greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Technical report for Schedule H of the Regional Plan working document for discussion

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September 2013

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Contents

1. Introduction

This document provides technical background to the outcomes listed in Schedule H of the Regional Plan: Working document for discussion (GWRC 2013) – a copy of this schedule is reproduced in Appendix 1. The information provided is primarily related to the numeric outcomes in the Schedule H tables, but where necessary narrative outcomes are also outlined. Information is presented separately for each of the following:

- rivers and streams
- lakes
- wetlands
- groundwater, and
- open coast, harbours and estuaries.

In general, the outcomes listed in Schedule H are intended to represent a 'good' (or 'healthy') state for their respective values. The exceptions are for 'significant', 'regionally important' or 'outstanding' waterbodies where some outcomes are included to represent an 'excellent' state.

The methods used to identify the thresholds that define the different states vary for the different attributes. For some, such as biological indicators of ecological health, the state is identified based on deviation from reference or pristine conditions. For others such as toxicants, thresholds are identified based on the measured responses of aquatic organisms to a known dose of toxicant.

The numeric outcomes are based largely on existing national and regional guidance or best practice where available. For many attributes in the Schedule H tables, technical guidance is still under development regionally and/or nationally (eg, through central government's National Objectives Framework). Where this is the case, or where data to set numeric outcomes is lacking, narrative outcomes have been used in place of numeric outcomes. It is expected that narrative outcomes may be replaced with numeric outcomes as further technical advice becomes available.

1.1 Shared values framework

The direction of Te Upoko Taiao, Greater Wellington Regional Council's Natural Resource Management Committee, has been that the revised Regional Plan provide for 'shared values' for water quality and quantity.[1] These shared values are:

- **Aquatic ecosystem health and mahinga kai.** To provide for the aquatic ecosystem health of a waterbody the quality and quantity of the water and associated habitat must be sufficient to sustain the range of species, processes and functions that would naturally occur in that water body. Human use and food gathering is an important aspect of the mahinga kai value and requires that water quantity and quality sustains flora and fauna important to tangata whenua.

[1] See Te Upoko Taiao Committee Paper for 4 December 2012 docs #1131834.

- **Contact recreation and tangata whenua use.** Contact recreation outcomes provide for people to undertake activities that involve direct contact with a water body. The tangata whenua use value is similar but stresses the importance of an integrated relationship with water to sustain physical, mental, community and spiritual wellbeing.

GWRC considers that there is a significant, though not complete, degree of cross-over between attributes of aquatic ecosystem health and mahinga kai as well as those of contact recreation and tangata whenua use. Further work into this cross-over is needed. There are also differences between these values. For this reason attributes specific to mahinga kai and to tangata whenua use have been recommended for inclusion in the Schedule H tables. A technical report to provide background to the shared values framework and these recommendations is currently being developed.

The narrative outcomes recommended are intended to provide for mahinga kai and tangata whenua values at a catchment scale. However, it is recognised that providing for these values may be more specifically dealt with at the scale of the individual site.

2. Rivers and streams

This section sets out information in relation to Tables H1.1–H1.2 and Tables H1.4–H1.5 in Schedule H, covering aquatic ecosystem health/mahinga kai, contact recreation/tangata whenua use, stock watering, and trout fishery/spawning values in rivers and streams. Background information regarding the selection of attributes to represent each value and the identification of numeric outcomes is provided in a number of different reports (Table 2.1).

Table 2.1: Technical reports relevant to each value identified for rivers and streams in Schedule H

Value	Relevant technical report
Ecosystem health and mahinga kai	Biological and habitat attributes: this report Water quality attributes: Ausseil (2013c)
Contact recreation and tangata whenua use	Ausseil (2013a)
Stock watering	Ausseil (2013a)
Trout fishery and spawning	Ausseil (2013b)

2.1 Aquatic ecosystem health and mahinga kai

2.1.1 River classes

The Freshwater Environments of New Zealand (FWENZ) classification has been used as the basis of river classes to represent natural variation in river and stream ecosystems across the Wellington region. The reasons for selection of the FWENZ classification and documentation of amendments for the Wellington region are documented in Warr (2009) and Warr (2010). Grouping of the amended FWENZ classes into the river classes listed in Schedule H is outlined in Table 2.2.

Table 2.2: Table of GWRC FWENZ classes included in each river class listed in Schedule H

River class	Description	GWRC FWENZ classes
1	Steep gradient, hard sedimentary	C7, C10, UR
2	Moderate gradient and coastal, hard sedimentary	C5, C1, C6b
3	Moderate gradient, soft sedimentary	C8
4	Low gradient, large, draining ranges	C6a
5	Low gradient, large draining plains and eastern Wairarapa	C6c
6	Low gradient, small	A, B

These river classes are illustrated in Maps 20A–20E of the Regional Plan: Working document for discussion (GWRC 2013). A copy of these maps is provided in Appendix 2.

2.1.2 Biological attributes

The biological attributes in Table H1.1 were chosen to represent different aspects of river and stream ecosystem health. Fish, macroinvertebrates[2], periphyton[3] and macrophytes[4] are all known to respond to a gradient of human related environmental stressors and are widely used as indicators of river and stream health both nationally and internationally (eg, Hudson et al. 2011; Schallenberg et al. 2011; Barbour et al. 1999).

(a) Narrative outcomes for fish, macroinvertebrates and macrophytes

The outcomes for biological attributes refer to community structure, composition, diversity and abundance. These different aspects are widely recognised as being an important part of an integrated analysis of the biological condition of rivers and streams (Barbour et al. 1999).

Note that the fish attribute refers only to the health of native fish communities. The health of trout fisheries and spawning grounds are covered in Section 2.4 and in Table H1.5 of Schedule H.

(b) Numeric outcomes for periphyton biomass

Although periphyton production provides the basis of the food chain in rivers and streams, excessive periphyton growth can have detrimental effects on river and stream ecosystem health.

Periphyton biomass is the quantity of organic matter that has accumulated from periphyton production per unit area of stream bed (Biggs 2000) and is most commonly represented by chlorophyll *a* concentration. Greenfield (in prep) provides the background to the selection of periphyton biomass as an indicator and its relationship with environmental variables and other biological indicators in the Wellington region.

Biggs (2000) estimates that the boundary between oligotrophic (low nutrient status) and mesotrophic (moderate nutrient status) conditions is represented by mean monthly and annual maximum chlorophyll *a* concentrations of 15 and 50 mg/m^2, respectively. An annual maximum concentration of 200 mg/m^2 is estimated to represent the boundary between mesotrophic and eutrophic conditions.

An additional chlorophyll *a* threshold of 120 mg/m^2 has been used by Environment Canterbury (Hayward et al. 2009) and Horizons Regional Council (Ausseil & Clark 2007). This threshold is identified in Biggs (2000) as protecting trout habitat and angling values in rivers dominated by filamentous algae. However, it has also been used to represent a state of enrichment that is intermediate between the oligotrophic/mesotrophic and mesotrophic/eutrophic (high nutrient status) thresholds. These thresholds are used as the basis of numeric outcomes for periphyton biomass across the different rivers classes in the Wellington region. The thresholds selected for each river class reflect the

[2] Macroinvertebrates are small insects, crustaceans, snails, worms and other animals that inhabit river and stream beds.

[3] Periphyton is the mixture of algae, cyanobacteria and heterotrophic microbes that covers a river or stream bed.

[4] Macrophytes are emergent, submerged or floating aquatic plants which grow in or near the water.

degree to which periphyton biomass varies naturally depending on environmental factors such as accrual period[5], water temperature and nutrient concentrations.

(i) River class 1

Rivers and streams in river class 1 are located in the upper Tararua, Rimutaka and Aorangi ranges and are subject to short accrual periods and naturally low nutrient concentrations. As such these rivers and streams support naturally low levels of periphyton biomass. Accordingly, a maximum annual chlorophyll *a* concentration of 50 mg/m^2 is identified as the outcome for both "significant aquatic ecosystem" and "healthy aquatic ecosystem" outcomes for this river class.

(ii) River classes 2 and 4

Rivers and streams in these classes have moderate accrual periods and occur at lower altitude and, as such are likely to support naturally higher periphyton biomass than rivers in class 1. Accordingly, the outcomes for "significant aquatic ecosystems" and "healthy aquatic ecosystems" in class 2 and 4 rivers and streams are recommended as a maximum annual chlorophyll *a* concentration of 50 and 120 mg/m^2, respectively.

(iii) River classes 3, 5 and 6

Rivers and streams in these classes generally have long accrual periods and occur at low altitude. As such, they are likely to support moderate periphyton biomass even under natural conditions. Accordingly the outcomes for "significant aquatic ecosystems" and "healthy aquatic ecosystems" in class 3, 5 and 6 rivers and streams are recommended as a maximum annual chlorophyll *a* concentration of 120 and 200 mg/m^2, respectively.

2.1.3 Water quality attributes

The selection of water quality attributes and numeric outcomes is documented in Ausseil (2013c). Those not covered or those for which the recommendation differs to that in Ausseil (2013c) are discussed below.

(a) Nutrients

The availability of nutrients – in particular nitrogen and phosphorus – is one of the factors that control instream plant growth. The relationship between concentrations of plant available nutrient concentrations and instream plant growth is complex and will vary both spatially and temporally depending on a number of environmental factors including light availability, flow variability, temperature, substrate type and invertebrate grazing (Matheson et al. 2012).

There are currently insufficient data to identify numeric outcomes for instream nutrient concentrations that can be applied at a regional scale.

[5] Accrual period relates to the length of time between high flows that flush periphyton from a river or stream.

(b) Toxicants

The numeric outcomes listed for nitrate-nitrogen and ammoniacal-nitrogen relate only to their toxic effects on aquatic life. These outcomes do not consider the effect of these nutrient species on instream plant growth.

The chronic toxicity outcomes identified for nitrate-nitrogen are based on the updated guidelines of Hickey (2013). The guideline for protection of 99% of species is recommended for rivers and streams identified as having significant indigenous ecosystem values while the 95% protection level guideline is recommended for all remaining rivers and streams in the region.

The chronic toxicity outcome for ammoniacal nitrogen differs from the recommendation in Ausseil (2013c). Due to uncertainty around the distribution of the freshwater clam *Sphaerium Novaezelandiae* across the different FWENZ classes it is recommended that the ANZECC (2000) 99% protection guideline apply across all rivers and streams.

2.1.4 Flow attributes

The quantity of flow in rivers and streams is a key factor that affects both the availability and quality of habitat for aquatic organisms. Minimum flow has been selected as the primary attribute to represent river and stream flow and numeric outcomes have been proposed in Policy LW.P57 of the Regional Plan: Working document for discussion (GWRC 2013) with the intention of maintaining ecological values (Thompson & Mzila in prep.). In addition, allocation limits that are also focussed on maintenance of ecological values have been identified in Schedule I and are discussed in Thompson and Mzila (in prep.).

2.1.5 Habitat attributes

There is extensive literature which demonstrates that the quantity and quality of physical river and stream habitat determines the successful colonisation and maintenance of aquatic organisms (eg, Harding et al. 2009). Physical river and stream habitat provides a basic medium for survival and can provide shelter, protection from predators, and habitat for eggs and oviposition.

The degree of fine sediment[6] cover of a river or stream bed is a specific aspect of habitat quality that is affected by changing land use and is known to have a major impact on river and stream ecosystem health. In particular, sediment alters the physical habitat by clogging interstitial spaces used as refugia by benthic invertebrates and fish, by altering food resources and by removing sites used for egg laying (Clapcott et al. 2011).

2.2 Contact recreation and tangata whenua use

The selection of biological and water quality attributes and numeric outcomes for contact recreation is documented in Ausseil (2013a). In addition to the recommendations of Ausseil (2013a) outcomes regarding cover of potentially toxic benthic cyanobacteria and deposited sediment have been included. These are discussed below.

[6] Fine sediment refers to inorganic particles that are less than 2 mm in size.

2.2.1 Benthic cyanobacteria

Benthic cyanobacteria are photosynthetic prokaryotic organisms that are integral parts of many aquatic ecosystems. However, under favourable conditions cyanobacterial cells can multiply and form dense mats which can be toxic. The toxins produced by cyanobacteria, known as cyanotoxins, are a threat to humans and other animals when consumed in drinking water or by contact during recreational activities (MfE/MoH 2009). The outcome for benthic cyanobacteria cover is based on the surveillance level of the MfE/MoH (2009) interim New Zealand guidelines for cyanobacteria in recreational fresh waters.

2.2.2 Sediment cover

Excess fine sediment cover can detrimentally affect the value of a river or stream for recreational use. Deposited fine sediment can reduce the aesthetic appeal of a river or stream as well affecting the physical experience of contact recreation due to poorer water clarity on contact as well as a 'feel' of fine sediment under the toes (Clapcott et al. 2011). The outcome for sediment cover is based on the recommendation of Clapcott et al. (2011).

2.3 Stock watering

The selection of water quality attributes and numeric outcomes for stock drinking water is documented in Ausseil (2013a).

2.4 Trout fishery and spawning

The selection of biological and water quality attributes and numeric outcomes for trout fishery and trout spawning waters is documented in Ausseil (2013b). Outcomes not discussed in Ausseil (2013b) or those where clarification is required are covered below.

2.4.1 Biological attributes

The recommendation to use Ash Free Dry Weight (AFDW) in place of chlorophyll *a* concentration to represent periphyton biomass was omitted in error from Tables A and 13 of Ausseil (2013b). The use of AFDW in Table H1.5 follows the recommendation made in section 3.2 of that report.

2.4.2 Water quality attributes

The need for nutrient outcomes to provide for trout fishery and spawning values is not discussed in Aussiel (2013b). The nutrient outcome is included as the availability of nutrients (specifically nitrogen and phosphorus) is a key factor controlling the growth of instream plants which in turn effects trout growth and abundance and the quality of the trout angling experience.

2.4.3 Habitat attributes

Fine sediment cover can reduce the quality of trout spawning habitat. The outcome for this attribute is based on the recommendation of Clapcott et al. (2011).

3. Lakes

This section sets out information in relation to Tables H2.1–H2.3 in Schedule H, covering aquatic ecosystem health/mahinga kai, contact recreation/tangata whenua use, and stock watering values in lakes.

3.1 Aquatic ecosystem health and mahinga kai

The numeric outcomes of the aquatic ecosystem health value centre around two commonly used and accepted indicators of lake condition, the Trophic Level Index (TLI) and the Lake Submerged Plant Index (LakeSPI). Each of these indicators is outlined below in relation to water quality and biological attributes, respectively.

Only one of these indicators is applied to some lakes, reflecting differences in characteristics between lakes (eg, Lakes Wairarapa and Onoke lack aquatic vegetation and therefore LakeSPI is not used as an indicator of ecological condition for these lakes) and the availability of data (eg, there is currently insufficient water quality data to recommend a TLI classification for Lakes Pounui, Kohangapiripiri or Kohangatera). In particular, Lake Onoke represents a unique environment in the region, being defined as an intermittently closed and open coastal lagoon (ICOL). As a result, ecosystem health attributes and outcomes for this lake have also been considered as part of the aquatic ecosystem health provisions for estuaries (see Section 6).

3.1.1 Water quality attributes – nutrients

The key measure of nutrient status and/or productivity in New Zealand lakes is the Trophic Level Index (TLI). The TLI is typically calculated using four separate water quality measurements: total nitrogen, total phosphorus, water clarity and chlorophyll *a*. In some lakes where clarity is affected by glacial flour deposits or wind-induced re-suspension of lakebed sediments, it is common practice to exclude clarity from the TLI calculation, resulting in what is referred to as the TLI-3. Because the water quality of both Lake Wairarapa and Lake Onoke is known to be affected by wind-induced re-suspension (Perrie & Milne 2012), Hamill (2013) has recommended applying the TLI-3 to these two lakes.

TLI and TLI-3 ‘scores’ can be calculated using slightly different approaches. Hamill (2013) has recommended the approach used in national reporting (eg, Verburg et al. 2011) which differs slightly from that used in the LakeWatch software (Burns 2000). This method involves calculating the TLI score for each sampling occasion and taking the average TLI score for the period in question (two years of monthly measurements is preferable) as opposed to calculation based on annual (or the time period in question) averages of the various water quality variables.

Due to the strong saline influence on water quality reported in both Lake Wairarapa and Lake Onoke (Perrie & Milne 2012), Hamill (2013) recommends that only sample results with electrical conductivity concentrations of less than 990 µS/cm and less than 5,000 µS/cm are used for calculating the TLI-3 for these lakes, respectively.

At the present time, numeric TLI outcomes have not been included in Table H2.1 of Schedule H. As indicated in Section 3.1, further work is required to identify appropriate TLI outcomes for some lakes, particularly Lakes Pounui, Kohangatera and Kohangapiripiri, where limited water quality data have been collected to date. In terms of Lake Waitawa, only one year's worth of data is available while for Lake Wairarapa, sampling has, until recently, been limited to just three or four occasions per year. Several years of near-monthly data exist for Lake Onoke but the current monitoring site is influenced by the Ruamahanga River outflow and therefore is not considered to be representative of overall lake water quality (Perrie & Milne 2012).

In the absence of numeric TLI outcomes, the approach taken in Table H2.1 is to use the TLI classification 'band' that represents a healthy ecosystem in the form of a narrative outcome. The TLI 'band' used takes into account that lake water quality and productivity varies naturally by lake type (eg, deep oligotrophic lakes *vs* shallow lowland coastal lakes).

Based on unpublished data from a preliminary assessment of reference or 'best available' conditions for different New Zealand lake types (Hamill, pers. comm.) and allowing for some departure from these 'best available' conditions (but not below a 'healthy state'), Lakes Wairarapa, Onoke and Waitawa could all be expected to support TLIs somewhere in the eutrophic range (ie, TLI of 4.0 to 4.99). Therefore this has been reflected in the narrative outcome for water quality in these lakes.

3.1.2 Biological attributes

The biological attributes in Table H2.1 were chosen to represent different aspects of lake ecosystem health. Only narrative outcomes are possible for fish and phytoplankton[7] at the present time.

(a) Lakes Submerged Plant Index (LakeSPI)

LakeSPI, like the TLI, is widely used in New Zealand as an indicator of a lake's overall ecological condition or health. LakeSPI is a synthesis of components from both native aquatic plant condition and invasive aquatic plant condition. Using LakeSPI, lake vegetation is placed into one of five categories of lake condition: excellent (>75% vegetated), high (>50–75%), moderate (>20–50%), poor (>0–20%) or non-vegetated (0%).

The LakeSPI outcomes listed in Table H2.1 for Lakes Kohangapiripiri and Pounui are based on those determined from actual lake assessments carried out in autumn 2011 by de Winton et al. (2011) and summarised in Perrie and Milne (2012). It is considered that these numeric outcomes (which fall in the 'high' LakeSPI category) reflect a 'healthy' ecological condition.

In the case of Lake Kohangatera, the numeric outcome represents the average between a 2011 survey and a more recent survey in 2013 (de Winton 2013), placing it in the 'excellent' LakeSPI category. Maintaining this current 'near reference' condition reflects the fact that Lake Kohangatera has been ranked in

[7] Phytoplankton are photosynthesising microscopic organisms that inhabit the upper sunlit layer of lakes (as well as other water bodies). They are agents for primary production, a process that sustains the aquatic food web.

the top 10 lakes nationally for aquatic vegetation values and is considered a nationally outstanding example of a lowland lagoon system (de Winton et al. 2011; de Winton 2013).

For assessment purposes, a change in LakeSPI score of less than 5% is taken to reflect no significant change in vegetation condition (de Winton 2013).

3.2 Contact recreation and tangata whenua use

Although it is recognised that most of the lakes in the Wellington region are not widely used for swimming and other forms of primary contact recreation, the national microbiological water quality guidelines (MfE/MoH 2003) lack guidance for secondary contact recreation (eg, kayaking, fishing) in New Zealand fresh waters. Therefore, in recognition of the likelihood that some primary contact recreation does occur (eg, Lake Waitawa) and for consistency with the narrative outcome for tangata whenua use and the approach taken for rivers and streams (see Section 2.2), the numeric outcome for *E. coli* indicator bacteria provided in Table H2.2 aligns with the alert/action mode of the MfE/MoH (2003) guidelines (ie, <260 *E. coli*/100mL).

An outcome regarding the presence of potentially toxic benthic cyanobacteria has been included based on the surveillance level of the MfE/MoH (2009) interim New Zealand guidelines for planktonic cyanobacteria in recreational lakes.

The clarity outcome is consistent with the horizontal distance for safe visibility in rivers and streams managed for recreational values (Table H1.2). The more stringent water clarity outcome for Lake Kohangapiripiri recognises that the lake bed is currently visible from the lake's surface and that it is desirable, from an aesthetics point of view, for recreational users to be able to view the bed from the lake's edge (Hamill 2013).

3.3 Stock watering

The water quality outcomes for stock drinking water are consistent with those recommended for rivers and streams in Table H1.2, as documented in Ausseil (2013a). The exception is the outcome for cyanobacteria which is based on best available national guidance for lakes (MfE/MoH 2009).

4. Wetlands

This section addresses Table H3.1 in Schedule H, covering wetland aquatic ecosystem health and mahinga kai values.

4.1 Aquatic ecosystem health and mahinga kai

4.1.1 Wetland classification

The wetland classes set out in Table H3.1 are defined by Johnson and Gerbeaux (2004), nationally recognised experts in wetland ecology. These classes describe functional wetland units, each of which is defined by a distinctive combination of factors related to hydrology, substrate and water quality. Bogs, for example, receive water input from rainfall only, are nutrient poor and usually acidic.

4.1.2 Water quality and habitat attributes

The water quality and habitat attributes selected reflect core aspects of wetland condition that have been chosen for national wetland monitoring purposes (Clarkson et al. 2003). The pH ranges listed for each wetland type in Table H3.1 are as described in Johnson and Gerbeaux (2004). These numbers represent a classification band for a healthy functioning ecosystem for each of the relevant wetland types.

5. Groundwater

This section sets out information in relation to Tables H4.1–H4.5 in Schedule H, covering groundwater values relating to aquatic ecosystem health/mahinga kai, contact recreation/tangata whenua use, health needs of people, and stock watering.

The groundwater tables explicitly recognise two principal types of groundwater:

- Groundwater directly connected with surface water (defined as Category A and Category B groundwater); and
- Groundwater not directly connected with surface water (defined as Category C groundwater).

The delineation of Category A, B and C groundwater in the Wellington region follows extensive numerical modelling work undertaken in the Wairarapa Valley (Gyopari & McAlister 2010a, b and c) that highlighted the linkages between groundwater and surface water. Categories A, B and C represent the varying degree of hydraulic connectivity between groundwater and surface water (direct, moderate and very little, respectively), with Hughes and Gyopari (2011) recommending that abstraction from Category A and B groundwater be managed under surface water allocation policy.

5.1 Aquatic ecosystem health and mahinga kai

The sole numeric outcome identified for groundwater ecosystem health relates to chronic toxicity of nitrate-nitrogen. The threshold set for nitrate-nitrogen in groundwater directly connected to surface water is consistent with the chronic toxicity threshold for rivers and streams in Table H1.1 and is derived from Hickey (2013) (see Section 2.1.3).

The chronic toxicity threshold set for groundwater that is not directly connected to surface water is also set at the 95% protection level. This is to recognise the need to maintain healthy groundwater-dependent ecosystems; recent scientific studies have indicated that the existence and function of subterranean fauna is an important component in maintenance of groundwater quality and healthy groundwater ecosystems (Fenwick & Scarsbrook 2008; Reid & Scarsbrook 2009; WA EPA 2012).

Table H4.1 also provides narrative outcomes to address other toxicants that can be present in groundwater and the potential for contaminants other than nitrate (eg, pathogens, nutrients and toxicants such as heavy metals) to impact on hydraulically connected surface waters. Therefore there is a close relationship between this table and Tables H1.1 and H2.1 relating to aquatic ecosystem health in rivers/streams and lakes, respectively.

5.2 Contact recreation and tangata whenua use

Table H4.2 provides narrative outcomes for groundwater with a direct hydraulic connection to surface water, in recognition of the influence that groundwater can have on recreational water quality values in rivers and lakes (eg, contribution to nuisance algal blooms through excessive nutrient inputs).

5.3 Health needs of people

Groundwater quality, quantity and flow need to be managed for potable supply and other related human health needs.

The Ministry of Health (2008) Drinking-water Standards for New Zealand (2008) are the specific guidelines used to assess water for potable uses. However, these guidelines are not referred to in Table H4.3. This is because in some parts of the Wellington region (eg, deep confined aquifers of the lower Wairarapa Valley), groundwater is naturally characterised by elevated concentrations of some elements (eg, iron, manganese and arsenic) and, moreover, groundwater may be treated prior to consumption.

5.4 Stock watering

The water quality outcomes for stock drinking water are consistent with those recommended for rivers and streams in Table H1.2, as documented in Ausseil (2013a).

6. Open coast, harbours and estuaries

This section sets out information in relation to Tables H5.1–H5.2 in Schedule H, covering the values of aquatic ecosystem health/mahinga kai and contact recreation/tangata whenua use in the coastal environment. These tables divide the coastal environment into three different types of receiving environment: estuaries (including Lake Onoke), harbours and the open coast.

6.1 Aquatic ecosystem health/mahinga kai

6.1.1 Estuaries (including Lake Onoke)

Attributes identified in Table H5.1 comprise a selection of commonly used and nationally accepted indicators of estuarine ecosystem health that target four common 'stresses' estuaries are exposed to (Table 6.1): sedimentation, eutrophication (nutrient enrichment), toxic contamination and habitat loss. Salinity, water clarity and nutrients are additional core estuarine water quality indicators that have been included in Table H5.1 (as narrative outcomes only – there is currently insufficient data available both regionally and nationally to establish numeric outcomes for these indicators).

Table 6.1: Summary of indicators used in Table H5.1 to assess ecological health of estuaries (adapted from Robertson & Stevens (2008); Stevens & Robertson (2008)

Estuary 'stress'	Indicator	Rationale
Sedimentation	Mud content	Estuaries are a natural sink for catchment-derived sediment but if sediment inputs are excessive, estuaries infill quickly with muds, reducing biodiversity and human values and uses. In particular: - muddy sediments have a higher tendency to become anoxic and anoxic sediments contain toxic sulphides and very little aquatic life. - elevated sedimentation rates are likely to lead to major and detrimental ecological changes within estuary areas that could be very difficult to reverse.
Sedimentation	Sedimentation rate	
Eutrophication	Redox Potential Depth (Sediment oxygenation)	Surface sediments need to be well oxygenated to support healthy invertebrate communities (anoxic sediments contain toxic sulphides and very little aquatic life).
Eutrophication	Sediment organic content	High sediment organic content can result in anoxic sediments and bottom water, release of excessive nutrients, and adverse impacts on biota.
Eutrophication	Nuisance macroalgae cover	Mass blooms of green and red macroalgae, mainly of the genera *Enteromorpha, Cladophora, Ulva,* and *Gracilaria,* can present a significant nuisance problem, especially when loose mats accumulate and decompose. Algal blooms also have major ecological impacts on water and sediment quality, such as reduced clarity, physical smothering and lack of oxygen, and can displace estuarine animals.
Toxic contamination	Sediment contamination (eg, concentrations of heavy metals, PAHs and pesticides)	Many chemicals discharged to estuaries via urban and rural runoff are toxic, even at very low concentrations. These chemicals can accumulate in sediments and bioaccumulate in fish and shellfish, causing health risks to people and marine life.
Habitat loss	Saltmarsh area	Estuaries function best with a large area of rooted vegetation such as saltmarsh and seagrass (as well as a healthy vegetated terrestrial margin). Loss of this habitat reduces ecological, fishery and aesthetic values, and adversely impacts on an estuary's role in flood and erosion protection, contaminant mitigation, sediment stabilisation and nutrient cycling.
Habitat loss	Seagrass area	

The numeric outcomes identified for some of the estuarine attributes in Table H5.1 represent the boundary of 'fair'/'good' classifications for each indicator, as set out in Robertson and Stevens (2008). In the case of toxicants, the low threshold of the ANZECC (2000) Interim Sediment Quality Guidelines (ISQG) has been applied; contaminant concentrations below this threshold are unlikely to adversely affect benthic fauna.

6.1.2 Harbours

Table H5.1 incorporates divides Porirua Harbour into two environments to recognise that it actually comprises two estuaries with both intertidal and subtidal habitats. The intertidal attributes and outcomes are consistent with those set for estuaries with the exception of the sedimentation rate (1 mm/yr by 2035). This value has been taken directly from the Porirua Harbour and Catchment Strategy and Action Plan (PCC 2012) as an aspirational target for a 'healthy harbour and catchment'.

For the remaining (subtidal) habitats of Porirua Harbour and all of Wellington Harbour narrative water quality outcomes have been identified for salinity, clarity and nutrients. Toxicants in both bottom sediments and the water column are also included, based on ANZECC (2000) ISQG-Low and 95% species protection thresholds, respectively. The 95% species protection level is the most commonly used level of protection for slightly modified fresh and coastal water ecosystems.

6.1.3 Open coast

The outcomes for open coastal waters focus on water quality attributes (salinity, water clarity, nutrients and toxicants). The high energy nature of open coastal waters in the Wellington region means that accumulation of nutrients and sediments in bottom sediments is unlikely.

6.2 Contact recreation and tangata whenua use

The numeric outcomes in Table H5.2 are drawn from the national microbiological water quality guidelines for coastal and recreational shellfish gathering waters (MfE/MoH 2003). The different bacteriological indicators reflect the recommendations of the guidelines:

- Freshwater (including estuarine waters): *Escherichia coli (E. coli)*
- Marine (coastal) waters: Enterococci
- Recreational shellfish-gathering waters: Faecal coliforms

The MfE/MoH (2003) guidelines are widely used across New Zealand to assess public health risks associated with contact recreation. The thresholds set for the summer bathing season (defined as 1 November to 31 March inclusive) reflect the boundary of the surveillance (safe) and amber (alert) modes of the guidelines[8] while the thresholds outside of the summer bathing season represent the boundary of the amber (alert) and red (action) modes of the guidelines. If water quality enters the 'action' category (>550 *E. coli*/100mL

[8] When water quality falls in the 'surveillance mode', this indicates that the risk of illness from bathing is acceptable – for coastal waters the accepted level of risk is 19 in every 1,000 bathers (MfE/MoH 2003).

for coastal waters and >280 enterococci/100mL for coastal waters), then the water poses an unacceptable health risk from bathing (MfE/MoH 2003).

Note that for contact recreation and tangata whenua use values, Lake Onoke is treated as a lake and not as an estuary (see Section 3.1).

References

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Appendix 1 – Schedule H outcomes tables

Schedule H1: Rivers

Table H1.1: Aquatic ecosystem health and mahinga kai

Water type	Rivers																		
Value	Aquatic ecosystem health and mahinga kai																		
Broad outcome	River water quality, quantity and habitat safeguards healthy aquatic ecosystems and supports mahinga kai																		
		Biological					**Water quality**										**Flows**	**Habitat**	
		Fish	**Macroinvertebrates**	**Periphyton biomass**	**Macrophyte cover**	**Mahinga kai**	**Temp**	**pH**	**Nutrients**	**DO**	**Water clarity**	**Toxicants**						**Sediment cover**	**Habitat**
												NO_3-N		**NH_3-N**		**Other**			
	River Class											**Chronic**	**Acute**	**Chronic**	**Acute**				
Outcome	**1**	Native fish community structure, composition, diversity, and abundance is within an acceptable range of that found under natural conditions	Macroinvertebrate community structure, composition, diversity, and abundance is within an acceptable range of that found under natural conditions	50 **SM:** 50	Macrophyte community structure, composition, diversity and abundance is within an acceptable range of that found under natural conditions	Taonga species are present in quantities, sizes and of a quality that is appropriate for the area	19 **SM:** 19	5.8-8.5 **SM:** 6.1-8.2	The concentration of plant-available nitrogen and phosphorus avoids nuisance in-stream plant growth	80 **SM:** 80	1.8 **SM:** 2.2	2.4/3.5 **SM:** 1.0/1.5	20	99	USEPA 2009	95 **SM:** 99	Minimum flows are met in accordance with policy LW.P57	Cover of fine sediment on the river bed is within an acceptable range of that found under natural conditions	The quality, diversity and connectivity of habitat including riparian margins is within an acceptable range of that found under natural conditions
	2			120 **SM:** 50			20 **SM:** 20	6.4-8.9 **SM:** 6.7-8.6		70 **SM:** 70	1.3 **SM:** 1.9								
	3			200 **SM:** 120			21 **SM:** 21	6.8-8.7 **SM:** 7.1-8.4		60 **SM:** 70	0.5 **SM:** 0.8								
	4			120 **SM:** 50			21 **SM:** 20	5.8-8.5 **SM:** 6.1-8.2		70 **SM:** 80	1.6 **SM:** 2.2								
	5			200 **SM:** 120			23 **SM:** 21	5.8-8.7 **SM:** 6.1-8.4		60 **SM:** 70	0.5 **SM:** 0.8								
	6			200 **SM:** 120			21 **SM:** 21	5.8-7.8* **SM:** 6.1-7.5*		60 **SM:** 70	1.3 **SM:** 1.6								
Limits	Relevant resource use limits to be defined																See interim limits set in Schedule I	Relevant resource use limits to be defined	

Interpretation of Table H1.1

River class	Description
1	Steep gradient, hard sedimentary
2	Moderate gradient and coastal, hard sedimentary
3	Moderate gradient, soft sedimentary
4	Low gradient, large, draining ranges
5	Low gradient, large, draining plains and eastern Wairarapa
6	Low gradient, small

River classes are mapped by stretches in Maps 20A to 20E

SM Stretches of rivers with significant macroinvertebrate values, as identified in the first column of the table in Schedule C1

Interpretation of rivers aquatic ecosystem health and mahinga kai Table H1.1					
Attribute		**Unit**	**Direction**	**Narrative**	**Compliance notes**
	Periphyton biomass	mg/m^2 Chl *a*	≤	Periphyton biomass does not exceed … mg/m^2 Chl *a*.	Maximum of monthly periphyton biomass measurements.
Temp	Temperature	°C	≤	The temperature of the water does not exceed …°C.	95th percentile of continuous temperature measurements, or if not available the maximum of monthly spot temperature measurement. Applies to all flows.
	pH	pH units	Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements or the minimum and maximum of monthly spot measurements. Applies at all flows. * indicates that these outcomes do not apply to streams with high peat cover in the upstream catchment.
DO	Dissolved oxygen	% saturation	≥	The concentration of dissolved oxygen exceeds …% of saturation.	5th percentile of continuous daily or the minimum of monthly spot measurements. Applies at all flows.
	Water clarity	m	≥	The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	20th percentile of monthly black disc measurements collected at flows at or below median flow.
NO_3-N	Nitrate-N	mg/L	Chronic: ≤ median/ ≤ 95th percentile Acute: <	Chronic: annual median nitrate-N concentration does not exceed … mg/L, and annual 95th percentile concentration does not exceed … mg/L. Acute: In-stream nitrate-N concentration does not exceed 20mg/L.	This outcome relates to nitrate toxicity only. Nutrient outcomes for management of in-stream plant growth will be developed as part of the whaitua process. The chronic outcomes are firstly a 'grading' outcome based on an annual median and secondly a 'surveillance' outcome based on an annual 95th percentile as stipulated in Hickey (2013). These outcomes correspond to a level of protection of 95 % of species and 99% of species for SM rivers. Both chronic and acute outcomes apply at all flows.
NH_3-N	Ammonia (chronic)	%	Chronic: ≤	Annual median ammonia concentrations must not exceed the trigger value for freshwaters defined in the ANZECC (2000) guidelines table 3.4.1 for the level of protection of …% of species. The trigger value must be adjusted for temperature and pH as directed in section 8.3.7.2 of the guidelines.	Annual median of monthly sample results. Applies at all flows.
	Ammonia (acute)	mg/L	≤	The concentration of ammonia does not exceed ….mg/L as defined in the US EPA 2009 table referring to acute criterion for freshwaters with mussels present.	Maximum concentration. Applies at all flows.
	Other toxicants	%	≤	Toxicants other than nitrate and ammonia do not exceed the trigger values identified in the ANZECC (2000) guidelines for the level of protection of …% of species.	Applies to the dissolved fraction of heavy metals and other contaminants. Based on annual median. Applies at all flows. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Table H1.2: Contact recreation and tangata whenua use

Water type	Rivers											
Value	Contact recreation and tangata whenua use											
Broad outcome	The quantity and quality of water in rivers are suitable for contact recreation, and support tangata whenua use and their relationship with water											
Outcome	**Health**					**Aesthetic**						
	E. coli	**Benthic cyanobacteria cover**	**pH**	**Toxicants/ irritants**	**Tangata whenua use**	**Macrophyte cover**		**Mat algae cover**	**Filamentous algae cover**	**Water clarity**	**Sediment cover**	**Sewage fungus**
						Total	**Emergent**					
	Bathing season: 260 at low flow* 550 at moderate flow** **Outside bathing season:** 550***	20	6.5-8.5	Refer to tables 5.2.3 and 5.2.4 ANZECC 2000	Rivers are safe for primary contact and ceremonial use	60	30	60	30	1.6	25	No bacterial or fungal slime growths visible to the naked eye as plumose growths or mats
Limit	Relevant resource use limits to be defined											

Interpretation of Table H1.2

Interpretation of rivers contact recreation and tangata whenua use Table H1.2					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* must not exceed 260cfu/100mL between 1 Nov - 31 Mar (inclusive) when flows are at or below the median flow, or 550cfu/100mL when flows are between the median and 3x median flow. The concentration of *E. coli* must not exceed 550cfu/100mL between 1 Apr – 31 Oct (inclusive) when flows below 3x median flow.	Bathing season is November to March inclusive. Non-bathing season is April to October inclusive. 95th percentile of at least 100 data points * at < median flows ** between median and 3x median flow *** at <3x median flow
	Filamentous algae	% cover	≤	Filamentous algae cover does not exceed …%	Applicable at all flows
	Mat algae	% cover	≤	Mat algae cover does not exceed …%	
	Benthic cyanobacteria	% cover	≤	Benthic cyanobacteria cover does not exceed …%	
	Macrophyte	% cover	≤	Macrophyte cover does not exceed …%	
	pH	pH units	Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements or the minimum and maximum of spot measurements. Applies at all flows.
	Water clarity	m		The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	20th percentile of black disc measurements collected at flows at or below median flow.
	Sediment cover	%	≤	Sediment cover of stream and river beds is less than …%.	
	Toxicants/irritants		≤	Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	Applies at all flows. ANZECC 2000 table available at http://www.daff.gov.au/__data/assets/pdf_file/0003/316128/wqg-ch5.pdf. Note that New Zealand's Ministry for the Environment/Ministry of Health guidance for contact recreation water quality standards does not cover toxicants/irritants

Table H1.3: Health needs of people

Water type	Rivers	
Value	Health needs of people	
Broad outcome	River water is suitable for the health needs of people	
Outcome	**Water quantity**	**Water quality**
	Sufficient water from rivers is available for the health needs of people	The quality of water within group and community water supply areas is maintained or enhanced

Table H1.4: Stock watering

Water type	Rivers			
Value	Stock watering			
Broad outcome	River water is available in quantities and is of a quality that is suitable for stock watering			
Outcome	***E. coli***	**Benthic cyanobacteria cover**	**pH**	**Toxicants/irritants**
	≤550	20	6.0-9.0	Refer to table 5.2.3 in ANZECC 2000
Limit	Relevant resource use limits to be defined			

Interpretation of rivers stock watering Table H1.4					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* does not exceed …cfu/100mL.	Applies at flows less than 3x the median flow Applies year round 95th percentile of at least 100 data points
	Benthic cyanobacteria cover	%	≤	Benthic cyanobacteria cover does not exceed …%	
	pH	pH units	Range	The pH of the water is between … and ….	
	Toxicants/irritants		≤	Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	See http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Table H1.5: Trout spawning and trout fisheries

Water type	Rivers														
Value	Trout spawning and trout fishery														
Broad outcome	Where appropriate, rivers support trout fisheries and trout spawning														
Outcome		**Biological**			**Water quality**										**Habitat**
		MCI	**In-stream plants**		**Temp**	**pH**	**DO**	**Water clarity**	**Nutrients**	**Toxicants**					**Sediment cover**
			AFDW	**Filamentous algae cover**						**NO_3-N**		**NH_3-N**		**Other**	
										Chronic	**Acute**	**Chronic**	**Acute**		
	Regionally important	120	35	30	19	6.3-8.4	80	Waikanae: 2.0 Wainuiomata: 2.0 Ruamāhanga: 3.0 Waiohine: 2.5 Hutt: 2.1	The concentration of plant-available nutrients supports healthy trout fisheries	1.0/1.5	20	95%	USEPA 2009	99%	20
	Locally important	100			24	6.0-9.0	70	2.0		2.4/3.5		95%		95%	
	Trout spawning	120			11	6.3-8.4	80	NA		1.0/1.5		95%		99%	

Interpretation of Table H1.5

For the purposes of this table, regionally and locally important trout fishery rivers and trout spawning waters are set out in Schedule N.

Interpretation of rivers trout fisheries Table H1.5					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
MCI	Macroinvertebrate community index		≥	The average MCI score shall be or exceed ….	Minimum score, applicable at all flows
AFDW	Ash free dry weight	mg/m^2	≤	Periphyton AFDW does not exceed …mg/m^2.	Annual maximum. Applies at all flows
	Filamentous algae	% cover		Filamentous algae cover does not exceed …% during the open fishing season.	See http://wellington.fishandgame.org.nz/local-fishing-regulations for details on the open fishing season.
Temp	Temperature	°C	≤	Water temperature does not exceed…°C.	95th percentile of continuous temperature measurements, or if not available the maximum of monthly spot temperature measurement. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
	pH		Range	The pH of the water is between … and ….	5th and 95th percentile of continuous measurements, or if not available the minimum and maximum of monthly spot measurements. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
DO	Dissolved oxygen	% saturated	≥	The concentration of dissolved oxygen exceeds …% of saturation.	5th percentile of continuous measurements, or if not available the minimum of monthly spot measurements. Outcomes for regionally and locally significant sites apply year round. The outcome for trout spawning sites applies between 1 May and 31 October. Applies at all flows.
	Water clarity	m	≥	The 20th percentile of visual clarity measured as the horizontal sighting range of a black disc is no less than …m, at flows at or below median flow.	
NO_3-N	Nitrate-N	mg/L	Chronic: ≤ median/ ≤ 95th percentile Acute: <	Chronic: annual median nitrate-N concentrations do not exceed … mg/L, and annual 95th percentile values do not exceed … mg/L. Acute: In-stream nitrate-N concentrations do not exceed 20mg/L.	This outcome relates to nitrate toxicity only. Nutrient outcomes for management of in-stream plant growth will be developed as part of the whaitua process. The chronic outcomes are firstly a 'grading' outcome based on an annual median and secondly a 'surveillance' outcome based on an annual 95th percentile as stipulated in Hickey (2013). These outcomes correspond to a level of protection of 95% of species for locally significant sites and 99% of species for regionally significant and trout spawning sites. Both chronic and acute outcomes apply at all flows.
NH_3-N (chronic)	Ammonia	%	≤	Annual median ammonia concentrations must not exceed the trigger value for freshwaters defined in the ANZECC (2000) guidelines table 3.4.1 for the level of protection of …% of species. The trigger value must be adjusted for	Annual median of monthly sample results. Applies at all flows.

			temperature and pH as directed in section 8.3.7.2 of the guidelines.	
NH_3-N (acute)	mg/L	≤	The concentration of ammonia does not exceed ….mg/L as defined in the US EPA 2009 table referring to acute criterion for freshwaters with mussels not present….	Maximum concentration. Applies at all flows.
Other toxicants	%	≤	Toxicants other than nitrate and ammonia do not exceed the trigger values identified in the ANZECC (2000) guidelines for the level of protection of …% of species	Applies to the dissolved fraction of heavy metals and other contaminants. Based on annual median. Applies at all flows. http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf
Sediment cover	%	≤	Sediment cover of river beds is less than …%.	Based on a bank side or in stream visual estimate of sediment cover, an annual average of monthly assessments. Sediment is defined as inorganic particles that are less than 2mm in diameter. Exceptions may be made where it can be proven that sediment cover naturally exceeds this outcome.

Schedule H2: Lakes

Table H2.1: Aquatic ecosystem health and mahinga kai

<table>
<tr><td>Water type</td><td colspan="5">Lakes</td></tr>
<tr><td>Value</td><td colspan="5">Aquatic ecosystem health and mahinga kai</td></tr>
<tr><td>Broad outcome</td><td colspan="5">Lake water quality, quantity and habitat safeguards healthy aquatic ecosystems and supports mahinga kai</td></tr>
<tr><td rowspan="8">Outcome</td><td></td><td>Water quality</td><td colspan="4">Biological</td></tr>
<tr><td></td><td>Nutrients</td><td>LakeSPI</td><td>Fish</td><td>Phytoplankton</td><td>Taonga species</td></tr>
<tr><td>Kohangapiripiri</td><td rowspan="3">NA</td><td>≥63</td><td rowspan="6">Fish communities are healthy and the structure, composition, diversity, resilience and abundance is within an acceptable range of that found under natural conditions</td><td rowspan="6">The lake is free of algal blooms</td><td rowspan="6">Taonga species are present in quantities, sizes and of a quality that is appropriate for the area</td></tr>
<tr><td>Kohangatera</td><td>≥88</td></tr>
<tr><td>Pounui</td><td>≥56</td></tr>
<tr><td>Onoke[1]</td><td rowspan="3">Trophic status shall be in the eutrophic range or better</td><td rowspan="3">NA</td></tr>
<tr><td>Wairarapa</td></tr>
<tr><td>Waitawa</td></tr>
<tr><td>Limit</td><td colspan="5">Relevant resource use limits to be defined</td></tr>
</table>

[1] Lake Onoke is an intermittently closed and open lake (ICOL), exhibiting ecological characteristics of both a lake and estuary. It is therefore considered as both a lake and an estuary for the purposes of aquatic ecosystem health and mahinga kai values. See the Coastal aquatic ecosystem health and mahinga kai table H5.2 for other relevant outcomes.

Interpretation of Table H2.1

Interpretation of lakes aquatic ecosystem health and mahinga kai Table H2.1					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
Trophic status	Nutrients		Range	The trophic status shall be in the eutrophic range	The eutrophic range for lakes using Trophic Level Index (TLI) is between 4 and 4.99 The TLI for Lakes Wairarapa and Onoke is calculated using TLI3.
LakeSPI	Lake Submerged Plant Indicator		≥	The Lake Submerged Plant Indicator value is equal to or greater than ….	See monitoring manual http://www.niwa.co.nz/sites/default/files/import/attachments/lakespi_manual.pdf

Table H2.2: Contact recreation and tangata whenua use

Water type	Lakes				
Values	Contact recreation and tangata whenua use				
Broad outcome	The quantity and quality of water in lakes are suitable for swimming and other types of recreation and amenity, and support tangata whenua use and their relationship with water.				
Outcome		***E. coli***	**Cyanobacteria**	**Clarity**	**Tangata whenua use**
	Kohangapiripiri	≤260	Cyanobacteria counts do not exceed Alert 1 ('safe' green mode)	Water clarity is high, so that the lake bed is visible	Lake waters are safe for primary contact and ceremonial use
	Kohangatera			≥1.6m Secchi depth	
	Pounui				
	Onoke[1]				
	Wairarapa				
	Waitawa				
Limit	Relevant resource use limits to be defined				

Interpretation of Table H2.2

[1] Lake Onoke is an intermittently closed and open lake (ICOL), exhibiting characteristics of both lakes and estuaries. For the purposes of contact recreation and tangata whenua use values, Lake Onoke is considered as a lake.

Interpretation of lakes contact recreation and tangata whenua use Table H2.2					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* does not exceed …cfu/100mL.	
	Secchi depth	m	≥	The Secchi depth is …m.	
	Cyanobacteria			Cyanobacteria counts do not exceed Alert 1 ('safe' green mode).	Ministry for the Environment/Ministry of Health (2009) interim national Guidelines for cyanobacteria

Table H2.3: Stock watering

Water type	Lakes			
Broad outcome	Lake water quality is suitable for stock watering			
Outcome	***E. coli* (cfu/100mL)**	**Cyanobacteria**	**pH**	**Toxicants/irritants**
	≤550	Cyanobacteria counts do not exceed Alert 1 ('safe' green mode)	6.0-9.0	Refer to Table 5.2.3 in ANZECC 2000
Limit	Relevant resource use limits to be defined			

Interpretation of Table H2.3

Interpretation of lakes stock watering Table H2.3					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* does not exceed …cfu/100mL	
	Cyanobacteria			Cyanobacteria counts do not exceed Alert 1 ('safe' green mode)	Ministry for the Environment/Ministry of Health (2009) interim national Guidelines for cyanobacteria
	pH	pH units	Range	The pH of the water is between … and ….	
	Toxicants/irritants		≤	Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Schedule H3: Natural wetlands

Table H3.1: Aquatic ecosystem health and mahinga kai

<table>
<tr><td>Water type</td><td colspan="8">Natural wetlands</td></tr>
<tr><td>Value</td><td colspan="8">Aquatic ecosystem health and mahinga kai</td></tr>
<tr><td>Broad outcome</td><td colspan="8">Natural wetland water quality, hydrologic regime and habitat safeguards healthy aquatic ecosystems and supports mahinga kai</td></tr>
<tr><td rowspan="8">Outcome</td><td></td><td colspan="4">Water quality</td><td colspan="2">Habitat</td><td>Mahinga kai</td></tr>
<tr><td></td><td>Hydrologic regime</td><td>Physicochemical indicators</td><td>pH</td><td>Nutrient status</td><td>Flora and fauna</td><td>Ecosystem function</td><td></td></tr>
<tr><td>Bog</td><td rowspan="6">Water table depth and hydrologic regime is appropriate to the wetland type</td><td rowspan="6">Physiochemical characteristics, including conductivity, are appropriate to the wetland type</td><td>3-4.8</td><td>Low or very low</td><td rowspan="6">Native plants dominate and introduced plants and animals do not adversely impact the integrity of the wetland</td><td rowspan="6">Natural wetlands have fair ecosystem intactness
Significant wetlands have good ecosystem intactness
Outstanding wetlands have excellent ecosystem intactness</td><td rowspan="6">Sustainably harvestable populations of mahinga kai species are present in or migrating through the wetland</td></tr>
<tr><td>Fen</td><td>4-6</td><td>Low to moderate</td></tr>
<tr><td>Marsh</td><td>6-7</td><td>Moderate to high</td></tr>
<tr><td>Seepage</td><td>4-7</td><td>Low to high</td></tr>
<tr><td>Swamp</td><td>4.8-6.3</td><td>Moderate to high</td></tr>
<tr><td>Saltmarsh</td><td>4.9-8</td><td>Moderate</td></tr>
<tr><td>Limit</td><td colspan="8">Relevant resource use limits to be defined</td></tr>
</table>

Interpretation of Table H3.1

The definitions of the different types of wetlands are sourced from Johnson and Gerbeaux (2004).

Table H3.2: Contact recreation and tangata whenua use

Water type	Natural wetlands
Value	Contact recreation and tangata whenua use
Broad outcome	The quantity and quality of water in natural wetlands are suitable for contact recreation and amenity, and support tangata whenua use and their relationship with water.

Schedule H4: Groundwater

Table H4.1: Aquatic ecosystem health and mahinga kai

Water type	Groundwater				
Value	Aquatic ecosystem health and mahinga kai				
Broad outcome	The water quality and quantity of groundwater safeguards aquatic and groundwater-dependent ecosystem health and supports mahinga kai				
Outcome		**Quality**			**Quantity and flow**
		NO_3-N	**Other toxicants**	**Connection to other water bodies**	
	Groundwater directly connected to surface water	95%	The quality of water is maintained to safeguard healthy groundwater-dependent ecosystems*	Water quality does not cause any outcome specified for the directly connected surface water body to be exceeded	The quantity of water is maintained to safeguard healthy groundwater-dependent ecosystems*
	Groundwater not directly connected to surface water			NA	
Limit	Relevant resource use limits to be defined				Relevant resource use limits are defined in Schedule I

Interpretation of Table H4.1

Groundwater directly connected to surface water includes **Category A groundwater** and any **Category B groundwater** which over the course of a pumping season, represents at least 60% flow depletion from local surface water. Groundwater which does not meet this classification is determined to be not directly connected to surface water, and includes **Category C groundwater** areas.

* See Rivers and Streams aquatic ecosystem health and mahinga kai table H1.1

Interpretation of groundwater aquatic ecosystem health and mahinga kai Table H4.1				
Attribute	**Unit**	**Direction**	**Narrative**	**Notes**
NO_3-N Nitrate-N	mg/L	≤	The annual 95th percentile nitrate-N concentrations do not exceed … mg/L.	This outcome relates to nitrate toxicity only. See Hickey (2013). Link

Table H4.2: Contact recreation and tangata whenua use

<table>
<tr><td>Water type</td><td colspan="3">Groundwater</td></tr>
<tr><td>Value</td><td colspan="3">Contact recreation and tangata whenua use</td></tr>
<tr><td>Broad outcome</td><td colspan="3">Ground water quality and quantity is suitable for contact recreation and tangata whenua use</td></tr>
<tr><td rowspan="3">Outcome</td><td></td><td colspan="2">Water quality</td><td rowspan="2">Tangata whenua use</td></tr>
<tr><td></td><td>Nutrients</td><td>E. coli</td></tr>
<tr><td>Groundwater directly connected to surface water</td><td>Plant-available nitrogen and phosphorus do not cause nuisance algal or macrophyte growth in the directly connected surface water body</td><td>Counts meet outcomes specified for the directly connected water body</td><td rowspan="2">Puna (freshwater springs) flow freely year round with water that is suitable for cultural cleansing</td></tr>
<tr><td>Groundwater not directly connected to surface water</td><td colspan="2">NA</td></tr>
<tr><td>Limit</td><td colspan="3">Relevant resource use limits and targets are defined in Schedule I</td></tr>
</table>

Interpretation of Table H4.2

Groundwater directly connected to surface water includes **Category A groundwater** and any **Category B groundwater** which over the course of a pumping season, represents at least 60% flow depletion from local surface water. Groundwater which does not meet this classification is determined to be not directly connected to surface water, and includes **Category C groundwater** areas.

Table H4.3: Health needs of people

Water type	Groundwater		
Value	Health needs of people		
Broad outcome	Ground water quality and quantity is suitable for the health needs of people		
Outcome	**Water quality**	**Water quantity**	
		Quantity	**Salt water intrusion**
	The quality of water within group and community water supply areas is maintained or enhanced.	Sufficient groundwater is available for the health needs of people	The taking of groundwater does not result in the landward movement of the saltwater/freshwater interface
Limit	Relevant resource use limits and targets are defined in Schedule I		

Table H4.4: Stock watering

Water type	Groundwater		
Value	Stock watering		
Broad outcome	Groundwater is suitable and available for livestock drinking.		
Outcome	***E. coli***	**pH**	**Toxicants/irritants**
	≤550	6.0-9.0	Refer to table 5.2.3 in ANZECC 2000
Limit	Relevant resource use limits to be defined		

Interpretation of Table H4.4

Interpretation of groundwater stock watering Table H4.4					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of *E. coli* does not exceed …cfu/100mL	
	pH	pH units	Range	The pH of the water is between … and ….	
	Toxicants/irritants			Concentrations of toxicants/irritants do not exceed those specified in tables 5.2.3 and 5.2.4 of ANZECC 2000.	http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Schedule H5: Coastal Water

Table H5.1: Aquatic ecosystem health and mahinga kai

<table>
<tr><td>Water type</td><td colspan="11">Open coast, harbours and estuaries</td></tr>
<tr><td>Value</td><td colspan="11">Aquatic ecosystem health and mahinga kai</td></tr>
<tr><td>Broad outcome</td><td colspan="11">Harbours, estuaries and open coastal waters safeguard healthy aquatic ecosystems and support mahinga kai</td></tr>
<tr><td rowspan="7">Outcome</td><td colspan="2"></td><td colspan="6">Sediment quality</td><td colspan="4">Water quality</td><td>Mahinga kai</td><td>Habitat</td></tr>
<tr><td colspan="2"></td><td>Mud content</td><td>Sedimentation rate</td><td>Redox potential depth</td><td>Total C</td><td>Toxicants – sediment</td><td>Macroalgal growth</td><td>Salinity</td><td>Toxicants – water column</td><td>Clarity</td><td>Nutrients</td><td></td><td></td></tr>
<tr><td colspan="2">Estuaries[1]</td><td>5*</td><td>5**</td><td>3</td><td>2</td><td rowspan="3">ISQG-low</td><td rowspan="3">There is no nuisance odours or sediment anoxia arising from nuisance macroalgal growth</td><td rowspan="3">The natural salinity regime is maintained</td><td rowspan="5">95%</td><td rowspan="5">Water clarity is suitable for healthy marine ecosystems</td><td rowspan="5">The concentration of plant available nutrients does not cause nuisance algal blooms</td><td rowspan="5">Taonga species are present in quantities, size and of a quality that is appropriate for the area</td><td rowspan="2">The extent and condition of existing seagrass beds and saltmarsh are maintained or enhanced</td></tr>
<tr><td rowspan="2">Porirua Harbour</td><td>Inter-tidal flats[2]</td><td>5</td><td>-</td><td>3</td><td>2</td></tr>
<tr><td>Harbour-wide</td><td>-</td><td>1 by 2035</td><td>-</td><td>-</td><td rowspan="2">NA</td></tr>
<tr><td colspan="2">Wellington Harbour</td><td colspan="4">NA</td><td>ISQG-low</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="2">Open coast</td><td colspan="8">NA</td></tr>
<tr><td>Limit</td><td colspan="11">Relevant resource use limits to be defined</td></tr>
</table>

Interpretation of Table H5.1

[1] Includes the Lake Onoke inter-tidal flats. Lake Onoke is an intermittently closed and open lake (ICOL), exhibiting characteristics of both a lake and estuary. It is therefore considered as both a lake and an estuary for the purposes of ecosystem health and mahinga kai values. See the Lakes aquatic ecosystem health and mahinga kai table for other relevant outcomes.

[2] Inter-tidal flats are defined as those areas of the harbour which is covered at high tide and uncovered at low tide.

The delineation of the coastal marine area where rivers meet the coast is delineated in Map 18.1 to 18.25.

Interpretation of harbours, estuaries and open coastal aquatic ecosystem health and mahinga kai table H5.1					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
	Mud content of surface sediments	%	≤	The mud content of surface sediments is at or less than …%, except where it can be proved that natural background levels are higher than this.	* indicates that this outcome does not apply where it can be proved that natural background levels are higher than this, particularly in eastern Wairarapa estuaries draining erosion-prone soft rock catchments (eg. Whareama)
	Sedimentation rate	mm/year	≤	The sedimentation rate is at or is less than …%, except where it can be proved that natural background levels are higher than this.	** indicates that this outcome does not apply where it can be proved that natural background levels are higher than this, particularly in eastern Wairarapa estuaries draining erosion-prone soft rock catchments (eg. Whareama)
	Redox potential depth	cm	≥	The redox potential depth is greater than …cm.	
Total C	Total organic carbon content of surface sediments	%	≤	The total organic carbon content of surface sediment does not exceed … %	
	Toxicants – sediment		≤	Toxicant concentrations in sediments do not exceed the ISQG-low interim sediment quality guideline values.	ISQG-low interim sediment quality guidelines, ANZECC (2000). http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf
	Toxicants – water column		≤	Toxicants concentrations in the water column do not exceed the trigger values identified in the ANZECC (2000) guidelines for the level of protection of …% of species	95th percentile protection level in ANZECC (2000) http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf

Table H5.2: Contact recreation and tangata whenua use

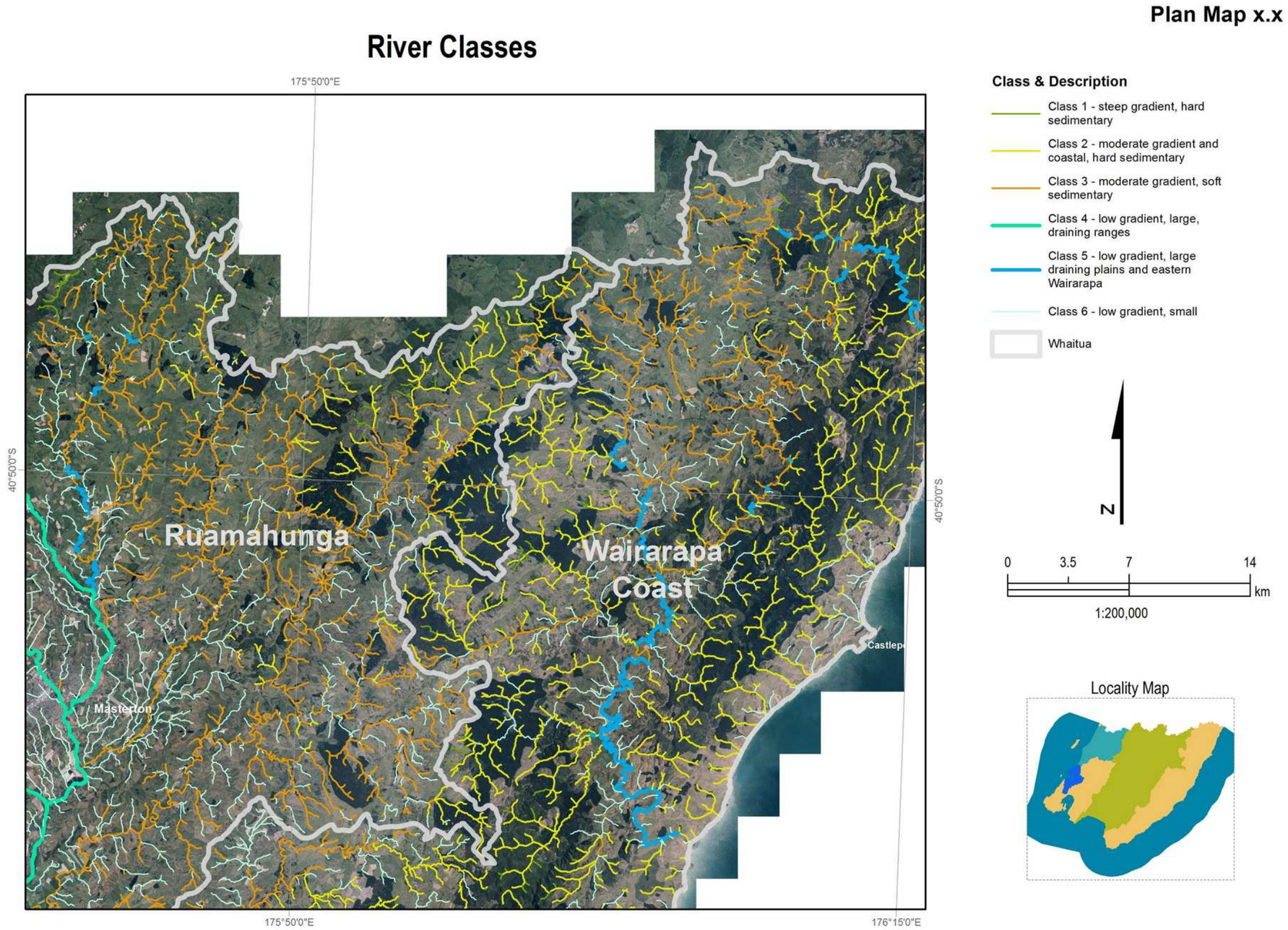
<table>
<tr><td>Water type</td><td colspan="8">Open coast, harbours and estuaries</td></tr>
<tr><td>Value</td><td colspan="8">Contact recreation and tangata whenua use</td></tr>
<tr><td>Broad outcome</td><td colspan="8">Open coastal waters, harbours and estuaries are suitable for contact recreation, shellfish gathering and amenity, and support tangata whenua use and their relationship with water</td></tr>
<tr><td rowspan="6">Outcome</td><td colspan="2"></td><td>Enterococci</td><td>E. coli</td><td>Faecal coliforms</td><td>Clarity</td><td>Macroalgae</td><td>Tangata whenua use</td></tr>
<tr><td colspan="2">Estuaries[1]</td><td>NA</td><td>Bathing season:
260
Non-bathing season:
550</td><td rowspan="4">43/14</td><td rowspan="4">Water is of a clarity that provides for a good swimming experience during the bathing season</td><td rowspan="4">There are no nuisance odours from sediment anoxia and macroalgal growth</td><td rowspan="4">Coastal waters and estuaries are safe for primary contact and ceremonial use</td></tr>
<tr><td colspan="2">Porirua Harbour</td><td>Bathing season:
140
Non-bathing season:
280</td><td>NA</td></tr>
<tr><td rowspan="2">Wellington Harbour</td><td>Outside Port Area</td><td>Bathing season:
140
Non-bathing season:
280</td><td>NA</td></tr>
<tr><td>Port Area</td><td colspan="4">The delineated Port Area is not managed for contact recreation</td></tr>
<tr><td colspan="2">Open coast</td><td>Bathing season:
140
Non-bathing season:
280</td><td>NA</td><td>43/14</td><td>Water is of a clarity that provides for a good swimming experience during the bathing season months</td><td>NA</td><td>Coastal waters and estuaries are safe for primary contact and ceremonial use</td></tr>
<tr><td>Limit</td><td colspan="8">Relevant resource use limits to be defined</td></tr>
</table>

Interpretation of Table H5.2

[1] Excludes Lake Onoke. For contact recreation and tangata whenua use outcomes, Lake Onoke is treated as a Lake and not as an estuary. The delineation of Port Areas is in accordance with the Commercial Port Areas shown in Map 15A, 15B and 15C.

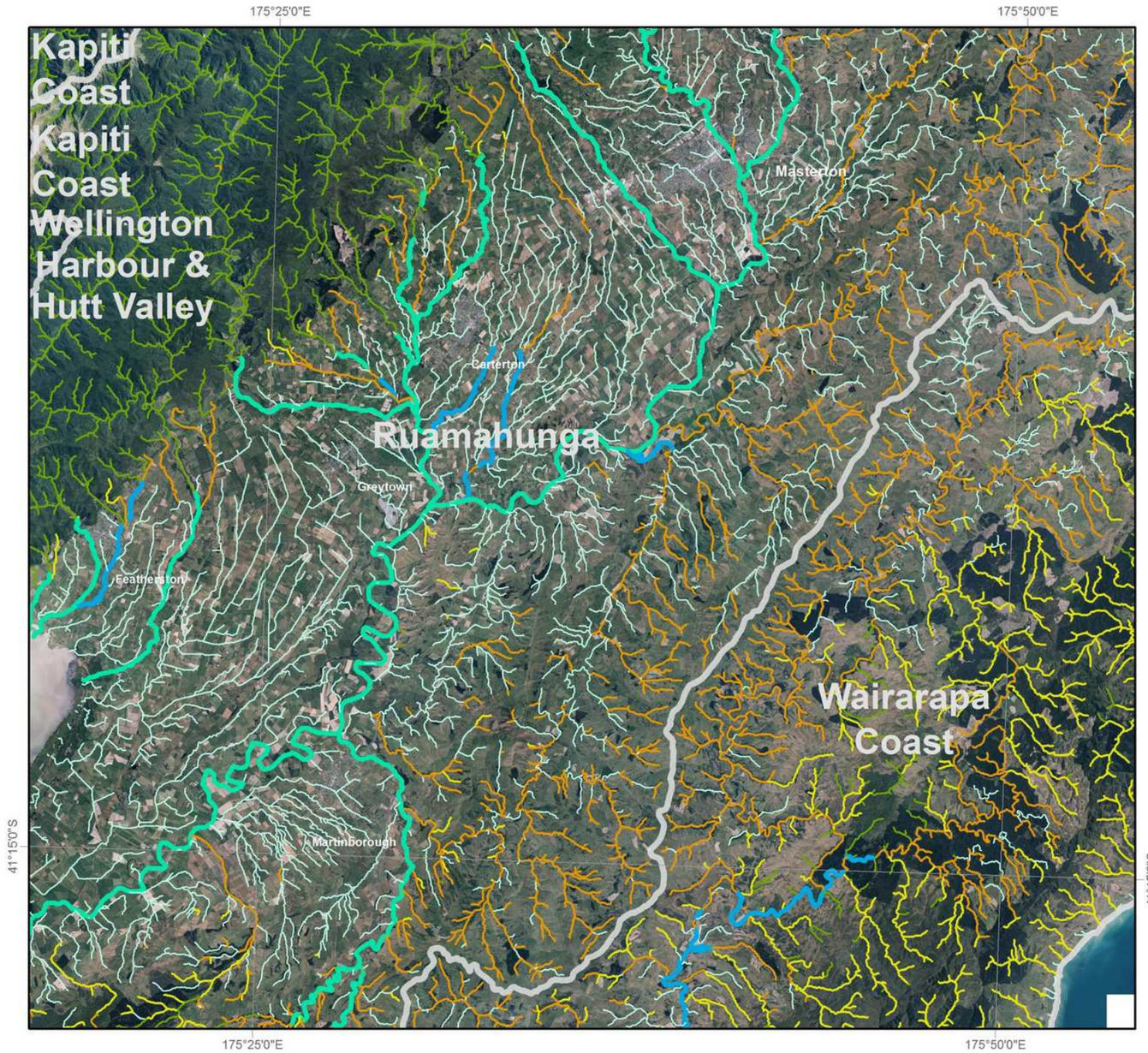
Interpretation open coast, harbours and estuaries contact recreation and tangata whenua use Table H5.2					
Attribute		**Unit**	**Direction**	**Narrative**	**Notes**
	Enterococci	cfu/100mL	≤	The Enterococci count does not exceed …cfu/100mL between 1 November and 31 March (inclusive). The Enterococci count does not exceed …cfu/100mL between 1 April and 31 October (inclusive).	Bathing season is November to March inclusive. Non-bathing season is April to October inclusive.
E. coli	*Escherichia coli*	cfu/100mL	≤	The concentration of E. coli does not exceed …cfu/100mL	
	Faecal coliforms	MPN/100mL	≤	The 90th percentile of faecal coliform count does not exceed …MPN/100mL and the median faecal coliform count does not exceed …MPN/100mL.	The 90th percentile and median values from the Ministry for the Environment/Ministry of Health (2003) microbiological water quality guidelines http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/microbiological-quality-jun03.pdf

Appendix 2 – Maps of river classes



Plan Map x.x

River Classes



Orthophoto: 2010
Projection: NZTM 2000

Class & Description

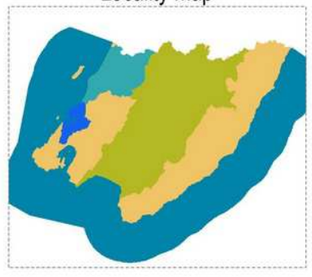
- Class 1 - steep gradient, hard sedimentary
- Class 2 - moderate gradient and coastal, hard sedimentary
- Class 3 - moderate gradient, soft sedimentary
- Class 4 - low gradient, large, draining ranges
- Class 5 - low gradient, large draining plains and eastern Wairarapa
- Class 6 - low gradient, small
- Whaitua

N

0 3.5 7 14
km

1:200,000

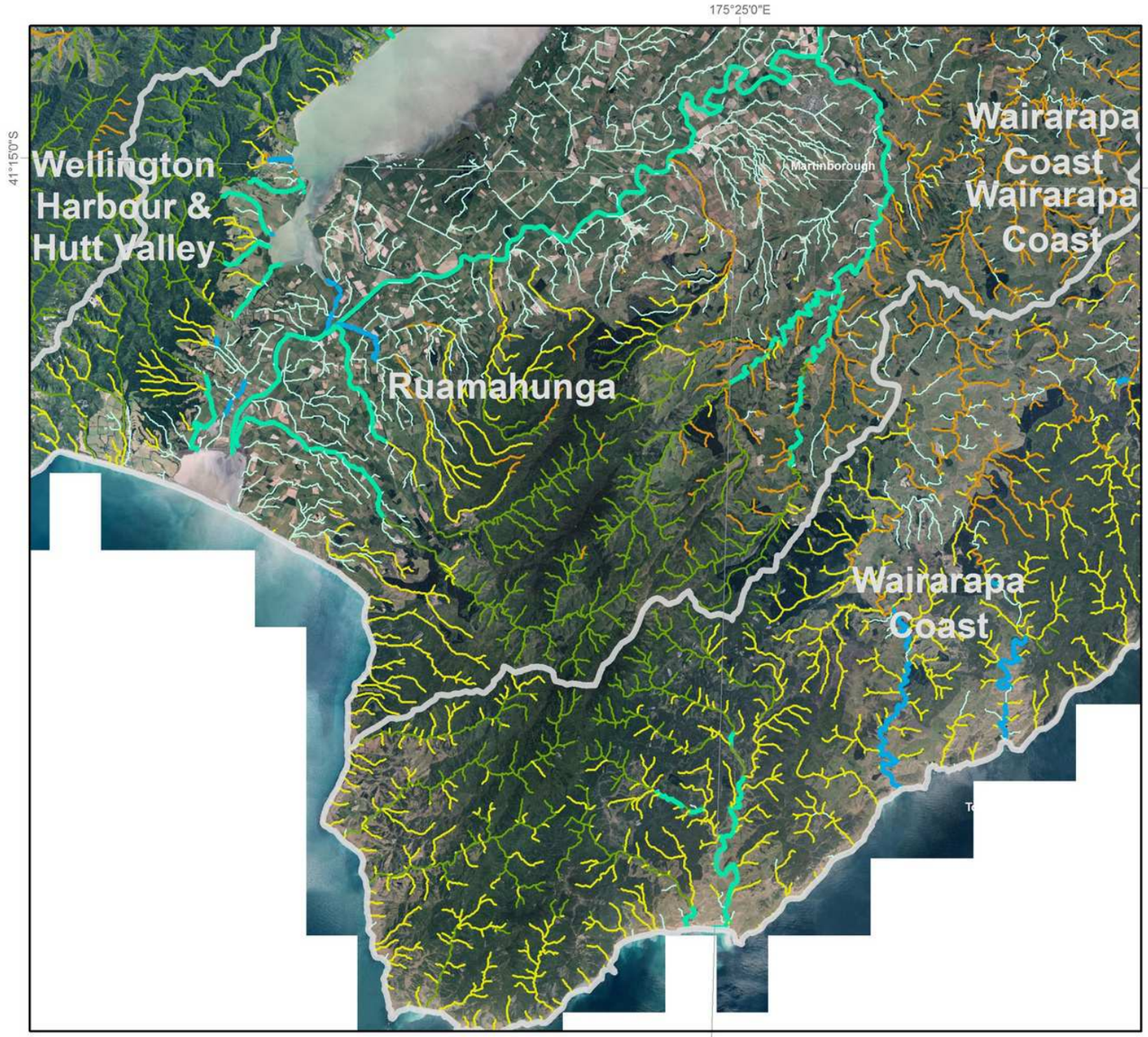
Locality Map



greater WELLINGTON
REGIONAL COUNCIL

Plan Map x.x

River Classes



Class & Description

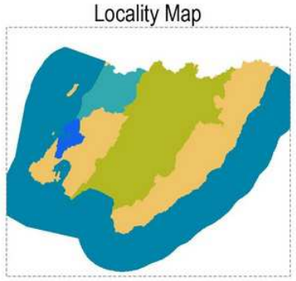
- Class 1 - steep gradient, hard sedimentary
- Class 2 - moderate gradient and coastal, hard sedimentary
- Class 3 - moderate gradient, soft sedimentary
- Class 4 - low gradient, large, draining ranges
- Class 5 - low gradient, large draining plains and eastern Wairarapa
- Class 6 - low gradient, small
- Whaitua

N

0 3.5 7 14 km

1:200,000

Locality Map

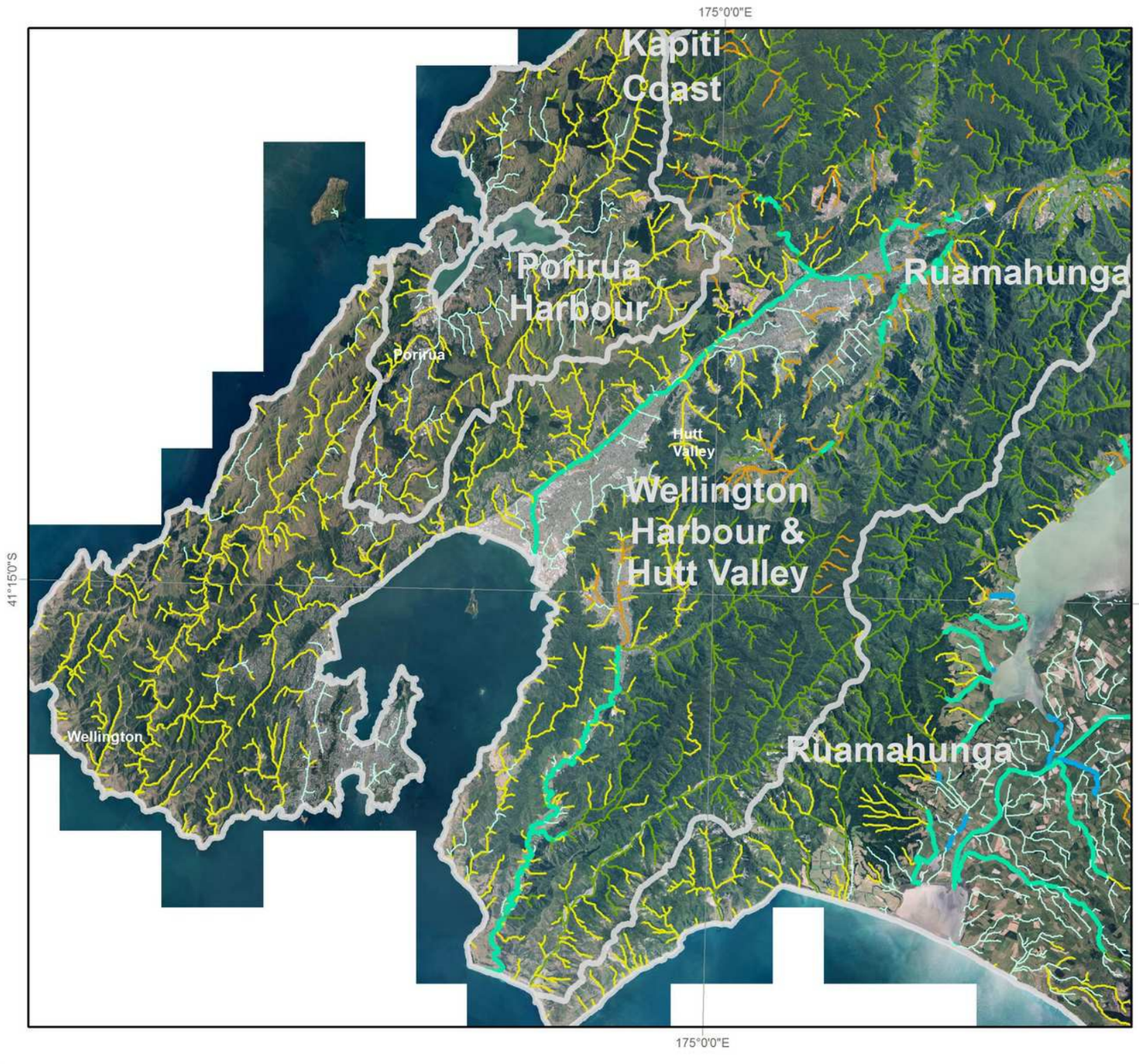


Orthophoto: 2010
Projection: NZTM 2000

greater WELLINGTON REGIONAL COUNCIL

Plan Map x.x

River Classes



Class & Description

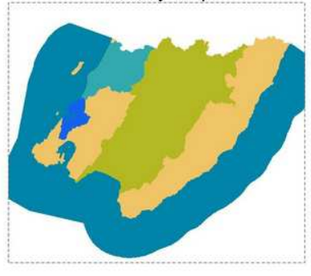
- Class 1 - steep gradient, hard sedimentary
- Class 2 - moderate gradient and coastal, hard sedimentary
- Class 3 - moderate gradient, soft sedimentary
- Class 4 - low gradient, large, draining ranges
- Class 5 - low gradient, large draining plains and eastern Wairarapa
- Class 6 - low gradient, small
- Whaitua

N

0 3.5 7 14 km

1:200,000

Locality Map

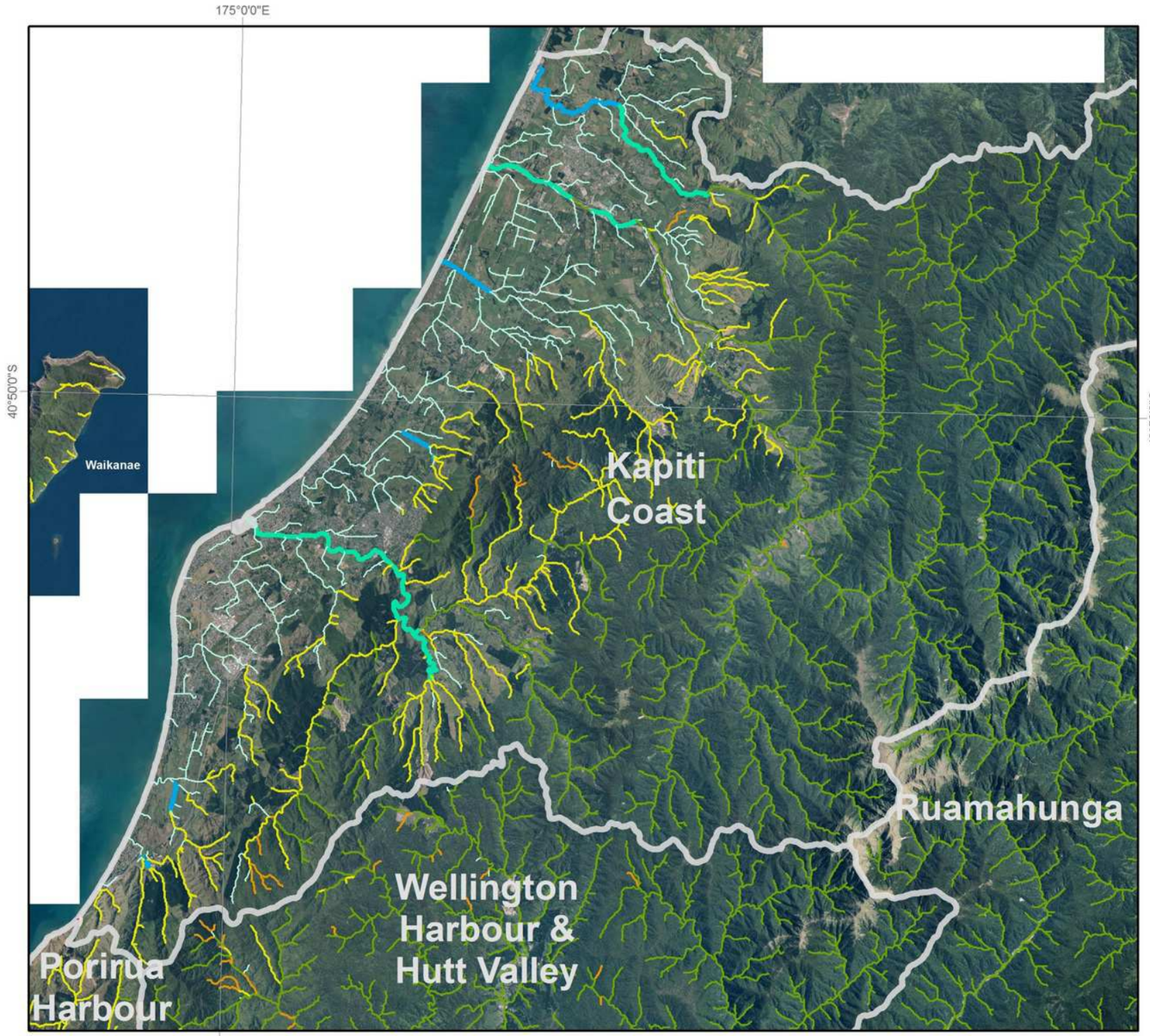


Orthophoto: 2010
Projection: NZTM 2000

greater WELLINGTON REGIONAL COUNCIL

Plan Map x.x

River Classes



Class & Description

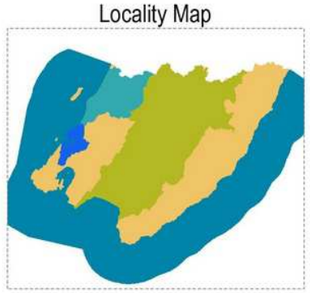
- Class 1 - steep gradient, hard sedimentary
- Class 2 - moderate gradient and coastal, hard sedimentary
- Class 3 - moderate gradient, soft sedimentary
- Class 4 - low gradient, large, draining ranges
- Class 5 - low gradient, large draining plains and eastern Wairarapa
- Class 6 - low gradient, small
- Whaitua

N

0 2.5 5 10 km

1:150,000

Locality Map



Orthophoto: 2010
Projection: NZTM 2000

greater WELLINGTON REGIONAL COUNCIL