



# Draft for discussion purposes

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## Baseline Report

This report was commissioned by the Technical Leaders Group for the Healthy Rivers Wai Ora Project

The Technical Leaders Group approves the release of this report to Project Partners and the Collaborative Stakeholder Group for the Healthy Rivers Wai Ora Project.

Signed by:

Date: 1 March 2016

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# Report 1.0 Integrated Assessment for Healthy Rivers Wai Ora: The Baseline Information

1 March 2016

Liz Wedderburn and Antoine Coffin on behalf of the Technical Leaders Group

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## Preface

The Healthy Rivers Wai Ora plan change project (the project) aims to update the Waikato Regional Plan in order to help restore and protect the health and wellbeing of the Waikato and Waipa rivers. The plan change seeks to reduce, over time, the levels of sediment, bacteria and nutrients (nitrogen and phosphorus) entering water bodies (including groundwater). A key driver of the project is the Vision and Strategy for the Waikato River. The Vision and Strategy identifies the objective of the restoration of water quality within the Waikato River, so that it is safe for people to swim in and take food from over its entire length<sup>1</sup>.

The Integrated Assessment (IA) is a key input into the project, providing an assessment of the environmental, social, cultural and economic impacts of the water quality scenarios modelled<sup>2</sup>. This work was led by Dr Liz Wedderburn (Portfolio Leader - Agri Policy & Principal Scientist, AgResearch) and Antoine Coffin (Te Onewa Consultants), from the Technical Leaders Group.

## Development of Integrated Assessment Framework

An initial workshop was held on 1 December 2014<sup>3</sup> to discuss the prosperous communities and social impact assessment for the project. It was attended by IA leads Liz Wedderburn and Antoine Coffin, as well as Dr Bryce Cooper (General Manager – Strategy, NIWA) as Chair of the Technical Leaders Group, Julie Meade Rose (Social and Environmental Ltd, Bruce Small (AgResearch), and Jacqueline Henry and Emma Reed (Waikato Regional Council).

The outcome of this workshop was a preliminary assessment framework, and identification of data sources for the IA. The framework was based on the values identified by the Collaborative Stakeholder Group (CSG). The workshop also identified key elements of the IA including the need for baseline information, and that the outcomes of testing water quality scenarios using a set of indicators would be provided to the CSG for consideration.

## Indicators

The draft environmental, social and economic indicators were developed through a series of workshops with the CSG<sup>4</sup> from February to April 2015, led by Liz Wedderburn. A sub-group of the CSG (Ruth Bartlett, Charlotte Rutherford, Gwyneth Verkerk and Sally Davis) met with Liz Wedderburn in May 2015 to further develop an Integrated Assessment framework that considered the Policy Selection Criteria, the indicators identified at CSG9, the Waikato Progress Indicators and the Waikato River Authority report card. At CSG13, CSG decided on the following list of indicators:

### Environmental

- Regional Ecological Monitoring of (wadeable) Streams (REMS which includes MCI, clogginess (Macrophytes), stream habitat)
- Riparian (effective for land-use) - Pareparenga o te wai (Riparian margin – access and acceptability)
- Wetland (unique habitat protected)

### Social

- Vibrant Resilient Communities

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<sup>1</sup> Te Ture Whaimana o te Awa o Waikato – The Vision and Strategy for the Waikato River

<sup>2</sup> See Doole, G. et al (2015). Economic modelling report- first round scenarios DM#3483793 and 2<sup>nd</sup> round scenarios DM#3564910

<sup>3</sup> Prosperous communities workshop notes December 2014. DM#3237973

<sup>4</sup> Integrated Assessment CSG history (summary) DM#3499887

- Employment (with an emphasis on type, variety and diversity of jobs)
- Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)
- Recreation use (including access and safety)

#### **Economic**

- Net Value Add \$m (Regional GDP with sector breakdown)
- Net International Exports \$m (Waikato regional contribution to national exports)
- Net Employment (Modified Employee Count or MEC) (Total value of employment)

The Mātauranga Māori indicators were developed through a separate process, led by Antoine Coffin. The details of this process are contained in a separate report<sup>5</sup>.

#### **Mātauranga Māori (Cultural)**

- Waitemata (water clarity)
- Te Rere (flow)
- Paemakariri (temperature)
- He kai pai (edible food)
- Te nui o nga kai i te wai (abundance of fish species – koura)
- Nga tarukino me nga ika rawaho i te wai (presence of pest weeds and fish)
- Mātauranga ki nga wai kaukau (Knowledge of swimming places)
- Au Putea (economic benefit of water)

#### **Baseline**

The baseline provides a reference from which to assess each of the indicators based on the scenario outputs. A baseline of quantitative and qualitative data and trends were prepared for each of the indicators. Both published and unpublished sources were used to provide the most up to date information. The ecological data were provided by Dr John Quinn (Chief Scientist - Freshwater and Estuaries, NIWA) from the Technical Leaders Group, the social indicators data by Beat Huser (Waikato Regional Council), Bruce Small and members of the CSG sectors<sup>6</sup>, and the baseline economic data by Dr Garry McDonald (Economist, Market Economics Ltd).

#### **Assessment process**

An expert panel was used to carry out the assessment. The purpose of the expert panel workshops was to bring together a range of expertise and knowledge to evaluate the results of the scenario modelling against the baseline information. The panel would then produce a narrative for each indicator and a trend for any change showing direction (either positive, negative or no change) and magnitude (i.e. a minor or more significant effect/change). The requirement was for the panel to use data where possible but due to timeframe constraints, to generally provide best professional judgement. A report was prepared for each of round one and round two scenario modelling assessments.

#### **Process**

A panel was convened comprising Liz Wedderburn, Jacqueline Henry, John Quinn, Wendy Boyce (Consultant), Emma Reed and Antoine Coffin. The panel met on Friday 28 August 2015 to consider the first round of economic modelling outputs. Using the baseline information, the panel assessed the model outputs against each indicator, and a draft narrative and trends were recorded.

<sup>5</sup> See Te Onewa Consultants (2015). Mātauranga Māori Knowledge Networks DM#3504062

<sup>6</sup> Relevant data was provided by representatives of the horticulture, tourism, and energy sectors.

A sub-group of CSG members, formed at the CSG13 meeting and comprising Sally Davis, Trish Fordyce, Stephen Colson, Jason Sebastian, Gwyneth Verkerk, George Moss, Weo Maag, James Bailey, Alastair Calder, James Houghton, and Al Fleming<sup>7</sup>, met with the panel on 15 September 2015 to finalise the first round IA. At this workshop a new indicator 'Vibrant Resilient Communities' was developed, after CSG identified a gap at their meeting on 8 September 2015.

The panel re-convened on 23 September 2015 to assess the outputs of the second round of modelling, for the 10, 25, 50 and 100% steps for Scenario 1<sup>8</sup>.

## Outputs

This report sets out the baseline information and should be read in conjunction with the two reports summarising the assessment of scenario modelling round one (Integrated Assessment One: assessment of scenarios from modelling round one) and round two (Integrated Assessment Two: Achieving water quality for swimming, taking food and healthy biodiversity. Assessment of Scenario 1 steps 10%, 25% and 50% from case 1 modelling round two).

## Introduction

This report contains information about the people and environment in the Waikato and Waipa river catchments. It summarises the current cultural, economic, environmental and social situation. This is called 'baseline information'. Baseline information is used to understand where things are at now. It is used to compare different options for managing land and water in the catchments. It is intended to assist the Collaborative Stakeholder Group in the project to understand the possible positive and negative impacts of these different options on the community and the environment. The indicators were chosen based on what people value about the Waikato catchment as well as the ways they use the land and rivers ([waikatoregion.govt.nz/csgdocs](http://waikatoregion.govt.nz/csgdocs)).

## Structure

The report is divided up into four categories:

1. Social
2. Environmental
3. Mātauranga Māori
4. Economic.

Each category has several key pieces of information to guide decisions about the Healthy Rivers Wai Ora (HRWO) project. These indicators are chosen because they provide a measurable snapshot of the current situation in the Waikato catchment and surrounds.

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<sup>7</sup> See Integrated Assessment CSG history (summary) DM#3499887

<sup>8</sup> Doole, G. et al (2015). Healthy Rivers Wai Ora Economic modelling report-2<sup>nd</sup> round scenarios DM#3564910

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# Social Indicators

## Vibrant and Resilient Communities

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline  |
|--|---|
| <p><b>Vibrant and Resilient Communities</b></p> <p>This indicator focuses on the health and sustainability of New Zealand rural communities. New Zealand's economy is dependent upon its national primary production system which in turn is dependent upon the performance of rural enterprises. Rural enterprises are strongly connected and interdependent upon vibrant rural communities to supply the necessary services, infrastructure, labour and skills. Therefore, declining rural communities presents a significant challenge for rural enterprises, the agribusiness value chain, industry good bodies, and local, regional and national government<sup>9</sup>.</p> <p><b>A definition of a vibrant community</b></p> <p>Challenges for rural enterprises and communities arise from both internal (e.g. debt, lack of available skilled employees) and external factors (e.g. changing resource management regulation, changing market demands, an increased incidence of extreme climate events). Challenges to rural communities, which support and sustain rural enterprises, include, decreasing social capital, rural – urban drift leading to declining populations and changing demographic structure, and declining services and infrastructure (e.g., health, education, policing, transport networks, drinking water, energy and communication<sup>10</sup>).</p> <p><b>A definition of a resilient community</b></p> <p>Resilience is the capacity of a community to deal with change and continue to develop. It is about the capacity to use shocks and disturbances like resource management regulation or climate change to spur renewal and innovative thinking. Resilience offers hope for rural enterprises and communities to cope, adapt and transform in the face of increasingly complex, uncertain, and volatile change. Social capital (an umbrella concept for social networks, strategic partnerships and alliances, and civic trust) facilitates knowledge search and knowledge sharing activities vital to entrepreneurship and innovation – activities important to maintaining successful rural businesses and vibrant rural communities enabling them to seize opportunities arising from changing</p> | <p><b>Vibrancy of communities</b></p> <p><b>Food security</b></p> <p>Fruit and vegetables are staples in the New Zealand diet. Many of these goods are non-substitutable with imports, particularly fresh vegetables such as leafy greens, potatoes, carrots, brassicas and a range of fruits. Waikato's domestic vegetable supply is linked with approximately ten other vegetable production nodes across the country that are integrated parts of the domestic food supply chain. Domestic food supply requires a range of factors for production to occur centred on the productions nodes, with one important factor being climate. Climatic conditions vary so nodes are located to ensure supply throughout the year and to protect against risks such as drought, floods, diseases and transport failure.</p> <p>Horticulture production in the Waikato River Catchment is primarily based in the Lower Waikato Catchment. The Pukekawa area is a significant vegetable production area for domestic and export food supply. The horticultural node of Pukekohe/Pukekawa together have between 6000-7000 hectares in production annually and are unique to other areas in the country due to the combination of soil, frost free growing conditions year around, settlement and large local market. Rotations can supply many crops year round, which is unique in New Zealand, due to the frost free conditions.</p> <p>Ensuring that rural areas can continue to have land available for food production and have reasonable and efficient use of water, will contribute to domestic food security in terms of the accessibility of fresh fruit and vegetables for communities that are vulnerable to food price fluctuations.</p> <p><b>Population size</b></p> <p>The population of the Waikato Region has grown steadily over the past twenty-five years, from 325,220 in 1986 to approximately 416,200 in 2012, an increase of 28 per cent. Steady growth is anticipated to continue to 2031. Hamilton City has the largest proportion of the region's population, increasing its share from 29.0 per cent in 1986 to 35.6 per cent in 2012 (p3) contributing to the majority of the region's growth (58.0 per cent). South Waikato and Waitomo are declining (19.7 and 9.3 per cent respectively). The greatest overall growth was experienced by Waikato District (77.4 per cent, contributing 31.0 per cent to the region's growth—a small portion of which reflects the 2010 boundary change), followed by Waipa which experienced a growth of 29.9 per cent (contributing 11.7 per cent). Otorohanga experienced negligible growth (0.7 per cent).</p> <p>The gains are not shared evenly across either the age distribution or by territorial authority (TA), with only Hamilton City projected to experience overall gains in all broad age groups, and all other TAs expected to see widespread decline across the younger and middle ages. Three areas (Otorohanga, South Waikato, and Waitomo) are projected to experience decline in all</p> |

<sup>9</sup> Small, 2015, p1

<sup>10</sup> Small, 2015, p1

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline  |
|---|---|
| <p>circumstances, and consequently strengthen the future performance of the New Zealand primary production value chain<sup>11</sup>.</p> <p><b>Purpose</b><br/>The purpose of this indicator is to show the current levels of vibrancy and resilience in rural communities in the Waikato catchment. For the purposes of the Healthy Rivers Wai Ora project, community vibrancy focuses on the diversity of employment in the rural areas, food security, population size and structure and levels of deprivation. Whereas community resilience focuses on social connectedness, community pride, volunteering and involvement in recreation.</p> <p><b>Vibrant</b><br/>Employment, and changes and threats to employment and job security, have crucial flow-on effects for communities. There is a fundamental link between local employment opportunities, the population and demographics of communities, and their resilience and vitality.</p> <p>To remain vibrant and attractive places to live, communities require a sufficient population of residents, spanning a full range of age-brackets. There is a big difference between communities where the residents are predominantly retired or older people and those where younger households, with working age members and children live.</p> <p><b>Resilient</b><br/>Schools, sports centres, clubs and fields, marae, community houses and halls, and other community facilities create hubs within communities, around which activities, events and initiatives can revolve. These in turn create a sense of vibrancy and place, and build people's sense of belonging. A sense of belonging in a community is also strongly related to people's sense of connection with others (or absence of loneliness), the pride they have in their local area and their involvement in recreation activity.</p> <p>The timeframes over which the changes in the scenarios occur will have a crucial impact on community resilience and vitality. Individuals and communities have substantial capacity to adapt, where they are given sufficient time and/or the right package of support and resources around them to assist change, e.g. incentives, training, internet connectivity.</p> | <p>age groups below 65 years<sup>i</sup>.</p> <p><b>Population growth and decline</b><br/>Except for a handful of TAs (only Hamilton City in the Waikato), all foreseeable growth in New Zealand's TA's will be at 65+ years, and most will see decline at most other ages<sup>12</sup>. These changes are not even across TAs, with only Hamilton City projected to experience overall gains in all age groups, and all other TAs expected to see widespread decline across the younger and middle ages. Three TAs (Otorohanga, South Waikato, and Waitomo) are projected to experience decline in all age groups below 65 years. The changes by age have important implications for the labour market (and educational demand).</p> <p><b>School children</b><br/>For the Waikato Region, the ratio of elderly (65+ years) to children (0-14 years) is projected to increase rapidly from its present 0.6 (six elderly for every ten children), to 1.1 by 2031 (eleven elderly for every 10 children). This profound shift to more elderly than children will by then be contributing to diminishing levels of natural increase, as will the slowly diminishing proportion projected to be at the key reproductive ages (24.6 per cent in 2031, down from 25.2 per cent in 2011).</p> <p><b>Resilience</b><br/><b>Social connectedness and community pride</b><br/>The Waikato Genuine Progress Indicators measure social connectedness using reported loneliness as the main. A smaller proportion of people living in the Waikato region reported feeling lonely in 2012 than in 2008, an improving trend. The level of community pride expressed in 2013 by people living in the Waikato region was similar to that measured in 2007<sup>ii</sup>.</p> <p><b>Recreation</b><br/>The majority of adults take part in sport and recreation each week. Weekly participation has grown slightly since 2007/08. While this is a small increase it is a positive change after 10 years with no growth (from 1997 to 2007). Participation is most often in outdoor environments, both in towns and cities (e.g., paths/cycleways and urban parks) and in more natural settings (e.g., waterways, bush and the countryside). The most popular activities of choice (walking, swimming, cycling and jogging/running) are often recreational in nature. Since 2007/08 there have been small increases in participation in cycling. There have been slightly larger decreases in walking and swimming. Membership of any club or centre (over 4 weeks) has remained stable (around 1/3 of participants) since 2007/08; however sports club membership decreased by 2 percentage points, while in contrast gym membership increased by 3 percentage points<sup>13</sup>. Looking at barriers to both trying a new activity and doing more of an existing one, lack of time was more likely to be a barrier for those aged 25 to 49 years, compared with other age groups<sup>iii</sup>.</p> <p><b>Connectivity</b></p> |

<sup>11</sup> Small, 2015, p1

<sup>12</sup> Jackson, 2013, 1

<sup>13</sup> Sport NZ, 2013, p.54



| About this indicator; the narrative | What the evidence says about the current situation; the baseline   |
|-------------------------------------|--|
|                                     | <p>Connectivity is a driver of resilience. Connectivity includes factors such as knowing other people in your community, access to services, internet access, commuting distance to work and remoteness. The emergence of universally available high speed broadband internet is an enabling technology that diminishes the challenge of time and space associated with rural locations. It will enable new forms of social connectivity and new types of employment and business will arise as the unfilled promise of developing technologies such as virtual reality, telepresence, telemedicine, nanotechnology and 3D printing are realised through broadband connectivity. Utilisation of universal broadband for business, recreation/entertainment, and the development and enhancement of personal relationships both proximal and distal could potentially revolutionise rural living and business activities<sup>14</sup>.</p> <p>The different FMUs have different spatial connectivity. State Highway 1 runs through the Upper FMU which assists with connections to other areas. The Middle and Lower FMUs are highly connected, the city of Hamilton in the Middle FMU, state highways run through this area, including the development of the expressway, and the Lower FMU particularly has an increasing connection to Auckland. The Waipa FMU is the least connected<sup>iv</sup>. This is also shown in commuting patterns, where there is an apparent divide between Auckland and Hamilton in the Waikato district, with northern residents commuting to Auckland and the rest of the community to Hamilton or Huntly.</p> <p>Within the catchment there are differences between which sectors and industries that particular towns have connections with, and therefore any losses in jobs from a particular sector may affect them differently. Te Awamutu, Tirau and Putaruru have strong dairy connections, Otorohanga and Te Kuiti have connections with dry stock, Tokoroa with forestry and Waitomo has a tourism influence.</p> |

<sup>14</sup> Small, 2015

## Employment

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline   |
|---|--|
| <p>(With an emphasis on type, variety and diversity of jobs)</p> <p>This indicator considers the type and diversity of jobs, new employment opportunities that may arise and the geographic spread of employment.</p> <p>When employment is affected, this has flow-on impacts for many other aspects of society and communities.</p> <p>The rivers support regionally and nationally significant primary production in the catchment (agricultural, horticultural, forestry). These industries contribute to the economic, social and cultural wellbeing of people and communities, and are a major contributor to wealth creation within the region. These industries, and associated primary production, also support other industries and communities within rural and urban settings.</p> <p>The rivers and the land surrounding them offer unique opportunities for how local communities and industries operate, contributing to the lifestyle and sense of community, pride and culture in rural Waikato.</p> <p>New opportunities for employment were not generated as part of the modelling outputs, so this aspect of this indicator was considered through the integrated assessment process.</p> | <p><b>Employment rate</b></p> <p>The employment rate in the Waikato has been on the rise since 2012, and in 2014 was 66%. At present, around 30–33% of the working-age population in the region can be classified as ‘not in the labour force’<sup>v</sup>.</p> <ul style="list-style-type: none"> <li>• The employment rate in the Waikato region has been on the rise since 2012, and currently sits at around 66%.</li> <li>• Businesses and other organisations provide a lot of employment, and there are substantial numbers of owner-operated businesses and self-employed people.</li> </ul> <p><b>Employment by sector</b></p> <p>In June 2014, 171,960 people were employed by businesses and other organisations in the Waikato region. This represents an increase of 3.5% since 2013. In addition, approximately 20,000 people were self-employed or owner-operators of small businesses. The largest employment sectors in the Waikato in 2014 (by employee counts) were:</p> <ul style="list-style-type: none"> <li>• health and education (35,290 employees)</li> <li>• wholesale and retail trade (24,440 employees)</li> <li>• business and finance services (20,860 employees)</li> </ul> <p>While dairy farming and processing is a relatively important sector in the Waikato region, it employed only 4.3% of the regional labour force in 2014 and 1.4% of the entire New Zealand labour force. By way of comparison, business services employed 12% of the regional labour force<sup>vi</sup>.</p> <p>The tourism sector is a major source of employment across New Zealand, accounting for 8.8% of the country’s total employment. In the Waikato, one in six jobs (16.6%) are supported by tourism, making the region one of the most reliant on tourism employment in the country. The proportion of local residents’ jobs that are supported by tourism vary throughout the region: from 7.1% in Hamilton City to 12.7% in the Waipa District<sup>vii</sup>.</p> <p><b>Employment growth</b></p> <p>From 2009 to 2014, the total number of employees in the Waikato region increased by 7073 people (4.3%). Employment growth was highest in the electricity, water and gas sector (39% increase) and dairy manufacturing sector (29% increase). Employment in the food and wood manufacturing sectors also grew over this period. In contrast, the transport and storage sector experienced the largest decline (5% decrease), with employment in the specialised and equipment manufacturing sector also declining<sup>viii</sup>.</p> |

## Infrastructure

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline   |
|--|--|
| <p>(Includes, water supply, wastewater, energy and flood protection)</p> <p>This indicators looks at the reliability and affordability to communities of the region’s energy, wastewater, water and flood protection infrastructure, and the investment or reinvestment risks associated with it. The key area of interest is whether or not the infrastructure will remain affordable over time.</p> <p><b>Water</b></p> <p>The rivers provide for community and municipal water supplies, and contribute to the broader health of the region. Water infrastructure can considered in terms of two different asset groups:</p> <ul style="list-style-type: none"> <li>• urban water infrastructure – the assets in this group provide safe and potable water, manage wastewater and stormwater, service business and residential water needs, and treat trade and industrial waste.</li> <li>• other water infrastructure – the assets in this group provide the infrastructure required for activities such as irrigation, hydro-generation, agro-processing, rural domestic supply and stock water.</li> </ul> <p><b>Energy</b></p> <p>The Waikato region plays a major role in ensuring the security of electricity supply for the country as a whole. Waikato is New Zealand’s premier electricity generating region, producing more electricity than any other region in the country. The river provides for reliable, renewable hydro and geothermal energy sources and thermal generation. New Zealand’s social and economic wellbeing depend on a secure, cost-effective electricity supply system, while renewable energy contributes to our international competitive advantage. Electricity also contributes to the health and safety of people and communities.</p> <p><b>Infrastructure affordability</b></p> <p>For the purpose of the integrated assessment, affordability relates household incomes to the price of a service or asset provided, to assess the ability of households and communities to pay.</p> <p><b>Flood protection</b></p> | <p><b>Water availability</b></p> <p>The Waikato Regional Council measures the level of water that has been allocated through resource consents, as a percentage of the total amount of water available for allocation in the Waikato region, as measured at the Waikato River mouth, during the summer months each year. From 2007 to 2014, the percentage of water that had been allocated has increased from 67% to 86%, with the rate of increase rising substantially from 2009. During non-summer months, the allocation level is substantially less, due to lower demand<sup>ix</sup>. Water and waste treatment facilities are funded through district and city rates, which are influenced by size of population and property values.</p> <ul style="list-style-type: none"> <li>• Demand for water from the Waikato River is increasing, with the proportion of water that is allocated through resource consents rising each year since 2007.</li> <li>• The Waikato supplies around 37%, and if required, up to 50% of New Zealand’s electricity each year.</li> <li>• Hydro-generation accounts for around 57% of the country’s electricity supply, with North Island hydro-electricity generators catering for around 14% of national supply.</li> <li>• Flood management schemes are a feature of land use in this catchment, especially in the lower Waikato.</li> </ul> <p><b>Electricity supply</b></p> <p>Historically New Zealand has enjoyed cheap and abundant energy. In recent years, however, electricity prices have risen in response to growing demand, and the depletion of the Maui gas field. The Waikato region includes hydro, geothermal and thermal electricity generation capacity, and plays a central role in ensuring the security of electricity supply for the country providing around 37%, and if required, up to 50% of New Zealand’s electricity. Huntly Power Station accounts for 17% of New Zealand’s electricity generation capacity. New Zealand generates the majority of its electricity from renewable sources, and is currently placed fourth among the OECD countries for the percentage of renewable energy that it generates. In 2014, the region provided approximately 45% of New Zealand’s renewable electricity across wind, hydro and geothermal. Hydro-generation accounts for around 57% of the country’s electricity supply. North Island hydro-electricity generators cater for around 14% of national supply. Seventy-five per cent of electricity generated in the Waikato region is exported to other regions of New Zealand. Electricity generation and supply creates sales of \$800 million per year in the Waikato region and employs more than 10,000 people.</p> <p><b>Pricing and affordability of electricity</b></p> <p>At present, New Zealand has a competitive retail market for electricity, with electricity prices among the lower half of those found throughout OECD countries<sup>x</sup>. Affordability is a difficult and somewhat controversial metric to calculate. According to Statistics NZ, electricity expenditure as a proportion of median household income has increased from 2.8% in 2007 to 3% in 2013<sup>15</sup>; however, relatively modest increases in prices have been observed in the past 2-3 years<sup>xi</sup>. However, these averages</p> |

<sup>15</sup> Statistics New Zealand, Household Expenditure and Household Income figures

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline   |
|--|--|
| <p>Waikato Regional Council is responsible for the sustainable management of the region's rivers and their catchments, including the effects of flooding and erosion. Catchment areas have been greatly modified. Much of the native vegetation that would have once slowed the flow of water from hillsides and helped to hold hillsides together, has been cleared. River and catchment modification have contributed to increased flooding and erosion. The Waikato Regional Council is responsible for the provision and maintenance of the major flood control schemes throughout the greater Waikato region. Some of these areas are managed in conjunction with district councils. The schemes include large-scale works that aim to reduce flood risks such as, stopbanks, pump stations, floodgates and detention dams.</p> | <p>can mask differences in affordability and energy costs as a proportion of income can vary compared to what the above statistics imply.</p> <p><b>Flood protection – lower Waikato</b></p> <p>There are 41,000 ha of land served by flood protection worth \$108 million in the lower Waikato. This includes 250km of stop banks, 253km of floodgates and 250km of channels and streams<sup>xii</sup>.</p> |

## Recreation

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline   |
|--|--|
| <p>(Including access and safety)</p> <p>This indicator focuses on whether or not there is sufficient access to the rivers for recreation.</p> <p>The rivers provide for people’s recreational use and social needs, are widely used by communities, and are a place to relax, play, exercise and enjoy an active lifestyle.</p> <p>Whether the rivers are safe for recreational use, from a health perspective, is gauged through the water quality attributes. It is important that the attributes that affect human health are at acceptable levels.</p> | <p><b>Types of recreational uses</b></p> <p>The main recreational uses of the river, in order of reported frequency, are<sup>xiii</sup>:</p> <ul style="list-style-type: none"> <li>• walking or cycling beside it</li> <li>• sightseeing, picnicking or camping</li> <li>• fishing or hunting</li> <li>• boating or water sports</li> <li>• kayaking, canoeing and waka ama</li> <li>• swimming</li> <li>• gathering kai.</li> </ul> <p>Around two-thirds of respondents in research about freshwater recreational use had visited a freshwater site in the Waikato region in the past year. The main factors that influenced which site people chose to visit were cleanliness of the site, clarity of the water and travel costs associated with accessing the site. The human health risks and ecological health of the site were not significant factors.</p> <p>This hierarchy is supported by other data about the preferred recreational uses of freshwater sites (which would include lakes). Again, the most common activities were walking or jogging or relaxing near the water. Of the in-the-water activities, swimming or paddling are the most popular (48% of users), followed by fishing (37%). Boating is the most popular on-the-water activity (33%). A smaller number of respondents reported doing traditional cultural activities like eeling, mahinga kai, customary and ceremonial uses<sup>xiv</sup>.</p> <p><b>Number of people using the rivers for recreation</b></p> <p>Research in 2012-2014 into the number of people using freshwater bodies (which includes rivers, streams, lakes and wetlands) for recreation found that 69% of the survey participants had visited a freshwater body in the Waikato region in the past year. Rivers were the most common type of freshwater site visited (57% of participants), followed by lakes (51 per cent), although there was some ambiguity over whether hydro lakes count as a lake or a river. A third of participants said they had visited a stream, and 17 per cent a freshwater wetland<sup>xv</sup>.</p> <p><b>How people choose a site</b></p> <p>The main factors that affect which freshwater site people chose to visit for recreational purposes are: travel cost, water clarity, land cover (urban and forest), facilities, accessibility, development, perceived site cleanliness, perceived safety of food gathered and flow adequacy. Water clarity was found to have a significant positive effect in motivating people to visit a site. Human health risk and ecosystem health measures were found to be not significant themselves in influencing site choice. Travel cost has just as large a negative effect as clarity’s positive effect. It means that sites further away are less likely to be visited, all else being equal. However, cleanliness of the site – including the land, as perceived by the user – has the largest single impact overall, having a very positive influence on site visits<sup>xvi</sup>.</p> |

# Environmental Indicators

## Regional Ecological Monitoring of Streams - REMS

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline   |
|--|--|
| <p>(REMS data includes the Macroinvertebrate Community Index (MCI) and channel clogginess (macrophytes) as indicators of stream health.</p> <p><b>Macroinvertebrate Community Index (MCI)</b><br/>           Macroinvertebrates are small organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate). They include insects, crustaceans, molluscs, arachnids and annelids that do not have a backbone. MCI is an index that uses macroinvertebrates to monitor and report on stream health in New Zealand. The MCI assigns a score to each species or taxon (from 1 to 10), based on its tolerance or sensitivity to organic pollution, then calculates the average score of all taxa present at a site. Different scores are used for naturally hard - and soft-bottomed streams, to allow for natural habitat effects. It is a qualitative sampling method, which means it indicates which species are present or absent in a sample. To know the abundance (i.e., how many) of a certain species in a sample, the Quantitative MCI (QMCI) sampling methodology is used.</p> <p><b>Macrophyte Clogginess</b><br/>           A macrophyte is an aquatic plant that grows in or near water and is either emergent, submergent, or floating. Clogginess refers to the amount of plant cover that is present in the stream channel. In lakes and rivers, macrophytes provide cover for fish and substrate for aquatic invertebrates, produce oxygen during the day and consume oxygen at night, and act as food for some fish and wildlife. High levels of macrophytes can have negative effects on ecosystem health, aesthetics, and suitability for recreational purposes.</p> <p><b>Ecosystem health</b><br/>           Ecosystem health encompasses the type and abundance of freshwater invertebrates in non-tidal wadeable streams, as well as the amount of algal and aquatic plant growth and the quality of the habitat in which organisms live.</p> <p><b>EPT Index</b><br/>           EPT Index is the botanical names of three types of aquatic insects that are easily sorted</p> | <p>Macroinvertebrate Community Index assessments show that stream health is typically good in the tributaries of the Waipa and upper Waikato Freshwater Management Units (FMUs), fair in the lower Waikato tributaries, and fair-to-poor in the mid-Waikato tributaries.</p> <p>Monitoring shows macrophyte channel clogginess levels are low in the upper upper-Waikato area, low-medium in both the lower upper-Waikato and Waipa areas, and high in the middle and lower Waikato areas. Clogginess is restricted in the Waikato and Waipa natural riverine reaches, and the hydro-lakes, due to their high flows and greater depths and widths, respectively.</p> <p>Habitat quality also declines markedly with catchment development and is lowest in streams draining catchments that have been almost entirely developed for agriculture. Overall, across the five long-term monitoring sites where riparian management has been carried out, there is an overall improving trend for both of these stream health metrics. Stream health would be enhanced by riparian planting, which is not currently included in the scenario evaluation.</p> <p><b>Stream health</b><br/>           Stream health is a function of the type and abundance of freshwater invertebrates in non-tidal wadeable streams, as well as the amount of algal and aquatic plant growth that is present, for example, as an invertebrate food source. The health of the Waikato region's streams declines progressively as the level of catchment development increases, and is lowest in urban streams influenced by stormwater. Habitat quality also declines markedly with catchment development and is lowest in streams draining catchments that have been almost entirely developed for agriculture. Overall, across the five long-term monitoring sites where riparian management has been carried out, there is an overall improving trend for both of these stream health metrics.</p> <p><b>Macroinvertebrate Community Index (MCI)</b><br/>           In 2013 the MCI was used to assess tributary sites in the Waikato region<sup>xvii</sup>. Sixty-two sites were covered, with between eight and 23 sites in each of the four tributary FMUs. For the Waikato main stem, MCI data is only available for the NIWA national rivers water quality monitoring network site at Hamilton Traffic Bridge (HM3).</p> <p>Table 1 summarises the indices and grades used in the monitoring. MCI and Quantitative Macroinvertebrate Community Index (QMCI), i.e: QMCI scores use the hard bottom (N = 38 sites) and soft bottom (N = 23 sites) scores, as appropriate, based on the REMS habitat assessment made at the time of monitoring<sup>xviii</sup>.</p> |

and identified and is commonly used as an indicator of water quality. The richness and relative abundance of EPT species – ephemeroptera/mayflies, plecoptera/stoneflies and trichoptera/caddisflies (excluding Oxyethira) provide information on the environmental quality of rivers and streams.

**Table 1:** Macroinvertebrate indicator grades used

| Classes | MCI     | QMCI      | Percentage EPT density | Percentage EPT richness |
|---------|---------|-----------|------------------------|-------------------------|
| A       | >119    | >5.99     | >70                    | >70                     |
| B       | 100-119 | 5.00-5.90 | 51-70                  | 51-70                   |
| C       | 80-99   | 4.00-4.99 | 25-50                  | 25-50                   |
| D       | <80     | <4.00     | <25                    | <25                     |

Table 2 summarises the indicator scores for each FMU.

**Table 2:** Indicator score by FMU

| FMU           | Site N | MCI | QMCI | Percentage EPT abundance | Percentage EPT richness | Overall score |
|---------------|--------|-----|------|--------------------------|-------------------------|---------------|
| Upper Waikato | 23     | A   | A    | B                        | C                       | B             |
| Mid Waikato   | 8      | C   | D    | D                        | C                       | D             |
| Lower Waikato | 12     | C   | C    | D                        | C                       | C             |
| Waipa         | 19     | B   | B    | C                        | C                       | B             |

Macroinvertebrates are rated D at the Hamilton traffic bridge site, based on QMCI (NIWA unpublished data). These results indicate that stream health is typically good in the tributaries of the Waipa and upper Waikato FMUs, fair in the lower Waikato tributaries, and fair-to-poor in the mid-Waikato tributaries. The lower scores in the mid-Waikato tributaries probably reflect the combined influences of rural and urban land use.

### Macrophytes

REMS data for 2013 and 2014 included 134 observations of macrophyte cover, as submerged and emergent plants, at 99 tributary sites. Macrophyte cover estimates were made using the methods outlined in Collier et al. (2014). Channel clogginess was calculated from these estimates (Collier et al. (2014), and states were assigned to the FMU mean value using the proposed suitability for trout fishing bands of Matheson et al. (2015) – see Table 3.

**Table 3:** Macrophyte channel clogginess states in relation to suitability for trout fishing

| Attribute  | Band/class    | Criteria |
|--|---------------|----------|
| Percentage of channel cross-sectional area or volume (CAV) | A – Excellent | <10%     |
| Percentage of channel cross-sectional area/volume (CAV)    | B – Good      | 10-20%   |

|  |          |        |
|--|----------|--------|
| Percentage of channel cross-sectional area or volume (CAV) | C – Fair | 20-30% |
| Percentage of channel cross-sectional area or volume (CAV) | D – Poor | >30%   |

Table 4 summarises the maximum channel clogginess statistics from 99 Waikato and Waipa tributary sites in 2013 and 2014, and the FMU states based on the average maximum clogginess observed.

**Table 4:** Maximum channel clogginess statistics and FMU states

| Tributary FMU                             | Count | Mean | Median | Standard deviation | Maximum | Trout fishing – FMU mean |
|---|-------|------|--------|--------------------|---------|--------------------------|
| Upper upper-Waikato (Taupo to Ohakuri)    | 7     | 4.9  | 0.1    | 11.2               | 30      | A                        |
| Lower upper-Waikato (Ohakuri to Karapiro) | 24    | 12.3 | 2.9    | 16.4               | 53      | B                        |
| Middle Waikato                            | 8     | 21.3 | 20.1   | 18.6               | 49.8    | C                        |
| Lower Waikato                             | 29    | 26.8 | 9.6    | 32.1               | 95.8    | C                        |
| Waipa                                     | 31    | 19.8 | 1.0    | 30.0               | 98      | B                        |

High flows restrict macrophyte biomass in the main stems of the Waikato and Waipa natural riverine reaches to the channel margins, so that channel clogginess will be less than 10% in all cases (A class for trout fishing). Macrophytes are more abundant in the hydro-lakes in places and, in those places can significantly impact upon recreational use but the greater depth and width are likely to still restrict overall channel clogginess to less than 10%<sup>xix</sup>.



## Pareparenga o te wai/riparian margins

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline  |                |                  |                          |                                    |                          |                                    |               |    |      |    |    |      |             |    |      |    |    |      |               |    |      |    |    |      |       |    |      |    |    |      |
|--|---|----------------|------------------|--------------------------|------------------------------------|--------------------------|------------------------------------|---------------|----|------|----|----|------|-------------|----|------|----|----|------|---------------|----|------|----|----|------|-------|----|------|----|----|------|
| <p>(riparian margins that are effective for land-use)</p> <p>Riparian refers to the margins of waterbodies (i.e. stream banks). They are typically managed for water quality through fencing and/or planting.</p> <p>River and stream riparian areas contribute to ecological integrity and aesthetic appeal, enhance terrestrial biodiversity and act as a 'last line of defence' in controlling contaminant inputs.</p> <p>The access of livestock to riparian areas and streams is a key driver of water quality and riparian condition in the pastoral farming systems that dominate productive land use in the Waikato and Waipa catchments.</p> <p>One acceptable measure for tracking the amount and effectiveness of riparian management is to record the percentage of fencing completed. The greater the amount of fencing, the less soil disturbance and bank erosion that occurs<sup>xx</sup>.</p> | <p>There has been a significant increase in the proportion of stream length fenced on both sides of waterways between 2002 and 2012, resulting in an overall increase in proportion fenced across the Waikato Region from 34% to 51%.</p> <p>The increase has been greater along streams on dairy farms (25% increase to 70% in 2012) compared to dry stock farms (7% increase to 29% in 2012).</p> <p>There has been little change in woody vegetation within riparian areas over the last decade. The modelling only includes fencing and grass buffers, not riparian planting requirements. There may still be co-benefits for biodiversity, aesthetics, ecological corridors and customary resources through natural re-vegetation of fenced areas.</p> <p>Over the past 5 years, riparian fencing has increased by about 3.5% of bank length per year for dairy and about 0.2% of bank length per year for dry stock. Since about equal numbers of dairy and dry stock farms were surveyed, this indicates an overall increase of around 2% per year over the last 5 years. A summary of the data for the 2012 survey of Jones et al. (2015) and predicted 2015 fencing, assuming the continuation of previous fencing trends is presented in Table 1.</p> <p><b>Table 1:</b> Summary of some results from stream riparian assessment surveys and estimated fencing and scores in 2014 (from percentage dairy and dry farms and annual percentage increase in fencing in 2007-2012<sup>xxi</sup>).</p> <table border="1" data-bbox="1279 1192 2267 1545"> <thead> <tr> <th>Tributary FMUs</th> <th>No Sites</th> <th>%woody veg</th> <th>%≥5m wide buffer</th> <th>% Effective fencing 2012</th> <th>Estimated % effective fencing 2014</th> </tr> </thead> <tbody> <tr> <td>Upper Waikato</td> <td>68</td> <td>44.9</td> <td>57</td> <td>67</td> <td>70.3</td> </tr> <tr> <td>Mid Waikato</td> <td>27</td> <td>15.7</td> <td>43</td> <td>55</td> <td>57.2</td> </tr> <tr> <td>Lower Waikato</td> <td>46</td> <td>15.1</td> <td>10</td> <td>45</td> <td>46.5</td> </tr> <tr> <td>Waipa</td> <td>79</td> <td>21.7</td> <td>47</td> <td>56</td> <td>58.3</td> </tr> </tbody> </table> <p>There has been a significant increase in the proportion of stream length fenced on both sides of waterways between 2002 and 2012, resulting in an overall increase in proportion fenced across the Waikato Region from 34% to 51%. The increase has been greater along streams on dairy farms (25% increase to 70% in 2012) compared to dry stock farms (7% increase to 29% in 2012). This reflects the requirement of the Dairying and Clean Streams Accord for dairy farmers to have their "Accord streams" (those wider than a stride (ca. 1m) and deeper than a red band (0.3 m) to be fenced by 2013. Over the 5 years to 2012, the rate of change was about 3.5% of bank length per year for dairy and about 0.2% of bank length per year for dry stock. The proportions and dairy and dry stock streams surveyed and their rates of increase in fencing between 2007 and</p> | Tributary FMUs | No Sites         | %woody veg               | %≥5m wide buffer                   | % Effective fencing 2012 | Estimated % effective fencing 2014 | Upper Waikato | 68 | 44.9 | 57 | 67 | 70.3 | Mid Waikato | 27 | 15.7 | 43 | 55 | 57.2 | Lower Waikato | 46 | 15.1 | 10 | 45 | 46.5 | Waipa | 79 | 21.7 | 47 | 56 | 58.3 |
| Tributary FMUs   | No Sites  | %woody veg     | %≥5m wide buffer | % Effective fencing 2012 | Estimated % effective fencing 2014 |                          |                                    |               |    |      |    |    |      |             |    |      |    |    |      |               |    |      |    |    |      |       |    |      |    |    |      |
| Upper Waikato  | 68  | 44.9           | 57               | 67                       | 70.3                               |                          |                                    |               |    |      |    |    |      |             |    |      |    |    |      |               |    |      |    |    |      |       |    |      |    |    |      |
| Mid Waikato  | 27  | 15.7           | 43               | 55                       | 57.2                               |                          |                                    |               |    |      |    |    |      |             |    |      |    |    |      |               |    |      |    |    |      |       |    |      |    |    |      |
| Lower Waikato  | 46  | 15.1           | 10               | 45                       | 46.5                               |                          |                                    |               |    |      |    |    |      |             |    |      |    |    |      |               |    |      |    |    |      |       |    |      |    |    |      |
| Waipa  | 79  | 21.7           | 47               | 56                       | 58.3                               |                          |                                    |               |    |      |    |    |      |             |    |      |    |    |      |               |    |      |    |    |      |       |    |      |    |    |      |

2012 were used to estimate the total fencing in 2014 (Table 2).

Fencing for dairy and dry stock streams in 2012 were estimated from the regional average differences in total fencing between dairy and dry stock streams (70% and 29%, respectively) and the number of streams surveyed in each FMU. The % fencing in 2014 was calculated from the 2012 data applying the annual average % increases of 3.5% for dairy farms and 0.2% for dry stock farms for the 2007-2012 period measured by Jones et al. (2015). The results are shown in Table 2.

**Table 2:** Estimated percentage of total fencing for streams on dairy and dry stock farms by FMU in 2012 and 2014

| Tributary FMU | 2012 % fenced | Dairy No | Dry No | Prop Dairy | Calc Dairy % fence 2012 | Calc Dry stock fence 2012 | Dairy % 2014 | Est Dairy % 2014 | Est Dry total 2014 |
|---------------|---------------|----------|--------|------------|-------------------------|---------------------------|--------------|------------------|--------------------|
| Upper Waikato | 66.6          | 45       | 23     | 0.66       | 94.2                    | 39.0                      | 100.9        | 39.2             |                    |
| Mid Waikato   | 54.2          | 19       | 8      | 0.70       | 76.6                    | 31.8                      | 82.1         | 31.9             |                    |
| Lower Waikato | 44            | 28       | 18     | 0.61       | 62.2                    | 25.8                      | 66.7         | 25.9             |                    |
| Waipa         | 55.4          | 49       | 30     | 0.62       | 78.3                    | 32.5                      | 83.9         | 32.6             |                    |

There has been little change in woody vegetation within riparian areas over the last decade. Amongst the FMUs, the percentage of woody vegetation is highest in the Upper Waikato (=44.9%), followed by the Waipa (21.7%), mid-Waikato (15.7%) and least in the Lower Waikato (15.1%). This may reflect the natural predominance of riparian wetland plants in the mid and lower Waikato to some extent.

Stock exclusion could increase biodiversity in stream. There may be further co-benefits for biodiversity, aesthetics, ecological corridors, and plant resources for customary use through natural re-vegetation of fenced areas, or voluntary planting of fenced areas by landholders.

## Wetland

### About this indicator; the narrative

(unique habitat protected)

Wetlands and floodplains provide water purification, refuge, feeding and breeding homes (or habitat) for aquatic species and homes for water fowl. Wetlands also provide ecosystem services, diluting or diffusing the effects of floods and contaminants. This is also called flood and contaminant attenuation. Apart from specific wetlands (e.g., Whangamarino) and wetlands around lake margins, wetlands in the catchment have largely been drained and converted to pasture.

Whangamarino is one of only six wetlands in New Zealand that is recognised as being of international significance. Wetlands were once widespread within the lower Waikato basin, but today, less than 20 percent of the original freshwater wetlands remain. Many of these are scattered around the catchment and smaller than 50 ha. For example, the once massive 25,840 ha Gordonton peat bog, now consists of a 60 ha remnant<sup>xxii</sup>.

In the lower Waikato basin there is a mosaic of shallow lakes and mineralised swamps all connected to the Waikato River, while the Hamilton basin has a unique assemblage of peat lakes and remnant peat domes

Whangamarino wetland is the second largest bog and swamp complex in the North Island and is an outstanding site for promoting the value of wetlands and species conservation<sup>xxiii</sup>.

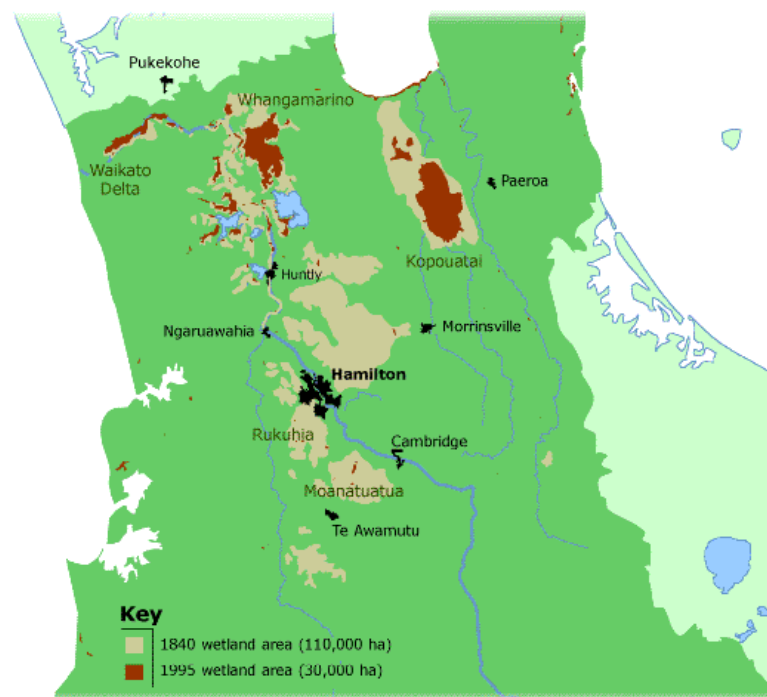
### What the evidence says about the current situation; the baseline

#### Wetland extent in catchment areas

Within the Waikato River Basin it is estimated that there has been a 92.3% decline in wetland areas, from 202,600 ha historically (Beard 2010)<sup>xxiv</sup>.

**Table 1** Current and historical areas (km2) of wetland types<sup>xxv</sup>

| Type    | Current | Historical | Percent decline |
|---------|---------|------------|-----------------|
| Bog     | 47.8    | 507.7      | 90.6            |
| Swamp   | 89.4    | 1064       | 91.6            |
| Marsh   | 16.8    | 245.8      | 93.2            |
| Fen     | 0.5     | 171.5      | 99.7            |
| Seepage | 0.5     | 37         | 98.8            |
| Total   | 155     | 2026       | 92.3            |



**Figure 1:** Comparison of current and historic (pre European development) wetland extent in the Waikato Region<sup>xxvi</sup>

# Economic Indicators

## Value Add

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline   |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
|---|--|----------|--|---------------------|-----|---------------|-------|----------|-----|---------------|-----|----------------------------------|-----|-------------------------------------|-----|-----------------------------|-----|------------------------------|-----|---------------------|-------|-----------|-------|--------------|-------|----------------------------|-------|-----------|-----|--|-----|------------------------------|-----|----------------|-------|------------------|---------------|
| <p>(proxy for Regional GDP with sector breakdown)</p> <p>Gross Domestic Product (GDP) is an internationally accepted measure of economic activity.</p> <p>The Regional Economic Model uses 'net value added' as a proxy for Regional GDP. Both are conceptually similar, with the main difference being how the tax of products is treated (i.e. GST)<sup>xxvii</sup>.</p> <p>The rivers support regionally and nationally significant primary production in the catchment (agricultural, horticultural, forestry). These industries contribute to the economic, social and cultural wellbeing of people and communities, and are the major component of wealth creation within the region. These industries and associated primary production also support other industries and communities within rural and urban settings.</p> <p>The rivers and the surrounding land offer unique opportunities for many communities and industries to operate, contributing to the lifestyle and sense of community, pride and culture in rural Waikato.</p> | <p>The largest sector for Value Add is 'Other services' (see table 1) followed by Dairy farming, and Wholesale and retail trade.</p> <p>Table 1. showing model results for Value Add for the Waikato Region by sector</p> <table border="1" data-bbox="1279 640 2095 1415"> <thead> <tr> <th>Industry</th> <th>Value Added (\$<sub>2014</sub>million)</th> </tr> </thead> <tbody> <tr><td>Sheep, beef &amp; grain</td><td>408</td></tr> <tr><td>Dairy farming</td><td>1,597</td></tr> <tr><td>Forestry</td><td>189</td></tr> <tr><td>Other primary</td><td>591</td></tr> <tr><td>Agriculture and forestry support</td><td>227</td></tr> <tr><td>Meat and meat product manufacturing</td><td>464</td></tr> <tr><td>Dairy product manufacturing</td><td>700</td></tr> <tr><td>Wood and paper manufacturing</td><td>491</td></tr> <tr><td>Other manufacturing</td><td>1,109</td></tr> <tr><td>Utilities</td><td>1,293</td></tr> <tr><td>Construction</td><td>1,185</td></tr> <tr><td>Wholesale and retail trade</td><td>1,532</td></tr> <tr><td>Transport</td><td>610</td></tr> <tr><td>Scientific, professional and administrative services</td><td>969</td></tr> <tr><td>Local and central government</td><td>218</td></tr> <tr><td>Other services</td><td>6,316</td></tr> <tr><td><i>Sub-Total</i></td><td><i>17,896</i></td></tr> </tbody> </table> <p>Tourism is one of New Zealand's biggest export industries, earning 16.1% of New Zealand's foreign exchange earnings (year ended March 2013).</p> <p>The total value of tourism (total visitor expenditure) to the Waikato region is \$1.7b. This is approximately equivalent to 10.9% of the regions Gross Domestic Product (GDP). Of this total, Hamilton/Waikato contributes \$1b (international = \$200m, domestic = \$800m), Great Lake Taupō contributes \$400m (international = \$135m, domestic = \$265m), and the Coromandel contributes \$315m (international = \$65m, domestic \$250m).</p> <p><b>Tourism<sup>16</sup></b></p> | Industry | Value Added (\$ <sub>2014</sub> million) | Sheep, beef & grain | 408 | Dairy farming | 1,597 | Forestry | 189 | Other primary | 591 | Agriculture and forestry support | 227 | Meat and meat product manufacturing | 464 | Dairy product manufacturing | 700 | Wood and paper manufacturing | 491 | Other manufacturing | 1,109 | Utilities | 1,293 | Construction | 1,185 | Wholesale and retail trade | 1,532 | Transport | 610 | Scientific, professional and administrative services | 969 | Local and central government | 218 | Other services | 6,316 | <i>Sub-Total</i> | <i>17,896</i> |
| Industry  | Value Added (\$ <sub>2014</sub> million)   |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Sheep, beef & grain   | 408  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Dairy farming   | 1,597  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Forestry  | 189  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Other primary   | 591  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Agriculture and forestry support  | 227  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Meat and meat product manufacturing   | 464  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Dairy product manufacturing   | 700  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Wood and paper manufacturing  | 491  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Other manufacturing   | 1,109  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Utilities   | 1,293  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Construction  | 1,185  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Wholesale and retail trade  | 1,532  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Transport   | 610  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Scientific, professional and administrative services  | 969  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Local and central government  | 218  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| Other services  | 6,316  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |
| <i>Sub-Total</i>  | <i>17,896</i>  |          |  |                     |     |               |       |          |     |               |     |                                  |     |                                     |     |                             |     |                              |     |                     |       |           |       |              |       |                            |       |           |     |  |     |                              |     |                |       |                  |               |

<sup>16</sup> The Technical Leaders Group acknowledge the inclusion of tourism only is a narrow focus for this indicator

Tourism is one of New Zealand's biggest export industries, earning 16.1% of New Zealand's foreign exchange earnings (year ended March 2013). Tourism directly and indirectly contributes almost 9% of gross domestic product (GDP) for New Zealand. The Waikato region is New Zealand's fourth largest destination for domestic travel, especially for holiday makers. Of the 13.4 million international visitor nights to New Zealand in 2010, 5.8 per cent of those nights were spent in the Waikato region.

Domestic and international visitors spent a total of 2.7 million guest nights in commercial establishments in the Waikato region during the year to December 2010. Visitor arrivals to New Zealand are expected to grow 4 per cent a year, reaching 3.8 million visitors in 2021 from 2.9 million in 2014. Total international spend is expected to reach \$11.1 billion in 2021, up nearly 48.5 per cent on 2014 total spend. Spending in 2015 is expected to surpass the pre-GFC high of \$7.6 billion in 2007<sup>xxviii</sup>.

Total value of tourism (total visitor expenditure) to the Waikato region is \$1.7b. This is approximately equivalent to 10.9% of the regions Gross Domestic Product (GDP). International tourists contribute \$400m to this total while domestic tourists contribute \$1.3b. Of this total, Hamilton/Waikato contributes \$1b (international = \$200m, domestic = \$800m), great lake Taupo contributes \$400m (international = \$135m, domestic = \$265m), and the Coromandel contributes \$315m (international = \$65m, domestic \$250m).

In comparison, the total value of tourism: to Auckland is \$4.7b; to Wellington is \$1.4b; to Queenstown is \$1.3b; to Christchurch is \$1.2b; to Northland is \$575m; to Hawkes Bay is \$553m; to Bay of Plenty is \$492; and to Rotorua is \$471m<sup>xxix</sup>.

## ***International exports***

### **International exports**

(proxy for Waikato regional contribution to national exports)

The Regional Economic Model uses 'net international exports' as a proxy for Waikato regional contribution to national exports. The two measures are the same. In the case of the indicator used, the 'net' relates to the aggregated (economy-wide) effects of the scenario.

## Employment

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
|--|---|--------|---|-----------------------|-------|---------------|--------|----------|-------|---------------|-------|----------------------------------|-------|-------------------------------------|-------|-----------------------------|-------|------------------------------|-------|---------------------|--------|-----------|-------|--------------|--------|----------------------------|--------|-----------|-------|--|--------|------------------------------|-------|----------------|--------|------------------|----------------|
| <p><b>Modified employee counts (MEC)</b><br/>(As a proxy for total value of employment)</p> <p>The Regional Economic Model uses 'net employment impact' as a proxy for the total value of employment indicator. Net employment impact is measured using modified employee counts (MEC), which capture both employees and working proprietors.</p> <p>The proxy is used because total value of employment is a measure of income, which is also captured by the regional GDP indicator. Using net employment impacts instead, enable the model to avoid double counting income.</p> | <p>The other services sector has the largest net employment impact for the region, with a modified employee (job) count of 72,281. Other major contributors are: wholesale and retail trade; dairy farming; scientific, professional and administrative services; and construction. Employed people's median weekly earnings in the Waikato region are below the national average.</p> <p><b>Modified employee counts (MEC) by sector<sup>xxx</sup></b></p> <table border="1" data-bbox="1279 579 2095 1423"> <thead> <tr> <th>Sector</th> <th>2014 employment (MEC in 2007 Equivalents)</th> </tr> </thead> <tbody> <tr><td>Sheep, beef and grain</td><td>8,210</td></tr> <tr><td>Dairy farming</td><td>19,732</td></tr> <tr><td>Forestry</td><td>1,663</td></tr> <tr><td>Other primary</td><td>9,552</td></tr> <tr><td>Agriculture and forestry support</td><td>4,740</td></tr> <tr><td>Meat and meat product manufacturing</td><td>4,272</td></tr> <tr><td>Dairy product manufacturing</td><td>2,813</td></tr> <tr><td>Wood and paper manufacturing</td><td>2,619</td></tr> <tr><td>Other manufacturing</td><td>15,323</td></tr> <tr><td>Utilities</td><td>2,239</td></tr> <tr><td>Construction</td><td>18,443</td></tr> <tr><td>Wholesale and retail trade</td><td>28,296</td></tr> <tr><td>Transport</td><td>7,316</td></tr> <tr><td>Scientific, professional and administrative services</td><td>18,653</td></tr> <tr><td>Local and central government</td><td>2,949</td></tr> <tr><td>Other services</td><td>72,281</td></tr> <tr><td><b>Sub-total</b></td><td><b>219,099</b></td></tr> </tbody> </table> <p><b>Real median weekly income</b><br/>Median weekly earnings for people in paid employment in the Waikato region are below the national average: \$800 in 2014, compared to \$860 for New Zealand overall (WRC).</p> | Sector | 2014 employment (MEC in 2007 Equivalents) | Sheep, beef and grain | 8,210 | Dairy farming | 19,732 | Forestry | 1,663 | Other primary | 9,552 | Agriculture and forestry support | 4,740 | Meat and meat product manufacturing | 4,272 | Dairy product manufacturing | 2,813 | Wood and paper manufacturing | 2,619 | Other manufacturing | 15,323 | Utilities | 2,239 | Construction | 18,443 | Wholesale and retail trade | 28,296 | Transport | 7,316 | Scientific, professional and administrative services | 18,653 | Local and central government | 2,949 | Other services | 72,281 | <b>Sub-total</b> | <b>219,099</b> |
| Sector   | 2014 employment (MEC in 2007 Equivalents)   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Sheep, beef and grain  | 8,210   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Dairy farming  | 19,732  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Forestry   | 1,663   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Other primary  | 9,552   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Agriculture and forestry support   | 4,740   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Meat and meat product manufacturing  | 4,272   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Dairy product manufacturing  | 2,813   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Wood and paper manufacturing   | 2,619   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Other manufacturing  | 15,323  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Utilities  | 2,239   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Construction   | 18,443  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Wholesale and retail trade   | 28,296  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Transport  | 7,316   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Scientific, professional and administrative services   | 18,653  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Local and central government   | 2,949   |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| Other services   | 72,281  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |
| <b>Sub-total</b>   | <b>219,099</b>  |        |   |                       |       |               |        |          |       |               |       |                                  |       |                                     |       |                             |       |                              |       |                     |        |           |       |              |        |                            |        |           |       |  |        |                              |       |                |        |                  |                |

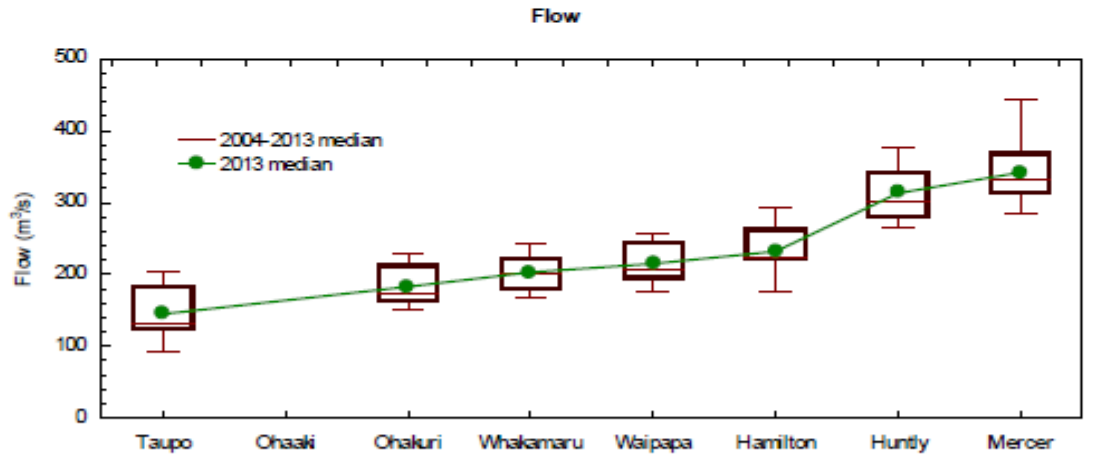
# Mātauranga Māori Indicators

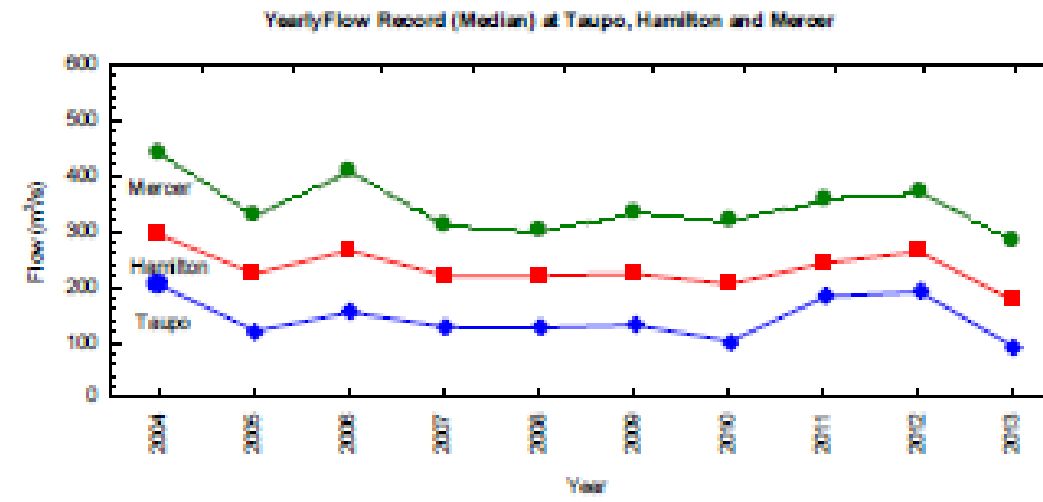
## Waitematā

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline  |
|---|---|
| <p>(water clarity, strong relationship to the turbidity measure in the environmental indicators)</p> <p>This indicator reflects River Iwi aspirations that people are able to see the bottom of a swimming place and to be reassured it is safe and that each successive generation is familiar with the swimming place. This could be at the bank of the river or lake and/or in the water. This is likely to be at a human scale, that is, shoulder to feet, or approximately 155cm vertically or 160+ cm horizontally.</p> | <p>Water clarity has been decreasing in the mainstem of the Waikato River.</p> <p>Water clarity is tracked using a black disc method, which measures the distance of sight in metres through the water<sup>xxxi</sup>. The black disc records began in early 1995 (18-year records).</p> <p>Visual clarity and turbidity are both measures of the optical properties of water, so they tend to broadly co-vary: higher turbidity is associated with lower clarity, and vice versa. So the trends in visual clarity that were observed in the region's streams are similar to those described above for turbidity.</p> <p>Significant trends in visual clarity were observed at about half (49) of the sites at which it was measured (96), and most (88%) were also important trends. Of these, deteriorations (35) were more than four times as common as improvements (8), so the overall pattern for sites in the region as a whole was a deterioration in visual clarity. The median value of the slopes (RSKSE) for the significant and important trends was -1.4% per year.</p> <p>Lake Waipapa, Hamilton (Wellington Street beach), Ngaruawahia, Huntly, lower river are popular swimming places</p> |



## Te Rere

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline   |          |                                |      |                                |      |      |      |      |      |      |      |                   |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
|---|--|----------|--------------------------------|------|--------------------------------|------|------|------|------|------|------|------|-------------------|--|-------------------|----|--|------|------|------|------|------|------|------|------|------|------|-------|-----|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|-----|---------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|-------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|-------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------|-------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|-------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|-------|--|-----|-----|-----|-----|-----|-----|------|------|------|-----|-----|----------------|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|-------------|-------|--|--|----|----|----|----|----|----|----|----|----|----|
| <p><b>Te Rere</b><br/>(flow)</p> <p>This indicator recognises that the level and flow of water at a swimming place is an important factor influencing the favourability of swimming. The flow rate of most of the region's rivers and streams varies with time. A change to water levels and flow (e.g. a significant reduction or significant increase) may make swimming difficult and unacceptable to swimmers<sup>xxxii</sup>. Periods of long dry weather and conversely periods of extreme high rainfall including storms may have some impact on swimming acceptability.</p> | <p><b>The baseline at a glance</b></p> <ul style="list-style-type: none"> <li>• Seasonal Weather (rainfall)</li> <li>• Land use</li> <li>• Allocation of water</li> <li>• Ground cover</li> </ul> <table border="1" data-bbox="1317 663 2338 1024"> <thead> <tr> <th rowspan="2">Location</th> <th colspan="2">DISTANCE</th> <th colspan="10">FLOW RATE+ (m<sup>3</sup>/s)</th> <th rowspan="2">10 YEAR<br/>Median</th> </tr> <tr> <th>km</th> <th></th> <th>2004</th> <th>2005</th> <th>2006</th> <th>2007</th> <th>2008</th> <th>2009</th> <th>2010</th> <th>2011</th> <th>2012</th> <th>2013</th> </tr> </thead> <tbody> <tr> <td>Taupo</td> <td>4.2</td> <td></td> <td>205</td> <td>123</td> <td>157</td> <td>130</td> <td>129</td> <td>134</td> <td>104</td> <td>185</td> <td>194</td> <td>93</td> <td>145</td> </tr> <tr> <td>Ohakuri</td> <td>75.8</td> <td></td> <td>214</td> <td>152</td> <td>184</td> <td>157</td> <td>163</td> <td>162</td> <td>192</td> <td>225</td> <td>229</td> <td>163</td> <td>183</td> </tr> <tr> <td>Whakamaru</td> <td>105.0</td> <td></td> <td>224</td> <td>175</td> <td>208</td> <td>178</td> <td>186</td> <td>196</td> <td>209</td> <td>242</td> <td>232</td> <td>168</td> <td>203</td> </tr> <tr> <td>Waipapa</td> <td>126.1</td> <td></td> <td>256</td> <td>200</td> <td>237</td> <td>190</td> <td>211</td> <td>194</td> <td>198</td> <td>250</td> <td>245</td> <td>175</td> <td>215</td> </tr> <tr> <td>Hamilton</td> <td>211.5</td> <td></td> <td>294</td> <td>224</td> <td>266</td> <td>220</td> <td>220</td> <td>224</td> <td>205</td> <td>243</td> <td>264</td> <td>175</td> <td>232</td> </tr> <tr> <td>Huntly</td> <td>246.5</td> <td></td> <td>376</td> <td>290</td> <td>343</td> <td>280</td> <td>274</td> <td>306</td> <td>296</td> <td>339</td> <td>345</td> <td>266</td> <td>313</td> </tr> <tr> <td>Mercer</td> <td>286.3</td> <td></td> <td>444</td> <td>332</td> <td>409</td> <td>313</td> <td>302</td> <td>334</td> <td>323*</td> <td>356*</td> <td>370*</td> <td>284</td> <td>342</td> </tr> <tr> <td>Waioatapu Strm</td> <td>46.6</td> <td></td> <td>3.7</td> <td>3.6</td> <td>3.8</td> <td>2.8</td> <td>3.0</td> <td>2.7</td> <td>3.3</td> <td>3.8</td> <td>3.5</td> <td>2.5</td> <td>3</td> </tr> <tr> <td>Waipa River</td> <td>232.7</td> <td></td> <td></td> <td>56</td> <td>58</td> <td>34</td> <td>52</td> <td>52</td> <td>32</td> <td>57</td> <td>53</td> <td>36</td> <td>48</td> </tr> </tbody> </table> <p data-bbox="1317 1058 1768 1083">+Rating curve errors mean estimates of flow are ± 8%</p> <p data-bbox="1317 1087 1967 1113">*Historical flow data updated due to rating changes from updated data received</p>  <p data-bbox="1555 1709 2110 1734">YearlyFlow Record (Median) at Taupo, Hamilton and Mercer</p> | Location | DISTANCE                       |      | FLOW RATE+ (m <sup>3</sup> /s) |      |      |      |      |      |      |      |                   |  | 10 YEAR<br>Median | km |  | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Taupo | 4.2 |  | 205 | 123 | 157 | 130 | 129 | 134 | 104 | 185 | 194 | 93 | 145 | Ohakuri | 75.8 |  | 214 | 152 | 184 | 157 | 163 | 162 | 192 | 225 | 229 | 163 | 183 | Whakamaru | 105.0 |  | 224 | 175 | 208 | 178 | 186 | 196 | 209 | 242 | 232 | 168 | 203 | Waipapa | 126.1 |  | 256 | 200 | 237 | 190 | 211 | 194 | 198 | 250 | 245 | 175 | 215 | Hamilton | 211.5 |  | 294 | 224 | 266 | 220 | 220 | 224 | 205 | 243 | 264 | 175 | 232 | Huntly | 246.5 |  | 376 | 290 | 343 | 280 | 274 | 306 | 296 | 339 | 345 | 266 | 313 | Mercer | 286.3 |  | 444 | 332 | 409 | 313 | 302 | 334 | 323* | 356* | 370* | 284 | 342 | Waioatapu Strm | 46.6 |  | 3.7 | 3.6 | 3.8 | 2.8 | 3.0 | 2.7 | 3.3 | 3.8 | 3.5 | 2.5 | 3 | Waipa River | 232.7 |  |  | 56 | 58 | 34 | 52 | 52 | 32 | 57 | 53 | 36 | 48 |
| Location  | DISTANCE   |          | FLOW RATE+ (m <sup>3</sup> /s) |      |                                |      |      |      |      |      |      |      | 10 YEAR<br>Median |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
|   | km   |          | 2004                           | 2005 | 2006                           | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |                   |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Taupo   | 4.2  |          | 205                            | 123  | 157                            | 130  | 129  | 134  | 104  | 185  | 194  | 93   | 145               |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Ohakuri   | 75.8   |          | 214                            | 152  | 184                            | 157  | 163  | 162  | 192  | 225  | 229  | 163  | 183               |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Whakamaru   | 105.0  |          | 224                            | 175  | 208                            | 178  | 186  | 196  | 209  | 242  | 232  | 168  | 203               |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Waipapa   | 126.1  |          | 256                            | 200  | 237                            | 190  | 211  | 194  | 198  | 250  | 245  | 175  | 215               |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Hamilton  | 211.5  |          | 294                            | 224  | 266                            | 220  | 220  | 224  | 205  | 243  | 264  | 175  | 232               |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Huntly  | 246.5  |          | 376                            | 290  | 343                            | 280  | 274  | 306  | 296  | 339  | 345  | 266  | 313               |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Mercer  | 286.3  |          | 444                            | 332  | 409                            | 313  | 302  | 334  | 323* | 356* | 370* | 284  | 342               |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Waioatapu Strm  | 46.6   |          | 3.7                            | 3.6  | 3.8                            | 2.8  | 3.0  | 2.7  | 3.3  | 3.8  | 3.5  | 2.5  | 3                 |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |
| Waipa River   | 232.7  |          |                                | 56   | 58                             | 34   | 52   | 52   | 32   | 57   | 53   | 36   | 48                |  |                   |    |  |      |      |      |      |      |      |      |      |      |      |       |     |  |     |     |     |     |     |     |     |     |     |    |     |         |      |  |     |     |     |     |     |     |     |     |     |     |     |           |       |  |     |     |     |     |     |     |     |     |     |     |     |         |       |  |     |     |     |     |     |     |     |     |     |     |     |          |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |     |     |     |     |     |        |       |  |     |     |     |     |     |     |      |      |      |     |     |                |      |  |     |     |     |     |     |     |     |     |     |     |   |             |       |  |  |    |    |    |    |    |    |    |    |    |    |



## Paemakariri; Temperature

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
|---|---|--------------|-----|--------|----|---------|-----|-----------|----|---------|-----|----------------|-----|----------------|----|--------|----|--------|------|---------------|------|----------------------|-----|--------------------------|-----|----------------|----|-----------------------|-----|------------------|-----|-------------------|-----|-------------------|-----|-------------------|-----|----------------------|----|----------------------|----|---------------------|-----|-----------------------|-----|-----------|-------|-------------------------|----|--------------------------|-----|----------------------|----|-----------------------|----|
| <p>Temperature is measured across the catchment in the monitoring sites, including tributaries of the Waikato and Waipa Rivers.</p> <p>This indicator reflects the expectation that cool water is present at swimming places for its healing qualities as well as life sustaining qualities. This indicator is moderated by contemporary access and use of public and private pools (tepid and thermal) and the sea which are usually warmer than lakes and rivers. Swimming preferences for cooler temperatures used for healing waters are likely to be associated with specific locations of aquifers (spring water).</p> <p>As increases in temperature make the water less suitable for temperature-sensitive organisms, particularly native fish, any observed increases can be regarded as undesirable. (TR201320:9)</p> | <p><b>The baseline at a glance</b></p> <ul style="list-style-type: none"> <li>No important improvements or deteriorations were observed in water temperature between 1993 and 2012.</li> <li>The median rate of temperature increase is no larger than <math>\pm 0.4\%</math> per year (or about <math>\pm 0.06^\circ\text{C}</math> per year).</li> </ul> <p>Temperature has been monitored at 114 sites across the whole Waikato Region with 10 on the Waikato River and some 38 on other rivers. On the Waikato River, significant trends in water temperature between 1993 and 2012 were observed at six sites, being four increases and two decreases (Table below). However, all these trends were slight, being no larger than <math>\pm 0.4\%</math> per year (or about <math>\pm 0.06^\circ\text{C}</math> per year). No important improvements or deteriorations were observed. (TR201320:2013:9)</p> <p><b>Table. Slopes (% per year) of statistically significant (<math>p &lt; 5\%</math>) trends in flow-adjusted water quality at ten Waikato River sites during 1993–2012. Secondary sites are shown in italics. Important improvements are shown in bold; important deteriorations are bold underlined; “ns”, not significant.</b></p> <table data-bbox="1279 884 1558 1199"> <tbody> <tr><td><i>Taupo</i></td><td>0.4</td></tr> <tr><td>Ohaaki</td><td>ns</td></tr> <tr><td>Ohakuri</td><td>0.2</td></tr> <tr><td>Whakamaru</td><td>ns</td></tr> <tr><td>Waipapa</td><td>0.2</td></tr> <tr><td><i>Narrows</i></td><td>0.2</td></tr> <tr><td><i>Horotiu</i></td><td>ns</td></tr> <tr><td>Huntly</td><td>ns</td></tr> <tr><td>Mercer</td><td>-0.3</td></tr> <tr><td><i>Tuakau</i></td><td>-0.4</td></tr> </tbody> </table> <p>On other rivers, there was no significant trend in water temperature (Table below). The median rate of change was 0.4% per year or about <math>0.06^\circ\text{C}</math> per year. The sites at which these trends occurred were distributed reasonably evenly. (TR201320:2013:14)</p> <p><b>Upland tributaries of the Waikato River</b></p> <table data-bbox="1279 1444 1644 1780"> <tbody> <tr><td><i>Kawaunui (48)</i></td><td>0.3</td></tr> <tr><td><i>Mangaharakek (43)</i></td><td>0.7</td></tr> <tr><td>Mangakara (49)</td><td>ns</td></tr> <tr><td><i>Mangakino (60)</i></td><td>0.5</td></tr> <tr><td>Otamakokore (46)</td><td>0.3</td></tr> <tr><td><i>Pueto (52)</i></td><td>0.4</td></tr> <tr><td>Tahunaaatara (44)</td><td>0.4</td></tr> <tr><td>Torepatutahi (51)</td><td>0.3</td></tr> <tr><td><i>Waiotapu (47)</i></td><td>ns</td></tr> <tr><td><i>Waiotapu (50)</i></td><td>ns</td></tr> <tr><td><i>Waipapa (42)</i></td><td>0.2</td></tr> <tr><td><i>Whirinaki (45)</i></td><td>0.1</td></tr> <tr><td>Imp – Det</td><td>0 – 0</td></tr> </tbody> </table> <p><b>Lowland tributaries of the Waikato River</b></p> <table data-bbox="1279 1793 1626 1915"> <tbody> <tr><td><i>Awaroa-Otau (27)</i></td><td>ns</td></tr> <tr><td><i>Awaroa-Rotowa (7)</i></td><td>0.5</td></tr> <tr><td><i>Karapiro (85)</i></td><td>ns</td></tr> <tr><td><i>Kirikiroa (90)</i></td><td>ns</td></tr> </tbody> </table> | <i>Taupo</i> | 0.4 | Ohaaki | ns | Ohakuri | 0.2 | Whakamaru | ns | Waipapa | 0.2 | <i>Narrows</i> | 0.2 | <i>Horotiu</i> | ns | Huntly | ns | Mercer | -0.3 | <i>Tuakau</i> | -0.4 | <i>Kawaunui (48)</i> | 0.3 | <i>Mangaharakek (43)</i> | 0.7 | Mangakara (49) | ns | <i>Mangakino (60)</i> | 0.5 | Otamakokore (46) | 0.3 | <i>Pueto (52)</i> | 0.4 | Tahunaaatara (44) | 0.4 | Torepatutahi (51) | 0.3 | <i>Waiotapu (47)</i> | ns | <i>Waiotapu (50)</i> | ns | <i>Waipapa (42)</i> | 0.2 | <i>Whirinaki (45)</i> | 0.1 | Imp – Det | 0 – 0 | <i>Awaroa-Otau (27)</i> | ns | <i>Awaroa-Rotowa (7)</i> | 0.5 | <i>Karapiro (85)</i> | ns | <i>Kirikiroa (90)</i> | ns |
| <i>Taupo</i>  | 0.4   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Ohaaki  | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Ohakuri   | 0.2   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Whakamaru   | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Waipapa   | 0.2   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Narrows</i>  | 0.2   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Horotiu</i>  | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Huntly  | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Mercer  | -0.3  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Tuakau</i>   | -0.4  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Kawaunui (48)</i>  | 0.3   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Mangaharakek (43)</i>  | 0.7   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Mangakara (49)  | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Mangakino (60)</i>   | 0.5   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Otamakokore (46)  | 0.3   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Pueto (52)</i>   | 0.4   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Tahunaaatara (44)   | 0.4   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Torepatutahi (51)   | 0.3   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Waiotapu (47)</i>  | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Waiotapu (50)</i>  | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Waipapa (42)</i>   | 0.2   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Whirinaki (45)</i>   | 0.1   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| Imp – Det   | 0 – 0   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Awaroa-Otau (27)</i>   | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Awaroa-Rotowa (7)</i>  | 0.5   |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Karapiro (85)</i>  | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |
| <i>Kirikiroa (90)</i>   | ns  |              |     |        |    |         |     |           |    |         |     |                |     |                |    |        |    |        |      |               |      |                      |     |                          |     |                |    |                       |     |                  |     |                   |     |                   |     |                   |     |                      |    |                      |    |                     |     |                       |     |           |       |                         |    |                          |     |                      |    |                       |    |

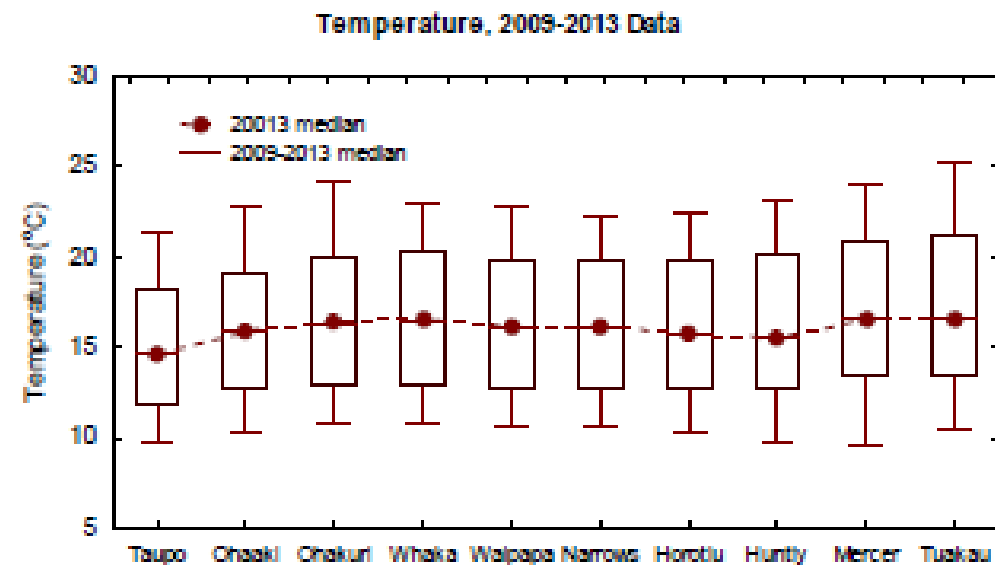
|                     |       |
|---------------------|-------|
| Komakorau (6)       | 0.4   |
| Little Waipa (38)   | 0.2   |
| Mangakotukut (87)   | ns    |
| Mangamingi (40)     | ns    |
| Mangaone (77)       | 0.5   |
| Mangaonua (78)      | ns    |
| Mangaonua (84)      | 0.3   |
| Mangatangi (30)     | ns    |
| Mangatawhiri (29)   | ns    |
| Mangawara (19)      | ns    |
| Mangawhero (86)     | 0.4   |
| Matahuru (20)       | 0.4   |
| Ohaeroa (25)        | ns    |
| Opuatia (24)        | ns    |
| Pokaiwhenua (39)    | 0.2   |
| Waerenga (21)       | 0.5   |
| Waitawhirihiri (89) | ns    |
| Whakapipi (26)      | ns    |
| Whakauru (41)       | ns    |
| Whangamarino (28)   | 0.6   |
| Whangamarino (22)   | 0.4   |
| Whangape (23)       | ns    |
| Imp – Det           | 0 – 0 |

**Waipa River and tributaries**

|                   |       |
|-------------------|-------|
| Kaniwhaniwha (11) | 0.5   |
| Mangaohoi (74)    | ns    |
| Mangaokewa (65)   | ns    |
| Mangapiko (76)    | ns    |
| Mangapu (63)      | ns    |
| Mangatutu (73)    | ns    |
| Mangauika (13)    | 0.5   |
| Ohote (88)        | ns    |
| Puniu (75)        | ns    |
| Waipa (61)        | 0.7   |
| Waipa (12)        | ns    |
| Waipa (2)         | ns    |
| Waipa (64)        | ns    |
| Waipa (1)         | ns    |
| Waitomo (18)      | ns    |
| Waitomo (17)      | ns    |
| Imp – Det         | 0 – 0 |

This indicator is also being reported as part of the Waikato Progress Indicators (Waikato River Quality), being the percentage of unsatisfactory river water samples for ecological water quality in the Waikato region's rivers and streams, as an average across all sites measured.

The 2013 data for temperature is shown on the following table. (TR201431:2014:20)



## He kai pai

### About this indicator; the narrative

#### He kai pai

(edible food) – E.coli measured but food standards not reported

This indicator measures the presence of bugs, or pathogens that may be harmful to human health. E.coli is a common indicator used for this purpose, however there are others that could be used such as enterococci and faecal coliforms, all indicators of faecal matter which is both a health and cultural risk. There are a range of diseases or bacteria present in food products derived from freshwater, some of which are tested in commercial food safety.

The aim of this indicator is to seek evidence that:

- food is safe to eat; and
- does not come into contact with human waste.

It would be desirable to identify a suitable attribute to reflect safe to eat (fish flesh following cooking) – a safe consumption limit level for heavy metals. Kai would be safe to harvest and eat and knowledge transfer is present (intergenerational harvest).

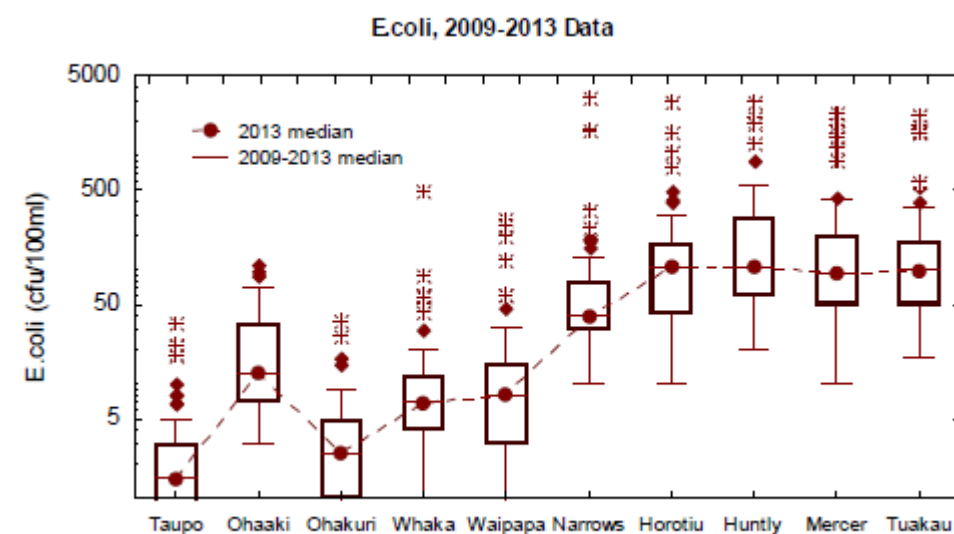
In freshwater management units that are highly valued for providing mahinga kai, the desired species are plentiful enough for long-term harvest and the range of desired species is present across all life stages. (NOF, 2014, page66).

There are two potential monitoring measures for this indicator:

- E.coli limits suitable for watercress consumption after blanching.
- Food quality standards (commercial eels). Commercial exporters will most likely comply with risk management plans that set out limits for food quality. These are limited to:
  - Salmonella spp. ND/25g.
  - L. monocytogenes ND/25g.
  - Coagulase positive Staphylococci (S. aureus). 1000cfu/g.
  - B. cereus 1000cfu/g.
  - E. coli 100cfu/g<sup>xxxiii</sup>.

### What the evidence says about the current situation; the baseline

E.coli 2010-2014



## Te nui o ngā kai i te wai

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline  |   |  |   |   |                                |
|---|---|---|--|---|---|--------------------------------|
| <p>(abundance of fish species – kōura – is monitored as part of Regional Ecological Monitoring Survey (in tributaries))</p> <p>This indicator measures the quantity of fish species present in waterbodies. It is a measure of abundance an important indicator of a healthy environment providing sustenance for human populations. In historic periods, this indicator was linked directly to the survival of River Iwi. Today, this measure reflects the ability of whanau to catch a feed or provide kai on the table as part of the ethic of manaakitanga.</p> <p>Located within the Waikato and Waipa rivers are 19 native fish species. A range of species have been identified to measure common to most Waikato river iwi including tuna, piharau, inanga, kakahi/kaeo, koura/kewai and watercress. The koura is likely to be the favourable indicator species as it is located in tributaries and is sensitive to sediment, one of the 4 contaminants.</p> <p>For this value, freshwater resources would be available and able to be used for customary use at some places (but not everywhere). In freshwater management units that are highly valued for providing mahinga kai, resources would be available for use, customary practices able to be exercised to the extent desired, and tikanga and preferred methods are able to be practiced.</p> | <p><b>The baseline at a glance</b></p> <ul style="list-style-type: none"> <li>• Koura are largely confined to river edges in larger streams lacking cover in their mid-channel areas.</li> <li>• In fishless streams (no predators) koura can occur in the middle of streams and pools during the day</li> <li>• Koura populations are common in the Waipa tributaries and Karapiro-Ohakuri, scarce in main stem below Karapiro, and very scarce or absent in lakes and much of the upper catchment.</li> </ul> <p><b>Kōura</b></p> <p>Table 2: Summary of Koura indicator narratives and grades by FMU.</p> <table border="1" data-bbox="1279 888 2644 1115"> <tr> <td data-bbox="1279 888 1478 1115">Koura Narrative</td> <td data-bbox="1478 888 1712 1115">A: Koura abundant and conform to expectations for location in the catchment if well managed.</td> <td data-bbox="1712 888 1947 1115">B: Koura common relative to expectations for location in the catchment if well managed.</td> <td data-bbox="1947 888 2294 1115">C: Koura scarce relative to expectations for location in the catchment if well managed.</td> <td data-bbox="2294 888 2644 1115">D: Koura absent or very scarce</td> </tr> </table> <p><b>FMU/grade</b></p> <p>Upper Waikato/D<br/>Mid Waikato/C<br/>Lower Waikato/C-<br/>Waipa/C</p> <p>Kōura were also graded by best professional judgement in the main stem<sup>xxxiv</sup> and 8 representative lakes<sup>xxxv</sup> using the A-D categories in Table 2<sup>xxxvi</sup>.</p> <p><b>Baseline Data:</b></p> <p>David B, Hamer M 2010. Regional Guidelines for Ecological Assessments of Freshwater Environments - Standardised Fish Monitoring for Wadeable Streams. Waikato Regional Council Technical Report: TR 2010/09, 21 p.</p> <p>Hicks BJ 2003. Distribution of fish and crayfish in a Waikato stream in relation to basin area. New Zealand Journal of Zoology 30: 149-160.</p> <p>Parkyn SM, Collier KJ, Hicks BJ 2002. Growth and population dynamics of New Zealand crayfish <i>Paranephrops planifrons</i> in streams within native forest and pastoral land uses. New Zealand Journal of Marine and Freshwater Research 36: 847-862.</p> | Koura Narrative   | A: Koura abundant and conform to expectations for location in the catchment if well managed. | B: Koura common relative to expectations for location in the catchment if well managed. | C: Koura scarce relative to expectations for location in the catchment if well managed. | D: Koura absent or very scarce |
| Koura Narrative   | A: Koura abundant and conform to expectations for location in the catchment if well managed.  | B: Koura common relative to expectations for location in the catchment if well managed. | C: Koura scarce relative to expectations for location in the catchment if well managed.      | D: Koura absent or very scarce  |   |                                |

## Ngā tarukino me ngā ika rawaho i te wai

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline   |
|---|--|
| <p>(presence of pest weeds and fish)</p> <p>This indicator measures the number of pest animals (fish) and introduced weed (except watercress). The presence of pest plants and weeds have an effect on acceptability of a place for swimming and mahinga kai.</p> | <ul style="list-style-type: none"> <li>The following are identified as pest fish in the Waikato Region Pest Management Strategy 2014-2024; brown bullhead catfish (<i>A. nebulous</i>), koi carp (<i>Cyprinus carpio</i>), gambusia (<i>Gambusia affinis</i>), wild goldfish (<i>Carassius auratus</i>), perch (<i>Perca fluviatilis</i>), tench (<i>Tinca tinca</i>) and rudd (<i>Scardinius erythrophthalmus</i>)</li> <li>A number of pest fish including Rudd, Gumbusia and Koi carp have very wide tolerance levels, can be found throughout the Waikato River system, are prolific breeders and have significant detrimental effects on aquatic macrophytes and water quality.</li> <li>The likely impacts of pest fish include habitat disruption, competition for space and food, predation and disease transfer. Koi carp and other pest fish have long been a serious problem in the lower Waikato River and nearby lakes. Unfortunately, effective control techniques have not been available.</li> <li>Introduced aquatic weeds provide habitat for indigenous fauna, however can choke irrigation and drainage channels impeding water movement; hinder recreational activities such as angling, boating, and rowing; clog hydroelectric and irrigation scheme intakes; and some invasive species develop monocultures to the detriment of native flora and fauna.</li> <li>The most effective methods for removal of aquatic weeds are mechanical, biological and chemical control.</li> </ul> <p>Data source:</p> <p>Coffin, A.; van Eyndhoven, E.; Beever, R. E.; Bellgard, S.J.; Harman, H. M.; Harmsworth, G.; Scheele, S. M.; Horn, C.; Martin, N. A. 2009: Native flora impact assessment. Biosecurity New Zealand Technical Paper 2009/32. [Wellington], Ministry of Agriculture and Forestry.</p> <p>David Speirs. The diversity and distribution of freshwater fish and their habitat in major rivers of the Waikato Region. Technical Publication 2001/11. June 2001.</p> <p>Pest fish in the Waikato. Brendan J. Hicks. July 2003.</p> <p>Waikato Regional Council. Waikato Pest Management Plan 2014-2024</p> <p>Waikato Regional Council. Biosecurity - Plant Pest Monitoring Database</p> <p>EOS Ecology. A Review of the Ecological Effects of Macrophyte Management in Soft-Bottomed Waterways EOS Ecology Report No. 11019-WRC02-01. September 2011</p> |



## Mātauranga ki ngā wai kaukau

| About this indicator; the narrative  | What the evidence says about the current situation; the baseline   |
|--|--|
| <p>(Knowledge of swimming places – information currently held by River Iwi)</p> <p>This indicator provides comments about the knowledge and traditions related to swimming in particular places which is held by current generations of iwi.</p> <p>The knowledge and experience of swimming is an important way of retaining inter-generational knowledge of the safest places to swim and most appropriate ways to access and use them.</p> <p>This indicator is challenging to describe in quantitative terms and would be better described as a narrative, for example, rating level of knowledge held by iwi of traditional swimming places, the ability to access these places during the year and methods of passing on knowledge about these places.</p> | <p><b>The baseline at a glance</b></p> <ul style="list-style-type: none"> <li>• River Iwi have identified popular swimming places, many of which are included in confidential GIS mapping.</li> <li>• Knowledge of swimming places and experiences of their use are held by living generations who were resident in proximity to swimming places. With so many people no longer living in traditional settlements, having moved to cities and other places for work, the transfer of knowledge through experience and telling stories is a significant challenge for Iwi.</li> <li>• A number of River Iwi have active projects developing knowledge of swimming places and passing these on to the next generation.</li> <li>• There are information gaps where swimming places are not accessible due to private ownership of adjoining land, intensive land-use, safety and physical barriers.</li> </ul> <p>Baseline data:<br/>Matauranga Maori Report: Swimming locations: Lake Aratiatia, Lake Whakamaru, Lake Atiamuri, streams, Lake Ohakuri, Lake Arapuni, and tributaries off Lake Karapiro and Lake Maraetai, area of Te Pūaha.</p> <p>Data source:<br/>River Iwi GIS and Iwi Mātauranga projects<br/>Waikato and Waipa River Iwi Values Document Review. Waikato Economic Joint Venture study. 8 December 2014</p> |

## Au Putea

| About this indicator; the narrative   | What the evidence says about the current situation; the baseline  |
|---|---|
| <p><b>Au Putea</b><br/>(economic benefit of water – can measure effects in employment and profit from sectors and industries and on farm cost in economic model)</p> <p>This indicator measures the impact of the scenarios on businesses reliant directly on water in the Waikato and Waipa that are owned and/or operated by Maori. This would focus on Forestry, Agriculture, Horticulture and Fisheries.</p> <p>The economic modelling has identified impacts of the scenarios on 16 industries covering value (\$m), employment (MECs) and International exports (\$m). This information is available at FMU level.</p> <p>The effects on profit of primary industry reliant on water as a result of land use change and/or mitigations.</p> | <p><b>The baseline at a glance</b></p> <ul style="list-style-type: none"> <li>• This indicator is a sub-set of other economic indicators (employment, value add and exports)</li> <li>• Maori have significant interests in dairy, sheep and beef, forestry and wood/paper manufacturing, fisheries and geothermal sectors</li> <li>• Iwi are owners of the CNI forests which provide significant economic benefits.</li> <li>• There are tensions between future economic development potential, getting the best returns from current uses and environmental and cultural values.</li> <li>• There is a strong desire to have flexibility in land-use to achieve best possible use and gain good returns.</li> </ul> <p>Baseline data:<br/>Impact on profit by sector by land area or farm – dairy, sheep and beef, horticulture, forestry.</p> <p>Data source:<br/>Doole,G., Elliott, S., and McDonald, G. 2015. Evaluation of scenarios for water-quality improvement in the Waikato and Waipa River catchments: Assessment of second set of scenarios.</p> |

# Attachment 1: Additional Information

## Building activity

Building activity in the Waikato region has been recovering from a slump during the period 2008 to 2012 but remains well below its mid-2000s peak. The Waikato Genuine Progress Indicators show a worsening trend<sup>xxxvii</sup>.

## Horticulture Area within the Waikato Region

New Zealand horticulture production is worth \$NZ7 billion annually, with \$3.2 billion worth of horticultural food products consumed domestically. The area of horticultural crops has increased 40% to 121,000 ha in just over 10 years. The horticultural industry is New Zealand's sixth largest export industry and employs 50,000 people in key growing regions/nodes- one of which is Waikato. The total area utilised for horticultural activities in the Waikato Region was approximately 6687 hectares (as at June 2012). The Waikato Region is the main region for onion and asparagus crops in New Zealand<sup>xxxviii</sup>. The land area in onion and potato crops in the Waikato Region has remained relatively high and consistent over the past 10 years with 3363 hectares of land in onions and potatoes in 2014. The land area in kiwifruit has also remained reasonably consistent making up 668 hectares of land in June 2014.

| Area                         | Waikato |                    |                    |                    |                    |                    |                    |                    |                    |                    |
|------------------------------|---------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
|                              | Year    | As at June 30 1994 | As at June 30 2002 | As at June 30 2003 | As at June 30 2005 | As at June 30 2007 | As at June 30 2009 | As at June 30 2011 | As at June 30 2012 | As at June 30 2014 |
| <b>Horticulture</b>          |         |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| Total apples (hectares)      |         | 67                 | 33                 | 27                 | 34                 | 22                 | 22                 | 16                 | 14                 | 13                 |
|                              |         | 9                  | 5                  | 6                  | 3                  | 8                  | 3                  | 2                  | 1                  | 5                  |
| Total kiwifruit (hectares)   |         | 78                 | 81                 | 78                 | 61                 | 75                 | 78                 | 65                 | 72                 | 66                 |
|                              |         | 3                  | 8                  | 7                  | 4                  | 3                  | 6                  | 9                  | 6                  | 8                  |
| Total avocados (hectares)    |         |                    | 16                 | 11                 |                    | 14                 |                    |                    | 17                 | 12                 |
|                              |         | 36                 | 7                  | 1                  | ..                 | 4                  | ..                 | ..                 | 6                  | 2                  |
| Total wine grapes (hectares) |         | 13                 | 21                 | 16                 | 15                 | 13                 |                    |                    |                    |                    |
|                              |         | 1                  | 8                  | 4                  | 3                  | 3                  | 46                 | 31                 | 26                 | ..                 |
| Total olives (hectares)      |         |                    | 10                 |                    |                    |                    |                    |                    |                    |                    |
|                              |         | ..                 | 7                  | ..                 | ..                 | 79                 | 42                 | 59                 | 55                 | 49                 |
| Total onions (hectares)      |         | 18                 | 21                 | 19                 | 15                 | 14                 | 12                 | 16                 | 18                 | 16                 |
|                              |         | 17                 | 03                 | 27                 | 74                 | 77                 | 65                 | 87                 | 37                 | 05                 |
| Total potatoes (hectares)    |         | 18                 | 21                 | 21                 | 22                 | 20                 | 20                 | 22                 | 20                 | 17                 |
|                              |         | 27                 | 17                 | 64                 | 67                 | 22                 | 92                 | 26                 | 74                 | 58                 |
| Total squash (hectares)      |         | 92                 |                    |                    |                    |                    |                    | 12                 |                    | 50                 |
|                              |         | 6                  | ..                 | ..                 | ..                 | ..                 | ..                 | 1                  | ..                 | 4                  |

Data Source: Agricultural Production Statistics (census), Statistics New Zealand

### ***Socioeconomic deprivation***

Many of the rural towns in the Waikato and Waipa catchment have a high deprivation index score (with 1 being the least deprived, 10 being the most deprived)<sup>xxxix</sup>. For 2013 the towns which have a deprivation score of 8 or above in each FMU are:

| <b>FMU</b>   | <b>Town</b> | <b>Socioeconomic Deprivation Indexes 2013</b> |
|--------------|-------------|---|
| <b>Waipa</b> | Te Awamutu  | 8   |
|              | Te Kuiti    | 10  |
|              | Otorohanga  | 9   |
|              | Kihikihi    | 8   |
| <b>Upper</b> | Tirau       | 8   |
|              | Tokoroa     | 10  |
|              | Mangakino   | 10  |
|              | Putaruru    | 9   |
| <b>Lower</b> | Huntly West | 10  |
|              | Huntly East | 9   |
|              | Ngaruawahia | 10  |
|              | Tuakau      | 9   |
|              | Taupiri     | 9   |

Any change for these towns will be felt more keenly than for a population which has a low deprivation score. For the Middle FMU, Cambridge and Hamilton City have deprivation scores of less than 8.

**Commuting Patterns**



Source: *Commuting patterns (2006 Census) from Ashraf and Phillips. 2012. Waikato regional economic profile. Waikato Regional Council, Hamilton. Page 88, figure 99.*

**Tourism**

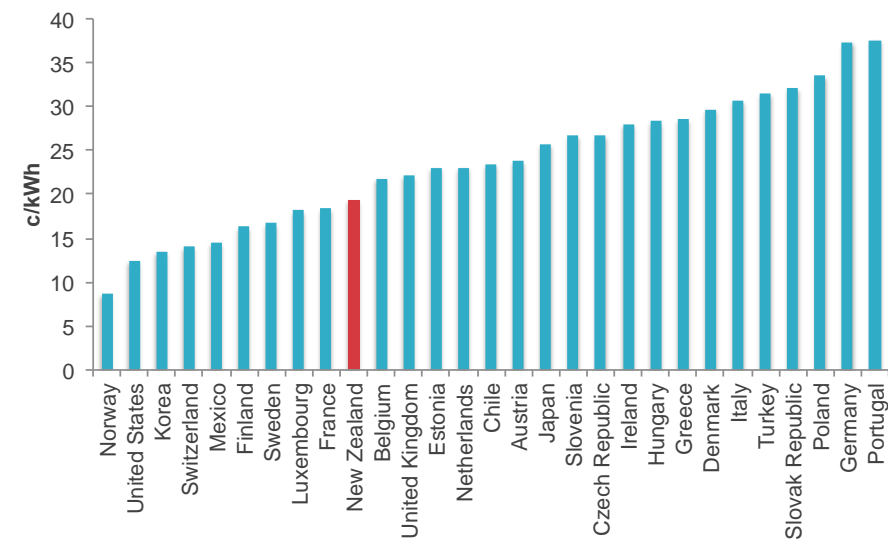
The proportion of local residents' jobs that are supported by tourism vary throughout the region: 7.1% in Hamilton City; 12.7% in the Waipa District; 11.5% in both Thames-Coromandel and Hauraki districts; 11.4% in Otorohanga District; 10% in Matamata–Piako District; 9.7% in South Waikato District; 9.3% in Waitomo District; and 9.8% in Taupo District.

## Flood infrastructure

|  |  |
|--|--|
| Flood protection provided to                 | 41,000 ha  |
| Value of flood assets<br>(replacement value) | \$108 million  |
| Annual expenditure<br>(flood/river only)     | \$3.7 million<br>(3.4% of asset value)   |
| Annual capital spend                         | \$1.3 million  |
| Annual depreciation                          | \$1 million  |
| Number of assets                             | <ul style="list-style-type: none"> <li>• Stop banks – 250km</li> <li>• Floodgates – 253</li> <li>• Pump stations – 66</li> <li>• Channels and streams – 250 km</li> <li>• Pumps – 120</li> </ul> |

## Electricity

OECD RESIDENTIAL ELECTRICITY PRICES, USD, PURCHASING POWER PARITY, 2014



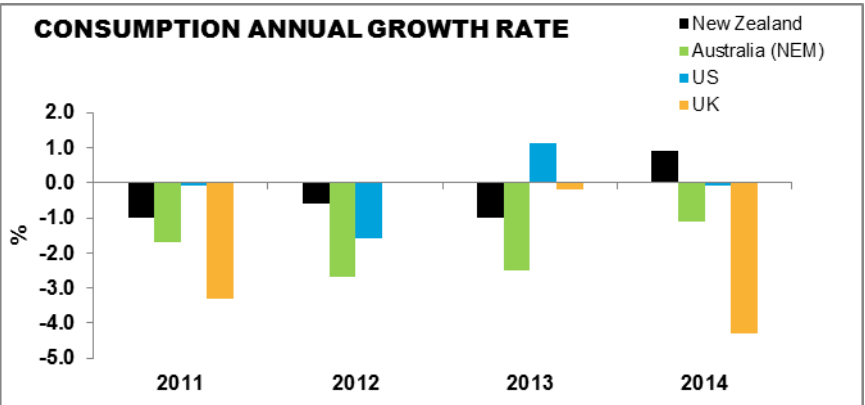
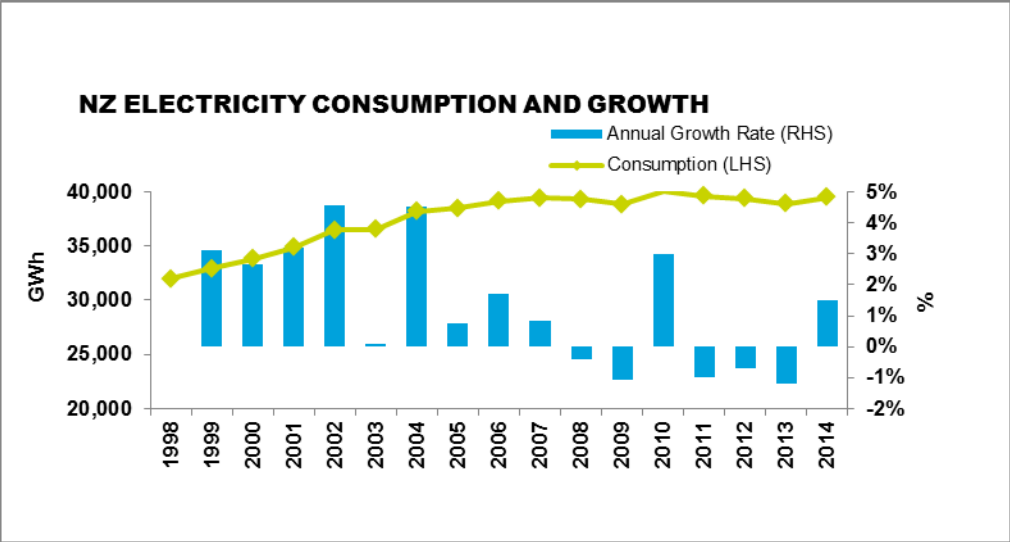
**National energy demand**

At a national level, demand for electricity fell from 2007 to 2013, due to reduced consumption by industry. Since 2014, however, this trend has reversed with demand increasing slightly.

**Energy use by sector**

Energy use by sector is indicated below<sup>x1</sup>:

| Sector                    | New Zealand | Waikato region |
|---------------------------|-------------|----------------|
| Agriculture               | 4%          | 7%             |
| Industrial                | 30%         | 38%            |
| Commercial                | 9%          | 7%             |
| Residential               | 12%         | 9%             |
| Transport (national)      | 37%         | 39%            |
| Transport (international) | 8%          | –              |



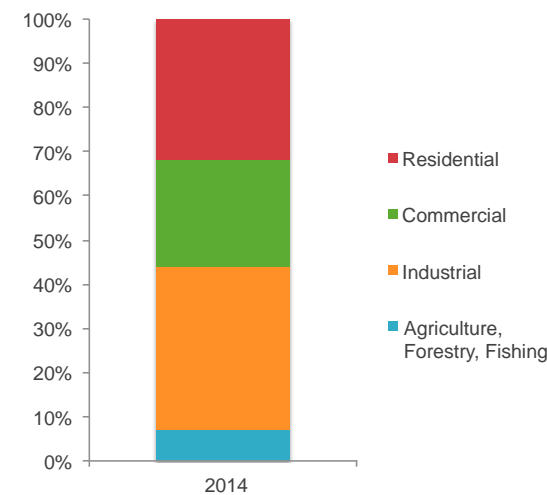
Data source: Transpower Information Exchange, JP Morgan, EIA, UK government

In the New Zealand economy, national transport consumes 37% of energy resources, industry consumes 30%, residential users consume 12%, the commercial sector consumes 9%, international transport consumes 8% and agriculture 4%.

### ***Electricity Consumption***

New Zealand's social and economic wellbeing are dependent on a secure, cost-effective electricity supply system. All sectors of the economy rely on electricity for their activity; consumption by key sectors is illustrated in Figure 1.

**Figure 1: MAKEUP OF ELECTRICITY DEMAND IN NEW ZEALAND, 2014**



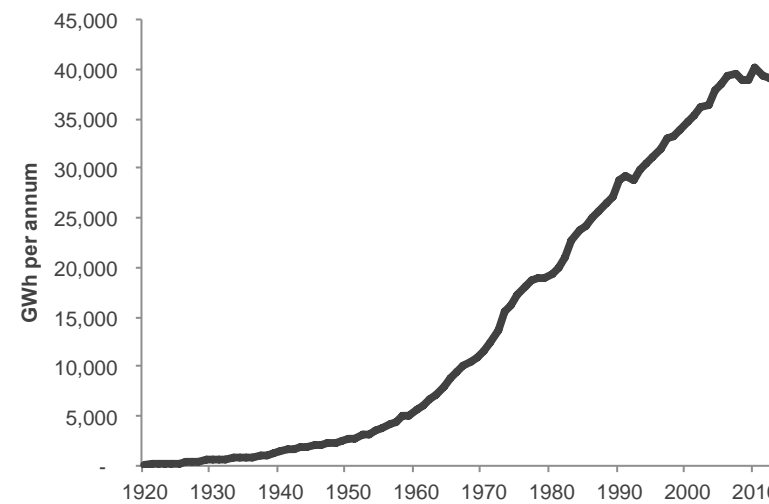
*Source: Ministry of Business, Innovation and Employment, Energy in NZ 2014*

As a result, the growth of electricity consumption since the early 1900s closely resembles the growth of the country, both in terms of population and GDP. However, the onset of the global financial crisis in 2008 and a significant reduction in industrial consumption led to a period of flat growth in demand that persisted until 2013 (



Figure 2). New Zealand was not exceptional in this regard; the same trend was observed in many developed economies around the world, including Australia, the US and Europe.

Figure 2: ELECTRICITY CONSUMPTION IN NEW ZEALAND, 1920 - 2014

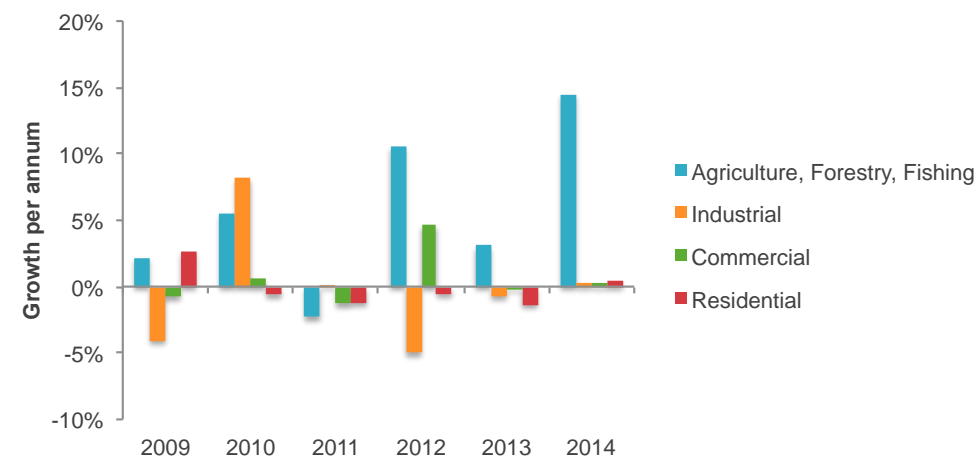


Source: Whiteboard Energy, ECNZ and Ministry of Business, Innovation and Employment

Between 2013 and 2014, however, demand growth was 1.2%, more reflective of its long-term growth rate. Throughout the low-growth period, agricultural consumption of electricity has grown the most consistently (

Figure 3). Agriculture, forestry and fishing now make up nearly 7% of national consumption, a similar proportion to wood, pulp and paper processing.

Figure 3: GROWTH RATES IN SECTORAL ELECTRICITY CONSUMPTION, 2009-2014



Source: Ministry of Business, Innovation and Employment, Energy in NZ 2014

In the residential sector, the proliferation of appliances in the home has been somewhat offset (in consumption terms) by increasing appliance efficiency. Refrigerators, lighting and heating have all experienced major efficiency improvements since the late 20<sup>th</sup> Century. This trend is expected to continue: as wealth grows, more energy consuming devices will make their way into the home, but newer technologies (heat pumps, LED light bulbs etc.) will mute the impact on demand growth, along with improved building insulation and design. The efficiency gains are likely to be observed in the commercial and industrial sector as well, especially in the use of more efficient lighting, electric motors, and heating, ventilation and air conditioning (HVAC)<sup>17</sup>.

<sup>17</sup> Batstone, S, "Trends in Residential Electricity Consumption, available from [www.comcom.govt.nz/dmsdocument/12306](http://www.comcom.govt.nz/dmsdocument/12306)

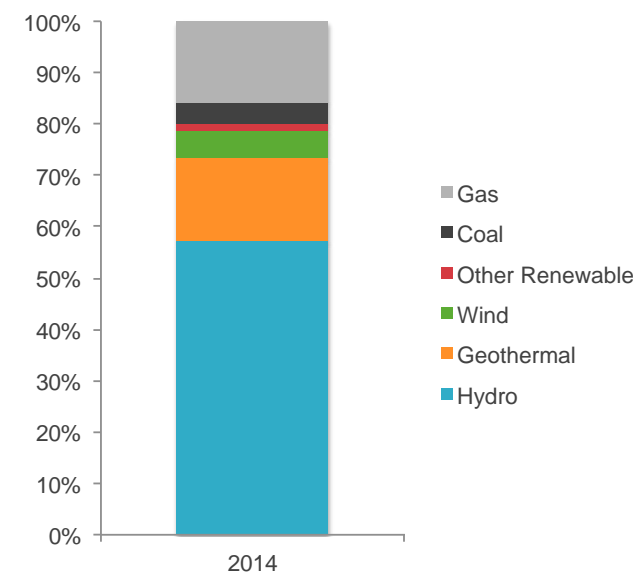
## Electricity Supply

The Waikato region plays a major role in ensuring the security of electricity supply for the country as a whole. As a region, Waikato generates approximately 14,000GWh per annum<sup>18</sup>, more electricity than any other region in the country. The Waikato River (4,000GWh) and geothermal (6,000GWh) are significant components of this, while the region also has fuel diversity and thus security of supply achieved through thermal generation at the Huntly Power Station. However, recently, Genesis Energy signalled its intention to permanently withdraw the remaining two operational coal/gas units from the market by December 2018<sup>19</sup> unless market conditions change significantly. Should this happen, significant high efficiency gas fuelled electricity generation<sup>20</sup> will continue at the Huntly Power Station and the significance of the Waikato region to the national electricity picture does not change.

New Zealand has a strong pedigree in renewable electricity generation (especially hydro) which dates back to the early 1900s<sup>21</sup>. In recent years New Zealand has increased its renewable forms of generation, particularly wind and geothermal, and now sources 80% of its electricity supply from renewable sources (Figure 4). The Waikato region has led this increase, with significant investment in geothermal as well as wind. As a result, New Zealand ranks 4<sup>th</sup> in the OECD for renewable generation, an enviable position relative to countries who are pursuing a transition away from a fossil-fuel based electricity system to more renewables. Consented projects amounting to approximately 12,000GWh underpin the future of renewables in New Zealand, sufficient to meet demand growth for some years to come<sup>22</sup>. This renewable energy opportunity also has the potential to have a significant impact on the country's carbon emissions and could also reduce our reliance on imported oil through alternative technologies like electric vehicles.

In 2014, the region provided approximately 45% of New Zealand's renewable electricity across wind, hydro and geothermal<sup>23</sup>. The region also provided approximately 50% of New Zealand's non-renewable generation<sup>24</sup>. Overall the region provided 35% of New Zealand's total electricity.

Figure 4: MAKEUP OF ELECTRICITY GENERATION IN NEW ZEALAND, 2014



Source: Ministry of Business, Innovation and Employment, *Energy in NZ 2014*.  
"Other Renewable" includes Biogas, Wood and Solar.

<sup>18</sup> Electricity Authority figures, available from [emi.ea.govt.nz](http://emi.ea.govt.nz)

<sup>19</sup> See <https://www.nzx.com/companies/GNE/announcements/268005>

<sup>20</sup> Including a 400MW combined cycle gas turbine and 50 MW open cycle gas turbine with options to develop additional thermal peaking capacity, should that be required in the future.

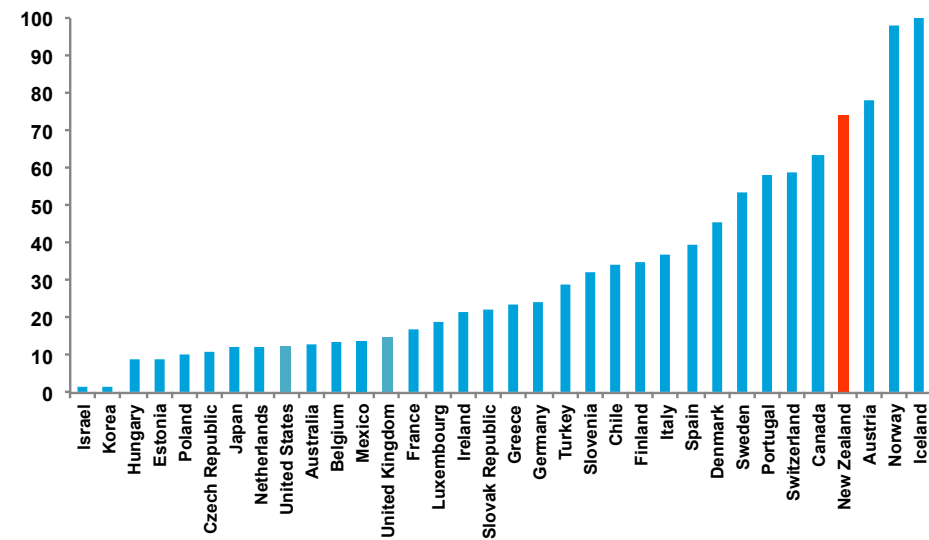
<sup>21</sup> From the construction of the Bullendale Power Station in Central Otago in 1886, the first industrial use of hydro power in the southern hemisphere, New Zealand pursued almost exclusively hydro power until the commissioning of Meremere in 1958. One of the most significant early projects was Arapuni, which almost doubled national electricity generation capacity at the time of its commissioning in 1927.

<sup>22</sup> Electricity Authority, "Proposed Generating Plant", [emi.ea.govt.nz](http://emi.ea.govt.nz)

<sup>23</sup> Electricity Authority figures, available from [emi.ea.govt.nz](http://emi.ea.govt.nz)

<sup>24</sup> MBIE and Transpower figures, not including cogeneration

Figure 5: PERCENTAGE RENEWABLES IN ELECTRICITY SUPPLY, OECD, 2013



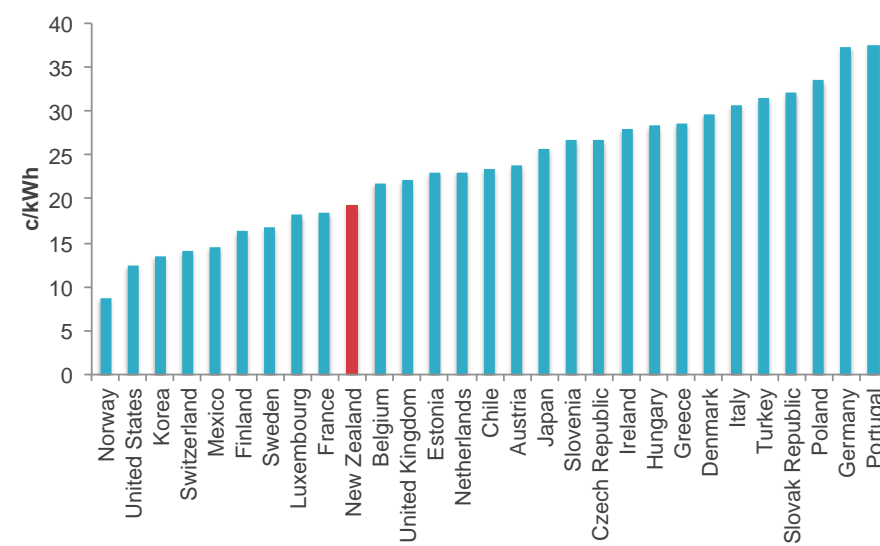
Source: International Energy Agency

### Prices and Affordability

Since 2007, real residential electricity prices have increased 2.5% per annum<sup>25</sup>, with contributing factors including the transition away from inexpensive Maui gas, and significant investment in the transmission and distribution networks. This network investment is a critical part of maintaining security of supply to many regions, as well as enabling competition between, and support from different forms of generation. As the Waikato region is an electricity exporter, it is heavily reliant on a secure and well-sized transmission grid.

Despite these increases, New Zealand still ranks in the lower half of OECD countries in terms of electricity price (Figure 6).

Figure 6: OECD RESIDENTIAL ELECTRICITY PRICES, USD, PURCHASING POWER PARITY, 2014



Source: Ministry of Business, Innovation and Employment and IEA

<sup>25</sup> Ministry of Business, Innovation and Employment, "Energy in NZ", 2014

Affordability is a difficult and somewhat controversial metric to calculate. According to Statistics NZ, electricity expenditure as a proportion of median household income has increased from 2.8% in 2007 to 3% in 2013<sup>26</sup>; however, only relatively modest increases in prices have been observed in the past 2-3 years. However, these averages can mask differences in affordability and energy costs as a proportion of income can vary compared to what the above statistics imply.

## ***Kōura***

### **Methods**

The state of the kōura indicator for the Kai Taura (which reflects the relative abundance of kōura) was assessed using a combination of quantitative data from the WRC Regional Environmental Monitoring Survey (REMS) and qualitative assessment from experienced people engaged in river assessments, kaitiakitanga and resource use (fishers).

Quantitative data on kōura abundance were provided in the latest WRC REMS data from standardised one pass electric fishing surveys of 150 m long reaches at 38 sites on wade-able streams within the Waikato and Waipa Catchments between December 2012 and February 2014.

Kōura numbers were in relative abundance from single pass electric fishing, rather than density estimates from depletion surveys.

Sites were ordered by Report card Units (RCU) and summary statistics were calculated within Datadesk. Results were expressed as kōura numbers per 100 m<sup>2</sup> and per 100 linear metres of stream length. Hicks (2003) argued for expressing koura densities per unit stream length, rather than stream bed area, because his studies along Mangaotama Stream (Waipa Tributary at Whatawhata) indicated that koura are largely confined to the river edges in larger streams lacking cover in their mid-channel areas. However, in fishless streams, kōura can occur out in the middle of pools during the day (personal observations of author (JQ) supported by pers. comm. Bruno David, WRC). The results are summarised below in Figure 1 and Table 1.

The number of sites per RCU ranged from 4 – 15 (median 6), with fewest in the mid-Waikato Tributaries (MT) and most in the Waipa Tributaries (WpT).

Relative abundances are generally low-moderate relative to densities reported by Parkyn et al 2002, who found peak densities of 600 Koura/100 m<sup>2</sup> in pasture and 900/m<sup>2</sup> in native forest streams (average c.200/m<sup>2</sup> in both land uses) at Whatawhata Research Centre, and Hicks (2003), who found 40-711/100 m<sup>2</sup> (median 86 m<sup>2</sup>) and 96-932/100 m reach (median 223/100 m) at pasture and native forest sites along the Mangaotama.

The Parkyn et al. (2002) and Hicks (2003) studies calculated koura densities using depletion methods with multi-pass electric fishing (except for Hicks data at upper Mangaotama sites that used hard counts from 2 passes) whereas the WRC data are the “hard counts” from single pass surveys.

Reanalysis of the Parkyn data base found that on average the koura density measured from the first pass of electric fishing was 60% of the final density calculated from depletion in numbers with multiple passes.

Therefore abundances in the Parkyn et al 2002 and Hicks (2003) surveys might be expected to be about 40% higher than would have been recorded using the REMS single pass methods.

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<sup>26</sup> Statistics New Zealand, Household Expenditure and Household Income figures

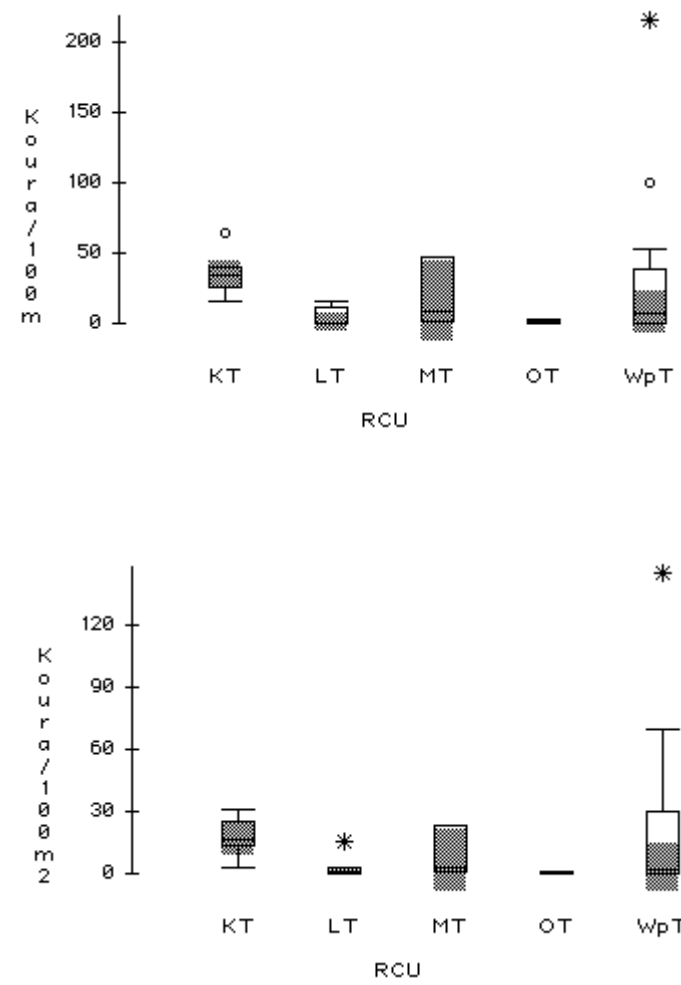


Figure 1: Boxplots of kōura relative abundance across 5 tributary Report Card Units (RCUs) within the Waikato/Waipā Catchment, 2012-2014 REMS data. RCU Codes: KT = Tributaries of Waikato River from Karapiro Dam to below Ohakuri Dam; LT = Tributaries of Waikato River from below Waipā confluence to the Port; MT = Tributaries of Waikato River from Karapiro Dam to Waipā confluence; OT = Tributaries of Waikato River from Ohakuri Dam to Taupo Outlet; WpT = Waipā River Tributaries.

Table 1: Summary statistics for kōura abundance amongst tributary Report Card Units (as defined in Figure 1 caption) and overall indicator grading based on these results relative to benchmarks for the Manganotama Catchment in Parkyn et al. (2002) and Hicks (2003).

| Group                         | T   | L        | M        | O        | W        |
|-------------------------------|-----|----------|----------|----------|----------|
| Number of sites               |     | 8        | 4        | 5        | 1        |
| <b>Koura/100m<sup>2</sup></b> |     |          |          |          |          |
| Mean                          | 7.9 | 3.0      | 8.4      | 0.6      | 2.16     |
| Median                        | 6.6 | 1.1      | 3.8      | 0.0      | 2.5      |
| Std Dev                       | .8  | 5.3      | 1.07     | 0.8      | 0.54     |
| Min                           | .5  | 0.0      | 1.7      | 0.0      | 0.0      |
| Max                           | 1.0 | 5.8      | 4.2      | 5.1      | 45.7     |
| <b>Koura/100 m</b>            |     |          |          |          |          |
| Mean                          | 6.6 | 5.1      | 7.2      | 1.2      | 3.29     |
| Median                        | 5.7 | 1.3      | 9.3      | 0.0      | 8.0      |
| Std Dev                       | 6.7 | 6.5      | 2.17     | 1.8      | 7.9      |
| Min                           | 6.0 | 0.0      | 2.0      | 0.0      | 0.0      |
| Max                           | 4.7 | 1.67     | 4.8      | 4.0      | 2.16     |
| Grade                         |     | <b>C</b> | <b>C</b> | <b>D</b> | <b>B</b> |

These findings contribute to the overall assessment of kōura indicator scores based on the REMS data for tributaries in the bottom row of Table 1 and in all RCU's in Table 2.

1. Qualitative assessments by best professional judgement (BPJ).

## References and Footnotes

- <sup>i</sup> Jackson, N (July 2013) Waikato Region - Demographic Profile 1986-2031 <http://www.mpd.govt.nz/waikatomayoralforum>.
- <sup>ii</sup> [waikatoregion.govt.nz/Community/Waikato-Progress-Indicators](http://waikatoregion.govt.nz/Community/Waikato-Progress-Indicators).
- <sup>iii</sup> [www.sportnz.org.nz/Sport and Active Recreation in the lives of New Zealand Adults](http://www.sportnz.org.nz/Sport%20and%20Active%20Recreation%20in%20the%20lives%20of%20New%20Zealand%20Adults).
- <sup>iv</sup> Ashraf and Phillips, (2012). Waikato regional economic profile. Waikato Regional Council, Hamilton.
- <sup>v</sup> Waikato Progress Indicator.
- <sup>vi</sup> WRC/SNZ.
- <sup>vii</sup> Tourism Industry Association New Zealand, 2015; MBIE: [mbie.govt.nz/regional-tourism-estimates/documents-image-library/Waikato%20RTO%20.pdf](http://mbie.govt.nz/regional-tourism-estimates/documents-image-library/Waikato%20RTO%20.pdf)
- <sup>viii</sup> WRC/SNZ.
- <sup>ix</sup> Waikato Progress Indicator.
- <sup>x</sup> OECD Residential Electricity Prices, USD, Purchasing Power Parity, 2014
- <sup>xi</sup> Statistics New Zealand, Household Expenditure and Household Income figures
- <sup>xii</sup> Waikato Regional Council.
- <sup>xiii</sup> Intensive Engagement period 1: Feedback report (Table 10). May 2015. <http://www.waikatoregion.govt.nz/PageFiles/37414/Intensive%20engagement%20period%201%20%20feedback%20report.pdf>
- <sup>xiv</sup> A tool for freshwater nutrient management in the Waikato–Waipa catchment: summary of the work by the Waikato Economic Impact Joint Venture.
- <sup>xv</sup> Non-market values for fresh water in the Waikato region: a combined revealed and stated preference approach. Waikato Regional Council Technical Report 2014/17
- <sup>xvi</sup> A tool for freshwater nutrient management in the Waikato-Waipā catchment: summary of the work by the Waikato Economic Impact Joint Venture.
- <sup>xvii</sup> Waikato Regional Council Regional (2013). Environmental Monitoring Survey (REMS)
- <sup>xviii</sup> See <http://www.lawa.org.nz/learn/factsheets/benthic-macroinvertebrates/>
- <sup>xix</sup> Collier, K. J.; Hamer, M.; Champion, P. (2014): Regional guidelines for ecological assessments of freshwater environments aquatic plant cover in wade-able streams – version 2. Waikato Regional Council Technical Report 2014/03; and Matheson, F.; Quinn, J.; Unwin, M. (2015, in review) Instream plant and nutrient guidelines: Review and development of an extended decision-making framework Phase 3. NIWA Client Report HAM2015-064, p. 112
- <sup>xx</sup> Jones H, Kimberley M, Hill R, Borman D 2015. Riparian characteristics of pastoral waterways in the Waikato region, 2002-2012. Waikato Regional Council DRAFT Technical Report
- <sup>xxi</sup> Waikato Regional Council, 2012 Stream Assessment Surveys
- <sup>xxii</sup> <http://www.waikatoregion.govt.nz/Environment/Environmental-information/Environmental-indicators/Freshwater/Wetlands/wet1-keypoints/>
- <sup>xxiii</sup> Department of Conservation. <http://www.doc.govt.nz/nature/habitats/wetlands/wetlands-by-region/waikato/>
- <sup>xxiv</sup> Note this is different from 110,000 ha for total Waikato region by WRC.
- <sup>xxv</sup> Beard 2010, Table 14.2.
- <sup>xxvi</sup> <http://www.waikatoregion.govt.nz/Environmental-information/Rivers-lakes-and-wetlands/Freshwater-wetlands/What-wetlands-have-we-got/Wetlands-in-the-Waikato-region/>
- <sup>xxvii</sup> In percentage terms the difference between the two indicators is less than 2%.
- <sup>xxviii</sup> Tourism Industry Association New Zealand (TIA) <http://www.hamiltonwaikato.com/industry/latest-news/new-statistics-highlight-tourism-value-to-waikato-region/>. Data created 2015; Ministry of Economic Development. 2010. *Regional Data - Waikato Region*. [www.tourismresearch.govt.nz](http://www.tourismresearch.govt.nz).
- <sup>xxix</sup> Don Scarlet and Tourism Industry Association, data created 2015
- <sup>xxx</sup> Technical advisory note: Estimates of employment are generated from StatsNZ's business directory. StatsNZ's employment measure is employment counts (ECs) and these are adjusted to include estimates of working proprietors to generate a new measure of employment in 'modified employment counts' (MECs). These figures must then be scaled again (generally upwards) to convert to employment in '2007 equivalent terms'. Note that the difference between employment in 2014 terms and 2007 terms can be quite significant due to changes in industry productivity. This accounts for any changes in labour or capital productivity that have caused the level of value added (or output) generated per employee to change between 2007 and 2014. For example, in dairy farming: Employment in this industry is currently recorded as 7,341 ECs. When converted to MECs, this becomes 11,914 (as the number of working proprietors in this industry is very large). The ratio of value added (measured in \$2007) to each employee has also increased quite substantially between 2007 and 2014. The MEC estimate is scaled by 1.66 to account for these changes. If this scaling was not done, the employment impacts generated by the model (which are in 2007 terms) would be overly large compared to the current situation.



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<sup>xxx</sup> [http://www.waikatoregion.govt.nz/Services/Publications/Technical-Reports/TR-201320/ Waikato Regional Council Technical Report 2014/31](http://www.waikatoregion.govt.nz/Services/Publications/Technical-Reports/TR-201320/Waikato%20Regional%20Council%20Technical%20Report%202014%2031); and [Waikato River water quality monitoring programme: data report 2013. http://www.waikatoregion.govt.nz/PageFiles/35239/TR201431.pdf.](http://www.waikatoregion.govt.nz/PageFiles/35239/TR201431.pdf)

<sup>xxxii</sup> There are two ways to measure this indicator. One is to measure flows or the cubic metres of water per second at particular monitoring sites. An alternative could be to use the water use indicator from the Waikato Progress Indicators. This indicator is the level of consented water allocation as a percentage of the amount of total water available for allocation in the Waikato region. It is measured at the Waikato River mouth during summer months each year and has been measured since 2007.

<sup>xxxiii</sup> This later measure will require buy in from industry and establishment of system that will share monitoring data with Waikato Regional Council. It is unclear what frequency of samples is being undertaken at the present time and what limitations that data may have for the purposes of this indicator.

<sup>xxxiv</sup> reaches (drawing on experts Drs Susan Clearwater, Ian Kusabs, Kevin Collier)

<sup>xxxv</sup> (based on Tracey Deans-Spiers WRC data summary spreadsheets)

<sup>xxxvi</sup> David B, Hamer M 2010. Regional Guidelines for Ecological Assessments of Freshwater Environments - Standardised Fish Monitoring for Wadeable Streams. Waikato Regional Council Technical Report: TR 2010/09, 21 p.

Hicks BJ 2003. Distribution of fish and crayfish in a Waikato stream in relation to basin area. *New Zealand Journal of Zoology* 30: 149-160.

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<sup>xxxvii</sup> [waikatoregion.govt.nz/Community/Waikato-Progress-Indicators.](http://www.waikatoregion.govt.nz/Community/Waikato-Progress-Indicators)

<sup>xxxviii</sup> *Agricultural Production Statistics (census), Statistics New Zealand – Fresh Facts 2014*

<sup>xxxix</sup> NZDep2013 Index of Deprivation. Atkinson, Salmond and Crampton 2014. Department of Public Health, University of Otago, Wellington.

<sup>xl</sup> Waikato Regional Energy Strategy. <http://www.waikatoregion.govt.nz/PageFiles/13327/Waikato%20regional%20energy%20strategy.pdf>