic potential do not decline below currently observed levels. This was achieved in the modelled scenario for the period through to 2050, after which further reductions in abstraction rates or the use of other tools would be necessary to prevent drawdowns exceeding the currently observed ones.

The reduction in groundwater abstraction by approximately 15%, as simulated under Scenario 7.1 and documented in Appendix C, results in groundwater pressures not declining below what has already been observed through until 2050. Base flows in surface water bodies increased in this scenario, with implied improvements in surface water ecosystems. However, this scenario did not result in key agreed cultural and water quality values being protected.

The concept of a sustainable groundwater allocation is intimately linked to the values that GDC is seeking to protect, and the ‘real world’ means that may be available for management. The results from each of the modelled scenarios, combinations of the modelled scenarios and any future modelled scenario should be considered in terms of protecting ‘real world’ values rather than simply and solely seeking to maintain groundwater levels.

Climate change complicates the evaluation because changing weather patterns will lead to ongoing increases in other stresses on the freshwater ecosystems, culturally valued features, and water quality conditions which are not directly linked to the changes in groundwater. Therefore, the management settings and techniques used to protect these values will require a comprehensive approach including land use, river management and human water supplies. The mitigations applied in the shorter term will likely need to be augmented and changed over the longer term as climate change effects become more pronounced.

The overall model results indicate increased pumping up to the currently consented allocation limit does not present a significant risk to regional water supply security in terms of the volumes of groundwater available. Increased modelled pumping from baseline conditions causes groundwater levels to be drawn down further but the system subsequently stabilises in a dynamic equilibrium at a lower level. Increased abstraction from each aquifer is balanced by increased diffuse inflows from adjacent strata, higher aquifers and from surface water bodies. Eventually, increased takes even from confined aquifers result in reduced base flows in surface water bodies.

The outcomes from the various scenarios do not indicate there is a tipping point at which climate change does not enable the groundwater system to reach stability or a new dynamic equilibrium. In each of the simulations, a clear dynamic equilibrium has been reached even under the most extreme of the climate projections.

The modelling indicates that any on-going pumping leads directly to some of the issues listed above getting worse and even reverting to natural state conditions (no pumping) does not lead to the aquifer returning to its natural state salinity levels. The cumulative model outcomes indicate the agreed objectives for groundwater management, as summarised in Table 15, can only be achieved through applying a range of water management techniques to manage all of the issues facing the Poverty Bay Flats groundwater system.

5.4 POTENTIAL USE OF TRIGGERS FOR GROUNDWATER MANAGEMENT

Triggers defined in groundwater monitoring and management plans have been used in many parts of New Zealand to support the management of groundwater resources. In some cases, councils have established triggers that are practical and help to proactively manage the quantity and quality of groundwater relative to abstraction and changes in quality. In other instances, arbitrary triggers have been set that are not linked to how aquifers respond to seasonal pumping and recovery periods. In some cases, poorly conceived and implemented triggers have led to significant on-going consent compliance and resource management issues for both water users and regional council management staff.

The use of triggers coupled with the establishment of dedicated sentinel monitoring wells in the Poverty Bay Flats could help GDC staff to manage key groundwater management issues including over abstraction and the degradation of groundwater quality. For example, triggers may be useful to help:

a) Manage the risk of declining water storage in the Makauri Aquifer through the establishment of winter groundwater recovery targets.
b) Protect groundwater quality through the use of sentinel salinity monitoring wells along the fringes of the western saline Makauri Aquifer area. Such sentinel wells could be linked to the application of targeted recharge (with freshwater MAR) coupled with allocation management to stablise and potentially reverse salinity movement toward the more productive parts of the aquifer.
c) Reduce the risk of on-going and increasing saline water intrusion to the coastal Te Hapara Sand Aquifer and possible saline water intrusion to the coastal Makauri Aquifer through the establishment of coastal sentinel monitoring wells. The water quality and level observations from these wells could be used to measure the potential impacts of sea level rise, saline water intrusion and aquifer pressure drawdown on the groundwater resource security.

Section 3.5.1 of this report summarises declining groundwater pressure trends in several of the Poverty Bay Flats groundwater aquifers. Figure 11 presents an example of hydraulic head trends in the Makauri Aquifer at monitoring well GPJ040 that demonstrate declining winter/wet season recovery levels over time. One potential application of trigger levels linked to a sentinel well like GPJ040 would be to define a series of late winter groundwater levels (seasonal peaks). These levels would then be linked to an integrated management strategy with the objective of stabilising any declining trend in winter levels, achieving a recovery in these levels and then enhancing the utilisation of water from the aquifer without increasing the risk to future groundwater resource security. Figure 41 provides a conceptual schematic of this type of groundwater management and trigger regime which could be incorporated into a community developed groundwater management strategy process.

A set of winter trigger levels for sentinel wells could be developed through a Solutions Scenario modelling process and working with Mana Whenua and the wider community. Potentially coupling the application of enhanced groundwater replenishment techniques with adaptable allocation criteria through a regional planning process should encourage the establishment and monitoring of adaptive management measures to increase groundwater security. The establishment of these winter trigger level objectives could be informed by the modelling process, and then adapted as the actual physical mitigations take effect.

The establishment of triggers without corresponding clear and practical measures to enable users to be able to comply to the intended objectives, particularly when faced with increasing pressures from climate change, will very probably result in difficulties achieving the intended objectives. In this situation fixed objectives may be difficult or even impossible to achieve whilst also providing security of supply for those how rely on the sustainable use of this resource.

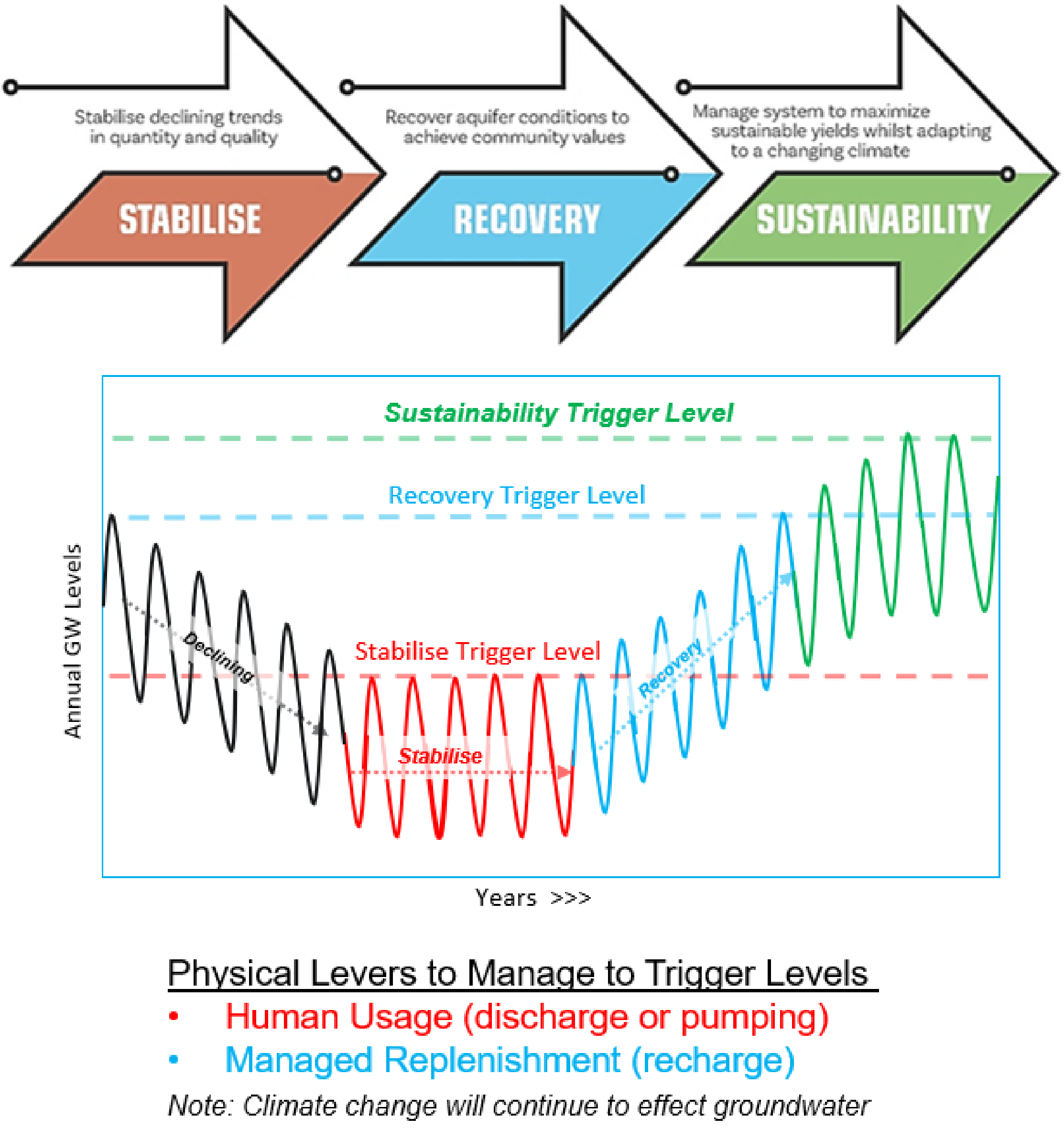


Figure 41: Conceptualised Application of Winter Trigger Levels Within a Groundwater Adaptive Management Strategy

5.5 MANAGEMENT RECOMMENDATIONS AND TRIGGERS

Based on discussion with GDC staff during a project completion workshop, WGA has provided the following management recommendations for the next phase of Solutions Scenario modelling and regional planning and science programme development (See process outlined in Figure 10).

5.5.1 Western Makauri Aquifer Salinity Management

Both the groundwater quality modelling and observed groundwater salinity trends along the western side of the Makauri Aquifer indicate continued pumping at the current rate will lead to the ongoing spread of saline water within the aquifer. It was not clear from the model results exactly how far the saline water might spread. However, there is also a balancing effect as pumping also causes additional fresh water to be drawn into the aquifer from the recharge areas at the northern end of the Poverty Bay Flats. It would take a long time for the saline water distribution within the Makauri Aquifer to reach a new balance.

Reducing the rate of modelled groundwater pumping slowed the spread of saline water within the aquifer. However, the spread was not stopped or reversed by simply reducing the pumping rate. Ceasing all pumping under the natural state scenario stopped further spread of saline water in the aquifer but it did not reverse the observed salinity changes in the short to medium term. The only scenario that presented an opportunity to reverse the observed spread of saline water in the western Makauri Aquifer was the MAR option.

It is important to reiterate here that our understanding of the extent and behaviour of the western saline area of the Makauri Aquifer is restricted by the lack of information about this area of the aquifer. It is likely that the projected spread of saline water in the western Makauri Aquifer under most predictive scenarios, including Scenario 2.1, has been underestimated. Field investigations leading to improvements in the conceptual and numerical models could address this shortcoming.

Aquifer interconnection in the western saline area of the Makauri Aquifer remains unclear. At least two wells used for groundwater quality monitoring and screened at shallower depths than the projected Makauri Aquifer elevation are characterised by elevated chloride concentrations in the water. These observations suggest an interconnection between the Waipaoa Aquifer and the Makauri Aquifer in the western area. However, until further drilling and lithology information is available for this interconnection, a clear conceptual model of these interactions is difficult conclude. Therefore the numerical model does not incorporate either aquifer extending out to these two monitoring wells.

<u>Management Measures</u>

Of the Exploratory Scenarios simulated, only the MAR scenario offered a clear option for the management of potential saline water spread within the Makauri Aquifer. Only one MAR scheme has been simulated under this project, with relatively small and focused recharge area. If the management of saline water spread in the Makauri Aquifer is an object of such a scheme, other recharge site layouts may be more effective in achieving this objective.

The simulated MAR scheme layout was not optimised in the modelled scenario for the purposes of managing saline water spread within the aquifer. Therefore, a separate assessment would be required to evaluate the effectiveness of different MAR scheme layouts and appropriate recharge rates.

The simulation of the MAR scheme, together with the field trials undertaken at Kaiaponi by GDC, has confirmed that focused recharge of clean water to the confined Makauri Aquifer results in a localised store of freshwater that does not move rapidly away from the recharge site. This concept (Figure 42) could form the basis for enhancing usable water resources within the western saline aquifer area.

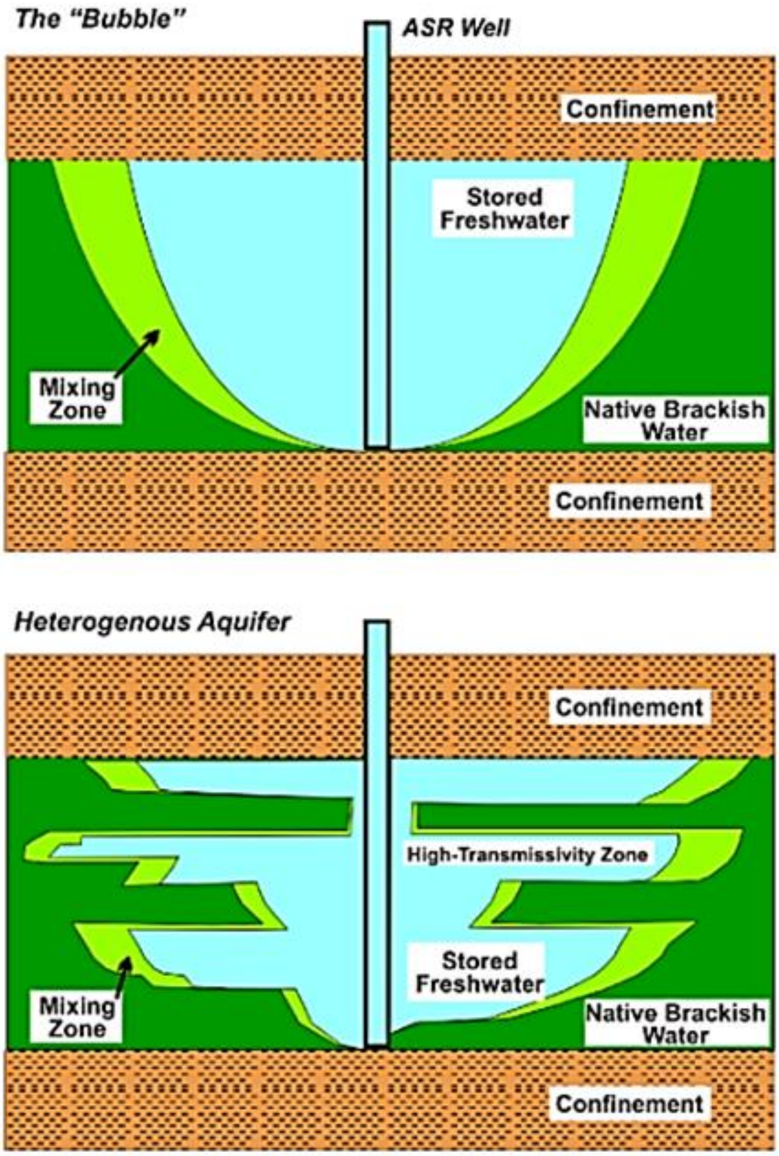


Figure 42: Aquifer Storage and Recovery Concepts (Maliva et al 2007)

<u>Monitoring and Sentinel Wells</u>

Existing monitoring of Makauri Aquifer groundwater levels and quality at GPI032, GPJ040 and GPD115 provide appropriate indicators of water quality and level trends in the western section of the Makauri Aquifer. We recommend the use of these monitoring wells as Sentinel Wells. Sentinel Wells are monitoring wells which have trigger levels for level and quality (often with electrical conductivity automated monitoring).

Additional groundwater quality and level monitoring is recommended for the Makauri Aquifer to the south of the above wells. Two additional Sentinel Wells could be designated or installed as part of future investigations into the western saline area of the Makauri Aquifer.

5.5.2 Coastal Saltwater Intrusion to Makauri Aquifer

The numerical modelling did not show any indication of saline water intrusion from the ocean to the Makauri Aquifer under the simulated Exploratory Scenarios. Appropriate calibration of the model was achieved without the need to conceptualise a direct hydraulic connection between the ocean and the aquifer. However, a slow and delayed interaction between the Makauri Aquifer, the overlying shallow aquifers and the ocean does occur in the model.

It is important to take a conservative position with respect to protecting groundwater quality in the confined aquifers underneath the coast as salinity is difficult to reverse. Drawdown of groundwater pressure in the Makauri Aquifer underneath the coast and offshore presents a clear risk off saline water intrusion developing. At present the groundwater pressure gradients between the Makauri Aquifer and the overlying shallow aquifers are upwards. The model outcomes suggest that these gradients may reverse seasonally under some groundwater increased pumping conditions, with sea level rise contributing to this change. In other words, groundwater flows that are currently upward in the area of the coast could reverse and become seasonally downward.

Further use of the Feflow model to help better quantify the consequences of saline intrusion and develop spatially specific policies or solutions is recommended for GDC to develop management policies.

<u>Management Measures</u>

The groundwater model outcomes suggest that two management options are available, should saline water intrusion become a real prospect rather than a modelled risk. A reduction in pumping from the aquifer at risk could be implemented, with the mitigation effect being immediate. The outcomes from the MAR scenario also indicate that implementing a MAR scheme close to the coast could effectively form a barrier to saline water intrusion to the confined aquifers.

<u>Monitoring and Sentinel Wells</u>

It is important to understand and monitor groundwater levels and pressure gradients close to the coast. This is a key factor enabling informed decisions on groundwater management for the confined aquifers in this area. There are currently no existing deep monitoring wells that are in a suitable location for this purpose.

We recommend that a set of monitoring wells be installed between the Awapuni Moana area and the coast. At a minimum, two wells could be installed with screens in the Te Hapara Sand Aquifer and the Makauri Aquifer. The drilling could extend to a depth that would potentially intersect any coastal section of the Matokitoki Aquifer. If either the Waipaoa or the Matokitoki Aquifer is intersected during drilling, additional monitoring wells could be installed and screened in these aquifers. These monitoring wells could be classed as Sentinel Wells and used to control abstraction rates near the coast. Groundwater levels and groundwater quality at these wells is recommended be carefully monitored to determine groundwater level and quality trends.

<u>Management Triggers</u>

We consider it appropriate to define aquifer management triggers that are linked to the above recommended Sentinel Wells. The objective of setting triggers would be to ensure that hydraulic gradients between the confined aquifers and the ocean remain in an upward direction. The triggers would be defined as the difference between mean sea level at the time and the groundwater level in the underlying aquifer.

Although a trigger could be set where the groundwater level is the same is the mean sea level, this would not take into account the potential for density driven flow to occur. In other words, the heavier salty seawater can potentially move downward into an underlying aquifer even if measurements indicate an upward hydraulic gradient.

Trigger conditions would be of value because management measures could be implemented that would achieve an immediate or short-term mitigation of the situation. For example, a reduction in groundwater pumping from bores close to the coast could be considered.

5.5.3 Waipaoa River Flow Loss During Summer

The groundwater modelling outcomes have shown that increased groundwater pumping is linked to a small reduction in flows in the Waipaoa River. For example, seasonal flow losses from the Waipaoa River increase by up to 300 m^3/day (3.5 L/s) under the consented allocation scenario (paper allocation) compared to the baseline + climate change scenario (Figure 43). This change forms a very small component of the overall flow in the Waipaoa River which would need to be verified through a hydrological assessment of the river separate than this groundwater modelling process.. However, it does need to be considered in the water balance for the river. The maximum modelled seasonal flow losses from the Waipaoa River to the groundwater system under the baseline + climate change scenario is in the order of 2,300 m^3/day.

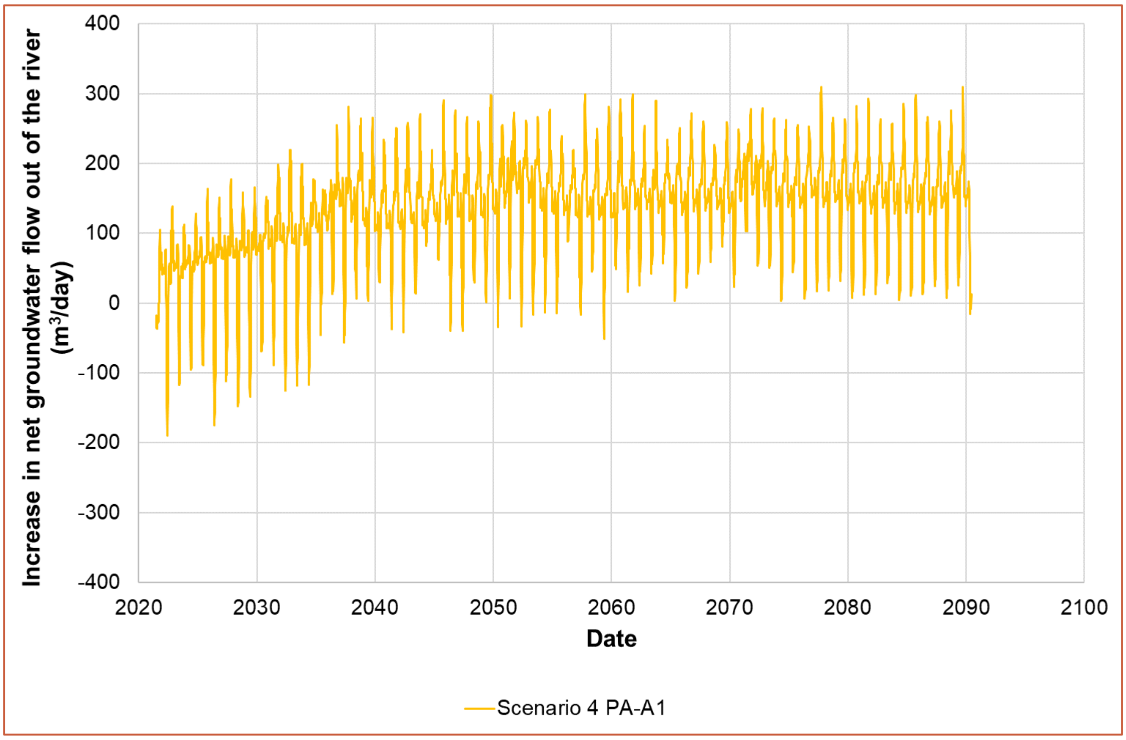


Figure 43: Reduction in Waipaoa River Flows Comparing the Consented Allocation to the Baseline + Climate Change Scenario

Management Measures

It is not clear that specific management measures need to be implemented to address the projected increases in flow losses from the Waipaoa River. Any proposed management measures would need to be considered in light of the expected ecological and cultural outcomes. Furthermore, it is not yet clear from the model outcomes what the main cause of the flow loss is. The relatively small abstractions from the shallow unconfined aquifers may be having a much larger effect on river flows than the large abstractions from the confined aquifers. This could be explored through further scenario modelling which exports the flow loss at various reaches of the river.

At this stage of the Exploratory Scenarios, we would not recommend any specific management measures be put in place.

Monitoring and Sentinel Wells

The small projected change in base flows in the Waipaoa River would be very difficult to detect using monitoring wells or river flow monitoring techniques. Changes in shallow groundwater levels that are associated with changes in Waipaoa River flows are very small and differ from well to well. Future development of Solution Scenarios of with the FEFLOW numerical modelling could be coupled with a bolt-on riverine numerical model (e.g., Mike 11) in order to improve GDC understanding of the interactions between surface and groundwater resources.

Management Triggers

No management trigger linked to groundwater levels is proposed. Any possible management trigger would need to be linked to flows in the Waipaoa River, which is outside the scope of this report.

5.5.4 Saline Water Intrusion Toward Awapuni Moana

It appears from existing observations that saline water intrusion from the ocean is already impacting on drain water quality at Awapuna Moana. However, as noted in the results section of this report, the groundwater quality model outcomes suggest that sea level rise would not lead to increased saline water intrusion through the Te Hapara Sand Aquifer toward Awapuna Moana. This appears to be a counter-intuitive outcome. Furthermore, the groundwater flow model indicates that increased sea levels lead to increased groundwater flows discharging to the Awapuna Moana drains.

The indicated groundwater flows to the Awapuna Moana drains under the baseline + climate change scenario range from 3,000 m^3/day to 13,500 m^3/day. What component of this flow comes from the ocean is not yet clear from the model. Furthermore, interpreting the effects that different modelled scenarios have on groundwater flows to these drains is complicated. This outcome reflects the difficulties in interpreting existing groundwater level and flow monitoring data from the Awapuna Moana area.

Management Measures

In light of the complicated model results, we would recommend an approach for continued and increased monitoring rather than specific management measures at this stage.

An enhanced groundwater recharge system along the sand barrier between the coastline and Awapuni Moana could potentially be used to limit and reverse further saline water intrusion to the Te Hapara Aquifer. However, simulating such a scheme was outside the scope of this project and will not be discussed further.

Monitoring and Sentinel Wells

Monitoring and Sentinel Wells between the coastline and Awapuni Moana have been proposed in Section 5.5.2 above. We recommend the installation of three Sentinel Wells in this area to monitor the effects of sea level rise on groundwater conditions within the sand barrier between the coast and Awapuni Moana.

Management Triggers

No management triggers linked to the Sentinel Wells are recommended. Such triggers would need to be linked to specific groundwater management measures and no measures have been recommended based on the outcomes of the modelling completed under this project.

5.5.5 Future Development of Other Quality Parameters

As part of the water quality conceptualisation and integration of groundwater quality into the Poverty Bay Flats Groundwater model, a copy of the GDC groundwater quality database was provided to WGA. A review of the data available for a range of parameters was undertaken. Salinity in the form of chloride concentration was taken as the key parameter for incorporation into the groundwater model.

The GDC database has been compiled and interpolated for parameters related to nutrient load, microbiology, salinity, and redox state. These maps provide an overview of the relative distribution of water quality within the aquifers underlying the Poverty Bay Flats. Maps have been prepared for each aquifer, where sufficient data is available for the various parameters covering two time periods of approximately 20 years each (1980-1999 and 2000-2022). The maps provide indicative relative distributions of aquifer geochemistry parameters. The bacterial content maps are derived from *E. coli* results, which have been mapped with respect to the number of times *E. coli* were detected in individual bores rather than the average of the detected counts. A summary of the technical methodology used to produce these maps along with copies of the derived heat maps are provided in the groundwater quality conceptualisation report (WGA 2022b).

The following parameters of interest were evaluated:

- Chloride (mg/L)
- Sulphate (mg/L SO_4)
- Iron (Total) (mg/L)
- Manganese (Total) (mg/L)
- Ammoniacal Nitrogen as Nitrogen (mg/L NH_4-N)
- Nitrate-Nitrogen (mg/L NO_3-N)
- Dissolved Oxygen (mg/L O_2)
- Biochemical Oxygen Demand (mg/L O_2)
- *E. coli* (CFU/100mL)

A full geochemical assessment of all groundwater quality parameters recorded in the GDC database, including most major ions, was outside scope of this project. The objective of this groundwater quality review is simply to document general trends in some of the water quality parameters linked to the concerns GDC has with water quality trends in the region.

6 CLOSING STATEMENT

This report summarises a comprehensive programme of community engagement and numerical modelling for the Poverty Bay Flats. The Exploratory Scenarios results and learnings from this overall process have been discussed along with some recommendations on potential future mitigations, additional resource exploratory data collection, and some guidance on GDC requested management goals. This report signifies the delivery of a fully functional numerical groundwater model for the Poverty Bay Flats and the start of the process by which groundwater management Solution Scenarios are evaluated in order to develop physical and regulatory mitigations. This modelling process has highlighted the fact that climate change is having and will have a growing influence on the way groundwater is managed in the Poverty Bay Flats and will require combinations of a mitigations in order to prepare for the effects on aquifers, water quality and cultural and environmental values.

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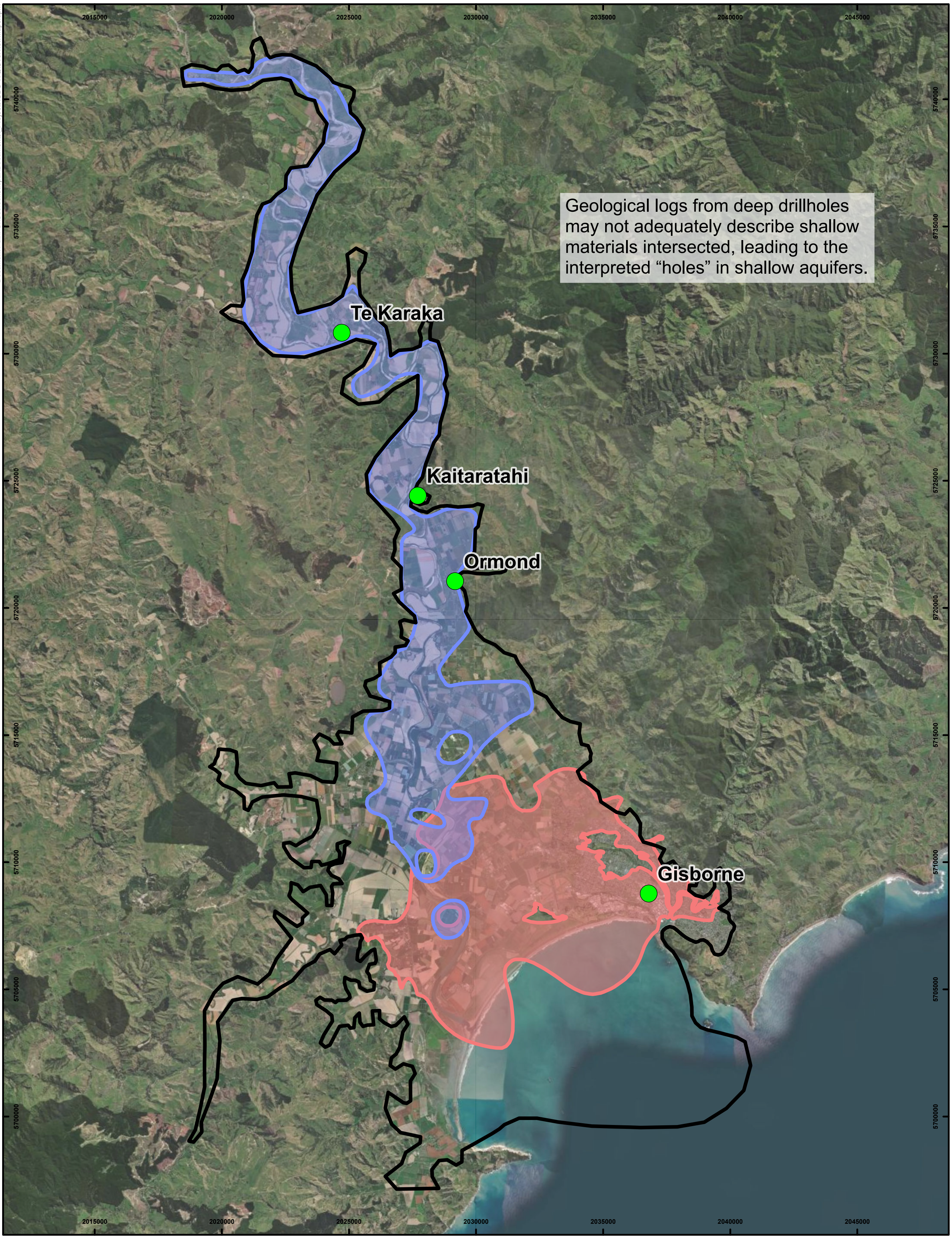
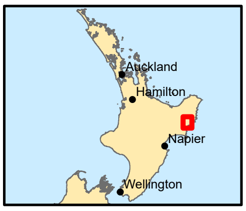
WGA 2022b. Poverty Bay Flats conceptual groundwater quality model. Report produced for Gisborne District Council by Wallbridge Gilbert Aztec. WGA report WGA210398-RP-HG-0005 Rev. B. October 2022.

APPENDIX A

AQUIFER EXTENT MAPS





N

0 0.8 1.6 2.4 3.2 km

Scale 1:200,000 @ A4

Coordinate System: NZGD 2000 New Zealand Transverse Mercator

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any relevance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2022

LEGEND

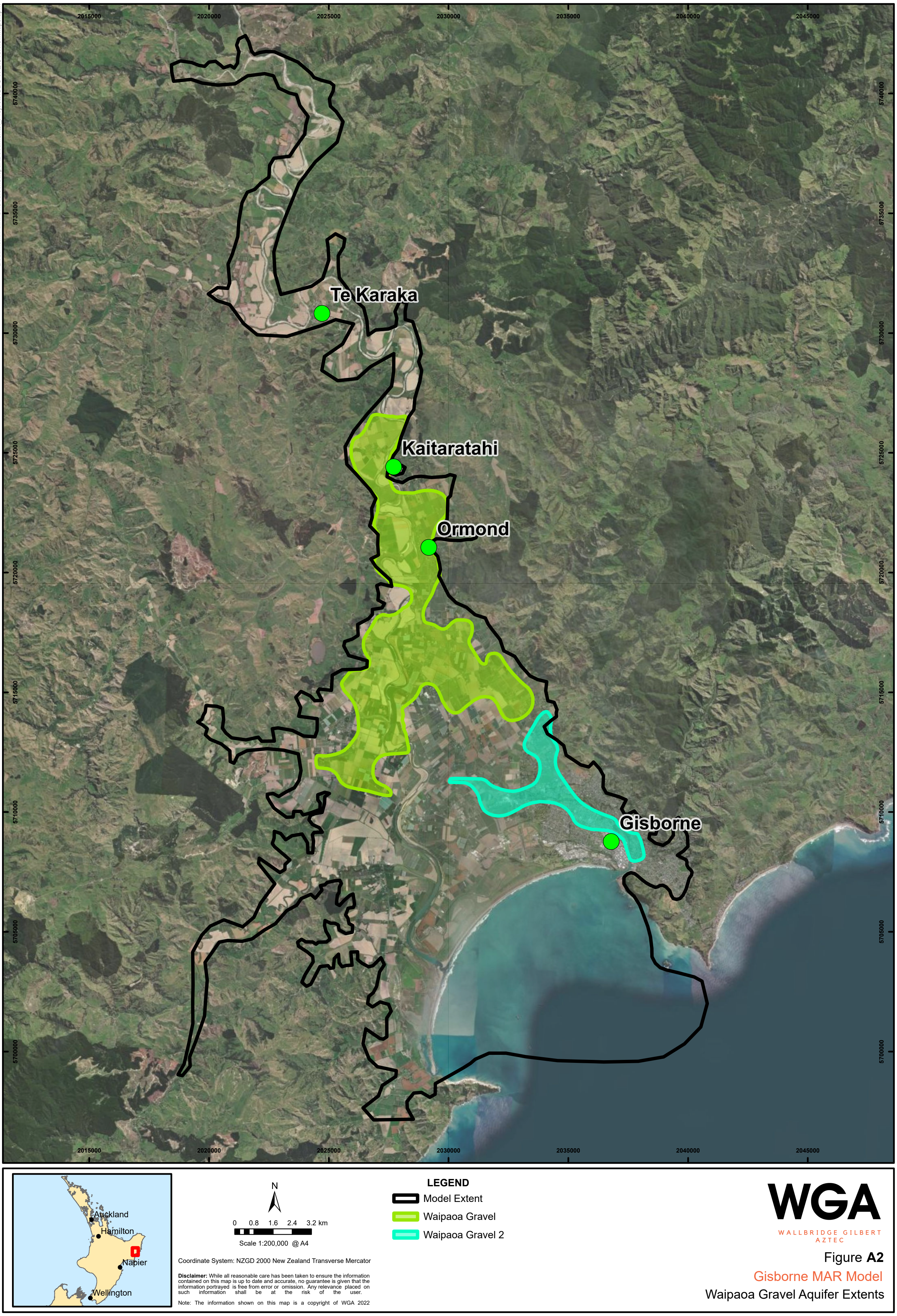
- Model Extent
- Shallow Fluvial Deposits
- Te Hapara Sands

WGA
WALLBRIDGE GILBERT AZTEC

Figure **A1**

Gisborne MAR Model

Shallow Fluviatile and Te Hapara Sand Aquifer Extents



Coordinate System: NZGD 2000 New Zealand Transverse Mercator

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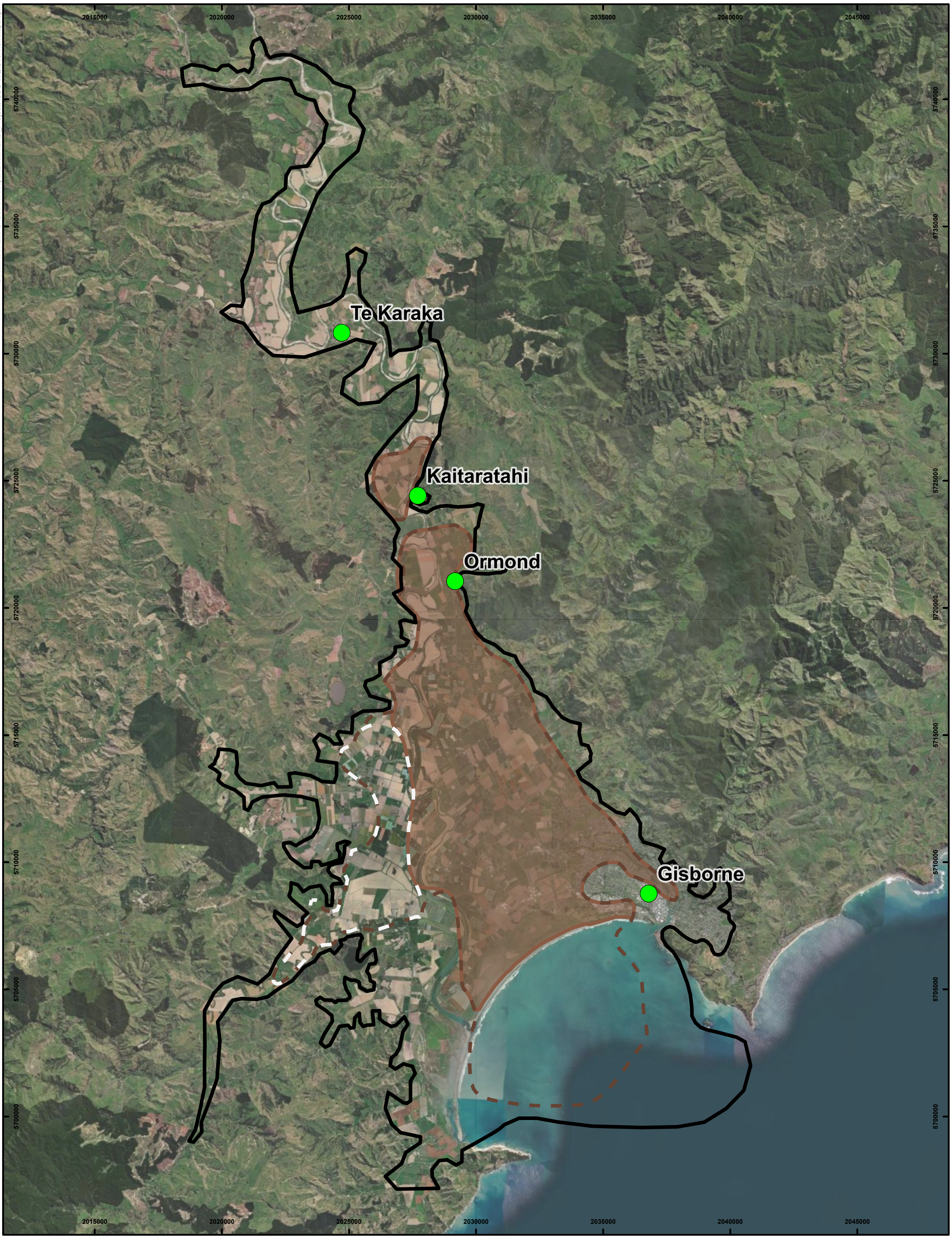
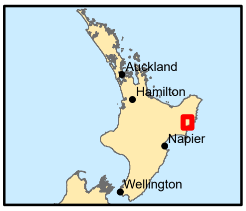
WGA
WALLBRIDGE GILBERT AZTEC

Figure **A2**

Gisborne MAR Model

Waipaoa Gravel Aquifer Extents





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Scale 1:200,000 @ A4

Coordinate System: NZGD 2000 New Zealand Transverse Mercator

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any relevance placed on such information shall be at the risk of the user.

LEGEND

- Model Extent
- Western Saline Area - Indicative
- Makauri Gravel - Indicative
- Makauri Gravel

WGA
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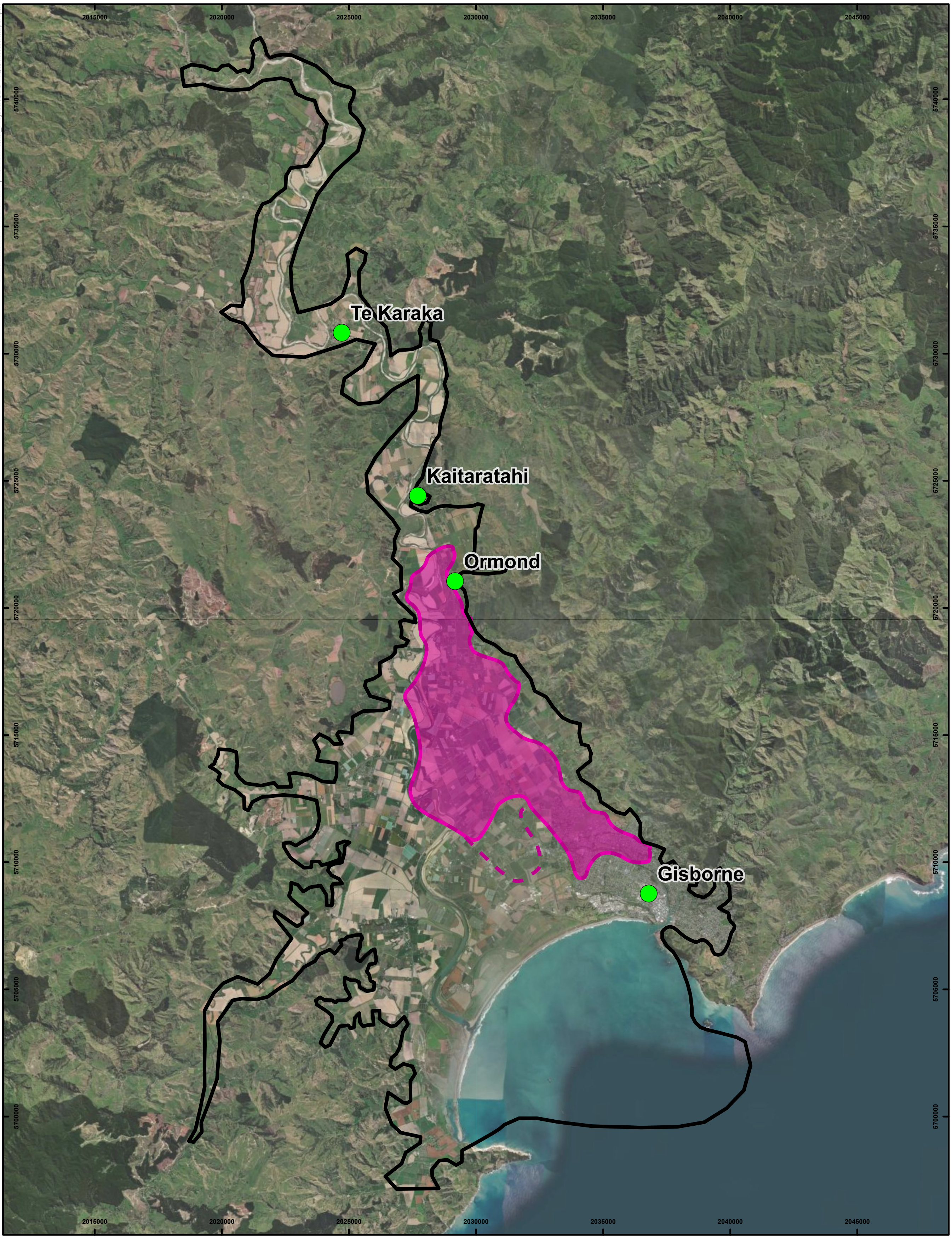
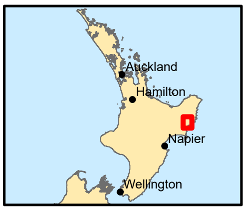
Figure **A3**
Gisborne MAR Model
Makauri Gravel Aquifer Extent





N

0 0.8 1.6 2.4 3.2 km

Scale 1:200,000 @ A4

Coordinate System: NZGD 2000 New Zealand Transverse Mercator

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LEGEND

- Model Extent
- Matokitoki Gravel - Indicative
- Matokitoki Gravel

WGA

WALLBRIDGE GILBERT AZTEC

Figure **A4**

Gisborne MAR Model

Matokitoki Gravel Aquifer Extent

APPENDIX B

GDC CLIMATE SCENARIO SETTINGS MEMORANDUM

Decision register for the Poverty Bay Flats Groundwater Model
CLIMATE CHANGE INPUT SETTINGS

First round of Scenarios

For the first round of scenarios completed in the model, climate change settings were applied to Scenarios 1-7 as only a **decrease** in rainfall rates (see RCP4.5 rainfall settings chosen in Section 1. below).

It was communicated and agreed with community that any future increase in rainfall will mostly be experienced as extreme flooding and surface runoff, therefore this has not been included in the model. It was also generally agreed upon for majority of the first round of modelling that the potential evaporation deficit (PED) could not be captured in FEFLOW as a surface interaction with the model.

However, in the last hour, the decision was made for Scenarios 8 and 9 to include additional climate change settings of sea level rise (see section 2. below), reoccurring droughts (see section 3. below) and increasing PED (see section 4. below). Due to the model's inability to capture PED from surface, the decision was made to represent PED as the additional abstraction that would be required to meet soil moisture deficits.

The chosen settings for each scenario can be viewed in Table A3-1 of the Aquasoil report.

Second round of Scenarios

Following the results of the first round of scenarios, it was observed that the impacts of climate change in Scenarios 1-7 were not significant. This was believed to be an error in decision making during scenario setting and subsequently a representation of more climate change impacts was decided upon. These are listed as below and captured in Table 4-1 of the Aquasoil report.

1. Rainfall (NIWA.2020)

Changes in rainfall rates were determined from Section 5.1 in the 2020 NIWA climate change report for Tairawhiti. Percentage decreases in rainfall were **chosen by GDC** for both RCP 4.5 and RCP 8.5.

Decrease <5 % of actual until 2040 (RCP4.5)
Decrease Summer 5-15% of actual until 2040 (RCP4.5)
Decrease Spring and Summer 5-15% of actual 2040-2090 (RCP4.5)

Decrease <10 % of actual until 2040 (RCP8.5)
Decrease Spring and Summer 5-15% of actual until 2040 (RCP8.5)
Decrease 5-15 % of actual 2040-2090 (RCP8.5)

For the purpose of step change modelling in FEFLOW, Aquasoil chose *to use the upper limits in each setting chosen.*
RCP 4.5 = -5% in 2040, -15% in Sept in 2090
RCP 8.5 = -10% in 2040, -15% in Sept 2040 and -15% in 2040-2090.

2. Sea level rise (NIWA.2017)

Changes in sea level rise follow the progressive scenarios (generic to NZ) presented in Table 10 (NIWA. 2017 and below) for RCP 4.5 and RCP 8.5, which are in groundwater terms only marginally different (Pers comm. B Sinclair, 2022).

3. Droughts (NIWA. 2013)

Total PED for 2012-2013 was the highest since the El Nino drought of 1997-1998, and about the fifth highest for the period of record since 1940 (**NIWA 2013**). Exceedances beyond the 500 PED roughly average every 7 years (Figure 2). However **Aquasoil determined** that to represent this 7 year frequency in the model, aquifer recovery generated would not be sufficient.

Therefore, three drought periods were suggested from Aquasoil. A ratio of the increased abstraction from the drought event from 2012-2015 was to reoccur in the model as the additional percentage of groundwater takes used to recover a significant drought. 3 year drought periods occur in the model from 2035-2038, 2050-2053 and 2070-2073.

See Chapter 4 and Table 4-4 in the Aquasoil report for more context.

4. PED (NIWA.2020)

PED for the Gisborne region is set at 350mm per year, this is the mid-range **chosen by GDC** from the NIWA reported 300-400 mm per year (NIWA.2020).

GDC also chose from Section 6.1 of the 2020 NIWA climate change report a change in PED to increase +125mm by 2090 (mid-range of the NIWA prediction +110-150mm until 2090 RCP4.5)

Due to the model's inability to capture PED from surface, the decision was made to represent PED as the additional abstraction that would be required to meet soil moisture deficits.

The mid-value of 125mm PED increase on the minimum current 300mm PED per year was chosen as a 42% increase in both PED and current abstraction rates by 2090.

For RCP 4.5 (all Scenarios with +CC) GDC took 15 year increments back from 2090 for the 42% increase and used a linear relationship to fill in the previous years.

Average (2008-2021) Takes to increase:
5% at 2030
15% at 2045
24% at 2060
33% at 2075 (**Aquasoil took this 33% as the final increase to 2090**)
42% at 2090 (this was disregarded in modelling)

For RCP 8.5 (Scenario 8) NIWA specifies two incremental changes. So I took the halfway point between each.

Average (2008- 2021) Takes to increase:
21% in 2030
42% at 2040
53% at 2065 (**Aquasoil took this 53% as the final increase to 2090**)
64% at 2090 (this was disregarded in modelling)

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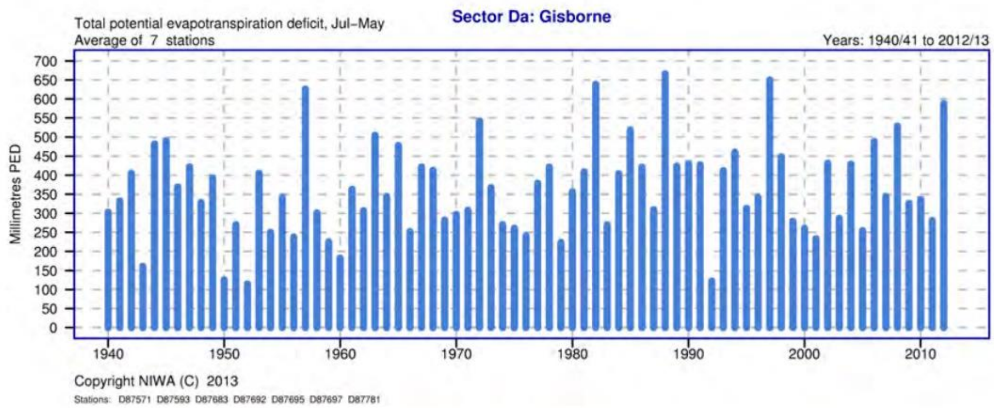
Referenced figures/data

Table 10: NIWA. 2017

Table 10: Decadal increments for projections of sea-level rise (metres above 1986–2005 baseline) for the wider New Zealand region (for the four future scenarios from figure 27)

NZ SLR scenario Year	NZ RCP2.6 M (median) [m]	NZ RCP4.5 M (median) [m]	NZ RCP8.5 M (median) [m]	NZ RCP8.5 H+ (83rd percentile) [m]
1986–2005	0	0	0	0
2020	0.08	0.08	0.09	0.11
2030	0.13	0.13	0.15	0.18
2040	0.18	0.19	0.21	0.27
2050	0.23	0.24	0.28	0.37
2060	0.27	0.30	0.36	0.48
2070	0.32	0.36	0.45	0.61
2080	0.37	0.42	0.55	0.75
2090	0.42	0.49	0.67	0.90
2100	0.46	0.55	0.79	1.05
2110	0.51	0.61	0.93	1.20
2120	0.55	0.67	1.06	1.36
2130	0.60*	0.74*	1.18*	1.52
2140	0.65*	0.81*	1.29*	1.69
2150	0.69*	0.88*	1.41*	1.88

* Extended set 2130–50 based on applying the same rate of rise of the relevant representative concentration pathway (RCP) median trajectories from Kopp et al, 2014 (K14) to the end values of the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5) projections. Columns 2, 3, 4: based on IPCC AR5 (Church et al, 2013a); and column 5: New Zealand RCP8.5 H+ scenario (83rd percentile, from Kopp et al, 2014). Note: M = median; m = metres; NZ = New Zealand; SLR = sea-level rise. To determine the local SLR, a further component for persistent vertical land movement may need to be added (subsidence) or subtracted (uplift).



Total PED for 2012−13 was the highest since the El Nĩno drought of 1997-98, and about the fifth highest for the period of record since 1940.

Figure 1 – NIWA. 2013.

APPENDIX C

MODEL ANNUAL WATER BALANCE RESULTS SUMMARY

WATER BALANCE GUIDANCE

The water balance components indicate NET annual flows

- Positive values indicate net recharge to the groundwater system
- Negative values indicate net discharge from the groundwater system

- **Rainfall recharge** can only be positive (represents a **TOTAL IN**)
- **Consented takes** can only be negative (represents a **TOTAL OUT**)
- Most **streams and drains** can only be negative (represents a **TOTAL OUT**)
- **MAR** can only be positive (represents a **TOTAL IN**)
- **River** reaches can be positive or negative (represents a **NET FLOW**)
- **Ocean** can also be positive or negative (represents a **NET FLOW**)

A groundwater budget can be calculated from the model as a whole.

- **TOTAL IN** for overall model and specific aquifers
- **TOTAL OUT** for overall model and specific aquifers
- **CHANGE IN STORAGE** for overall model and individual aquifers

The current model version is not tracking volumetric changes in aquifer groundwater storage.

Table notes

▲ Flow rate increases (the net flow direction does not change unless specifically noted)

▼ Flow rate decreases (the net flow direction does not change unless specifically noted)

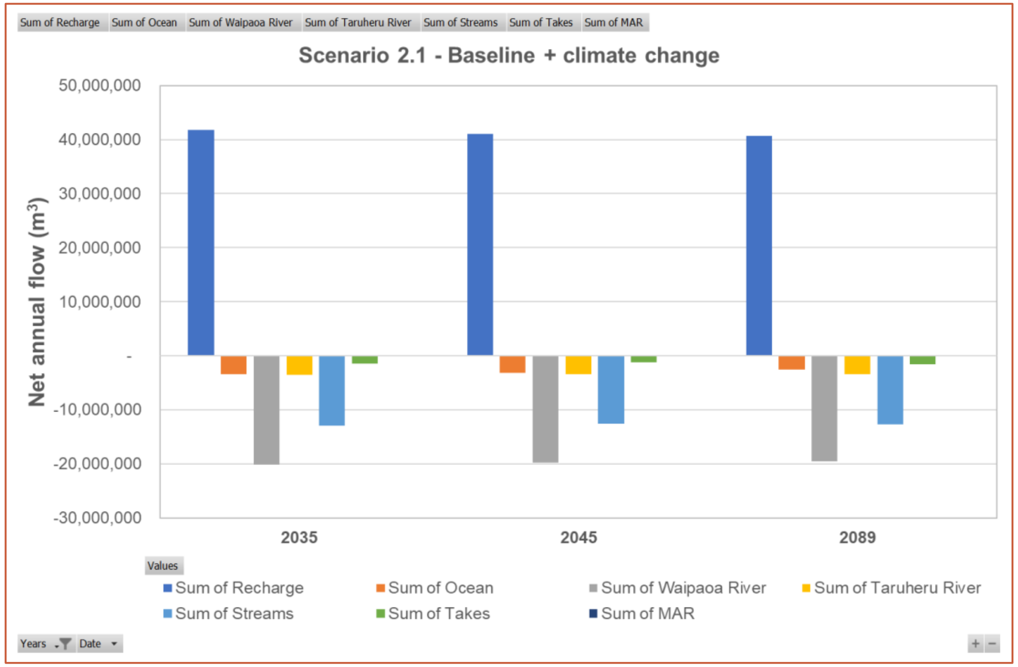
Text in **red bold font** indicates the Scenario input changes compared to Scenario 2.1.

SCENARIO 2.1 – BASELINE + CLIMATE CHANGE

Table C1: Scenario 2.1 Net Groundwater Balance

Year	Rainfall Recharge	Ocean	Waipaoa River	Taruheru River	Streams	GW Takes	MAR
2035	41,729,347	- 3,360,701	- 20,169,431	- 3,539,601	- 12,886,408	- 1,504,648	0
2045	41,047,252	- 3,194,815	- 19,722,899	- 3,436,594	- 12,563,487	- 1,263,022	0
2089	40,673,814	- 2,585,114	- 19,517,003	- 3,363,957	- 12,732,652	- 1,541,773	0

Note: positive values = net annual groundwater recharge negative values = net annual groundwater discharge All values in m³/year.



Key Features

Declining rainfall recharge mainly leads to:

- Declining discharge to ocean over time
- Declining net discharge to Waipaoa River over time

Table C2: Scenario 2.1 Aquifer Groundwater Balance Results Summary

Aquifer / Parameter	Annual groundwater flows - averages for defined periods / single year result for defined drought years									
	2024 - 30	2031 - 34	2036	2039 - 45	2046 - 49	2051	2054 - 60	2061 - 69	2071	2076 - 88
Shallow Fluviatile / Te Hapara Sand Aquifers										
Total inflow	44,107,343	43,713,461	43,305,733	43,150,603	43,097,551	43,037,228	43,056,079	42,988,518	42,925,650	42,907,269
Total outflow	-44,228,443	-43,874,250	-43,585,349	-43,297,463	-43,237,653	-43,219,080	-43,193,680	-43,118,965	-43,109,687	-43,042,007
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-140,383	-146,942	-211,630	-147,812	-160,928	-230,027	-161,905	-173,377	-248,029	-186,232
Waipaoa Aquifer										
Total inflow	5,788,641	5,792,163	5,985,796	5,766,580	5,800,091	6,012,162	5,799,666	5,826,336	6,054,598	5,859,915
Total outflow	-5,808,936	-5,812,993	-6,011,177	-5,787,122	-5,821,761	-6,038,122	-5,821,792	-5,849,570	-6,082,972	-5,884,547
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-69,193	-72,442	-104,699	-72,845	-79,338	-113,752	-79,805	-85,472	-122,655	-91,821
Makauri Aquifer										
Total inflow	2,490,192	2,514,172	2,820,313	2,507,311	2,563,888	2,896,820	2,562,698	2,609,959	2,973,276	2,660,561
Total outflow	-2,490,269	-2,514,180	-2,818,835	-2,507,484	-2,563,879	-2,894,435	-2,562,909	-2,609,883	-2,970,762	-2,660,676
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-849,307	-889,204	-1,284,812	-894,032	-973,833	-1,396,668	-979,256	-1,049,148	-1,505,972	-1,126,868
Matokitoki Aquifer										
Total inflow	214,998	217,447	252,260	217,437	223,152	263,093	223,356	228,674	274,248	234,710
Total outflow	-215,073	-217,445	-251,676	-217,511	-223,187	-262,056	-223,484	-228,751	-273,201	-234,902
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-62,189	-65,130	-94,426	-65,459	-71,333	-102,727	-71,691	-76,859	-110,767	-82,541

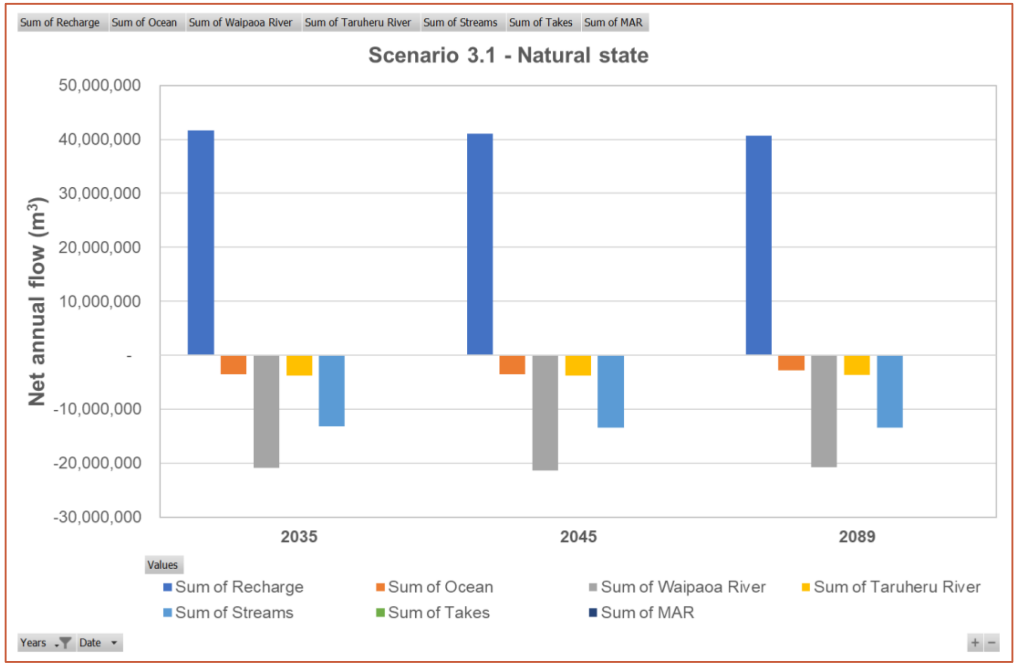
Notes: Yellow cells identify drought year outcomes.

SCENARIO 3.1 – NATURAL STATE

Table C3: Scenario 3.1 Net Groundwater Balance

Year	Rainfall Recharge	Ocean	Waipaoa River	Taruheru River	Streams	GW Takes	MAR
2035	41,711,948	▲ - 3,486,297	▲ - 20,882,686	- 3,735,576	- 13,222,727	0	0
2045	41,047,252	▲ - 3,514,542	▲ - 21,399,853	- 3,812,220	- 13,387,392	0	0
2089	40,673,815	▲ - 2,803,982	▲ - 20,701,234	- 3,697,365	- 13,419,120	0	0

Note: positive values = net annual groundwater recharge negative values = net annual groundwater discharge All values in m³/year.



Key Features

Compared to Scenario 2.1:

- Net discharges to ocean increase
- Net discharges to Waipaoa River increase

Table C4: Scenario 3.1 Aquifer Groundwater Balance Results Summary

Aquifer / Parameter	Annual groundwater flows - averages for defined periods / single year result for defined drought years									
	2024 - 30	2031 - 34	2036	2039 - 45	2046 - 49	2051	2054 - 60	2061 - 69	2071	2076 - 88
Shallow Fluviatile / Te Hapara Sand Aquifers										
Total inflow	44,545,703	44,579,323	43,944,690	43,599,716	43,584,578	42,199,665	43,782,970	43,302,136	41,856,424	43,431,918
Total outflow	-44,622,740	-45,017,452	-44,192,457	-43,769,597	-43,759,458	-41,189,392	-44,150,216	-43,302,088	-40,859,304	-43,600,756
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	0	0	0	0	0	0	0	0	0	0
Waipaoa Aquifer										
Total inflow	5,477,100	5,569,096	5,478,295	5,440,661	5,439,378	5,081,206	5,499,671	5,383,038	5,001,859	5,428,060
Total outflow	-5,481,524	-5,574,110	-5,485,339	-5,444,743	-5,444,368	-5,083,141	-5,504,929	-5,387,947	-5,005,272	-5,433,250
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	0	0	0	0	0	0	0	0	0	0
Makauri Aquifer										
Total inflow	1,944,269	1,978,778	1,946,260	1,931,345	1,929,473	1,796,652	1,948,212	1,903,661	1,759,470	1,913,493
Total outflow	-1,944,224	-1,979,088	-1,946,489	-1,931,325	-1,929,449	-1,795,506	-1,948,380	-1,903,482	-1,758,204	-1,913,548
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	0	0	0	0	0	0	0	0	0	0
Matokitoki Aquifer										
Total inflow	179,066	182,388	179,734	178,862	178,832	166,930	180,891	177,064	163,940	178,678
Total outflow	-179,196	-182,762	-180,047	-178,991	-178,971	-166,258	-181,159	-177,087	-163,194	-178,811
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	0	0	0	0	0	0	0	0	0	0

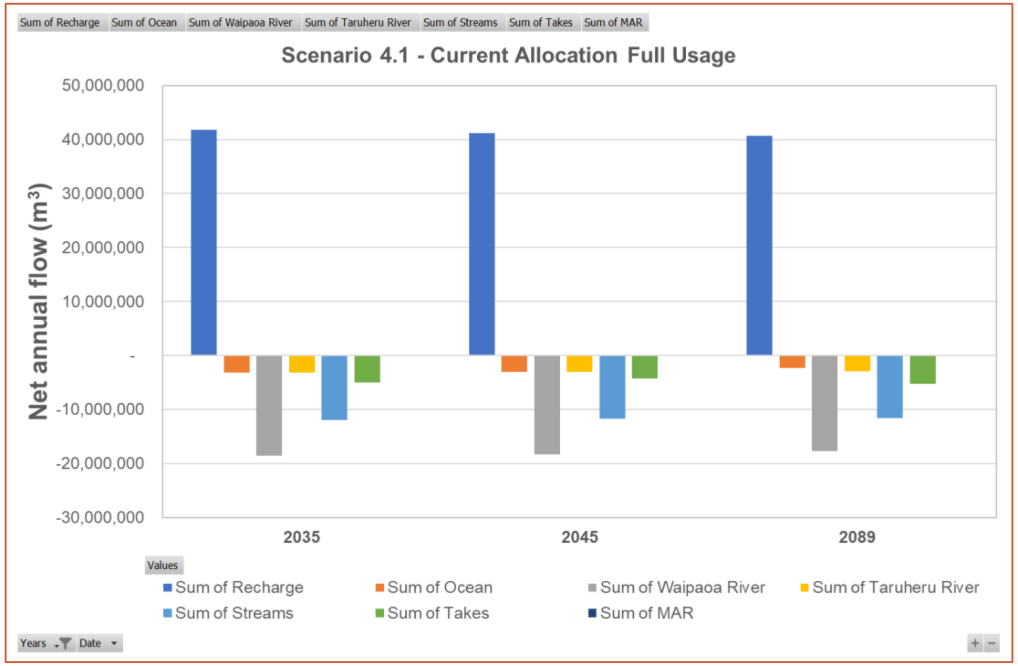
Notes: Yellow cells identify drought year outcomes.
Values in red indicate key differences from Scenario 2.1.

SCENARIO 4.1 – CURRENT ALLOCATION FULL USAGE

Table C5: Scenario 4.1 Net Groundwater Balance

Year	Rainfall Recharge	Ocean	Waipaoa River	Taruheru River	Streams	GW Takes	MAR
2035	41,729,513	- 3,131,882	▼ - 18,503,782	▼ - 3,143,464	▼ - 11,955,960	▲ **- 5,023,185**	0
2045	41,107,802	- 2,988,138	▼ - 18,294,106	▼ - 3,057,728	▼ - 11,707,063	▲ **- 4,277,026**	0
2089	40,740,429	- 2,313,761	▼ - 17,698,600	▼ - 2,885,049	▼ - 11,630,797	▲ **- 5,214,928**	0

Note: positive values = net annual groundwater recharge   negative values = net annual groundwater discharge   All values in m^3/year.



Key Features:

Compared to Scenario 2.1, the increased groundwater takes result in:

- Net discharges to rivers decrease.
- Net discharges to streams decrease.
- Net discharge to ocean decreases

Table C6: Scenario 4.1 Aquifer Groundwater Balance Results Summary

Aquifer / Parameter	Annual groundwater flows - averages for defined periods / single year result for defined drought years									
	2024 - 30	2031 - 34	2036	2039 - 45	2046 - 49	2051	2054 - 60	2061 - 69	2071	2076 - 88
Shallow Fluviatile / Te Hapara Sand Aquifers										
Total inflow	44,018,569	43,629,001	43,411,209	43,045,976	42,996,894	43,193,179	42,948,800	42,962,695	43,176,692	42,857,088
Total outflow	-44,204,364	-43,775,068	-43,759,934	-43,147,281	-42,910,397	-43,405,319	-42,896,121	-43,042,977	-43,417,533	-42,914,452
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-1,033,039**	**-1,081,262**	**-1,555,241**	**-1,087,581**	**-1,183,938**	**-1,690,745**	**-1,191,143**	**-1,275,547**	**-1,821,891**	**-1,370,013**
Waipaoa Aquifer										
Total inflow	6,649,816	6,694,145	7,396,720	6,677,868	6,808,622	7,570,117	6,807,413	6,949,021	7,756,333	7,048,473
Total outflow	-6,655,891	-6,698,428	-7,393,174	-6,682,610	-6,813,143	-7,569,591	-6,813,421	-6,951,211	-7,757,340	-7,054,904
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-536,988**	**-562,089**	**-807,630**	**-565,403**	**-615,610**	**-880,187**	**-619,092**	**-663,396**	**-947,937**	**-712,245**
Makauri Aquifer										
Total inflow	3,338,650	3,414,394	4,309,787	3,410,181	3,573,808	4,571,541	3,575,818	3,729,429	4,830,299	3,885,291
Total outflow	-3,338,644	-3,414,166	-4,307,013	-3,410,691	-3,573,397	-4,566,944	-3,576,142	-3,730,010	-4,827,589	-3,885,420
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-1,911,232**	**-2,001,210**	**-2,893,421**	**-2,011,630**	**-2,191,450**	**-3,147,745**	**-2,203,238**	**-2,361,132**	**-3,391,550**	**-2,535,750**
Matokitoki Aquifer										
Total inflow	476,614	495,069	688,030	496,504	535,226	744,225	536,293	570,328	794,732	606,914
Total outflow	-477,231	-495,640	-686,578	-497,332	-535,625	-741,457	-537,144	-571,122	-794,074	-607,828
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-344,884**	**-361,163**	**-522,995**	**-363,032**	**-395,550**	**-569,087**	**-397,602**	**-426,184**	**-612,990**	**-457,702**

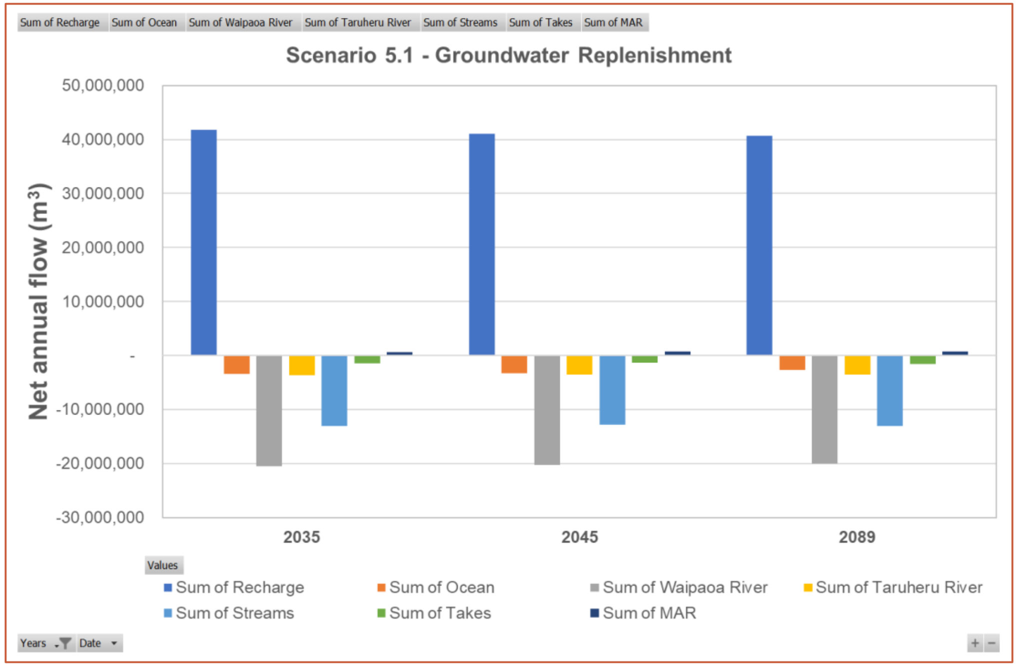
Notes: Yellow cells identify drought year outcomes.
Values in red indicate key differences from Scenario 2.1.

SCENARIO 5.1 – GROUNDWATER REPLENISHMENT

Table C7: Scenario 5.1 Net Groundwater Balance

Year	Rainfall Recharge	Ocean	Waipaoa River	Taruheru River	Streams	GW Takes	MAR
2035	41,729,332	- 3,437,776	▲ - 20,488,042	- 3,637,804	- 13,065,595	- 1,499,899	630,000
2045	41,047,251	- 3,300,645	▲ - 20,210,138	- 3,566,934	- 12,820,811	- 1,296,652	691,406
2089	40,710,194	- 2,693,638	▲ - 20,047,406	- 3,519,611	- 13,034,061	- 1,578,902	798,443

Note: positive values = net annual groundwater recharge negative values = net annual groundwater discharge. All values in m^3/year.



Key Features:

Compared to Scenario 2.1, the application of enhanced recharge techniques results in:

- Net discharges to Waipaoa River increase.
- Net discharges to the other surface water features also increase but to a smaller degree.

Table C8: Scenario 5.1 Aquifer Groundwater Balance Results Summary

Aquifer / Parameter	Annual groundwater flows - averages for defined periods / single year result for defined drought years									
	2024 - 30	2031 - 34	2036	2039 - 45	2046 - 49	2051	2054 - 60	2061 - 69	2071	2076 - 88
Shallow Fluviatile / Te Hapara Sand Aquifers										
Total inflow	44,315,215	43,931,203	43,481,976	43,354,350	43,319,744	43,233,312	43,282,516	43,231,707	43,128,784	43,171,299
Total outflow	-44,431,924	-44,094,260	-43,759,454	-43,511,346	-43,473,800	-43,429,747	-43,427,704	-43,367,862	-43,320,946	-43,317,548
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-140,383	-146,941	-211,634	-147,815	-160,929	-230,019	-161,899	-173,379	-248,020	-186,217
Waipaoa Aquifer										
Total inflow	5,606,355	5,602,348	5,767,132	5,576,051	5,593,662	5,774,830	5,591,372	5,603,572	5,800,439	5,619,530
Total outflow	-5,626,989	-5,623,681	-5,793,032	-5,596,945	-5,616,166	-5,800,183	-5,613,834	-5,626,845	-5,827,931	-5,644,363
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-69,182	-72,429	-104,681	-72,834	-79,329	-113,726	-79,789	-85,459	-122,626	-91,800
Makauri Aquifer										
Total inflow	2,771,767	2,806,104	3,066,442	2,809,198	2,884,317	3,165,624	2,892,116	2,956,777	3,262,168	3,031,424
Total outflow	-2,771,810	-2,806,138	-3,065,107	-2,809,284	-2,884,335	-3,163,365	-2,892,294	-2,956,702	-3,259,733	-3,031,492
Wells recharge	**607,435**	**630,230**	**629,568**	**644,692**	**690,216**	**690,000**	**702,949**	**744,354**	**744,000**	**797,878**
Wells abstraction	-849,327	-889,223	-1,284,757	-894,059	-973,819	-1,396,708	-979,275	-1,049,177	-1,506,016	-1,126,802
Matokitoki Aquifer										
Total inflow	237,033	240,150	260,418	241,405	247,756	270,983	248,987	254,533	281,300	261,576
Total outflow	-237,040	-240,152	-259,760	-241,411	-247,768	-270,038	-249,046	-254,515	-280,263	-261,609
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	-62,205	-65,148	-94,475	-65,479	-71,351	-102,771	-71,711	-76,879	-110,814	-82,560

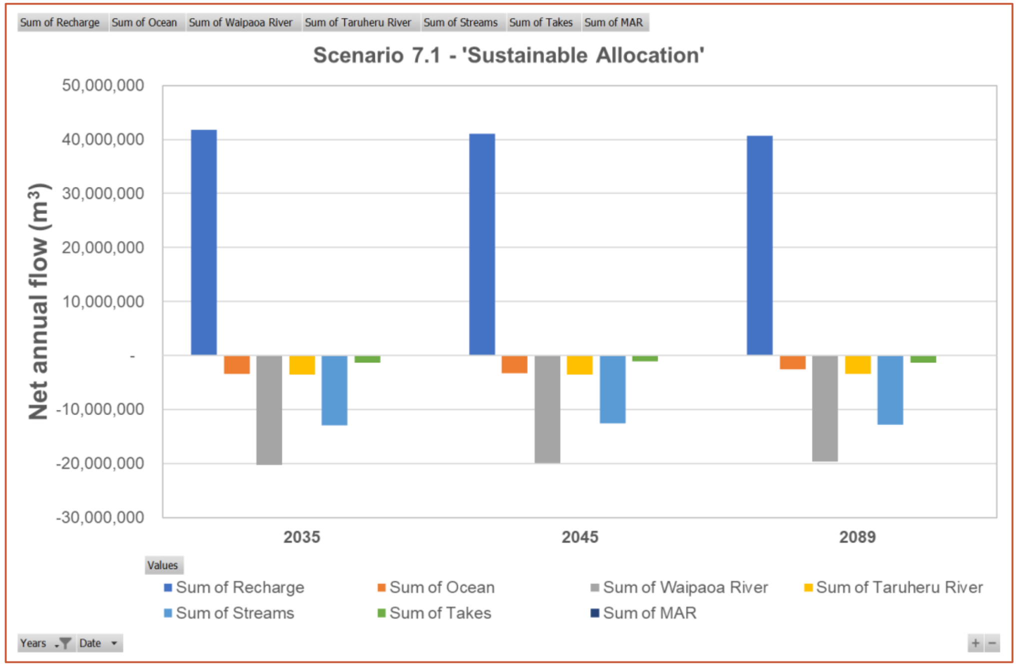
Notes: Yellow cells identify drought year outcomes.
Values in red indicate key differences from Scenario 2.1.

SCENARIO 7.1 – 'SUSTAINABLE ALLOCATION'

Table C9: Scenario 7.1 Net Groundwater Balance

Year	Rainfall Recharge	Ocean	Waipaoa River	Taruheru River	Streams	GW Takes	MAR
2035	41,729,438	- 3,380,568	- 20,254,318	- 3,566,530	- 12,941,914	**- 1,278,950**	0
2045	41,047,252	- 3,219,202	- 19,850,903	- 3,466,337	- 12,585,898	**- 1,070,878**	0
2089	40,673,814	- 2,605,719	- 19,635,724	- 3,402,168	- 12,791,495	**- 1,307,739**	0

Note: positive values = net annual groundwater recharge negative values = net annual groundwater discharge. All values in m^3/year.



Key Features:

Compared to Scenario 2.1, the reduction in groundwater takes results in:

- Groundwater discharges to most receiving waters increase .

Table C10: Scenario 7.1 Aquifer Groundwater Balance Results Summary

Aquifer / Parameter	Annual groundwater flows - averages for defined periods / single year result for defined drought years									
	2024 - 30	2031 - 34	2036	2039 - 45	2046 - 49	2051	2054 - 60	2061 - 69	2071	2076 - 88
Shallow Fluviatile / Te Hapara Sand Aquifers										
Total inflow	44,146,625	43,756,080	43,348,335	43,185,300	43,135,814	43,077,484	43,107,663	43,046,347	42,991,406	42,969,291
Total outflow	-44,270,157	-43,930,278	-43,635,353	-43,351,146	-43,293,101	-43,252,430	-43,248,610	-43,173,952	-43,144,500	-43,106,557
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-119,331**	**-124,900**	**-179,895**	**-125,682**	**-136,792**	**-195,523**	**-137,643**	**-147,378**	**-210,824**	**-158,316**
Waipaoa Aquifer										
Total inflow	5,734,814	5,735,454	5,891,570	5,710,033	5,736,186	5,909,148	5,736,648	5,755,884	5,944,465	5,779,169
Total outflow	-5,752,845	-5,754,120	-5,914,948	-5,728,414	-5,755,725	-5,931,452	-5,755,909	-5,775,868	-5,968,655	-5,800,720
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-58,816**	**-61,575**	**-88,997**	**-61,937**	**-67,441**	**-96,689**	**-67,851**	**-72,653**	**-104,256**	**-78,059**
Makauri Aquifer										
Total inflow	2,400,094	2,418,995	2,669,898	2,411,918	2,457,528	2,729,815	2,455,969	2,493,772	2,791,689	2,533,194
Total outflow	-2,400,161	-2,419,011	-2,668,753	-2,412,080	-2,457,525	-2,727,888	-2,456,149	-2,493,704	-2,789,548	-2,533,209
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-721,933**	**-755,822**	**-1,092,173**	**-760,163**	**-827,734**	**-1,187,168**	**-832,523**	**-891,821**	**-1,280,076**	**-957,962**
Matokitoki Aquifer										
Total inflow	207,290	209,088	234,486	209,031	213,159	242,565	213,267	217,018	250,702	221,450
Total outflow	-207,311	-209,114	-234,007	-209,140	-213,161	-241,880	-213,329	-216,962	-249,983	-221,458
Wells recharge	0	0	0	0	0	0	0	0	0	0
Wells abstraction	**-52,857**	**-55,360**	**-80,268**	**-55,633**	**-60,632**	**-87,318**	**-60,943**	**-65,327**	**-94,151**	**-70,163**

Note: Yellow cells identify drought year outcomes.

SCENARIO 7.1 – 'SUSTAINABLE ALLOCATION'

Table C6: Groundwater Volumes Taken at Selected Years

Year	Matokitoki Aquifer	Makauri Aquifer	Waipaoa Aquifer	Shallow Fluviatile Gravel Aquifer	Te Hapara Sand Aquifer
2034	54,936	749,751	61,039	105,566	80,712
2036	80,267	1,092,169	88,997	151,064	117,517
2049	60,244	821,680	66,877	115,621	88,438
2051	87,318	1,187,168	96,689	164,659	127,707
2069	65,407	892,940	72,735	125,256	96,153
2071	94,152	1,280,076	104,256	177,546	137,701

Note: Some annual values differ slightly from those in Table C10 due to different flow calculation methodology applied in FEFLOW.

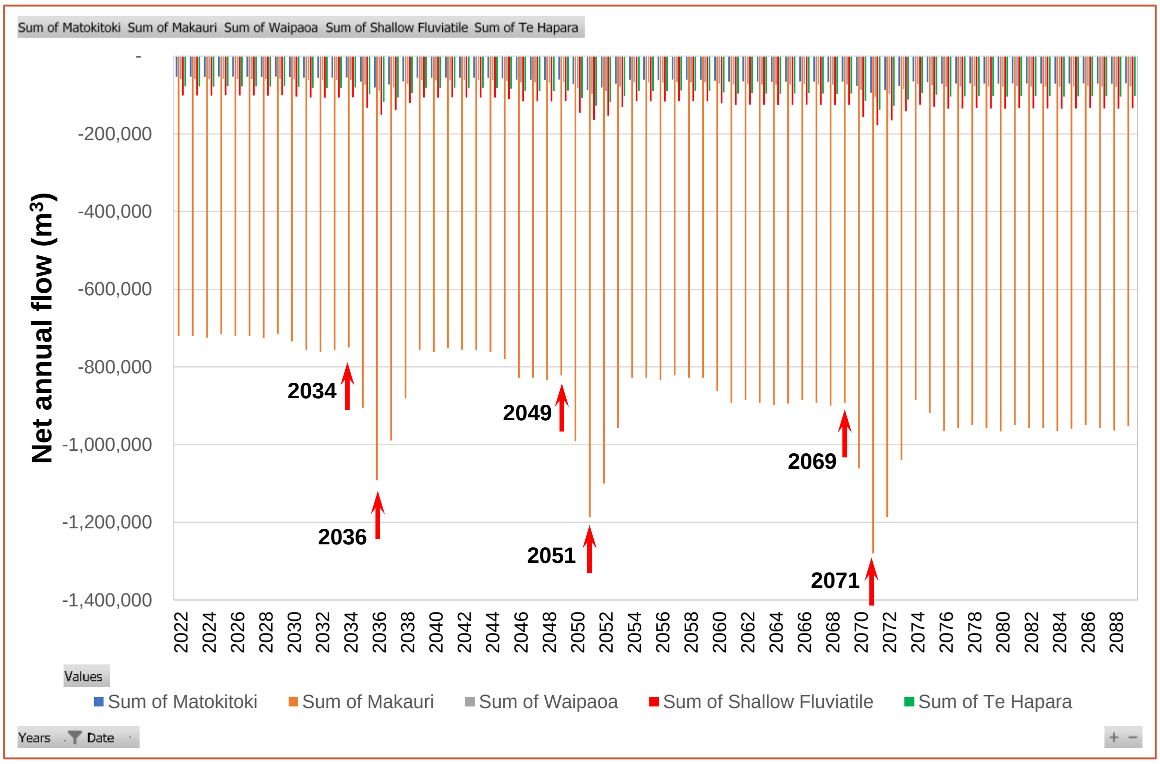


Figure C1. Years Interrogated for Groundwater Take Volumes

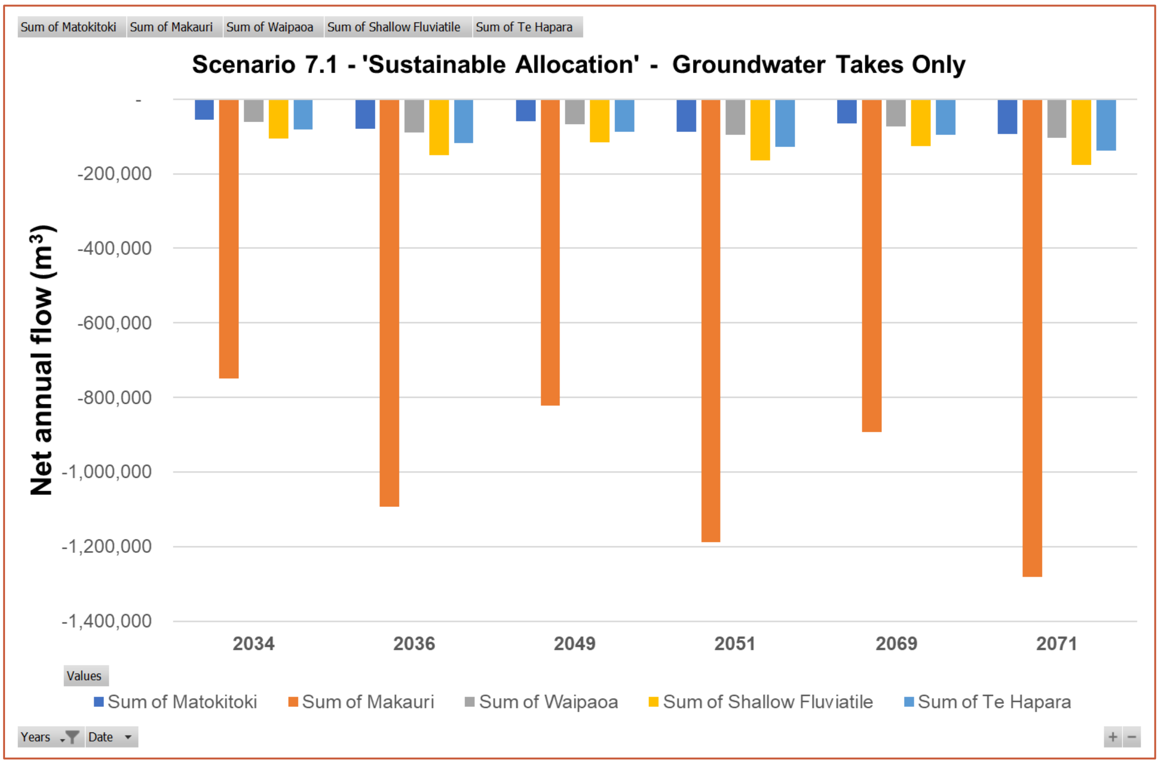


Figure C2. Comparison of Groundwater Take Volumes by Aquifer under Scenario 7.1

Table C7: Net Groundwater Balance at Decade Intervals

Scenario	Rainfall Recharge	Ocean	Waipaoa River	Taruheru River	Streams	Groundwater Takes	MAR
2035							
Scenario 2.1	41,729,347	- 3,360,701	- 20,169,431	- 3,539,601	- 12,886,408	- 1,504,648	0
Scenario 3.1	41,711,948	- 3,486,297	▲ - 20,882,686	- 3,735,576	- 13,222,727	**0**	0
Scenario 4.1	41,729,513	▼ - 3,131,882	▼ - 18,503,782	▼ - 3,143,464	▼ - 11,955,960	**- 5,023,185**	0
Scenario 5.1	41,729,332	- 3,437,776	- 20,488,042	- 3,637,804	- 13,065,595	- 1,499,899	**630,000**
Scenario 7.1	41,729,438	- 3,380,568	- 20,254,318	- 3,566,530	- 12,941,914	- 1,278,950	0
2045							
Scenario 2.1	41,047,252	- 3,194,815	- 19,722,899	- 3,436,594	- 12,563,487	- 1,263,022	0
Scenario 3.1	41,047,252	▲ - 3,514,542	▲ - 21,399,853	▲ - 3,812,220	- 13,387,392	**0**	0
Scenario 4.1	41,107,802	▼ - 2,988,138	▼ - 18,294,106	▼ - 3,057,728	▼ - 11,707,063	**- 4,277,026**	0
Scenario 5.1	41,047,251	- 3,300,645	- 20,210,138	- 3,566,934	- 12,820,811	- 1,296,652	**691,406**
Scenario 7.1	41,047,252	- 3,219,202	- 19,850,903	- 3,466,337	- 12,585,898	- 1,070,878	0
2055							
Scenario 2.1	40,673,814	- 2,585,114	- 19,517,003	- 3,363,957	- 12,732,652	- 1,541,773	0
Scenario 3.1	40,673,815	▲ - 2,803,982	▲ - 20,701,234	▲ - 3,697,365	▲ - 13,419,120	**0**	0
Scenario 4.1	40,740,429	▼ - 2,313,761	▼ - 17,698,600	▼ - 2,885,049	▼ - 11,630,797	**- 5,214,928**	0
Scenario 5.1	40,710,194	- 2,693,638	▲ - 20,047,406	- 3,519,611	- 13,034,061	- 1,578,902	**798,443**
Scenario 7.1	40,673,814	- 2,605,719	- 19,635,724	- 3,402,168	- 12,791,495	- 1,307,739	0

WGA

WALLBRIDGE GILBERT AZTEC

Brett Sinclair
SENIOR PRINCIPAL HYDROGEOLOGIST

Telephone: +64 21 190 1605

Email: bsinclair@wganz.co.nz

CHRISTCHURCH
4 Ash St
Christchurch Central
Christchurch NZ 8011
Telephone: +64 29 201 2996

HAMILTON
Room 38 'The Homestead', 10 Bisley Rd
Hamilton NZ 3214
Telephone: +64 27 609 4618

AUCKLAND
2/2 Boundary Road,
Catalina Bay, Hobsonville Point
Auckland, NZ 0618
Telephone: +64 21 190 1605

WALLBRIDGE GILBERT AZTEC
www.wganz.co.nz

12. Public Excluded Business

RESOLUTION TO EXCLUDE THE PUBLIC

Section 48, LOCAL GOVERNMENT OFFICIAL INFORMATION and MEETINGS ACT 1987

That:

1. **The public be excluded from the following part of the proceedings of this meeting, namely:**

   Item 6.0 Gisborne Holdings Ltd

2. **This resolution is made in reliance on section 48(1)(a) of the Local Government Official Information & Meetings Act 1987 and the particular interest or interests protected by section 6 or section 7 of that Act which would be prejudiced by the holding of the whole of the relevant part of the proceedings of the meeting in public are as follows:**

Item	7(2)(i)	Enable any Council holding the information to carry on, without prejudice or disadvantage, negotiations (including commercial and industrial negotiations).