



Combined Tairāwhiti Regional Freshwater Planning Advisory Group and Waipaoa Catchment Planning Advisory Group – Hui 12

Date: 20 November 2024

Title of report: Overview of evidence base to inform freshwater provisions

Report no: **4**

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Purpose of this report

This report provides an overview of the technical evidence base underpinning the review of freshwater provisions in the Tairāwhiti Resource Management Plan (TRMP). This includes work already procured by Gisborne District Council as of November 2024, as well as further work planned through to mid-2025.

Outcomes sought

Members of this Advisory Group understand the scope of the evidence base underpinning the review of regional and catchment freshwater provisions, and next steps to address gaps.

Getting ready for the hui

Please consider the material in this report ahead of the hui to aid discussion.

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1 Background and context

Gisborne District Council (Council) relies on research and information to inform the review and development of its freshwater plans. Its programme of technical work builds on a wealth of existing national and regional research and seeks to provide current, locally relevant information to support informed responses to our region's most pressing freshwater issues:

- sediment and e.coli across the region
- the effects of intensive land-use on water quality in the Tūranga Flats, and
- water quantity and allocation on the Tūranga Flats.

The programme also includes technical work to meet statutory requirements of the National Policy Statement for Freshwater Management 2020 (NPS-FM), such as identifying locations of threatened species habitat and natural inland wetlands.

Council's freshwater team includes the consultancy Traverse Environmental, which provides freshwater science expertise to support our technical work programme. Their guidance has been central to our developing evidence base.

This paper builds on previous Advisory Group discussions on key technical reports and presents a broader picture of the scope of the technical work programme with a focus on next steps.

2 Overview of technical work

This section summarises the focus of technical work grouped around the following topics:

- Water quantity and allocation
- Water quality and discharges to land and water
- Activities in the beds of lakes and rivers; and
- Updating other Schedules and Appendices.

The scope of previous and planned technical work is included at **Appendix A**.

Water quantity and allocation

The NPS-FM requires Council to set minimum flows, levels and allocation limits to achieve environmental outcomes, values and long-term visions. Minimum flows and limits are particularly important on the Tūranga Flats where there is more pressure on water supply. The process of setting environmental flows, defining limits and actions to achieve them can be complex and understanding the costs and benefits of different options is essential to achieving outcomes. This has been a key message through Advisory Group discussions.

We are focusing our research efforts on key water quantity issues:

- The over allocation of water takes in the Waipaoa catchment including both river and groundwater sources
- Improving ecological outcomes for the Waipaoa catchment relating to low flow restrictions
- Responding to localised water take environmental effects

- Stabilising the declining groundwater levels in the deep Poverty Bay aquifers
- Avoiding potential saltwater intrusion from the coast and to potentially mitigate further spreading of high conductivity groundwater in the deep Poverty Bay aquifers
- Establishing a sustainable default methodology regional water take framework
- Improving our understanding of the relationship between water quantity and water quality issues.

Key technical work to date to inform water quantity provisions includes:

- *Flow requirements of Te Arai and Waipaoa Rivers* (NIWA, 2023), and
- *Poverty Bay Flats Groundwater Modelling Programme Summary Report* (WGA, 2023).

These reports have been discussed with the Regional and Waipaoa Advisory Groups, and feedback from members has informed a draft list of more technical issues relating to the surface water quantity issues outlined above (see **Appendix B**).

We're looking to procure technical expertise to help us respond to these technical issues and refine water quantity management scenarios. In tandem, we are progressing further data analysis and fieldwork to better understand the effects of water abstraction on flow levels, how changes to minimum flows will affect water users and different crop types, and habitat availability.

We're also considering an economic analysis of water quantity scenarios to support informed conversations and decision making around limit setting and water allocation.

The scope of previous and planned technical work on water quantity and allocation issues is summarized in **Appendix A**.

Water quality and discharges to land and water

The National Objectives Framework (NOF) process outlined in the NPS-FM requires the setting of environmental outcomes, freshwater values and baseline and target attribute states for 22 freshwater quality attributes for every river and lake in the region. Where some councils may have undertaken more comprehensive technical work across all 22 NOF attributes, we have focused on those relevant to our region's core issues, namely the effects of intensive cropping on the Tūranga Flats, and issues with sediment and E. Coli across the region.

An Expert Panel has now been established to advise on two key research gaps relating to water quality:

1. Research gap 1 – how to set realistic and defensible target attribute states on the Turanga Flats
2. Research gap 2 – how to deal with region-wide water quality issues (particularly sediment and E.coli)

Panel membership and expertise is included at **Appendix C**. A list of questions for the Expert Panel was previously shared with the Advisory Groups and has been updated to reflect feedback (see **Appendix D**).

The scope of previous and planned technical work on water quality and discharges is summarized in **Appendix A**.

Activities in the beds of lakes and rivers

We are planning technical work to inform appropriate gravel management settings. The aim is to

- (a) improve our understanding of sediment dynamics and gravel storage rates of river systems, and
- (b) identify the ecological and cultural values associated with our braided rivers.

The scope of this work is summarised in **Appendix A**.

Updating other Schedules and Appendices

We are also progressing further technical work to update plan Schedules and Appendices in line with NPS-FM requirements. This includes mapping natural inland wetlands (Refer *Hui 12 Report 3: Wetlands Identification*), and to identify locations of threatened species habitat.

3 Next steps and timing

We expect to complete the majority of technical work by mid-2025 (see **Appendix A**). We will report back to the Advisory Groups with findings and implications for policy options throughout 2025.

4 Appendices

Appendix A: Overview of technical work

Appendix B: Draft Technical Issues for Freshwater Quantity Experts

Appendix C: Tairāwhiti Freshwater Quality and Ecosystem Health Expert Panel Members

Appendix D: Questions for Tairāwhiti Freshwater Quality and Ecosystem Health Expert Panel (Updated November 2024)

Appendix A: Overview of technical work

Water quantity and allocation					
#	Catchment	Project	Status	Description	How will this inform freshwater provisions?
1	REGIONAL	Regional Water Assessment (Aqualinc, 2023)	COMPLETED	This regional-scale water assessment quantifies risks to water supply security, including where and how this will be experienced most acutely and how it may be amplified or accelerated looking out to 2055.	The assessment informs regional priorities for freshwater security. The findings highlight acute pressure on the future balance of freshwater supply and demand in the Waipaoa catchment area.
2	WAIPAOA	Flow requirements of Te Arai and Waipaoa Rivers (NIWA, 2023)	COMPLETED	This report determines how different minimum flow scenarios might affect the availability of physical habitat for aquatic organisms within the Te Arai and Waipaoa Rivers. It reviews river level data for both rivers and provides environmental flow options to support instream values.	The report will inform appropriate Critical Low Flows and Cease to Take Flows for the Waipaoa and Te Arai Rivers. The Critical Low Flow management options identified in the report provide a starting point for beginning informed decision-making to safeguard environmental values.
3	WAIPAOA	Poverty Bay Flats Groundwater Modelling Programme Summary Report (WGA, 2023)	COMPLETED	This report summarises the Poverty Bay Flats Groundwater Modelling Programme, providing insights into groundwater dynamics. Several exploratory scenarios were run in the model to provide guidance on potential groundwater management measures.	The WGA report will inform decisions regarding groundwater limits and targets in the Waipaoa Catchment Plan.
4	WAIPAOA	Development of an Approach for Flow Naturalisation in Tairāwhiti (NIWA, 2024)	COMPLETED	Provides a regionally applicable approach for creating naturalised flow time series in the Tairāwhiti region and applies this approach to gauging stations in the Waipaoa, Te Arai, and Taruheru catchments using observed flow data. The analysis indicates significant flow alterations at gauging stations located in the lower reaches of rivers due to surface and groundwater withdrawals.	The estimates of naturalised flows will inform the limit-setting process.
5	REGIONAL	Groundwater Dynamics and Hydrochemical Evolution as Inferred from	COMPLETED	Describes the flow source, pathways and lag times of water through the rivers and aquifers of the Tairāwhiti catchments. It brings together geochemical data from shallow and deep groundwater sources, providing an update from the 2001 regional synthesis.	This will inform water quantity settings for groundwater and surface water.

		Regional Water Age & Chemistry Data (GNS Science, 2024)			
6	WAIPAOA / NORTHERN / WAIAPU / WAIMATA-PAKARAE	Aquifer mapping and Surface water investigations – SKYTEM	<i>IN PROGRESS</i> <i>Data capture complete, data interpretation in progress</i>	Aerial mapping was conducted in January 2024 using technology that scanned ~300m underground. The goal is to improve our understanding of the Poverty Bay Flats and coastal sands aquifer systems; groundwater resources in the Te Araroa, Hicks Bay and Ruatoria areas; and surface water flows in Maraehara, Waiomoko and Pakarae rivers.	This will help to guide appropriate management approaches for groundwater resources in the Te Araroa, Hicks Bay and Ruatoria areas; and surface water flows in Maraehara, Waiomoko and Pakarae rivers.
7	WAIPAOA	Review of Hydrological Data and Relationship Between Flow Monitoring Sites	<i>IN PROGRESS</i> <i>To be completed end of 2024.</i>	<ul style="list-style-type: none"> Reviewing water level, flow, gaugings and rating curves at Matawhero. Assessing relationship between flow monitoring sites at Kanakanaia and Matawhero to better understand effects of water abstraction on water levels in the river. 	This will inform Minimum flows and Cease To Take Flows for the Waipaoa River.
8	WAIPAOA	Past water-use data analysis	<i>IN PROGRESS</i> <i>To be completed end of 2024.</i>	<ul style="list-style-type: none"> Assessing how water use has changed since the introduction of transfers Assessing water use of different crop types across the year and at different levels of rainfall Report how many water users are on telemetry, by take rate. 	This will inform minimum flow and allocation settings in the Waipaoa catchment, by improving our understanding of the distribution of impacts of different flow settings.
9	WAIPAOA, ŪAWA, WAIAPU, NORTHERN	Ecological Habitat Assessments	<i>Field work planned for Summer 2024/25</i>	<ul style="list-style-type: none"> Updating original ecological based assessments from 2010 in Te Arai and Waipaoa catchments. New ecological habitat-based fieldwork, modelling and reporting for Karakatuwhero, Awatere, Wharekahika and potentially Uawa and Tapuaeroa catchments. 	To inform minimum flows for the Waipaoa and Te Arai rivers, as well as support the development and establishment of new water allocation frameworks for the Uawa, Tapuaeroa, Karakatuwhero, Awatere and Wharekahika (northern) river catchments.
10	WAIPAOA	Cultural Flows for the Te Arai	<i>To be completed in 2025</i>	Work with mana whenua to better understand how different flow settings impact on cultural values.	To inform minimum flow settings for the Te Arai river.

11	WAIPAOA/ REGIONAL	Expertise to Inform Water Quantity Provisions	To be completed in early 2025	As set out on page 3, expertise will cover freshwater ecology, hydrology, habitat modelling, agronomy and mātauranga māori to advise on: <ul style="list-style-type: none"> how to set sustainable and defensible minimum flows and water take allocation framework within Te Arai and Waipaoa Rivers how to develop ecologically sound default limits guidance on an ecologically sound framework for the potential augmentation of rivers from water storage. 	Informs the setting of freshwater objectives, limits, methodologies and timeframes as mandated by the NOF.
12	WAIPAOA	Economic Analysis of Water Quantity Scenarios	To be completed by mid-2025	Economic analysis of water quantity scenarios to determine economic costs and benefits. This will seek to include an assessment of social impacts.	

Water quality and discharges to land and water

	Catchment	Project	Status	Brief description	How will this inform the freshwater provisions?
13	REGIONAL	State and Trends of River Water Quality in Tairāwhiti, Regional Reference Report (Aquanet, 2023)	COMPLETED	Summarises current and historical state of water quality in Tairāwhiti, and temporal trends over the last 5, 10 and 15 years based on SoE data.	The data informs baseline attribute states and priority issues to address.
14	REGIONAL	Freshwater Quality and Ecosystem Health in the Gisborne Region: State and Trends (GDC, 2024)	COMPLETED	Updates the report above, using data from the 5 years to June 2023 for state analyses and up to 10 years' data (until June 2023) for trend analyses. The findings, presented on a site and catchment basis, also include the eDNA results for the presence of any threatened species.	The data informs baseline attribute states and priority issues to address.
15	REGIONAL	Baseline attribute state and reference state estimates for Tairāwhiti monitoring sites (Traverse Environmental, 2024)	COMPLETED	Provides baseline attribute state and reference state estimates for Tairāwhiti monitoring sites. Attributes for which BAS has been assessed are ammoniacal nitrogen, nitrate-nitrogen, dissolved reactive phosphorus, E. coli, dissolved inorganic nitrogen, total nitrogen, total phosphorus and the macroinvertebrate community index. Attributes for which reference state has been assessed are nitrate, nitrogen, dissolved reactive phosphorus, E.	<ul style="list-style-type: none"> Provides baseline attribute states as required by the NPS-FM 2020, and Provides reference state estimates that will inform setting target attribute states, as well as assist the Water Quality and Ecosystem Health Expert Panel in assessing expected changes in water quality

				coli, visual clarity, total nitrogen total phosphorus and the macroinvertebrate community index.	and ecological attributes under different management scenarios.
16	WAIPAOA / ŪAWA	Land Management Practices and nutrient losses from farms on the Poverty Bay and Ūawa Flats (SPASMO)	COMPLETED	This project evaluates scenarios for the Taruheru River Catchment Area and then Ūawa Flats, to explore the impacts and trade-offs of land management practices and land use types. The project models scenarios using SPASMO software.	The findings will guide land use mitigation options.
17	REGIONAL	Development and verification of a Morphometric Landslide to Stream Connectivity Layer for Tairāwhiti	IN PROGRESS <i>Model complete, verification in progress</i>	The model identifies which areas have a high likelihood of landslides occurring and the likelihood that these landslides will affect our waterways. The model will inform the Land Overlay 3B, identifying the worst eroding land across the region which will need to transition out of plantation forestry and/or pastoral farming and into permanent vegetation cover.	The findings will inform forestry provisions, which will have important implications for setting and achieving target attribute states for sediment.
18	WAIPAOA	Expert Panel – Water Quality and Ecosystem Health	IN PROGRESS <i>To be completed mid-2025</i>	A Water Quality and Ecosystem Health Expert Panel has been appointed. The Expert Panel will develop the methodology for assessing water quality scenarios and apply that methodology to provide a consensus view on what the effects under each scenario will look like “on the ground”, and the likely changes in technical attributes under each scenario.	The findings will inform provisions to manage water quality, in particular sediment, e.coli and nutrients.
19	ŪAWA	Sediment Analysis for Ūawa Catchment	IN PROGRESS <i>To be completed by early 2025</i>	Analysis of sediment samples in the Ūawa catchment to determine whether sediment found in the river and marine samples comes from a particular soil, lithology and vegetation type. This will provide important information on land uses and geographic areas that provide disproportionate contributions of sediment to waterways and the marine environment, smothering benthic species and forcing fish species to migrate or perish.	The findings will enable Council to target policies and land management activities to manage sediment.
20	WAIPAOA / WAIMATA-PAKARAE / ŪAWA	E.Coli monitoring and Faecal source tracking (FST)	Planned for Summer 2024/25 and Autumn/ Winter 2025	Sampling and testing to conclusively determine the source of E. Coli within the Waipaoa, Waimata-Pakarae and Uawa catchments through the collection of water samples and DNA testing.	Differentiating between E. Coli sources, human, birds, pets and livestock, as well as between naturalised vs chronic vs event-based discharges, will inform the appropriate management options to address E.coli.

21	WAIPA OA	Testing in the Taruheru	<i>Planned for Summer 2024/25 and Autumn/ Winter 2025</i>	Sampling in the Taruheru to identify sources of nitrate and dissolved reactive phosphorous (DRP) contamination, specifically at Tuckers Rd bridge monitoring site. We also plan to deploy temperature monitoring loggers for the summer season within the Taruheru catchment, in addition to dissolved oxygen and periphyton monitoring, to assist with developing an improved understanding of freshwater quality in the Taruheru catchment.	The findings will inform appropriate planning response to manage high levels of nitrate and DRP.
22	REGIONAL	Region-wide Sediment Transfer Model (LandCare)	<i>To be completed early 2025</i>	Modelling to understand the effect of different land-use scenarios on instream (deposited) sediment loading and ability to achieve Target Attribute States over what timeframe.	The findings will inform Target Attribute States for sediment.

Activities in the beds of lakes and rivers

	Catchment	Project	Status	Brief description	How will this inform the freshwater provisions?
23	WAIAPU	Grain size monitoring	IN PROGRESS <i>Further sites to be assessed in Summer 2024/25</i>	Gathering baseline data and monitoring gravel rivers particle size distribution to better understand the sediment dynamics of river systems, including <ul style="list-style-type: none"> the impact of natural events and human activities (e.g. gravel extraction) on particle size distribution the transport potential of sediment the morphological and ecological health of our rivers including likely potential spawning grounds; and the locations of higher gravel to scalping ratios. 	This will inform appropriate management settings for gravel extraction.
24	WAIAPU	LiDAR Differencing	IN PROGRESS	LiDAR differencing to inform gravel storage rates through the gravel system.	This will inform an appropriate allocation framework for gravel extraction.
25	WAIAPU	Ecological Values and Natural Character Assessment	<i>To be completed mid-2025</i>	A geospatial assessment to inform where gravel extraction could be undertaken without creating adverse effects on the physical river habitat and species requirements within it with particular focus on the extent, scale and timing of the activity.	The ecological values and natural character assessment will inform where gravel extraction should not occur, as well as decisions regarding minimum bed-levels.
26	WAIAPU	Cultural Values Assessment	<i>To be completed mid- 2025</i>	To identify <ul style="list-style-type: none"> sites/locations where gravel, larger rock material, and water abstraction, as well as other bed modification and the discharge of contaminants (to land or water) is inappropriate for cultural reasons; any other riverine cultural sites where consultation with hapu may be necessary to any resource consents being issued; and sites where there are no specific cultural concerns around freshwater resource abstraction. 	The cultural values assessment will inform provisions for the sites where abstraction or modification is / is not appropriate for cultural reasons and/or where consultation with hapu may be necessary.

Wetlands and riparian margins

	Catchment	Project	Status	Brief description	How will this inform the freshwater provisions?
27	WAIPA OA	Geomorphology Assessment and Recommendations for the Te Arai River	COMPLETED	The focus of this geomorphic and riparian assessment was to improve our understanding of how the geology and landform influences the hydrology of the Te Arai catchment. The report includes recommendations to improve the health of the river, while balancing the risks around flooding, erosion, channel change and bed aggradation.	This will inform action planning for the Te Arai river and broader provisions.
28	REGIONAL	Tairāwhiti Regional Wetlands Identification and Mapping Project (Morphum Environmental)	COMPLETED	Morphum Environmental conducted an initial desktop analysis of potential NPS-FM wetlands in Gisborne-Tairāwhiti. Using LiDAR, GIS, and aerial imagery, 3500 potential sites were identified as a geospatial layer. Not all of these sites will be wetlands and it is likely that further unmapped wetlands are present in the region. An important next step is to determine which of them are wetlands under the NPS-FM definition.	The Morphum Layer shows <i>indicative</i> wetland sites — it is a starting point for discussion and further investigation. It will be refined with further technical work in 2025 (described below).
29	WAIPA OA	Te Maungarongo o te Kooti Wetland Hydrological and Hydrogeological Assessment (SLR, 2024)	COMPLETED	This assessment seeks to increase understanding of the dynamics and relationships between water levels within the wetland, groundwater, and adjacent surface water bodies.	This assessment informed the development of the wetland management plan, to inform action plans, management and monitoring provisions in the Waipaoa Catchment Plan. It will also inform the NOF process for the Regionally Significant Wetland.
30	WAIMATĀ-PAKARAE	Waimatā Nature-Based Solutions (NBS) Feasibility Study	IN PROGRESS To be completed early 2025	Development of a spatial model or tool for the purpose of testing the feasibility of Nature-based Solutions at a sub-catchment level.	This will inform land management options to reduce sediment, woody debris and run off into the Waimatā River system.
31	REGIONAL	Regional wetlands mapping - verification of desktop analysis and prioritized database	To be conducted in the first half of 2025	Vegetation is the primary method of identifying and delineating wetlands. Oblique aerial imagery is intended in early 2025 to enable wetland ecologist(s) to conduct a desktop vegetation assessment of indicative wetland sites. It is intended that the wetland inventory ultimately provides the community with surety of wetland location and information on their value and condition. The wetland inventory will also provide a regional wetlands baseline that can be monitored; guide consent applicants and decision-makers in assessing the appropriateness of activities that might impact wetlands; and inform restoration and reinstatement efforts.	Understanding regional wetland extent will allow Council to engage on wetland values, objectives, aspirations and priority sites for monitoring, and to design appropriate rule settings for the protection and enhancement of wetlands.

Other Schedules and Appendices

#	Catchment	Project	Status	Brief description	How will this inform the freshwater provisions?
32	REGIONAL	Regional eDNA testing and spatial analysis tool of threatened and at risk species	COMPLETED	EDNA monitoring provides a snapshot of the presence or absence of freshwater species. eDNA sampling was conducted by GDC annually during the summer seasons from Feb 2020 to June 2023 from 101 sites covering different stream and river sites each year.	eDNA results may inform the update of Schedule G15 – Aquatic Ecosystem Waterbodies.
33	REGIONAL	Fish passage assessments	IN PROGRESS To be completed in 2025	Assessment of fish passage barriers through a desktop analysis followed by ground truthing. The desktop assessment has been completed for the Waipaoa catchment, with other catchments to be completed in 2025.	This will inform the development of fish passage action plans.
34	REGIONAL	Location of inanga spawning sites	IN PROGRESS	Desktop assessment of inanga spawning sites has been completed for the region using a digital elevation model (DEM), with wedges being progressively validated and mapped through fieldwork.	This will inform updated Schedule for location of threatened species habitat.
35	REGIONAL	Further targeted fine-resolution eDNA sampling	Planned for Summer 2024/25	Targeted sampling at aquatic ecosystem waterbody sites particularly focused on aquatic species presence.	eDNA results may inform the update of Schedule G15 – Aquatic Ecosystem Waterbodies.

Appendix B: Draft Technical Issues for Freshwater Quantity Experts

We are seeking to procure expertise in freshwater ecology, hydrology, habitat modelling, agronomy and mātauranga māori to advise on the following technical issues regarding water quantity. This will inform water quantity management scenarios for economic analysis.

- How to manage water takes upstream of flow monitoring sites.
- How success of environmental flow and take limits should be measured.
- How a “restrictions regime” could be implemented so that environmental flow limits are achieved but in a manner that reflects the limitations and practicalities of water users.
- What hydrological, ecological or cultural considerations need to be considered when determining an appropriate transition time to achieving new limits.
- What hydrological or ecological effects or benefits should be considered when determining appropriate timeframes for interim limits/phasing.
- What assessment criteria should be applied to evaluate the hydrological, ecological and (cultural) benefits of the scenarios.
- The hydrological or ecological benefits of restricting takes above Kanakanaia to “B Block” only.
- The ecological or hydrological benefits of amending the FMU boundaries to align with the flow monitoring site at Kanakanaia.
- The hydrological or ecological benefits of transitioning to new environmental flow limits if water quality remains at current levels.
- Guidance on a minimum catchment area or similar where no water takes are recommended to avoid potential effects
- If there is a standardised setback that could be applied to sensitive waterbodies to avoid drawing water from these sources to protect their sensitive values
- What information is required to understand the impacts of an augmentation proposal.
- Recommendations for assessing augmentation applications and managing the potential effects to ensure environmental flow and take limits are achieved.

Appendix C: Tairāwhiti Freshwater Quality and Ecosystem Health Expert Panel Members

Person	Organisation	Area of Expertise
Dr. Joanne Clapcott	Cawthron	River water quality and ecology, nutrients and periphyton, Mātauranga Māori and Te Ao Māori
Ned Norton	Land Water People	River water quality and ecology, lake water quality and ecology, catchment modelling, erosion and sediment transport processes and loss mitigation, E.Coli transport processes and loss mitigation, nutrients and periphyton
Anna Madarasz-Smith	Pattle Delamore Partners (PDP)	E.Coli transport processes and loss mitigation, estuarine water quality and ecology
Dr. Richard Muirhead	AgResearch	Catchment modelling, erosion and sediment processes and loss mitigation, E.Coli transport processes and loss mitigation
Dr. Andrew Neverman	Landcare Research	Catchment modelling, erosion and sediment transport processes and loss mitigation
Paul Murphy	Gisborne District Council	Technical lead, GDC, catchment planning

Appendix D: Questions for Tairāwhiti Freshwater Quality and Ecosystem Health Expert Panel (Updated November 2024)

The overarching purpose of the GDC expert panel process is to provide expert opinion on the potential outcomes of the various scenarios, particularly on matters that cannot be suitably covered by existing catchment models, and where interpretation and integration of multiple strands of information is required.

Below is a list of topics (questions) the Panel will be asked to comment on, noting that input from the Panel is sought on the exact wording and framing of these questions as well as on the design of the assessment framework. It is anticipated some questions may not be able to be answered (or answered fully) on the basis of the information available, or due to gaps in scientific understanding. In this situation, the Panel must feel free to say so, and where possible, provide reasons.

Current, baseline and reference states and temporal trends

For each key attribute considered, the Panel will be asked to express a view about how the current baseline and reference states were characterised in the available supporting technical documentation, including:

- Are data and information sufficient to characterise current and baseline states and with what level of confidence?
- Was reference state adequately characterised, and with what level of confidence?
- Were temporal trends analysed following "best practice" methodology?
- Are the comparison (% improvement) with higher attribute states (including National Bottom Line (NBL) where applicable) robust?
- What are the most critical water quality and aquatic ecosystem health issues in the region?
- Should any additional analysis be undertaken and/or are there any existing data or information sources (e.g. existing national models) that should be used to supplement the information base provided to the Panel?
- Are there any significant information gaps the Panel recommends addressing in upcoming years?

Scenarios

The Panel will not be asked to comment on the feasibility, achievability or cost of the scenarios; however, we would like to hear any comments and / or concerns regarding the scenarios, including:

- How the scenarios are described - are the scenarios clear and understandable and described in sufficient detail to support the Panel's work?
- Are the scenarios consistent with the nature and significance of the issues identified for the region?
- In the Panel's experience, are the scenarios generally consistent with approaches taken in other regions?

- With specific regard to E. coli mitigation, are any key mitigation actions not included in the scenarios?

Modelling approaches and outputs

The Panel will be asked to comment on the modelling methodologies and outputs, for example:

- Input data limitations / gaps
- Key limitations of the model / modelling approach
- Level of confidence in modelled outputs
- How the modelling outputs should or should not be used (conditions of use)

Complement to modelling outputs

All models have limitations and critical aspects of the water quality response may not be able to be modelled. The Panel will be asked a series of questions to provide additional interpretation of the modelling results. The following questions are anticipated:

- Response timeframes: for each modelled attribute, what are the potential response timeframes of the attribute following implementation of mitigation actions?
- Likelihood of response: for each modelled attribute, how likely is the modelled response to occur in reality? Are there mechanisms not considered in the model that may prevent a response?
- What are the likely effects of climate change on scenario outcomes?
- Of the mitigations considered in each scenario, what are those likely to be most effective on each attribute / indicator?
- For E. coli, what is the likely outcome of each scenario on:
 - NPS-FM Attribute State (Attribute 2A and 2B) and national target for primary contact?
 - swimmability / health risk during bathing season and under baseflow conditions?

Non-modelled Attributes (freshwater)

It is anticipated that scenarios will only be modelled for a limited range of water quality attributes. A key function of the Panel is to provide an assessment of the potential / likely outcomes of each scenario on non-modelled attributes or indicators, especially those relating to ecological health.

Macroinvertebrates

- What are the key pressures and drivers leading to poor macroinvertebrate community health in the region?
- What are the likely outcomes of each scenario on macroinvertebrate health?
- What are the potential response timeframes of macroinvertebrate community health following implementation of mitigation actions?

Fish

- What are the key pressures and drivers of fish community health in the region?
- What are the likely outcomes of each scenario on fish community health?
- What are the likely outcomes of each scenario on tuna population health
- What are the potential response timeframes of fish / tuna communities following implementation of mitigation actions?

Periphyton

- What are the likely outcomes of each scenario on periphyton growth?
- Given what is known of periphyton state and issues in the region, is detailed modelling of periphyton outcomes of scenarios useful / required? If yes, what methodology is recommended by the Panel?

Temperature

- Is temperature likely to be a key driver of ecological health in the region?
- What are the likely outcomes of each scenario on water temperature?
- Should outcomes of each scenario on water temperature be modelled?

Deposited Sediment (note: no monitoring data available):

- Is deposited sediment likely to be a key driver of ecological health in the region?
- What are the likely outcomes of each scenario on deposited sediment?
- Are outcomes of each scenario on sediment able to be modelled?

Estuarine systems

At this stage, the GDC technical team have not decided on an approach to assess the potential outcomes of each scenario on the health of estuarine systems. The Panel will be asked to recommend an approach consistent with the level of understanding and knowledge of these systems, their state and the pressures or threats they face.

- Are data and information sufficient to characterise the current state of estuarine systems and with what level of confidence?
- What are the key pressures and drivers of fish community health in the region?
- Are there any significant information gaps the Panel recommends addressing (e.g. regular or targeted monitoring) in upcoming years?
- What are the likely outcomes of each scenario on estuarine system health?
- What are the potential response timeframes of estuarine health following implementation of mitigation actions?