Kaupapa Māori Freshwater Assessments

A SUMMARY OF IWI AND HAPŪ-BASED TOOLS, FRAMEWORKS AND METHODS FOR ASSESSING FRESHWATER ENVIRONMENTS

Hannah Rainforth[1] and Garth Harmsworth[2]

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[1] Perception Planning Ltd
[2] Manaaki Whenua – Landcare Research

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[3] Māori knowledge and knowledge systems

1 Executive Summary

1.1 Project and client

Kaupapa Māori Freshwater Assessments was written at the request of regional councils and territorial authorities across Aotearoa. Recent changes to the National Policy Statement for Freshwater Management (NPS-FM) now require that councils include mātauranga Māori in their monitoring plans. Councils sought information that would aid them in meeting this requirement, and wanted to understand the range of tools available and the matters that iwi and hapū considered important around the freshwater environment. It is hoped that the report will not only be of assistance to councils, but will be a useful summary for iwi authorities, tangata tiaki and iwi environmental staff as well.

1.2 Objectives

The purpose of the report is to:

- provide an overview of kaupapa Māori tools, frameworks and methods available to assess and evaluate aspects of freshwater
- provide information on the range of indicators used across these tools, frameworks and methods, and
- provide an overview of which tools are used in which areas of Aotearoa.

1.3 Methods

The report is based on a literature review and summarises a total of 13 tools, frameworks or methods. Some approaches were not able to be covered in the timeframe. These are listed at the end of Section 2. Case studies were developed for four of the tools, as an example of how they can be used. Indicators found within each kaupapa assessment approach were categorised according to type, and assessed for how often they occurred across the approaches. A survey of which tools are used in which regions was conducted with council staff. Recommendations are suggested for consideration.

1.4 Results

1.4.1 Tools, frameworks and methods

The 13 tools, frameworks and methods are listed Table 1-1, with a brief summary as to their purpose. Two of the tools are available as a digital app (the Wai Ora Wai Māori app and the Mauri Compass), and cultural mapping generally uses GIS and Google Earth tools. The remainder of the approaches are paper-based. Many could easily be adapted to a digital format.

TABLE 1-1: SUMMARY OF KAUPAPA MĀORI ASSESSMENT TOOLS COVERED IN THIS REPORT

Taonga species monitoring	A range of tools, methods and approaches to monitor individual species that are important to iwi.
Cultural Health Index (original version)	The seminal Māori cultural monitoring tool, the CHI monitors site status, mahinga kai and cultural stream health. It has been widely adapted for other uses.
Mauri Compass	A digital tool covering 12 aspects in three kete: Tangata Whenua, Tāne and Tangaroa. It combines mātauranga Māori with Western indicators to answer questions important to iwi and hapū. The results are presented in an accessible, visual compass.
Mauri Model / Mauri-o-meter / Ngāti Mākino Model	A tool to assist with decisions around potential engineering projects and their benefit to or impact on mauri.
Cultural flow preference study	A method to assess cultural values and satisfaction for different flow regimes.
Wai Ora Wai Māori	A framework and digital tool to assess the state of a waterbody from a Māori perspective. It can be adapted to local iwi and hapū views.
Cultural mapping	Various approaches to mapping cultural information and values.
Māori environmental performance indicators for wetland condition and trend	A method and set of indicators to assess wetland condition from a Māori perspective.
Mauri of Waterways Kete	A comprehensive assessment of environmental outcomes according to kaupapa Māori.
Waikato River Catchment Report Cards	A means of conveying available (largely Western science-based) data to iwi and communities.

State of the Takiwā	A database and method for cultural and environmental assessments of freshwater environments. No longer active but provides useful examples of what is possible.
Mātauranga Māori Knowledge Networks	A project to examine factors affecting river quality from a Māori perspective. It provides a model for iwi and councils wishing to research important aspects for freshwater monitoring locally.
Significance sssessment method	A means of applying cultural values into the RiVAS assessment system. RiVAS is a standardised method to help resource managers grade rivers by relative importance for different uses.

1.4.2 Common indicators across all tools, frameworks and methods

The most common aspects included as indicators in kaupapa Māori assessments covered in this report were:

- Mauri
- Iwi health and well-being
- Tikanga and cultural practices
- Sites of significance
- Fish and mahinga kai species presence/absence
- Species abundance
- Species health
- Food safety
- Access
- Availability of mahinga kai (links with species abundance above)
- Landscape-level habitat and catchment land use
- Riparian habitat and
- Water quality parameters (clarity, pH, temperature, dissolved oxygen etc)

These cover five key areas: meta-physical aspects, cultural and social aspects, species information, mahinga kai aspects, and ecology, water quality and habitat aspects. These indicate that monitoring plans that include mātauranga Māori will need to cover a broad range of matters in order to meet iwi and hapū aspirations and understandings around what is important for monitoring.

1.4.3 Use of kaupapa Māori assessment tools, frameworks and methods by region

The survey focused on tools that councils themselves are using with iwi partners. As such, the results do not necessarily capture instances where iwi are using tools and councils are unaware of that work, however, where possible data was added in to augment the survey responses. The results are presented in Figure 1-1.

The most widely used and adapted tool was the Cultural Health Index, with 12 out of 16 regions reporting its use. The CHI is closely followed by cultural mapping, which is known to be used in 11 of the 16 regions. The Māori environmental performance indicators for wetland condition and trend is widespread, but does not seem to be have used greatly since its development. Taonga species monitoring is relatively common, with half of all regions undertaking some form of individual species monitoring.

The Waikato and Bay of Plenty regions used the widest range of tools. This is possibly a reflection of the number of research institutes who are involved in kaupapa Māori tool development that are located in or nearby these areas, such as The University of Waikato, NIWA and Manaaki Whenua. It may be helpful for research institutions to actively pursue relationships with iwi in more remote areas of the country, in order to support local development of tools, frameworks and methods in those areas too.

FIGURE 1-1: THE USE OF KAUPAPA MĀORI MONITORING TOOLS, FRAMEWORKS AND METHODS BY REGION

1.5 Key considerations

Several key considerations became evident as this report was developed. These are outlined below.

1.5.1 Resourcing

Iwi and hapū have multiple demands on their time and resources. While environmental concerns are high on the agenda, the resources and capacity to undertake the sort of monitoring iwi aspire to is not always available. Support to undertake kaupapa Māori assessments would often be welcomed. Capacity within councils is also likely to be needed.

1.5.2 The mandate to decide

Monitoring using mātauranga Māori needs to meet Māori aspirations and requirements, and answer questions that are important to iwi and hapū. It needs to be undertaken by Māori, for Māori, based on kaupapa Māori. Iwi and hapū across the country have different approaches, and some tools will suit some groups more than others. The decisions on whether to undertake mātauranga-Māori based monitoring, and which tools, frameworks and methods each iwi or hapū chooses to use will need to remain with those iwi and hapū.

1.5.3 Intellectual property

Many of the tools involve collecting or using sensitive data. This intellectual property will need to be protected in a manner that iwi and hapū feel comfortable with. Structures and agreements will need to be developed so that mātauranga Māori is not at risk of being misappropriated.

1.6 Conclusions and recommendations

There are a range of tools, frameworks and methods available to iwi and hapū, and their council partners. These range from decision-making tools, to digitally-based assessments, to mapping approaches for understanding and recording cultural knowledge, preferences and monitoring requirements, to research around important species, through to kaupapa Māori assessments of the state and health of a waterbody. Most of these tools, frameworks and methods are able to be adapted to suit local priorities, preferences and protocols. Many are inter-related. The various approaches can be used in tandem to meet different aspects of kaupapa Māori-based monitoring needs. Given the developments in recent years and the resourcing now being put into mātauranga Māori-based assessment approaches, it is likely that even more tools, frameworks and methods will become available in the near future.

We recommend that:

- this report be distributed to iwi and hapū throughout Aotearoa, as a resource for their use in decision-making around monitoring programmes
- the appetite for a national, iwi-run database to support kaupapa Māori-based assessments be tested
- wānanga to discuss the concepts, issues and opportunities around kaupapa Māori-based assessments be held, and
- that research with iwi partners be conducted to investigate why mātauranga Māori has not been included in council-run monitoring programmes to the extent possible to date, and what solutions to this might be.

2 Introduction

Kaupapa Māori Freshwater Assessments was written at the request of regional councils and territorial authorities across Aotearoa. Recent changes to the National Policy Statement for Freshwater Management (NPS-FM) now require that councils include mātauranga Māori in their monitoring plans. Councils sought information that would aid them in meeting this requirement, and wanted to understand the range of tools available and the matters that iwi and hapū considered important around the freshwater environment. It is hoped that the report will not only be of assistance to councils, but will be a useful summary for iwi authorities, tangata tiaki and iwi environmental staff as well.

3 Monitoring – What and why?

3.1 Freshwater legislative and policy reform framework

In response to increasing demands and pressures on New Zealand's freshwater resources, and widespread and worsening degradation of freshwater ecosystems, new policy and planning processes were introduced in 2009–2017[4]. The intention was to provide an effective policy and planning framework to incorporate multiple values and improved processes for collaboration, management, and decision-making, to ensure the long-term sustainability and viability of our freshwater resources. New Zealand's freshwater habitats and the species that live in them are intimately linked to our national identity and ways of life, whether it is through recreation, industry, tourism, energy production, biodiversity, ecological function or cultural and social values. Freshwater ecosystems are significant to Māori, and are integral to Māori cultural identity.

With increasing demands on finite freshwater resources and pressures on water quality and habitats, there is potential for increased resource conflict and the need for balancing competing demands as a part of decision-making and management. This raises many questions when using freshwater resources locally and regionally, namely: What values are important and which take priority? Who decides this? How are indigenous rights taken into account? Who has the final say over how freshwater is managed and used? Who are the major stakeholders? And how are community, societal, and cultural values recognised and incorporated into decision-making processes and management? These issues further raise questions about the dimensions of power between various user groups and stakeholders, including local and central government, and iwi and hapū, and about the need to understand the complex processes and dynamics between stakeholders – often with various agendas – before finding and determining long-term equitable solutions and implementing effective management strategies to sustain freshwater resources.

Internationally, there is an increasing trend to engage with indigenous communities for research and collaboration, including indigenous groups as active participants in resource management decision-making. The drivers (e.g. indigenous rights, treaties, legislation, social policy, strategies to achieve equity, and ethical considerations) to encourage and promote engagement and collaboration with indigenous communities are very different in each country. In New Zealand, the Treaty of Waitangi provides the foundation for giving effect to indigenous rights and fulfilling requirements and obligations to the Treaty by the Crown. Importantly, in the context of environmental monitoring, the most recent (2017) amendments to the NPS-FM include a requirement that regional councils produce monitoring plans that 'must at least include … mātauranga Māori' (Policy CB 1 aa) v.). This has given rise to the need for support for both councils and iwi and hapū in order to meet this requirement. This report aims to

[4] i.e. Resource Management Act (1991) reforms, National Policy Statement for Freshwater Management (NPS-FM) 2011 and its 2014 and 2017 amendments, including the National Objectives Framework – NOF

meet that need, by providing a summary of kaupapa Māori[5] assessment tools, methods and frameworks to guide councils and iwi in developing appropriate monitoring plans.

3.2 Māori and freshwater management

To understand the role of Māori within a modern collaborative freshwater management and policy space, it is important to first acknowledge and understand the unique te ao Māori[6] world view and perspective. This perspective is largely derived from traditional mātauranga Māori[7], providing concepts and values that shape contemporary perspectives and thinking. Māori have developed a comprehensive knowledge base of New Zealand's ecosystems, habitats and species that evolved and endured over the last 1000 years, through an intimate connection with the natural environment, usually in local areas. In terms of resource management, freshwater resources were sustained, managed and regulated through local cultural practice, based on iwi and hapū values and principles, such as kaitiakitanga[8], whakapapa[9], and rangatiratanga[10], linked to and managed through spiritual atua[11] domains. This connection and knowledge provides Māori today with a unique indigenous perspective for planning, policy, decision-making and other activities (Tipa and Teirney, 2003, Selby et al., 2010, Harmsworth, 2005). Many Māori resource management issues will therefore be inherently different from those of other stakeholder and community groups.

Since the Resource Management Act 1991 (RMA), there have been difficulties through lack of formal recognition for incorporating and understanding this unique Māori perspective and knowledge at the local and central government level (Jollands and Harmsworth, 2007, Allen et al., 2011, Harmsworth, 2005). This is starting to change under the freshwater reforms as policy and planning seeks greater involvement of Māori in freshwater management. Outside drivers such as Government policy and legislation, Māori wish to play a greater role in the management of resources because of their values and responsibility to their ancestors to uphold, express and articulate Māori culture and values in modern society (Nelson and Tipa, 2012, Harmsworth, 2005). The importance of working with Māori groups, particularly around issues affecting the natural environment, therefore goes beyond considering Māori as just another stakeholder.

Ultimately the effective inclusion of Māori values and mātauranga Māori in freshwater planning will have wide reaching benefits to all stakeholders and the community.

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[5] Something based on Māori principles, practices, or ideology; "a philosophical doctrine, incorporating the knowledge, skills, attitudes and values of Māori society" MOORFIELD, J. 2011. *Te Aka Māori-English, English-Māori Dictionary and Index,* New Zealand Longman/Pearson Education

[6] Māori world

[7] Māori knowledge, data, understandings and observations

[8] kaitiakitanga as a concept embodies the responsibility of iwi and hapū to care for and protect the land, air and water in their tribal regions. A kaitiaki is also a spiritual or supernatural being, and some iwi use the term tangata tiaki instead of kaitiaki to acknowledge the special nature of those beings and differentiate between the role of humans as environmental caretakers.

[9] genealogical links, geneology, interconnectedness

[10] sovereignty, autonomy, self-governance

[11] god, deity

Shared knowledge and experience are very important in collaborative processes; they help build capacity within groups and can lead to innovative solutions to address specific issues (Allen et al., 2011, Robb, 2014, Harmsworth, 2005). Since the signing of Treaty of Waitangi, a raft of Crown legislation and policies have historically been viewed as disempowering for Māori with regard to resource management decision-making. A number of authors (Selby et al., 2010, Mead, 2012) suggest that the combination of power, legislation, and social inequality has typically led to the undermining and diminishing of Māori values, issues, and knowledge. In addition, the privileging of non-Māori values and knowledge systems has often marginalised iwi and hapū groups from constructive dialogue and created barriers for meaningful engagement (Tipa and Welch, 2006, Ahuriri-Driscoll et al., 2007, Joseph, 2008).

3.3 Mātauranga Māori and the environment

Loss of indigenous knowledge and barriers to the transmission of knowledge are significant issues well documented in New Zealand (Williams, 2001, Pihama, 2012, Royal, 2012). The scarce use and understanding of mātauranga Māori in respect to environmental research and resource management can be attributed to a range of factors, including: general lack of understanding of mātauranga Māori and its role in modern society; loss of mātauranga Māori in local areas; knowledge inequality in decision-making; lack of mātauranga Māori used in science and resource management; disconnection of Māori from customary resources; and the way historical legislative barriers have impacted on the use of knowledge.

Māori epistemology, beliefs and philosophy, and the natural environment can be thought of as a broad foundation for developing many forms of mātauranga Māori, influencing modern attitudes and patterns of thinking (Durie, 2005). However, in many areas of cross-cultural research there is a risk of assimilating the indigenous world view into the dominant cultural world view for that geographical area (Agrawal, 1995, Pihama, 2012, Smith, 2012). In terms of mātauranga Māori, the Māori world view is valid in its own right, but the co-option of this knowledge within a more dominant knowledge system – such as Western knowledge – can perpetuate power inequality and the dominance of the mainstream and scientific world view. To this end there are inherent difficulties describing concepts and values of te ao Māori using scientific language and scientific frameworks (Metge and Kinloch, 1978, Townsend et al., 2004, Joseph, 2008, Allen et al., 2011, Muru-Lanning, 2012, Harmsworth, 2001). Te reo Māori[12] is typically shaped by Māori communities to express their Māori culture and there are risks of this being 'lost in translation' (Joseph, 2008). Attempts to manipulate, assimilate or interpret a Māori world view using scientific methods or language are therefore fraught with difficulties.

Communicating mātauranga Māori and stressing its importance within a science-dominated collaborative arena is a challenge, given the prevailing world view is often unaccommodating of alternative and indigenous views and values. However, this can

[12] The Māori language

also be an opportunity for innovation and relationship building, should both parties be working towards a common vision or set of goals.

3.4 The development of environmental monitoring and cultural monitoring

Environmental monitoring is a concept, framework, methodology, collection of indicators, and set of applications that follows international approaches and agreements to assess, monitor and report on the state of the environment (SOE). Environmental monitoring was largely promoted around the world within a sustainable development framework, such as the pressure-state-response model (Organisation for Economic Co-Operation and Development, 1997, Organisation for Economic Co-Operation and Development, 1993), and an agenda item at the United Nations (UNCED) Earth Summit in Rio de Janeiro 1992. Although some New Zealand approaches were developed early in the 1950s and 1960s for localised monitoring of key aspects of the environment (particularly rivers, lakes, soils, and indigenous flora and fauna species), these were piecemeal and in a national context poorly resourced and uncoordinated. In New Zealand, in line with international concepts and initiatives, the development of national environmental indicators began in earnest in the early 1990s. Most monitoring initiatives followed legislative requirements in the 1990s 'to monitor', such as in resource management legislation (e.g. the RMA 1991), but were not mandatory, and largely focussed on local government and Government science agencies with minimal community and iwi or hapū input and involvement. A national Ministry for the Environment environmental performance indicator (EPI) programme that ran from 1998-2000 was short-lived (Ministry for the Environment, 1998a, Ministry for the Environment, 1998b, Ministry for the Environment, 1999, Jollands and Harmsworth, 2007, Ministry for the Environment, 1997b, Ministry for the Environment, 1997a), and had limited opportunity for Māori involvement.

From this early work on Māori environmental indicators, some progressive work did eventuate (Ministry for the Environment, 1998a, Ministry for the Environment, 1997a), which provided the building blocks for Māori-led cultural monitoring. A Māori advisory panel was asked to provide a concept and definition of a Māori environmental performance indicator or MEPI (Ministry for the Environment, 1998a, Ministry for the Environment, 1998b). The concept evolved from a series of ideas and culturally-based concepts, and the following definition was given:

> *A Māori Environmental Performance Indicator (MEPI) is a tohu[13] created and configured by Māori to gauge, measure or indicate change in an environmental locality. A Māori EPI leads a Māori community towards and sustains a vision and a set of environmental goals defined by that community.*

Very few formal Māori-led monitoring and indicator approaches were developed pre-2000 (i.e. they were not recognised in monitoring programmes, didn't inform planning

[13] sign, indicator

and policy, and relied on observation rather than any formal recording or assessment). Since 2000 reasonable progress has been made on the development of approaches, information systems, and datasets to support state of the environment reporting both at regional and national levels.

The Environmental Reporting Act (2015) requires the Ministry for the Environment and Statistics New Zealand to regularly report on the state of the environment using a pressure-state-impact framework model (Ministry for the Environment and Statistics New Zealand, 2015). Data and knowledge will be aggregated up to national scale from regional, district, and local groups such as local government and Māori (iwi and hapū) in the form of regional and national statistics, case studies and supporting information. It is hoped this will provide a constructive Māori lens or cultural perspective for environmental monitoring and reporting in New Zealand.

3.5 Cultural Monitoring

Since early Polynesian arrival 1000 years ago, Māori have always monitored their environment in some way, to assess natural resources as a basis for sustenance, well-being, and survival. As a result, Māori have increasingly used this knowledge to guide the management of important resources, their scarcity, and their condition. Traditional concepts and values were fundamental to this management responsibility, which reinforced the interconnection with the natural and spiritual environment. Since the late 1990s, Māori have become increasingly interested and active in national environmental programmes, and Māori monitoring approaches were developed to complement and contribute to mainstream state of the environment monitoring and reporting. At the heart of most kaupapa Māori approaches is the concept of mauri, which provides the fabric or whāriki[14] for defining Māori aspirational targets and outcomes.

There are a growing number of cultural monitoring and assessment methods and tools. These are based on a blend of mātauranga Māori, traditional concepts, and Western science, and are being continually adapted and modified for local use (Awatere and Harmsworth, 2014, Environs Holding Trust, 2014, Harmsworth et al., 2013). Most cultural monitoring has developed a set of standard indicators (e.g. water quality, taonga[15] species, mahinga kai[16]) that builds up a knowledge base of local areas. In some iwi and hapū monitoring projects, indicators have been organised into atua domains, or, in the first instance, selected within these atua domains as part of a mātauranga Māori framework.

3.5.1 The value of cultural monitoring

Robb et al. (2015) found that cultural monitoring can be used to build capacity and capability of Māori communities, identify cultural values and priorities, strengthen connections between Māori and freshwater resources, build skills and knowledge in

[14] Woven mat

[15] something valued and treasured

[16] the practice of gathering food, or a site for doing so

both mātauranga Māori and Western science and measure progress towards agreed goals to achieve desired freshwater outcomes and Māori aspirations. It has also been found that cultural monitoring and cultural projects provide a basis to build understanding, share learnings, and develop methods (e.g. through wānanga and field work) in order to set standards and limits within freshwater ecosystems. Cultural monitoring is typically used to articulate values as well as assess, measure, and monitor changes to the environment from a Māori perspective, and report those changes.

Cultural monitoring tools can be used to contribute to, or inform, some formalised assessment (qualitative or quantitative) or statement of cultural values through time and space. This is especially relevant when assessing habitat and water quality to show trends.

Although still somewhat in its infancy as a tool, cultural monitoring is being carried out in many parts of New Zealand from early development to implementation. Because of iwi and hapū capacity and resourcing issues, the methods and assessment approaches are often not used regularly. However, monitoring provokes much interest and can increase participation at the local level in many iwi and hapū-led projects. Many groups have developed planning and policy frameworks to show where monitoring fits, to help meet overall objectives, and to monitor change. Te Uri o Hau, in the Kaipara harbour region, developed the framework in Figure 3-1, showing how monitoring is linked to outcomes and aspirations as part of a regular cycle providing information on progress towards addressing issues and goals (Environs Holding Trust, 2014).

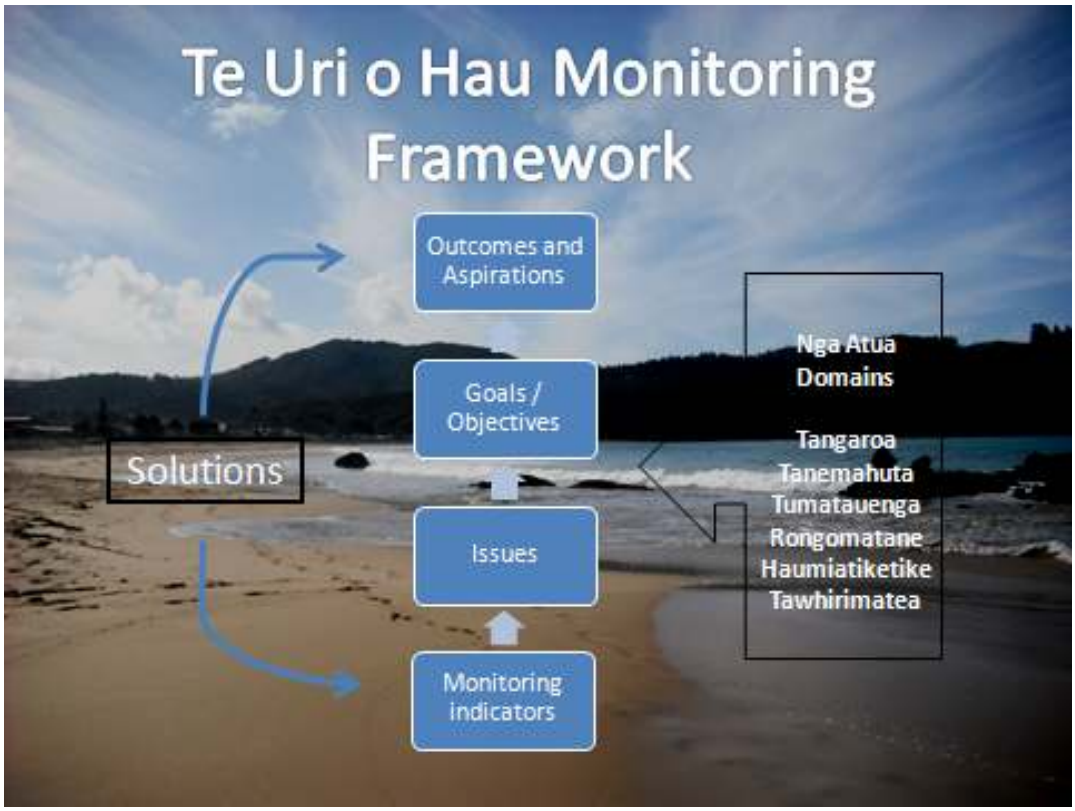

FIGURE 3-1: TE URI O HAU MONITORING FRAMEWORK FOR THE KAIPARA HARBOUR

FIGURE 3-2: BUILDING EXCELLENT RELATIONSHIPS AND COLLABORATIVE RESEARCH PROVIDES THE BASIS FOR INTEGRATING MĀTAURANGA MĀORI IN COMPLEMENTARY MONITORING FRAMEWORKS IN NEW ZEALAND.

Cultural monitoring can help build strong relationships between Māori communities, stakeholders, local Government and scientists (Figure 3-2). As well as tracking progress towards goals and aspirations for particular local ecosystems, it can be used to link or make a statement about relationships between human and cultural well-being and the health of the environment, given that they are intimately connected. It can also be used in local iwi and hapū areas to identify the source of issues and problems, to pin-point impacts and effects (e.g. critical source areas), and to identify suitable responses to address issues through a set of actions (e.g. limiting nitrates, restoration, riparian planting, best management practice).

Beyond monitoring

Cultural monitoring is becoming increasingly important to enable kaitiaki to carry out their duties as environmental resource managers and provide information to their communities. This goes beyond the monitoring itself, with mana whenua[17] retaining control over data interpretation and reporting. By tāngata whenua connecting with their tribal lands and environments on a practical level, knowledge is gained and capacity is built. This also strengthens connections between people and across generations. Tāngata tiaki become a link between people and place, as well as facilitating discussion around the state of environment and issues that are affecting the group (Robb, 2014).

[17] The people holding responsibility in a location; tāngata whenua

3.6 Considerations around including mātauranga Māori in council monitoring plans

3.6.1 Potential barriers to including mātauranga Māori in monitoring

Further research is needed into potential barriers to including mātauranga Māori in monitoring programmes, but it is likely that some of the same difficulties apply as for those identified by Robb et al. (2015) around participation in collaborative processes, for example:

- Overcoming historical tension and conflict
- Lack of capacity and resourcing, for both parties
- Difficulty getting 'buy-in' for institutional change
- Uncertainty about who to engage with
- Internal politics
- Lack of capability/capacity to understand Māori values
- Lack of capability/capacity to implement Māori values

3.6.2 Intellectual property concerns

The 2017 amendments to the NPS-FM included, amongst other things, a requirement that information gathered under regional council monitoring plans be made publicly available (New Zealand Government, 2017). For many iwi and hapū, this will raise questions around ownership and control of the data and whether iwi and hapū knowledge is at risk of being appropriated (or misappropriated) for council needs, as opposed to kaupapa Māori assessments being used by Māori, for Māori, to answer questions important to Māori. Intellectual property protection mechanisms will need to be in place to answer this concern.

3.6.3 Suitability of tools for use nationwide

As discussed above, iwi and hapū have been developing tools that suit local uses since the early 2000s. It is important, when discussing how to meet the monitoring requirements of the NPS-FM, to remember that local developments suit local needs, local priorities and local tikanga[18]. While some tools may be transferrable from region to region, not all tools will be suitable in all situations. Again, the decisions around what and how tools are used with regards to mātauranga Māori needs to rest with iwi and hapū.

[18] protocols and ways of doing things

4 Tools, frameworks and methods

As outlined above, numerous tools have been developed in the past two decades or so to help iwi and hapū monitor or assess aspects of the freshwater environment from a kaupapa Māori perspective. This section provides summaries of a number of those tools, frameworks and methods. Some are generic approaches, such as taonga species monitoring and cultural mapping, and some are specific tools developed for a particular purpose. Case studies for some of the approaches are included in Section 6. The summaries are provided in a consistent format, covering:

- the tool name
- the developer/s
- where to source information about the tool
- whether or not is it available in a digital form (ie as an app)
- whether variants exist
- when it was developed
- a general overview
- a summary of how to use the tool
- what sort of data is collected
- who it is designed for use by
- where in the country it has been used
- any considerations concerning the tool and
- references.

A summary of the tools covered is provided in Table 4-1.

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Mauri Model / Mauri-o-meter / Ngāti Mākino Model	A tool to assist with decisions around potential engineering projects and their benefit to or impact on mauri.

Cultural flow preference study	A method to assess cultural values and satisfaction for different flow regimes.
Wai Ora Wai Māori	A framework and digital tool to assess the state of a waterbody from a Māori perspective. It can be adapted to local iwi and hapū views.
Cultural mapping	Various approaches to mapping cultural information and values.
Māori environmental performance indicators for wetland condition and trend	A method and set of indicators to assess wetland condition from a Māori perspective.
Mauri of Waterways Kete	A comprehensive assessment of environmental outcomes according to kaupapa Māori.
Waikato River Catchment Report Cards	A means of conveying available (largely Western science-based) data to iwi and communities.
State of the Takiwā	A database and method for cultural and environmental assessments of freshwater environments. No longer active but provides useful examples of what is possible.
Mātauranga Māori Knowledge Networks	A project to examine factors affecting river quality from a Māori perspective. It provides a model for iwi and councils wishing to research important aspects for freshwater monitoring locally.
Significance sssessment method	A means of applying cultural values into the RiVAS assessment system. RiVAS is a standardised method to help resource managers grade rivers by relative importance for different uses.

4.1 Taonga species monitoring

Taonga species monitoring	
Tool name	There is no one tool name for this, instead it covers a range of approaches to investigate aspects about species of high importance to iwi and hapū.
Designed by	Multiple investigators, utilising mātauranga handed down from their pahake[19] and kaumātua[20].
Available at	Kusabs et al. (2015b), Kusabs et al. (2015a), Williams et al. (2014), Kitson et al. (2012), Kitson et al. (2010), Rainforth (2008), Morris et al. (2013), Kapa and Clarkson (2009)
Digital version	N/A
Developed/in use since	N/A
Variants	Multiple variants. This topic covers monitoring of kōura, kākahi/kāeo/freshwater mussels, tuna, kanakana/piharau/lamprey, native fish species such as īnanga, kōkopu and kōaro, and plants such as kuta, raupō and harakeke.

Overview

Taonga species monitoring can involve any technique deemed appropriate by iwi, hapū and whānau to answer questions about the species that are important to them. To date it has involved using measures of catch per unit effort, counts by expert harvesters, habitat assessments, tracking using PIT (passive integrated transponder) tags, traditional trapping methods such as tau kōura, traditional knowledge of abundance and distribution, measures of growth and health (e.g. examining otoliths, parasite load), research around spawning grounds, and plant ecology.

[19] elders, one's parents' generation
[20] elders, older generation

How to use

The method used depends on the questions iwi and hapū seek to answer, and can involve a number of different approaches (see the Taonga Species Monitoring – Kanakana in the Waikawa case study in Section 6). The main points to note are that taonga species monitoring is focused around iwi and hapū questions, is heavily reliant on local iwi and hapū knowledge (of the species, of catch methods for that species, and of catch history, for example historic abundance and distribution of populations, and historic size ranges), and is undertaken by iwi, hapū and whānau, or in partnership with them.

Type of data collected

The type of data collected varies greatly, depending on the research questions and the methods. It ranges from abundance estimates, to size class distributions, habitat requirements and use, range and distribution, and data on growth rates and species health. This data often helps to quantify iwi and hapū kōrero[21] and observations about decline in species abundance, distribution and size.

Designed for use by

iwi and hapū, at times in partnership with or supported by researchers or organisations such as Crown Research Institutes or councils.

Places used

Throughout Aotearoa, with documented work available for the Waikato region, the Rotorua district, the Whanganui River, the Kāpiti Coast, the Wairarapa, and Murihiku.

Considerations

When undertaking taonga species monitoring, consideration should be given to intellectual property arrangements and agreements. Sensitive data will need to remain within iwi, hapū and whānau control.

References

Kusabs et al. (2015b), Kusabs et al. (2015a), Williams et al. (2014), Kitson et al. (2012), Kitson et al. (2010), Rainforth (2008), Morris et al. (2013), Kapa and Clarkson (2009), Kusabs et al. (2018)

[21] Discussion, discourse, narrative, story, statement, information

4.2 Cultural Health Index

Cultural Health Index	
Tool name	Cultural Health Index
Designed by	Gail Tipa and Laurel Tierney
Available at	https://www.mfe.govt.nz/sites/default/files/chi-for-streams-and-waterways-feb06-full-colour.pdf
Digital version	No
Developed/in use since	2003/2004
Variants	Yes. The Cultural Health Index has been adapted to local situations and for different kaupapa by many different iwi and hapū across Aotearoa.

Overview

The Cultural Health Index, or CHI, is the seminal cultural monitoring tool. It was developed in the early 2000s to help iwi quantify cultural knowledge around and assessments of local waterbodies. It has been widely used across the country, both in its original form and as local variants.

How to use

The original CHI has three key elements:

Site Status	This classifies whether a site is of traditional significance to iwi and hapū, and whether or not iwi and hapū would return to that site in future.
Mahinga Kai	This assesses the status of mahinga kai values at a site. It covers four areas: how many different kai species are present at the site; how many kai species are present in

	comparison to the numbers traditionally present; do iwi members have access to the site; and would iwi and hapū return to the site in future?
Cultural Stream Health	This covers eight parameters: catchment land use, riparian vegetation, use of riparian margin, riverbed condition/sediment, channel modification, flow and habitat variety, water clarity and water quality.

Scores for **Site Status** are allocated based on the following:

- A-1 is a traditional site Māori would return to in future;
- A-0 is a traditional site Māori would *not* return to in future;
- B-1 is not a traditional site, but Māori would go there in the future; and
- B-0 is not a traditional and not a site Māori would use in future.

Scores for **Mahinga Kai** are allocated as follows:

- The number of mahinga kai species present at a site is given a score between 1 and 5. A site with a higher number of mahinga kai species is considered healthier.
- The comparison between the species present today and the traditional mahinga kai species found at a site is also given a score between 1 and 5.
- The site access is given a score of either 1, 3, or 5.
- A score of either 1 or 5 is given for the assessment of whether tangata whenua would return to the site in the future as they did in the past.

The four mahinga kai elements are averaged to give a single mahinga kai score between 1 and 5.

The **Cultural Stream Health** component is scored based on observers' judgements, with a range of 1 to 5. Examples from the field sheet are briefly included in Table 4-2. The eight components in Cultural Stream Health are then averaged for a final score between 1 and 5.

TABLE 4-2: EXAMPLES OF QUESTIONS ON THE FIELD SHEET FROM THE ORIGINAL CULTURAL HEALTH INDEX (SOURCE: TIPA AND TEIRNEY (2006B))

Indicators	Unhealthy				Healthy
Riverbed condition (sediment)	1. Covered by mud/sand/slime/weed	2.	3.	4.	5. Clear of mud/sand/slime/ weed
Water clarity	1. Water badly discoloured	2.	3.	4.	5. Water is clear

Finally, the three component scores are collated to give an overall assessment, such as:

Component 1: **Site status**	Component 2: **Mahinga kai measure**	Component 3: **Stream health measure**
A-1	3.25	4.87

Type of data collected

Tipa and Teirney (2006b) list the following as types of data collected using the CHI:

- recordings, transcripts or notes from interviews
- maps and plastic overlays from interviews
- photographs and diagrams
- lists of traditional sites
- mahinga kai information
- record and assessment sheets
- consent forms
- various other notes, planning papers and reports.

Designed for use by

Primarily designed for use by iwi practitioners.

Places used

The CHI is publicly recorded as being used in: Waikato, Bay of Plenty, Hawke's Bay, Tasman, Canterbury, Otago, Southland (see https://statisticsnz.shinyapps.io/cultural_health/). Other locations of use may exist, however that information is likely to rest with individual iwi and hapū.

Considerations

As with all mātauranga Māori tools, the decisions on whether and how to use the CHI needs to rest with iwi and hapū, as would decisions around how data is managed and handled. Given sensitive data is likely to be collected through the CHI process, intellectual property considerations would need to be agreed if councils were wanting to utilise the CHI with local iwi and hapū.

References

Tipa (1999), Tipa and Teirney (2003), Tipa and Teirney (2006b), Tipa and Teirney (2006a), Townsend et al. (2004), Nelson and Tipa (2012), Hughey and Taylor (2009), Taranaki District Council (2007), Walker (2009), Harmsworth et al. (2011), Tipa (2013), Pauling et al. (2007), Young et al. (2002)

4.3 Mauri Compass

Mauri Compass	
Tool name	Mauri Compass
Designed by	Ian Ruru, Te Rūnanga o Tūranganui a Kiwa, and David Wilson, Gisborne District Council
Available at	https://www.mauricompass.com
Digital version	Yes, for any device or browser. It works offline in remote locations. It is supported by an online database.
Developed/in use since	2014
Variants	Yes – coastal, catchment, aquifer.

Overview

Mauri is deeply important to iwi across the country. In Gisborne, it is included as a compulsory freshwater value in the Tairawhiti Resource Management Plan. As such, the Gisborne District Council (GDC) must aim to improve the water quality and mauri of Turanganui a Kiwa under their Wastewater Resource Consent.

To do this, iwi and the GDC needed a pragmatic tool founded on tikanga Māori, scientific research and resource management planning. The Mauri Compass was developed to answer this need.

Developers Ian Ruru and David Wilson describe the Mauri Compass as a tool for assessing the current state of the mauri of any ocean, river or lake, and a framework for planning the restoration of those waters.

How to use

The compass assesses 12 aspects of a water body, ranging across three kete: the Tangata Whenua Kete, the Tāne Kete, and the Tangaroa Kete. Tangata whenua aspects are assessed in the first four attributes: Tangata Whenua, Tikanga, Wairua, and Mahinga Kai. Values are assessed by the tangata whenua of each iwi or hapū area using narrative questions (see Figure 4-1 as an example). Tangata whenua cultural knowledge and data is safeguarded throughout the process. The next four attributes, in the Tāne Kete, are environmental – Habitat, Biodiversity, Biohazards and Chemical Hazards. The final four attributes, from the Tangaroa Kete, assess the quality and quantity of fish species – these attributes are Fish species, Abundance, Fish Health and Growth Rates.

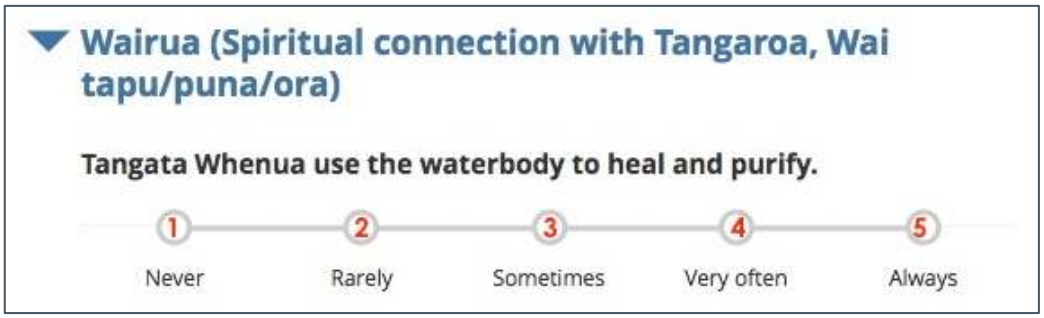


FIGURE 4-1: AN EXAMPLE OF HOW THE WAIRUA ATTRIBUTE OF THE MAURI COMPASS IS DERIVED FROM A LIKERT SCALE.

Once the values are assessed, the scores are presented on a 'compass' or dashboard (see Figure 4-4 and Figure 4-6 for examples). The dashboard provides a quick view of the 12 attributes and indicates the state of mauri of any particular waterbody. Past, present and future states are used to show key priorities for restoration (Figure 4-4).

Type of data collected

Data incorporates both qualitative and quantitative measures. The voice of tangata whenua is measured through narrative objectives. Figure 4-4 shows an example of a question used to collect data for the Mauri Compass assessment; it is based on a Likert scale.

The environmental attributes include data from Land, Air, Water Aotearoa (LAWA), the regional council monitoring programme and ongoing monitoring by tangata whenua. Figure 4-6 shows an example of how LAWA data is used to derive the Biohazard attribute data for the Mauri Compass assessments. The fisheries attributes are derived from a standardised stock assessment model that includes catch-per-unit effort (CPUE) and growth model data.

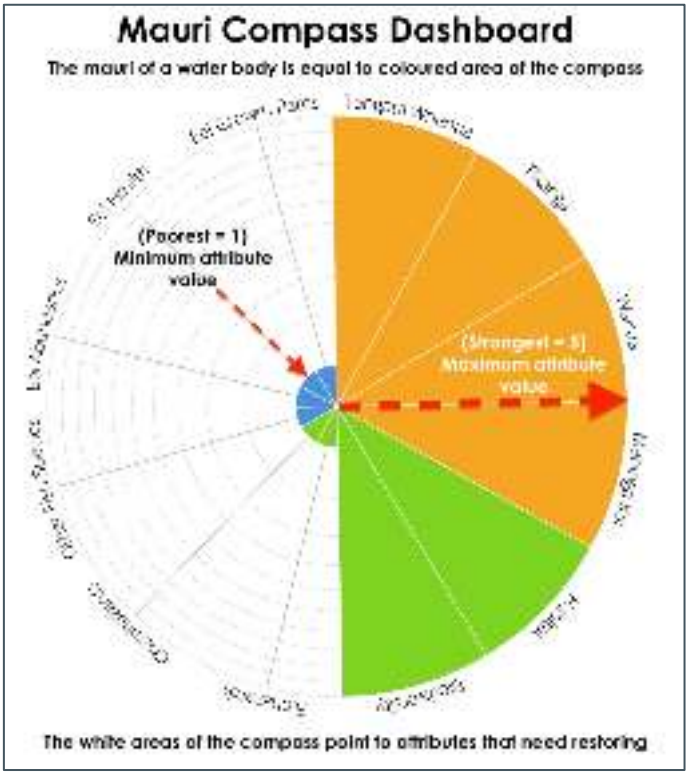


FIGURE 4-2: AN EXAMPLE OF THE MAURI COMPASS SHOWING THE ELATIONSHIPS BETWEEN THE 12 ATTRIBUTES. EACH ATTRIBUTE VALUE RANGES BETWEEN 1 (POOR) AND 5 (STRONG). EELS ARE TYPICALLY USED AS A SENTINEL FOR RIVERS. KŌURA (ROCK LOBSTERS) HAVE BEEN USED AS A SUITABLE SENTIN

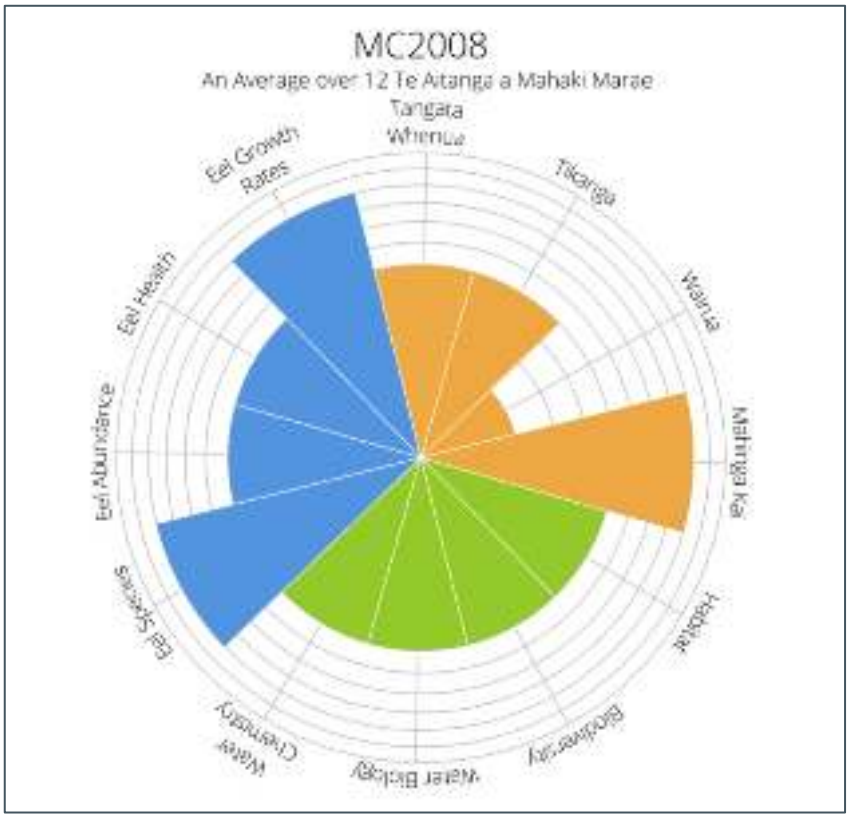


FIGURE 4-3: RESULTS FROM A MAURI COMPASS STUDY IN 2008, SHOWING SCORES ACROSS THE VARIOUS ATTRIBUTES

FIGURE 4-4: A SCREEN SHOT OF A MAURI COMPASS ASSESSMENT QUESTION, SHOWING HOW IT CAN BE USED FOR PAST, PRESENT OR FUTURE STATES, AS WELL AS ONGOING MONITORING.

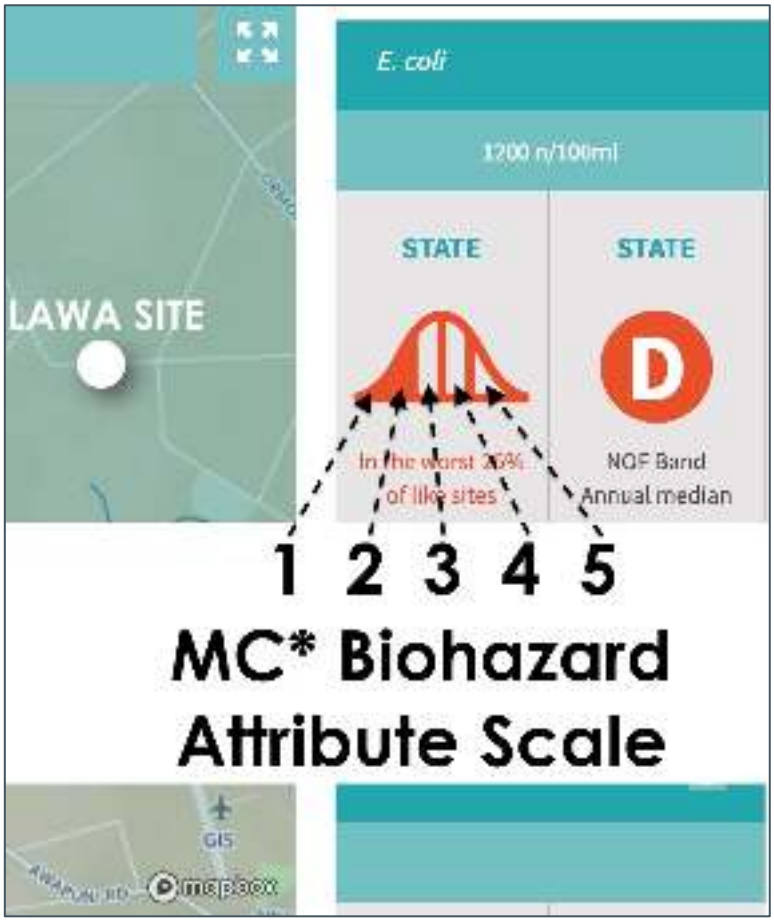


FIGURE 4-5: AN EXAMPLE OF HOW THE BIOHAZARD ATTRIBUTE IS DERIVED USING E. COLI LEVELS. SOURCE: WWW.LAWA.ORG.NZ

Designed for use by

Iwi, regional councils, planners and schools. Currently the Mauri Compass is endorsed by Te Rūnanga o Tūranganui a Kiwa, Te Aitanga a Māhaki, Ngāti Oneone, Te Rūnanganui o Ngāti Porou, Ngāti Porou Seafoods Group and the Gisborne District Council.

Places used

The Mauri Compass is widely used in Te Tairāwhtii by iwi and in joint projects with GDC. Examples include:

- Toitū te Mauri o Te Pā o Kahu – a landfill remediation project between the Paokahu Trust and the GDC.
- Te Rūnanga o Tūranganui a Kiwa and Te Aitanga a Māhaki are using the Mauri Compass to assess and restore the mauri of the Waipaoa River Catchment, the Makauri Aquifer and the local marine environment.
- The framework is being used in Gisborne District Council's 2017 Freshwater Plan and to assist with state of the environment reporting for the Waipaoa River and the rohe[22] of Te Aitanga a Māhaki.
- GDC Wastewater Management Committee is using the tool to assess the efficiency and effectiveness of the council's wastewater consent condition "to improve the mauri and water quality of Turanganui a Kiwa".
- The Te Aitanga a Māhaki Iwi Management Plan.

Considerations

This tool provides an immediate visual representation of the state of a waterbody across a range of values. It is therefore useful for providing an understanding of the range of factors affecting mauri at any one time. As with all tools discussed in this report, the decision on whether the Mauri Compass is the most appropriate tool for a local situation needs to remain with local iwi and hapū.

FIGURE 4-6: IWI MEMBERS INVESTIGATING THE STATE OF A TUNA AS PART OF THE MAURI COMPASS ASSESSMENT. PHOTO: MAURICOMPASS.COM

References

www.mauricompass.com

[22] Tribal area; region

4.4 Mauri Model/Mauri-o-meter/Ngāti Mākino Model

Mauri Model	
Tool name	Mauri Model (also known as the Mauri-o-meter or Ngāti Mākino Model)
Designed by	Te Kipa Kepa Brian Morgan
Available at	Numerous academic papers describing the tool are available, but in general it is best sourced through direct instruction from the developer.
Digital version	No. The spreadsheets used for calculations are digital, but there is no portable app for field use available.
Developed/in use since	~2003
Variants	To some extent. It has been applied in different situations with different weightings and ranges of scores, but the underlying structure remains consistent.

Overview

The Mauri Model is a tool to help to incorporate iwi values and viewpoints into decision-making, particularly around engineering projects such as stormwater infrastructure.

Often, iwi views are overlooked in selecting engineering solutions, predominantly in favour of economic considerations. The Mauri Model helps decision-makers to avoid this, and to adequately weight iwi views.

Fundamentally, it works by asking a team of assessors to judge the effect that a particular option will have on the mauri, from a range of categories from mauri-enhancing to mauri-degrading. The Mauri Model is not a tool to collect mātauranga Māori about the current state of a waterbody or ecosystem, but is instead focused on selecting between options for future projects. The developer states that, “This tool is

intended to significantly improve the quality of decision-making within and outside the engineering profession".

How to use

Participants assess options to determine what effect each option will have on the mauri. Each option is given a rating depending on how it will affect mauri. The descriptions and scores are listed below[23].

Enhancing	mauri kaha	+ 2
Maintaining	mauri ora	+ 1
Neutral	mauri māori	0
Diminishing	mauri kino	- 1
Destroying	mauri mate	- 2

These ratings are applied for each option across four 'contexts' – economic, social, cultural, and environmental. Some examples are given below.

Example one: **Discharge to water**	**Example two:** **Full treatment with land-based disposal**
Economic (whānau) + 2	Economic (whānau) - 1
Social (community) + 1	Social (community) + 2
Cultural (hapū) - 2	Cultural (hapū) + 2
Environmental - 2	Environmental + 2

Finally, these scores are multiplied by a weighting set out by the users before the assessment. This gives a total score between -2 and +2.

Example one: **Discharge to water**	**Example two:** **Full treatment with land-based disposal**
Economic (whānau) + 2 x 10% = 0.2	Economic (whānau) - 1 x 10% = - 0.1
Social (community) + 1 x 20% = 0.2	Social (community) +2 x 20% = 0.4

[23] NB Some versions of the Mauri Model use scores of 1-5 instead of -2 to 2, but the principle is the same.

Cultural (hapū)	- 2 x 30% = - 0.6	Cultural (hapū)	+2 x 30% = 0.6
Environmental	- 2 x 40% = - 0.8	Environmental	+2 x 40% = 0.8
Total score:	**- 1**	**Total score:**	**1.7**

Type of data collected

The data collected using the Mauri Model is scores and rankings of options for engineering or infrastructure projects that reflect a Māori worldview, making it easier for decision-makers to meet their obligations in giving weight to cultural views in RMA and planning matters.

Designed for use by

Trained practitioners, engineers and decision-makers

Places used

Locations in the Bay of Plenty including Tauranga, Rotorua, Tarawera and Rotoitipaku.

Considerations

This is a tool to assist with decision-making around potential mitigation, infrastructure or engineering options. It can help iwi and hapū to make choices based on cultural, social, environmental and economic concerns from a Māori perspective. It is not a monitoring tool *per se*. As with all tools, some iwi and hapū will find it more suitable and aligned with their values than others, and decisions around its use need to rest with iwi and hapū.

References

Morgan (2007), Morgan et al. (2013), Morgan (2006a), Morgan (2006b), Morgan (2015), Nelson and Tipa (2012)

4.5 Cultural flow preference studies

Cultural flow preference studies	
Tool name	Cultural Flow Preference Studies
Designed by	Gail Tipa
Available from	Gail Tipa
Digital version	No
Developed/in use since	2011, with concept development from 2009
Variants	No

Overview

The Cultural Flow Preference Study is a decision-making and negotiation tool. It documents iwi values for and use of a water body, and provides a statistical analysis of iwi satisfaction scores for different flows.

How to use

The first stage entails interviews with iwi members to document kōrero for the rohe, including what aspects are important to the iwi, and the connections to and use of local water bodies. This stage also involves a mapping exercise. This information is then used to develop a set of assessment statements that are specific to that iwi or hapū and the waterbody in question. The assessment statements often cover three main categories:

- cultural use,
- wai, and
- cultural landscape and health and well-being.

Examples of assessment statements include: “Flow will enable use of the site for kai gathering”; “Flow will keep riparian wetlands, springs, or tributaries connected to the mainstem”, and “Flow will protect features important in tribal stories, waiata”.

Iwi members then use these statements to assign a score of 1-7 for different flow levels, with 1 being little or no satisfaction, 4 being moderate satisfaction and 7 being

very satisfied. Flows can be assessed throughout the year if the assessments are undertaken independently by the iwi, or assessments can be undertaken in pre-arranged blocks if the iwi is working collaboratively with a consent holder who has the ability to set river flows, for example through dam releases. Information on flow levels needs to be accessed for each flow assessment event, either through specific hydrological assessments or through use of existing flow monitoring data (e.g. regional council monitoring or consent-holder monitoring). Statistical analyses of the scores are calculated, producing data on potential flow regimes that will meet iwi requirements and aspirations.

Type of data collected

Iwi kōrero, mapping information, and satisfaction scores on different flow levels.

Designed for use by

The developer, to assist iwi and hapū during flow-setting procedures, such as in resource consent hearings and appeals, negotiations with applicants, or in plan reviews. It can also be used to monitor impact on cultural values of an established flow regime.

Places used

Upper Whangaehu, Kakaunui, Waimakariri/Selwyn-Te Waihora

References

Tipa (2009, 2012), Tipa and Severne (2010), Tipa and Nelson (2011, 2012), Tipa and Associates (2013), Rainforth (2014), (Hayes et al., 2014)

4.6 Wai Ora Wai Māori

Wai Ora Wai Māori	
Tool name	Wai Ora Wai Māori
Designed by	Kiri Reihana, Shaun Awatere, Mahuru Robb, Garth Harmsworth, Yvonne Taura, Evelyn Forrest, John Te Maru, Erina Watene-Rawiri
Available from	Landcare Research Manaaki Whenua
Digital version	Yes, available as an app and supported by a database.
Developed/in use since	2017
Variants	Currently two versions of the tool exist. However, this is a new tool and versions are currently being developed for other iwi.

Overview

Wai Ora Wai Māori is a framework that utilises iwi and hapū-specific mātauranga and tikanga to assess the health of local waterbodies. It is available as a paper-based version and as a digital app with a supporting database.

It is deliberately aligned with the National Objectives Framework and can be used to set limits in a Freshwater Management Unit. It is developed collaboratively with Landcare Research Manaaki Whenua and interested iwi and hapū.

FIGURE 4-7: THE WAI ORA WAI MĀORI FRAMEWORK AND APP IN USE. PHOTO: KIRI REIHANA, MANAAKI WHENUA

How to use

The development team (which includes iwi members) firstly conducts research to understand attributes important to local iwi and hapū. This is achieved through wānanga and interviews, and a review of any relevant literature. These important attributes are refined to a manageable number (usually six), and grouped into domains (usually three). This stage is unique to each iwi or hapū wishing to use the framework, and results in different attributes and domains (see Table 4-3 for an example of domains and attributes of the two versions currently in use – one for Waikato Tainui and one for Ngāti Tahu-Ngāti Whaoa).

TABLE 4-3: DOMAINS AND ATTRIBUTES DEVELOPED BY WAIKATO-TAINUI AND NGĀTI TAHU-NGĀTI WHAOA FOR USE IN THE WAI ORA WAI MĀORI ASSESSMENT TOOL

Waikato-Tainui Framework		**Ngāti Tahu-Ngāti Whaoa Framework and app**	
Domain	**Attributes**	**Domain**	**Attributes**
Taha Kikokiko – Physical or biophysical type attributes	Kai is safe to eat – taonga species like kāeo[24], tuna, and īnanga are safe for human consumption.	Taiao Ora – Flourishing nature	Is it safe to eat taonga species from this site? Taonga species like kōura, tuna, and watercress are safe for human consumption.
	Kai has a strong whakapapa – taonga species like kāeo, tuna,		Do taonga species have a suitable habitat? Taonga species like kōura,

[24] freshwater mussels, kākahi

	and īnanga are part of a flourishing ecosystem.		tuna, and watercress are part of a flourishing ecosystem.
Taha Whānau – Social type attributes	Whānau satisfaction – whānau well-being is enhanced or diminished through the availability of taonga species at functions like hui and tangihanga.	Whānau Ora – thriving families	Can whānau exercise manaakitanga? The ability for whānau to support the well-being of both themselves and wider whānau, is enhanced or diminished through the availability of taonga species at functions like hui, tangihanga.
	Kaitiaki are effective – the ability to practise what is correct from an iwi and hapū position (tikanga), e.g. maramataka[25], rāhui[26], karakia[27], and wānanga[28], etc.		Can whānau participate effectively in whānaungatanga? The ability to practise taonga tuku iho – intergenerational knowledge transfer, e.g. maramataka, rāhui, and wānanga etc.
Taha Wairua – Metaphysical or spiritual type attributes	Condition of mauri – resilience and adaptation of ecosystems as measured by the level of life-force.	Domain: Mauri Ora – The essence of vitality	Are the senses awakened at the mahinga kai site? Connecting to the mahinga kai site using all 5 senses.
	Condition of kaitiaki/tipua/taniwha[29] – resilience and connectivity of human beings to metaphysical beings such as kaitiaki/tipua/taniwha.		Do tangata tiaki feel connected to the mahinga kai site? Acknowledgement of feeling connected to the mahinga kai site.

[25] Māori calendar, incorporating knowledge such as indicators on when to plant and when to fish
[26] a restriction placed on an area or resource
[27] prayers
[28] higher learning
[29] kaitiaki, tipua and taniwha are spiritual beings and guardians

Once this stage is completed, iwi members complete field evaluations of the state of the attributes. Attribute guidance is available to guide observers' decisions (see Table 4-4 for an example). Some fields are an āe/kāo (yes/no) assessment, while others are arranged on a Likert scale (Table 4-4). Āe/kāo answers are given values of 1 for āe and 0 for kāo, and these are added to the Likert scores to reach a cumulative total score. Cumulative scores given by individual observers are then averaged to give an overall site score (see Table 4-5 for example). A minimum of three assessments must be completed to give robust results and accuracy in the overall score. The overall site score is categorised into a band in the A-D range, as follows:

- A = 17–21
- B = 12–16
- C = 7–11
- D = 2–6

The bands can be used for reporting, and for setting standards, targets or limits. Iwi and hapū can, for example, determine that while their local waterbody is currently in the C-band, they want to restore it to an A-band. This can feed into the setting of values and attribute states required under the NPS-FM.

The developers recommend that narrative and commentary taken from observers' notes also accompany any reporting on overall score or band, to give a rounded picture of the cultural assessment.

TABLE 4-4: ASSESSMENT TYPE, SCORE RANGE, AND MEASURES/ATTRIBUTE GUIDANCE FOR ATTRIBUTES UNDER THE TAIAO ORA DOMAIN IN THE NGĀTI TAHU-NGĀTI WHAOA VERSION OF THE WAI ORA WAI MĀORI TOOL

Taiao Ora – Flourishing Nature		
Is it safe to eat taonga species from this site?		
ĀE	1	Kōura: Tail is tightly curved
KĀO	0	Kōura: Tail muscle underneath is porcelain white, or other signs of disease
ĀE	1	Tuna: Has an even colouring, fins are intact and eyes are bright
KĀO	0	Tuna: Looks dull or pale with visible signs of boils, ulcers, parasites, and pale eyes
ĀE	1	Watercress: No evidence of animal grazing, young shoots
KĀO	0	Watercress: Evidence of recent grazing by animals, or in flower, green/purple stalks, located close to riparian margins
Do taonga species have a suitable habitat?		
PAI RAWA	4	Is the habitat capacity very strong and is there minimal impact from invasive pest species and land-use change
PAI	3	Is the habitat capacity strong and is there some impact from invasive pest species and land-use change
ĀHUA PAI	2	Is the habitat capacity limited and is there significant impact from invasive pest species and land-use change

PŌHARA	1	Is the habitat capacity severely limited and is there significant impact from invasive pest species and land-use change
AUĒ	0	Is the habitat capacity very severely limited and is there significant impact from invasive pest species and land-use change

Type of data collected

In the creation of the app, the data collected involves interviews and cultural kōrero. In the use of the app, data captured includes evaluations, observations, notes and photographs.

Designed for use by

Iwi members, from young to old, regardless of experience levels.

Places used

Waikato, Bay of Plenty

TABLE 4-5: MANGAKARA STREAM ASSESSMENTS USING THE WAI ORA WAI MĀORI TOOL

MAHINGA KAI	Kaimahi 1	Kaimahi 2	Kaimahi 3	Kaimahi 4
Ingoa	Mangakara	Mangakara	Mangakara	Mangakara
Ra	21/04/2017	21/04/2017	21/04/2017	21/04/2017
Wa	10.40:00 a.m.	10.40:00 a.m.	10.40:00 a.m.	10.40:00 a.m.
Taunga	38°27'11.18"S, 176°19'33.66"E	38°27'11.18"S, 176°19'33.66"E	38°27'11.18"S, 176°19'33.66"E	38°27'11.18"S, 176°19'33.66"E
TAIAO ORA				
Is it safe to eat taonga species from this site?	AE	AE	AE	AE
Do toanga species have a suitable habitat?	PAI	POHARA	AHUA PAI	AHUA PAI
WHANAU ORA				
Can whanau exercise manaakitanga?	POHARA	AHUA PAI	AHUA PAI	AHUA PAI
Can whanau particpate effectively in whanaungatanga?	AHUA PAI	AHUA PAI	POHARA	AHUA PAI
MAURI ORA				
Are the senses awakened at the mahinga kai site?	MAURI OHO	MAURI OHO	MAURI OHO	MAURI PIKI
Do tangata tiaki feel connected to the mahinga kai site?	MAURI OHO	MAURI OHO	MAURI OHO	MAURI OHO
MAHINGA KAI INDEX SCORE	11	10	10	12
AGGREGATE SITE SCORE				**11**

Considerations

As with all mātauranga Māori tools, the decisions on whether and how to use the Wai Ora Wai Māori tool needs to rest with iwi and hapū. One safeguard built-in to Wai Ora Wai Māori is that it is designed so that iwi are the administrators and managers of the framework, app and all collected data. This allows iwi to retain control over the sensitive

cultural data used in its development and over the observation data produced through field assessments. This protects iwi and hapū intellectual property surrounding this tool.

In their material about the tool, the developers rightly point out that iwi need to be resourced to participate in monitoring and planning processes. This applies to the development and use of the Wai Ora Wai Māori tool, as well as to other tools covered in this document.

The app can easily be adapted to other iwi, waterbodies, or environments.

References

Awatere et al. (2017), Taura et al. (2018)

4.7 Cultural mapping

Cultural mapping	
Tool name	There is no one tool name for this, instead it covers a generic method
Designed by	N/A
Available from	Iwi interested in undertaking mapping projects could contact Te Kāhui Manu Hōkai, the Māori GIS Association on https://www.tekahuimanuhokai.org
Digital version	Yes – e.g. GIS and Google Earth
Developed/in use since	N/A
Variants	Multiple approaches to this tool exist.

Overview

Cultural mapping covers a wide range of purposes and functions. It can capture broad-scale values for an area, cultural perspectives, uses and practices, specific site knowledge, and mātauranga around spiritual and metaphysical elements. For freshwater monitoring purposes, cultural mapping can be applied to determine what species were once present in a waterbody, how abundant those species were, what cultural practices occurred in an area, and what the special values and metaphysical aspects of a place are. Ngāi Tahu have a comprehensive cultural mapping project accessible online (Figure 4-8).

http://www.kahurumanu.co.nz/atlas

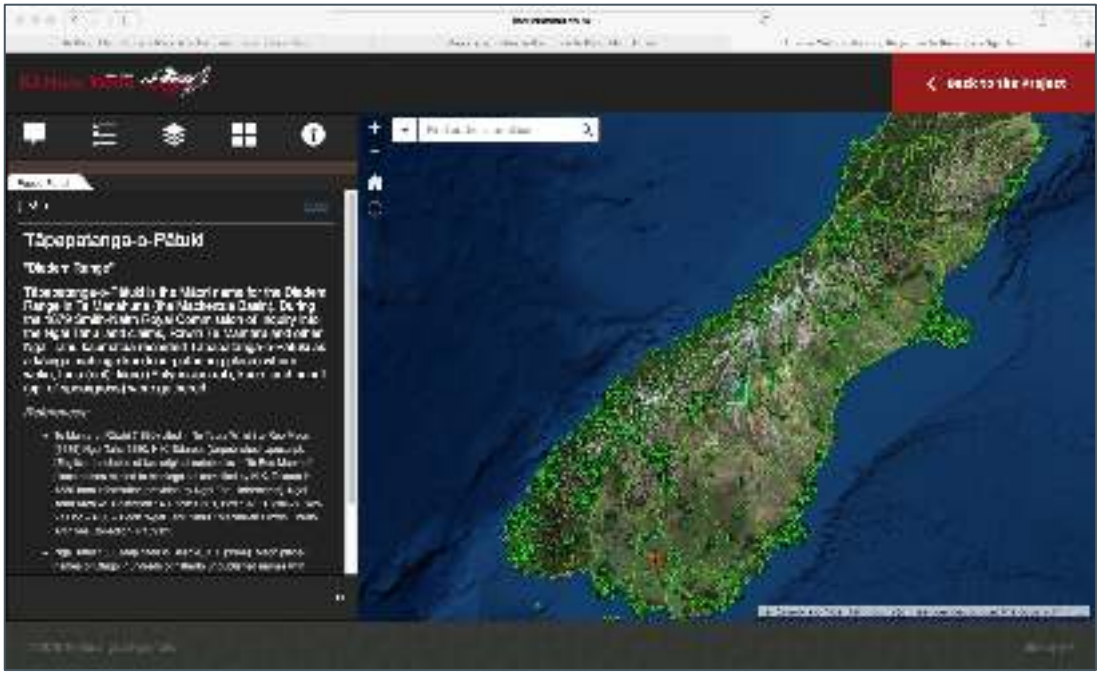


FIGURE 4-8: A SCREENSHOT FROM KĀ HURU MANU, THE NGĀI TAHU MAPPING PROJECT. SOURCE: HTTP://WWW.KAHURUMANU.CO.NZ/ATLAS. ACCESSED 31 AUGUST 2018

Cultural mapping is also used as part of a number of tools and approaches around mātauranga Māori, including cultural flow preference studies, which can involve Cultural Opportunity Mapping Assessment (COMA) and Cultural Opportunity Mapping Assessment and Responses (COMAR) techniques.

How to use

Most cultural mapping either utilises GIS software or Google Earth. It captures whānau, hapū and iwi information and translates this into a visual format. Cultural mapping often involves a process of collecting data from a myriad of sources – for example manuscripts, iwi documents, interviews and old maps – and collating this into a database. Data is usually analysed and categorised during this process. Harmsworth (1997) provides one of the first models of cultural mapping in Aotearoa (Figure 4-6). The data can then be used by iwi for retention and transfer of cultural knowledge, resource management processes such as producing evidence in consenting matters and participating in regional plan development, environmental work such as restoration projects, and, relevant to this report, freshwater monitoring.

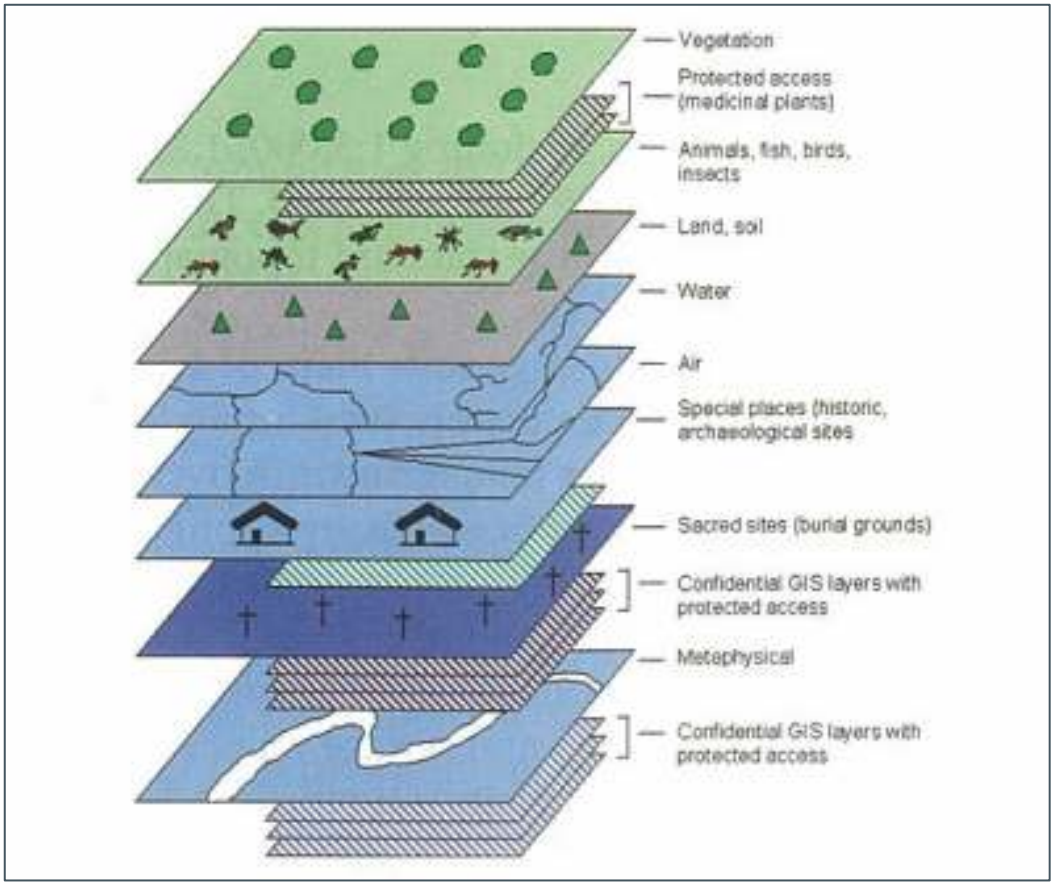


FIGURE 4-6: CONCEPTUAL MODEL OF GIS LAYERS FOR MĀTAURANGA MĀORI IN CULTURAL MAPPING PROJECTS

Type of data collected

The type of data collected usually involves mātauranga around resource use, cultural practices, species distributions and abundance. The raw data used to create the maps can be captured in interviews, video recordings, physical maps (including overlays) or sourced from historical maps, archival records, and writings such as manuscripts, land court records, briefs of evidence, iwi environmental plans and Waitangi Tribunal reports.

Designed for use by

Iwi, hapū and whānau, primarily. Information can be provided to councils for use in planning and consenting processes at the discretion of iwi, hapū and whānau.

Places used

Widely used across Aotearoa.

Considerations

Cultural mapping by nature involves capturing very sensitive data. Public access to all layers is likely to be restricted. If councils are working with iwi and hapū on mapping projects, protection mechanisms for the data will need to be established. Harmsworth (1997) provides guidance on some means to achieve this. He suggests recording the information as silent or concealed files, recording the information as an overlay with a

grid network that does not identify the actual location of restricted data (e.g. sacred sites) but gives an indication that sensitive data exists in that general area, and setting up a directory to direct an inquirer to a particular person or organisation for information.

References

Tipa (2013), Harmsworth (1997), Harmsworth (1998), Tipa and Severne (2010), Tipa (2010), Tipa and Nelson (2012), Harmsworth et al. (2005)

4.8 Māori environmental performance indicators for wetland condition and trend

Māori EPIs for wetlands	
Tool name	Coordinated Monitoring of New Zealand Wetlands, Phase 2, Goal 2: Māori environmental performance indicators for wetland condition and trend
Designed by	Garth Harmsworth, Landcare Research
Available from	Garth Harmsworth, Landcare Research, or from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.485.6751&rep=rep1&type=pdf
Digital version	No
Developed/in use since	2002
Variants	No

Overview

The Māori environmental performance indicators for wetland condition and trend were developed to enable the assessment of wetlands from an iwi and hapū perspective. The work was part of a larger project comprising four goals:

- science-based indicators for wetland condition and trend
- a generic set of mātauranga Māori based indicators for wetland condition and trend (this tool)
- an illustrated field guide and key to the national wetland classification, and
- a handbook for managers.

The developer (in conjunction with iwi representatives) considered a large number of factors in order to select mātauranga Māori-based indicators, such as availability/access to scientific and mātauranga Māori knowledge, tikanga, previous knowledge of wetlands, and other organisational frameworks (e.g. Māori Environmental

Performance Indicators (MEPIs), Māori classification systems, methodologies, and the ability to record and analyse information). Various methods were used to establish the indicators, such as understanding Māori concepts for environmental monitoring, and developing Māori methods for environmental assessment and SOE reporting by working with a number of iwi and hapū representatives, researchers and kaitiaki communities.

It was considered critical to create a conceptual and culturally appropriate process and framework that included whakapapa, te reo, mauri, tikanga, kaitiakitanga, and Māori frameworks and classifications (e.g. wāhi tapu, mahinga kai and waiora). The aim was to create a process that allowed:

- information on wetlands to be collected and stored;
- spatial databases on wetlands to be created;
- mātauranga on wetlands to be legitimised and acknowledged;
- wetlands to be restored;
- the status, changes, modification and restoration of wetlands through time to be monitored in a robust manner
- monitoring systems for use by kaitiaki or tangata whenua to monitor the health of wetlands to be made available; and
- mātauranga Māori-based contributions to be made to state-of-the-environment reporting.

The indicators

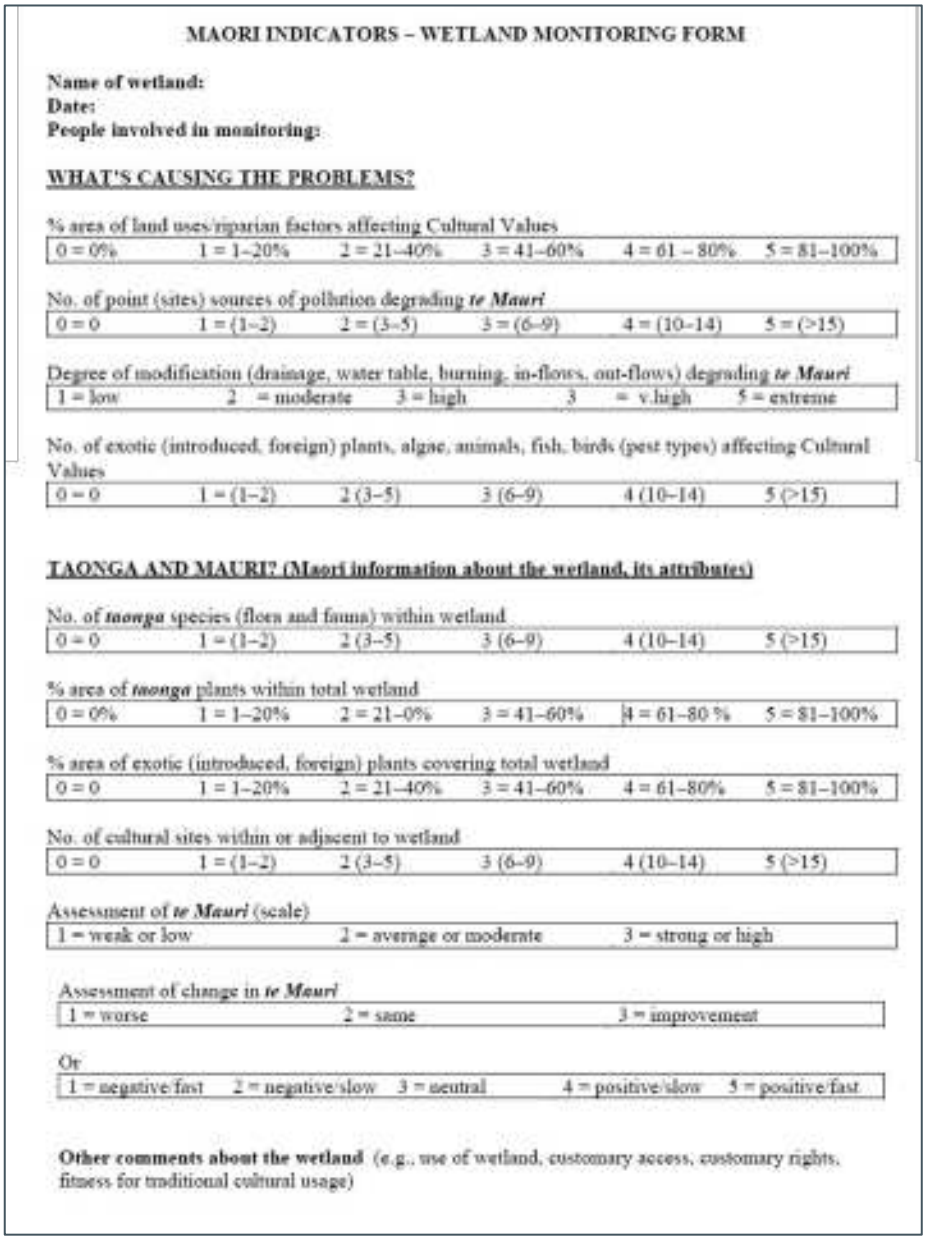
Nine key indicators were chosen through a comprehensive selection process (see below). Each of the indicators are based on Māori knowledge and can be used to monitor positive and negative environmental changes. Indicators four to eight were deemed most critical for assessing environmental change from a Māori perspective.

1. Percentage (%) area of land uses/riparian factors affecting cultural values
2. Number of point (sites) sources of pollution degrading te mauri
3. Degree of modification (draining, water table, in-flows, out-flows) degrading te mauri
4. Number of (and change of) unwanted (e.g., exotic, introduced, foreign) plants, algae, animals, fish, birds (pest types) affecting cultural values
5. Number of (and change of) taonga species within wetland
6. % area of (and change in area) taonga plants within total wetland
7. % area of (and change in area) unwanted (e.g. exotic, introduced, foreign) plants covering total wetland
8. Assessment of, and change in te mauri (scale) (where mauri is defined by numerous factors – some examples are listed in the paper)
9. Number of cultural sites protected within or adjacent to wetland.

How to use

The developer has provided a wetland monitoring form (Figure 4-7) and methodology for measuring and recording data for each indicator. However, as there are no specific ‘how

to' instructions, those wishing to use this methodology may find it beneficial to be supported by someone trained by the developer. Suggestions on how data might be analysed and presented were offered by the developer, and are shown in Figure 4-8 and Figure 4-9.



MAORI INDICATORS – WETLAND MONITORING FORM

Name of wetland:
Date:
People involved in monitoring:

WHAT'S CAUSING THE PROBLEMS?

% area of land uses/riparian factors affecting Cultural Values

0 = 0%	1 = 1–20%	2 = 21–40%	3 = 41–60%	4 = 61 – 80%	5 = 81–100%

No. of point (sites) sources of pollution degrading ***te Mauri***

0 = 0	1 = (1–2)	2 = (3–5)	3 = (6–9)	4 = (10–14)	5 = (>15)

Degree of modification (drainage, water table, burning, in-flows, out-flows) degrading ***te Mauri***

1 = low	2 = moderate	3 = high	3 = v.high	5 = extreme

No. of exotic (introduced, foreign) plants, algae, animals, fish, birds (pest types) affecting Cultural Values

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (10–14)	5 (>15)

TAONGA AND MAURI? (Maori information about the wetland, its attributes)

No. of ***taonga*** species (flora and fauna) within wetland

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (10–14)	5 (>15)

% area of ***taonga*** plants within total wetland

0 = 0%	1 = 1–20%	2 = 21–0%	3 = 41–60%	4 = 61–80 %	5 = 81–100%

% area of exotic (introduced, foreign) plants covering total wetland

0 = 0	1 = 1–20%	2 = 21–40%	3 = 41–60%	4 = 61–80%	5 = 81–100%

No. of cultural sites within or adjacent to wetland

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (10–14)	5 (>15)

Assessment of ***te Mauri*** (scale)

1 = weak or low	2 = average or moderate	3 = strong or high

Assessment of change in ***te Mauri***

1 = worse	2 = same	3 = improvement

Or

1 = negative/fast	2 = negative/slow	3 = neutral	4 = positive/slow	5 = positive/fast

Other comments about the wetland (e.g., use of wetland, customary access, customary rights, fitness for traditional cultural usage)

FIGURE 4-7: MĀORI INDICATORS — WETLAND MONITORING FORM. SOURCE: HARMSWORTH (2002)

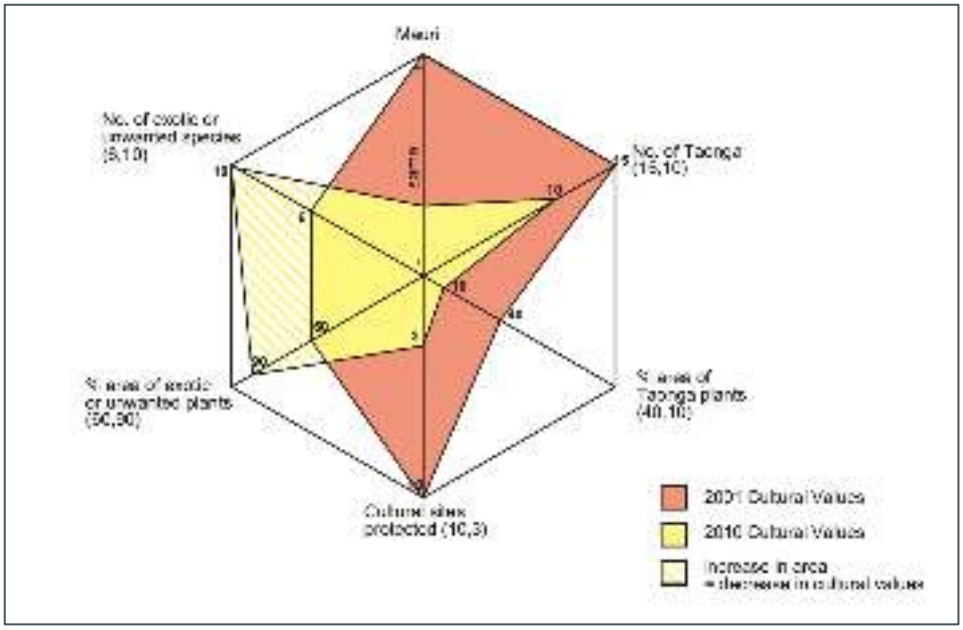


FIGURE 4-8: A RADAR MAP DEMONSTRATING HOW DATA FROM MĀTAURANGA MĀORI-BASED WETLAND MONITORING INDICATORS MIGHT BE ANALYSED AND PRESENTED. SOURCE: HARMSWORTH (2002)

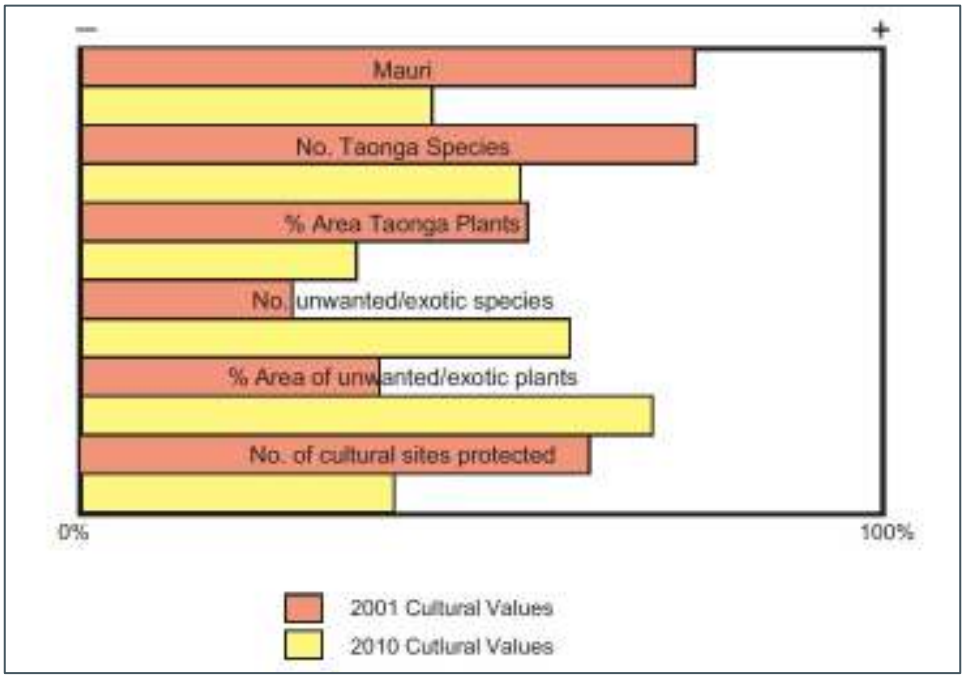


FIGURE 4-9: A BAR GRAPH DEMONSTRATING HOW DATA FROM MĀTAURANGA MĀORI-BASED WETLAND MONITORING INDICATORS MIGHT BE ANALYSED AND PRESENTED. SOURCE: HARMSWORTH (2002)

Type of data collected

The monitoring methodology collects several types of quantitative and qualitative data that can be incorporated into state of the environment reporting, if so desired by iwi and hapū, for example:

- presence and spatial extent, such as presence and spatial extent of culturally significant species. (Asking, for example, what is present, what was there and what has changed.)
- quantity of culturally significant species (e.g. areal extent, density, population, access); and
- quality or condition of culturally significant species (e.g. mauri and assessments of health).

Designed for use by

Iwi and hapū organisations individually and/or in collaboration with regional and local councils, central government and community organisations.

Places used

Developed and trialled with various iwi, hapū and Māori organisations including: Tainui (Makaurau Marae), Ngāti Te Ata, Te Arawa, Ngāti Naho, Hauraki, Ngāti Rauhoto, Ngāti Te Urunga, Ngāti Tūwharetoa, Ngāti Raukawa, Ngāti Tukorehe, Ngāti Rārua, Te Āti Awa, Ngāti Tama and Ngāi Tahu.

Considerations

Because this method was intentionally designed to apply nationally, it should be usable in any rohe across Aotearoa. However, the same considerations around iwi and hapū retaining the mana to select the tools they wish to use apply here as for other tools, as do considerations around sensitive information and intellectual property.

References

Harmsworth (2002)

4.9 Mauri of Waterways Kete and Framework

Mauri of Waterways Kete	
Tool name	Mauri of Waterways Kete and Framework
Designed by	Richard Jefferies and Nathan Kennedy
Available from	https://researchcommons.waikato.ac.nz/handle/10289/895
Digital version	No
Developed/in use since	2009
Variants	No

Overview

The Mauri of Waterways Kete and Framework is one of three kete, the other two being Mana Whenua and Wāhi Tapu. The kete and framework were developed within a wider international research programme, the Planning Under a Cooperative Mandate project. The focus for the Mauri of Waterways work was "to develop effective tools for use by RMA practitioners that reflect a kaupapa Māori perspective" (Jefferies and Kennedy, 2009c).

It was a multi-year project, the first stage of which was to develop a kaupapa Māori framework upon which kaupapa Māori outcome and indicator tools would be based (Kennedy and Jefferies, 2009b). This resulted in a "workable method for assessing by councils, iwi and Crown agencies environmental outcomes, including those resulting from statutory plan processes, from a Māori perspective" (Jefferies and Kennedy, 2009c).

The Mauri of Waterways Kete and Framework is primarily a framework and tool for assessing how well council plans and the implementation of those plans meet Māori expectations for environmental outcomes. The report authors describe the purposes of the research as:

1. interpreting anticipated environmental results (AERs) relating to Māori issues in district and regional plans;
2. evaluating a Māori view of the state of the environment, leading to the selection of indicators for relevant AERs (outcomes); and
3. assessing the effectiveness of the district plan in achieving its desired AERs (Jefferies and Kennedy, 2009c).

They envisaged that the product of the research would be to:

1. provide a framework and methods for Māori and councils to assess the achievement of AERs (outcomes) from a Māori perspective;
2. determine and explain differences between Māori and Council in AER; and
3. determine what will improve AER achievement for Māori (Jefferies and Kennedy, 2009c).

As such, the tool can help councils build a monitoring plan that assesses environmental trends not only for general improvement or decline, but also whether those changes are meeting iwi and hapū aspirations. Of note is that the Mauri of Waterways Kete assessment evaluates not only council actions and effects on mauri, but those of iwi, other agencies and the wider community. The entire research project was conducted according to kaupapa Māori principles; this in itself provides useful examples of appropriate approaches to Māori-based research.

How to use

There are multiple reports produced for the project, with Ngā Mahi: A Kaupapa Māori Outcomes and Indicators Kete PUCM Māori Report 2 (Jefferies and Kennedy, 2009b) providing the most detailed description on how to use the kete. Worksheets were developed for all three kete, with the following structure:

- Kaupapa: the overarching principle to which outcomes and indicators relate;
- Tikanga: the high-level principle or rule which must be upheld;
- Outcome: a single expression of a group's ideal result for a particular tikanga;
- Indices: a series of indicators grouped by theme;
- Indicators: the high-level enquiry for evaluating whether outcomes are being achieved;
- Measures: lower-level enquiry or method, several of which collectively provide the information required for an indicator.

Each index has three to five indicators, and each of these in turn has up to seven measures.

The list of indices and indicators for the Mauri of Waterways Kete is shown in Figure 4-10, however given the full set of worksheets for this kete runs to 20 pages, only a sample of the assessment forms are shown. Figure 4-11 and Figure 4-12 show:

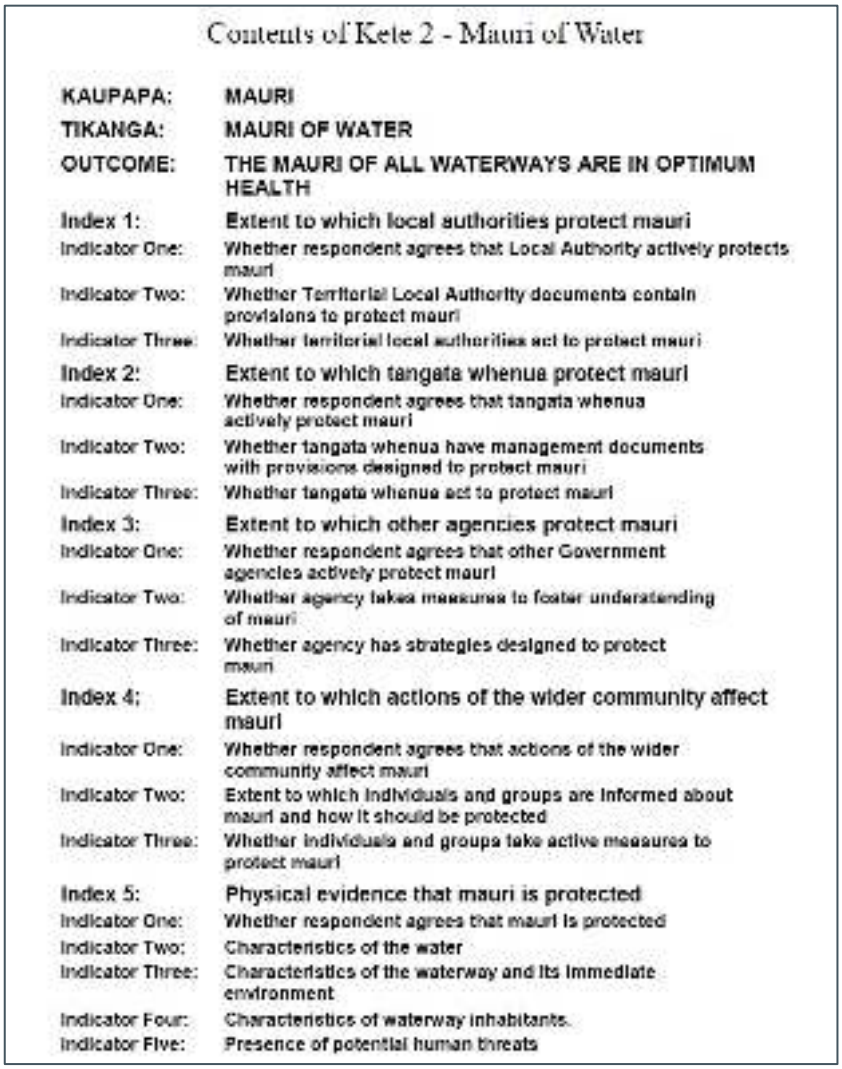
- Index 1: Extent to which Local Authorities Protect Mauri
- Indicator 3: Whether territorial local authorities act to protect mauri

- Measure 4: Territorial Local Authorities have a track record in the protection of mauri

and Figure 4-12 shows:

- Index 5: Physical evidence that mauri is protected
- Indicator 4: Characteristics of waterway inhabitants
- Measure 3: Health of fish present.

Figure 4-13 shows the penultimate page of the overall scoring form, to give readers an idea of how the tool works as a whole and the range of measures in the kete.



Contents of Kete 2 - Mauri of Water

KAUPAPA:	**MAURI**
TIKANGA:	**MAURI OF WATER**
OUTCOME:	**THE MAURI OF ALL WATERWAYS ARE IN OPTIMUM HEALTH**
Index 1:	Extent to which local authorities protect mauri
Indicator One:	Whether respondent agrees that Local Authority actively protects mauri
Indicator Two:	Whether Territorial Local Authority documents contain provisions to protect mauri
Indicator Three:	Whether territorial local authorities act to protect mauri
Index 2:	Extent to which tangata whenua protect mauri
Indicator One:	Whether respondent agrees that tangata whenua actively protect mauri
Indicator Two:	Whether tangata whenua have management documents with provisions designed to protect mauri
Indicator Three:	Whether tangata whenua act to protect mauri
Index 3:	Extent to which other agencies protect mauri
Indicator One:	Whether respondent agrees that other Government agencies actively protect mauri
Indicator Two:	Whether agency takes measures to foster understanding of mauri
Indicator Three:	Whether agency has strategies designed to protect mauri
Index 4:	Extent to which actions of the wider community affect mauri
Indicator One:	Whether respondent agrees that actions of the wider community affect mauri
Indicator Two:	Extent to which individuals and groups are informed about mauri and how it should be protected
Indicator Three:	Whether individuals and groups take active measures to protect mauri
Index 5:	Physical evidence that mauri is protected
Indicator One:	Whether respondent agrees that mauri is protected
Indicator Two:	Characteristics of the water
Indicator Three:	Characteristics of the waterway and its immediate environment
Indicator Four:	Characteristics of waterway inhabitants.
Indicator Five:	Presence of potential human threats

FIGURE 4-10: THE CONTENTS, INCLUDING INDICES AND INDICATORS, FOR THE MAURI OF WATERWAYS KETE. SOURCE: JEFFERIES AND KENNEDY (2009B)

Measure 4. Territorial Local Authorities have a track record in the protection of mauri

Level	Description	Ideal	Actual
Level 5	A large number of Council activities contribute significantly toward the improvement of the mauri of waterways		
Level 4	Council activities have had a slightly positive effect on the mauri of waterways		
Level 3	Council activities have had a neutral effect on the health and protection of mauri		
Level 2	Council activities have had a slightly negative effect on the mauri of waterways		
Level 1	Evidence suggests that overall Council activities have a strongly negative effect on mauri		

Other / Comments

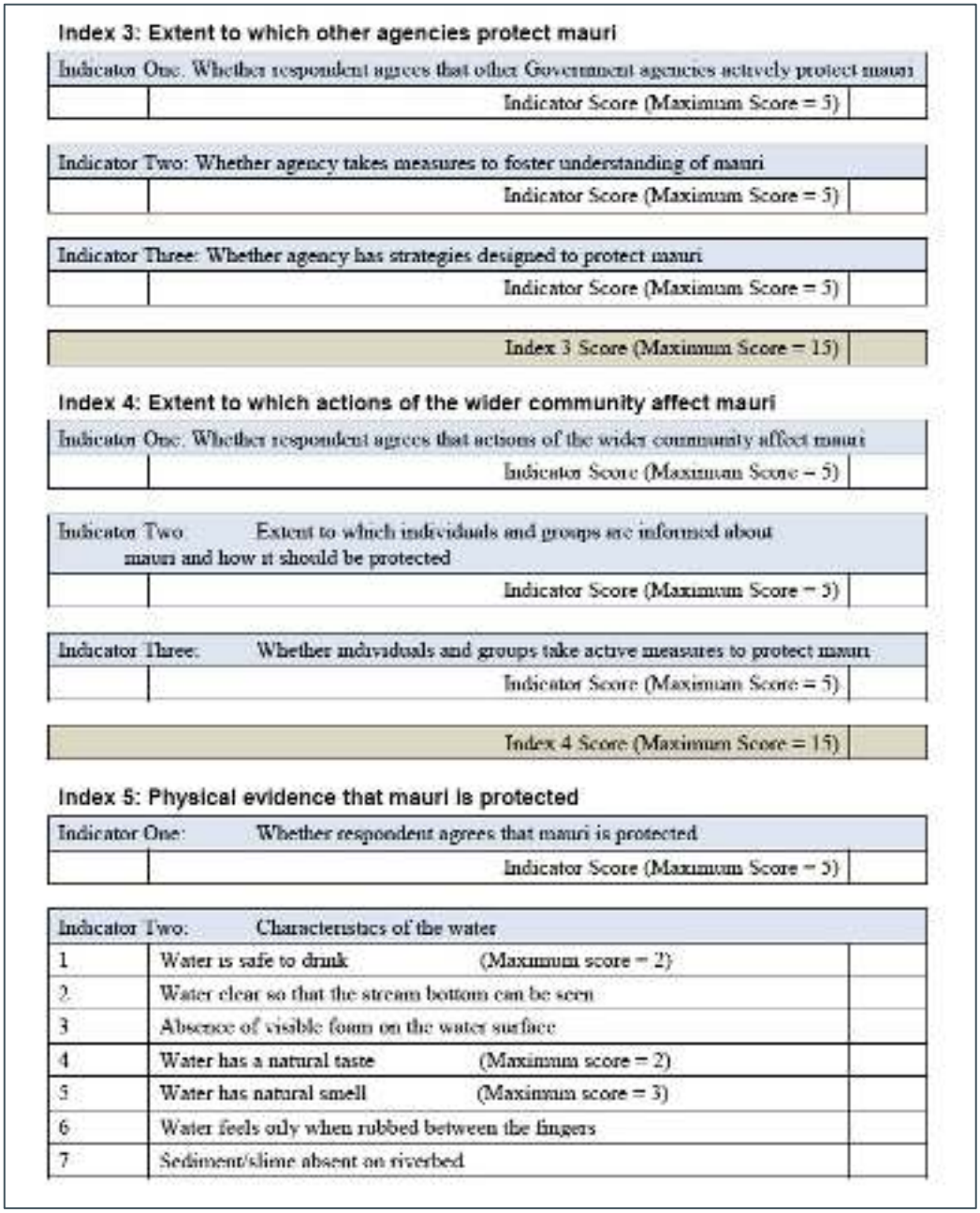
FIGURE 4-11: INDEX 1, INDICATOR 3, MEASURE 4 FROM THE MAURI OF WATERWAYS KETE. SOURCE: JEFFERIES AND KENNEDY (2009B)

Measure 3. Health of fish present

Level	Description	Ideal	Actual
Level 5	All specimens are healthy		
Level 4	Very rarely unhealthy or dead fish found		
Level 3	Sometimes unhealthy or dead fish found – but in small numbers		
Level 2	Frequently unhealthy or dead fish found – increasing numbers		
Level 1	Unhealthy or dead specimens are common		

Other / Comments

FIGURE 4-12: INDEX 5, INDICATOR 4, MEASURE 3 FROM THE MAURI OF WATERWAYS KETE. SOURCE: JEFFERIES AND KENNEDY (2009B)



Index 3: Extent to which other agencies protect mauri

Indicator One. Whether respondent agrees that other Government agencies actively protect mauri		
	Indicator Score (Maximum Score = 5)	

Indicator Two: Whether agency takes measures to foster understanding of mauri		
	Indicator Score (Maximum Score = 5)	

Indicator Three: Whether agency has strategies designed to protect mauri		
	Indicator Score (Maximum Score = 5)	

	Index 3 Score (Maximum Score = 15)	

Index 4: Extent to which actions of the wider community affect mauri

Indicator One. Whether respondent agrees that actions of the wider community affect mauri		
	Indicator Score (Maximum Score = 5)	

Indicator Two Extent to which individuals and groups are informed about mauri and how it should be protected		
	Indicator Score (Maximum Score = 5)	

Indicator Three: Whether individuals and groups take active measures to protect mauri		
	Indicator Score (Maximum Score = 5)	

	Index 4 Score (Maximum Score = 15)	

Index 5: Physical evidence that mauri is protected

Indicator One: Whether respondent agrees that mauri is protected		
	Indicator Score (Maximum Score = 5)	

Indicator Two: Characteristics of the water		
1	Water is safe to drink (Maximum score = 2)	
2	Water clear so that the stream bottom can be seen	
3	Absence of visible foam on the water surface	
4	Water has a natural taste (Maximum score = 2)	
5	Water has natural smell (Maximum score = 3)	
6	Water feels oily when rubbed between the fingers	
7	Sediment/slime absent on riverbed	

FIGURE 4-13: PENULTIMATE PAGE OF THE SCORING SHEET FROM THE MAURI OF WATERWAYS KETE. SOURCE: JEFFERIES AND KENNEDY (2009B)

Type of data collected

Assessments and evaluations of a range of measures affecting the mauri of a waterway

Designed for use by

Iwi and hapū, councils and Crown agencies

Places used

Trialled with Ngāti Maru in Hauraki, Ngāti Awa of Whakatāne, Bay of Plenty Regional Council and with the Matamata-Piako District Council.

Considerations

The three kete together – Mauri of Waterways, Mana Whenua and Wāhi Tapu – provide a comprehensive, well-researched, kaupapa-Māori framework for assessing a range of factors deeply important to iwi and hapū. While the framework is intentionally designed to be usable by iwi nationally, it is, as always, up to local iwi and hapū to determine whether this tool suits their needs.

References

Jefferies and Kennedy (2009c), Jefferies and Kennedy (2009a), Jefferies and Kennedy (2009b), (Kennedy and Jefferies, 2009a, Kennedy and Jefferies, 2009c)

4.10 Waikato River Catchment Report Card

Report Card	
Tool name	The Waikato River Catchment Report Card 2016
Designed by	Bruce Williamson (Diffuse Sources Limited), John Quinn (NIWA), Erica Williams (NIWA), Cheri van Schravendijk-Goodman (Waikato Raupatu River Trust). The framework was guided by an advisory rōpū comprising representatives from five Waikato River iwi.
Available from	https://waikatoriver.org.nz/wp-content/uploads/2016/04/TECHNICAL-SUMMARY-FINAL-MARCH-2016.pdf http://versite.co.nz/~2016/19099/ Waikato River Authority National Institute of Water & Atmospheric Research Ltd
Digital version	No
Developed/in use since	2016
Variants	Multiple

Overview

Report cards are a tool used internationally. Their purpose is to use available data to determine whether certain prescribed values are in a healthy state, and to present this in a summarised form. Report cards aim to 'engage stakeholders in environmental management by communicating information from a range of measures in a condensed, relevant and simple message' (Williamson et al., 2016). Report cards tend to have a strong focus on Western science measures, and are not considered a mātauranga Māori Tool per se.

The Waikato Report Card, however, does take available Western science data and analyse it from an iwi perspective, focusing on eight values that support Te Ture Whaimana, the Vision and Strategy for the Waikato River. These values, called taura[30], cover the cultural, social, environmental and economic health and wellbeing of the Waikato River catchment. The taura were plaited into a taura whiri, or woven cord, by the report card in order to communicate the state of the awa.

How to use

The report card process involves collecting all known and available data relevant to a catchment and presenting it in an accessible format. As described above, the Waikato River Report Card used taura to categorise all of this data. The report card developers describe the taura as 'mega-value sets'. These sets and their subsets are outlined here:

Taura (= mega-value set)	A Healthy Waikato River Catchment (= value sub-sets)
Kai	Fisheries and kai (e.g., tuna, whitebait, kōura, ducks)
Water Quality	Water quality (e.g., clarity, nutrients)
Sites of Significance	Sites of significance (e.g., waahi tapu, place names, historic sites, puna)
Ecological Integrity	Ecology Biodiversity Physical character
Experience	Access Human health (e.g., contaminants) Contact recreation (e.g., *E.coli*) Rubbish Intergenerational response Information / enabling tools Education
Water Security	Water allocation / flow Efficiency and use Environmental flows, hydro ramping
Economics	Economics (e.g., GDP)
Effort	Effort in restoration (e.g., $ invested)

The data gathered under each of these taura was assessed against specific indicators or by best professional judgement (BPJ) and given a grade of A to D, according to whether it met the following:

A. Excellent – delivers in full on the Vision & Strategy for a healthy Waikato River
B. Good – delivers in part on the Vision & Strategy for a healthy Waikato River
C. Low – delivers on only some of the Vision & Strategy for a healthy Waikato River
D. Poor – does not deliver on the Vision & Strategy for a healthy Waikato River

[30] rope

The indicators and BPJs for two of the taura are shown below, as examples. Examples of some of the other indicators in the remaining taura include physical access, median values for total nitrogen, microbiological quality (median readings for *Escherichia coli* at all flows and for the bathing season) and chlorophyll median and maximum values.

The Ecological Integrity Taura

The Ecological Integrity Taura captures the overall wellbeing and biodiversity of species in the catchment, and the health of the ecosystems that naturally support them.

Indicator Group	Indicators and/or Best Professional Judgement (BPJ)
Water quality and sediment	Dissolved oxygen, temperature, ammonia, dissolved As, sediment As, sediment Zn.
Riparian Condition	Riparian (native, exotic, buffer) vegetation, fencing and shade.
Habitat	Presence of native and exotic plants, periphyton, macrophytes, macroinvertebrates.
Fish	Native fish diversity, exotic fish diversity.
Connectivity	Fish passage (dams, culverts, flood gates, tide gates, pumps in the lower Waikato) and hydrology.

The Kai Taura

The Kai Taura covers information about species harvested by tangata whenua and the wider community.

Indicator Group	Indicators and/or Best Professional Judgement (BPJ)
Tuna	Recruitment, relative abundance, condition.
Whitebait	Recruitment, abundance.
Kāeo / Kākahi	Relative abundance, condition, size distribution.
Kōura	Relative abundance, distribution.
Piharau	Recruitment, relative abundance, size composition.

Trout	Recruitment, relative abundance, size composition, condition.
Waterfowl	Relative abundance, regulations, diversity of available species.

The assessments were applied at 17 sites throughout the catchment, with an overall grade given to the entire catchment, as shown in Figure 4-14:

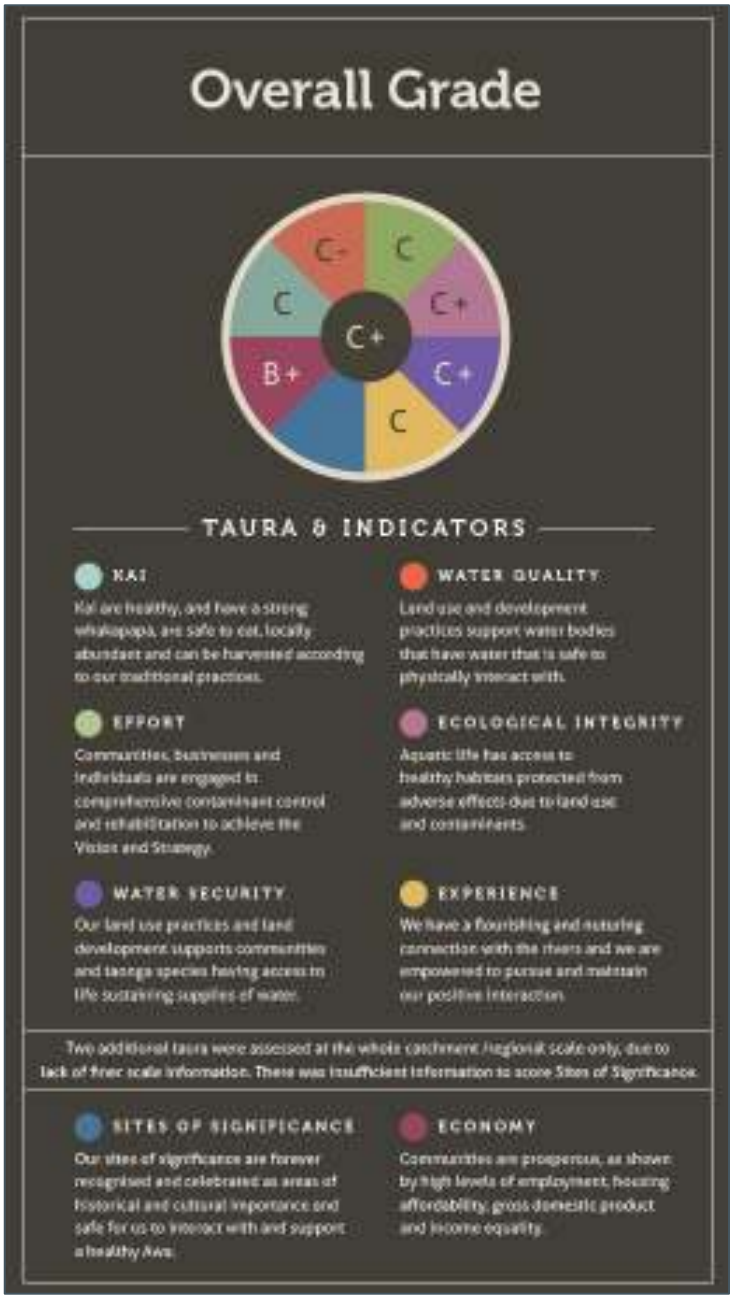


FIGURE 4-14: OVERALL CATCHMENT GRADE

Type of data collected

Data included available information (e.g. from regional council and Western science monitoring programmes) and the best professional judgements of personnel who have worked in the catchment for many years (including staff from Waikato Regional Council, Fish and Game and NIWA). It did not involve collecting new, kaupapa Māori-based data.

Designed for use by

The report card approach is generally designed for use by technicians and Western scientists, to make information available to iwi and the public.

Places used

Waikato River catchment.

Considerations

While this tool is useful for communicating the state of the awa back to iwi, hapū and river communities, it does not, as such, collect data from a mātauranga Māori perspective.

References

Williamson et al. (2016)

4.11 State of the Takiwā

State of the Takiwā	
Tool name	Takiwā 3.0
Designed by	Craig Pauling (Te Rūnanga o Ngāi Tahu, Boffa Miskell), Barry Mattingly (Environmental Science and Research New Zealand) in collaboration with MfE, Manaaki Whenua Landcare Research, NIWA, Evirolink, Southern Community Labs, Environment Southland, and Environment Canterbury. Further development was undertaken by Dr Chris Hepburn (University of Otago), Nigel Scott, Dr Daniel Pritchard and Iain Gover (all from Te Rūnanga o Ngāi Tahu).
Available from	Archival material for the Takiwā tool is available from Ngāi Tahu on https://www.takiwa.org.nz. This page also has some digital support tools, such as an R-package. The Takiwā project is now continuing only as an internal Ngāi Tahu project.
Digital version	No. The Takiwā database was digital, but the field forms were paper-based and there is no app to enter data in the field.
Developed/in use since	The monitoring plan was first in use in 2005 but has since been archived by Te Rūnanga o Ngāi Tahu.
Variants	Yes – marine. See https://dpritchard.ocpu.io/ntstatR/www/statm.html.

Overview

State of the Takiwā was an environmental monitoring approach that integrated Māori cultural values and Western science measures. State of the Takiwā was developed by Te Runanga o Ngai Tahu as part of their 'Ki Uta Ki Tai – Mountains to the Sea Natural Resource Management' framework. It incorporated a specially designed database and print centre and so that Ngāi Tahu could develop its own monitoring and reporting programme.

The primary aim of the Takiwā database was to collect and store data and make information available to tāngata whenua to help them identify and quantify the current or changing quality of a particular site, and to be able to report this data is an easy, clear and repeatable way.

The Takiwā tool provided a diagnostic tool for identifying issues (and sites) of concern to iwi and allowed for remedial action to be prioritised, implemented and monitored for performance over time.

How to use

Takiwā Site Assessment Module

The State of the Takiwā monitoring forms could be printed directly from the database to gather information about sites and store and report data from the field. Takiwā monitoring recorded observations and assessments by tāngata whenua for a particular site using three main forms:

1. The Site Definition form (e.g. names, site location, special features, heritage/site significance and historical information, with GPS reference);
2. A Visit Details form that recorded visit-specific aspects (e.g. date and time, photographic references); and
3. A Site Assessment form, which was completed by individual members.

In order to grade and compare sites and visits, index calculations were included within the database. This involved ranking site health using a sliding scale of 1 to 5 (1 for worst and 5 for best) for:

- overall health/state of the site;
- levels of modification/change at the site;
- suitability of the site for harvesting mahinga kai;
- access issues;
- amount of pressure from external factors;
- presence, abundance and diversity of taonga bird, plant and fish species, and other culturally significant resources as well as pest and weed species; and
- willingness to return to the site for harvesting mahinga kai.

These questions served to give an indicative score or grade for the overall health of the site (the Health Index Score). The second part of the Site Assessment form included the

Species Abundance Index where a weighting was given to relative abundance (few/some/many), and within which details from the Cultural Health Index for waterways (CHI), Stream Health Monitoring and Assessment Kit (SHMAK), electric fishing surveys and *E. coli* testing could also be included.

Data Management and Interpretation

The Takiwā database gave tāngata whenua the ability to manage the data gathered in a way that was appropriate to them. It included a data transfer module that allowed for the centralised storage of data. This in turn enabled regional and national collection, analysis and reporting of cultural monitoring data. The transfer module worked by allowing users to export and import selected data. If an agency wanted access to any data held within Takiwā they would first need to get the approval of tāngata whenua.

Takiwā Reporting Functions

Tāngata whenua could use the Takiwā tool to analyse and report on monitoring activities and interpret their own data through a printable query and reporting function. This was possible through a 'print centre' that offered a range of different reports for sites, visits and questionnaires. These reports could also be exported to Word or Excel to assist in report writing and graphic representations of the data.

Type of data collected

The data collection included Takiwā site assessments and monitoring, *E. coli* water testing, CHI (site status, mahinga kai, cultural stream health and overall CHI), SHMAK assessments and electric fishing surveys.

Designed for use by

The State of Takiwā tool was developed for Ngāi Tahu to monitor environmental health in their rohe.

Places used

Throughout the South Island:

- 12 sites in the Waiau River catchment for a pilot study
- 100 sites in 20 catchments to test and refine the method and develop a report on the health of freshwater resources of Te Waipounamu from a cultural perspective
- Te Waihora/Lake Ellesmere
- O Tu Wharekai/The Ashburton Lakes
- the Avon-Heathcote Estuary and Catchment and
- the Ruataniwha/Cam River.

Considerations

There was a substantial amount of work involved in establishing the State of the Takiwā tool. Although it has been archived, it provides a valuable resource to iwi throughout the country as to what is possible for monitoring and reporting. Other iwi may wish to

investigate establishing versions in their own areas. It also provides a valuable model for how mātauranga Māori-based data can be protected by iwi, for iwi.

References

Pauling (2010), Pauling et al. (2007), Pauling et al. (2005), Pauling (2003), Te Rūnanga o Ngāi Tahu (2001), Pauling (2004)

4.12 Mātauranga Māori Knowledge Networks

Knowledge Networks	
Tool name	Mātauranga Māori Knowledge Networks
Designed by	Antoine Coffin (Te Onewa Consultants) with support from Jacqueline Henry (Waikato Regional Council) and John Quinn (NIWA).
Available from	https://www.waikatoregion.govt.nz/assets/PageFiles/40444/3504062.pdf
Digital version	No
Developed/in use since	2015
Variants	No

Overview

Mātauranga Māori Knowledge Networks examines factors affecting river quality from a Māori perspective. As a project, it was designed to support the Technical Leaders Group who in turn assisted the Collaborative Stakeholder Group deliberating on the Healthy Rivers Plan Change to the Waikato Regional Plan. The project identified key subject areas for monitoring freshwater from a Māori point of view as:

- swimming in rivers (kaukau),
- mahinga kai/hauanga kai species, and
- special characteristics of rivers from a river iwi perspective.

The research identified two interconnected perspectives for Waikato River iwi. The first is that "the river, stream or lake is an entity in itself that includes the land, the water, the rocks, the air, the living plants and animals, and the spiritual dimension of place". The second related to the qualities of the water. These two things were inseparable. The Mātauranga Māori Knowledge Networks approach can be used as a model for iwi and councils wishing to research important aspects for freshwater monitoring locally.

How to use

The approach used in this project was to conduct a literature review, undertake hui with individual river iwi, and run a one-day, catchment-wide River Iwi Mātauranga workshop. The research identified that swimming is important as more than just a recreational pass-time, but that it provided connections to place and continuation of iwi mātauranga. Factors affecting swimming were identified, and included: poor water quality (faecal bacteria and low clarity), algal blooms, access, low flows, weeds, bank erosion, pest fish, sediment build up and more. These were used to develop attributes from a river iwi perspective (Table 4-6). This process could be used to construct a monitoring programme for swimming that includes mātauranga Māori, and meets iwi aspirations around what aspects are monitored. The same process was undertaken for mahinga kai and special characteristics, resulting in suggested attributes and measures of those attributes for both of those aspects as well.

TABLE 4-6: SUGGESTED ATTRIBUTES, STATES AND NARRATIVES RELATING TO SWIMMING FOR THE WAIPĀ AND WAIKATO RIVERS, FROM A RIVER IWI PERSPECTIVE. SOURCE: COFFIN (2015)

Attribute	Attribute State	Attribute Narrative
Waitemata (water clarity)	Swimmers can see the bottom of the swimming place.	To be reassured it is safe and familiar.
Te Rere (flows)	The historic flow of the water, speed and quantity.	
Paemakariri (temperature)	Historic temperature of swimming places in rivers and lakes.	Rivers and lakes would have cooler temperatures (than oceans and swimming pools for example).
Waipara (settled sediment and periphyton)	Sediment < 2 cm, periphyton < 20% cover.	The feel of the bottom of the swimming place with the feet is a consistent test of swimmability for River Iwi.
Haumaru (safety)	The presence of debris and unseen rocks in the waterbody that is a hazard to human health.	
Mātauranga ki ngā waikaukau	The knowledge and traditions related to	

	swimming in particular places are held by current generations.	
Pareparenga o te wai (riparian margin)	Vegetation, stability and access of river or lake bank.	The river margin provides access and its physical characteristics influence acceptability for swimming.
Ara ki te wai (access)	The ability to access the swimming place from a public reserve, road or walkway.	Vegetation, fencing or structures may prevent or discourage access to a swimming place.

Designed for use by

Iwi, in conjunction with researchers and regional councils.

Places used

Waikato and Waipā River catchments

Type of data collected

Hui notes, interviews, information from available literature

Considerations

This is not a 'tool' as such, but provides useful examples of how a monitoring programme might be collaboratively developed between iwi and council. Furthermore, the research involved collecting sensitive information, and how this was protected and managed could prove a helpful model for other situations. The same considerations apply here as for other approaches, in terms of iwi and hapū retaining the decision-making power on whether this method would suit local needs.

References

Coffin (2015)

4.13 Significance assessment method

Significance assessment method	
Tool name	Significance assessment method for tangata whenua river values.
Designed by	Gail Tipa (Tipa & Associates)
Available from	Tipa (2010)
Digital version	No
Developed/in use since	2010
Variants	No

Overview

The significance assessment method provides guidance on how to apply the RiVAS approach to assess iwi and hapū river values. RiVAS (Hughey and Booth, 2012) is a standardised method to help resource managers grade rivers by relative importance for different uses. The significance assessment method discussed here is based on four overarching principles from the Māori world view: Te Wairua, Māoritanga, Kaitiakitanga and Mahinga Kai. The four overarching principles and concepts are accompanied by a set of attributes. These are used to help measure significance from a cultural perspective.

The significance assessment method was applied in Murihiku with the Iwi Resource Management Plan for the Murihiku region Te Tangi a Tauira as its starting point.

How to use

There are two main steps when using the Significance Assessment Method:

- Developing the assessment criteria – this involves identifying all attributes, selecting the primary attributes, and identifying and applying indicators for those attributes. Indicators must be quantifiable, or able to be assessed by an expert panel

- Determining the significance – this involves evaluating scores given to indicators against significance thresholds, determining the overall significance of the river from the combined indicator scores, and outlining any factors that can't be quantified.

Development of the assessment criteria

In the Murihiku project, a comprehensive list of 64 initial attributes was developed. This included matters such as taonga pounamu, takiwā, marae and koha under the Māoritanga category, rangatiratanga, mauri, and ki uta ki tai under the Wairua category, kaumātua, uri, waipuna and mana whenua under the Kaitiakitanga category, and nohoanga and tauranga ika under the Mahinga kai category. A final list of attributes was selected from this comprehensive list. In order to be considered a primary attribute, attributes had to be:

- able to be used to distinguish between catchments and sub-catchments;
- able to be described by physical features of a catchment;
- able to be assessed by a quantifiable indicator; and
- related to something tangible.

An iterative process of refinement concluded with the development of the following key attributes and indicators for assessment of Murihiku river values.

Attribute	Indicators for the attribute
Ngā Takiwā o ngā awa	Variable flow
	Source protected
	Connections to groundwater/surface water
	Continuous flow source to sea
	Natural river mouth
	Ecosystem integrity
	Passage/movement of sediment
	Mostly native/little or no invasive species
Wai	Character of different water bodies protected
	Continued utility of different water bodies
	Connections – riparian to water
	Quality of waters in different water bodies protected

Settlements	Nohoanga, kaika, marae have a safe water supply
Mahinga kai	Presence of mahinga kai species – known sites
	Healthy condition of target species and fit for use
	Passage throughout catchment
	Abundance populations of target species
Wāhi ingoa	Place names as indicators of condition of awa
Access	Satisfactory physical access for tangata whenua

Determining the significance

The attributes and indicators were then placed into a wider framework that allowed for the overall significance assessment to be undertaken. The framework is a four-part, eight step process of which the indicators are the final step (Table 4-7). Scores are given at steps 2 – 8, and an average of these determines the overall ranking for that river. Scores of 1.0 – 1.5 indicate lesser significance, 1.51 – 2.5 indicate moderate significance, and 2.51 – 3.0 higher significance.

TABLE 4-7: THE FOUR-PART FRAMEWORK FOR A SIGNIFICANCE ASSESSMENT METHOD TO APPLY THE RIVAS APPROACH TO IWI AND HAPŪ VALUES. SOURCE: TIPA (2010).

Preparation – identify wahi tapu and taonga	Step 1: Define river segments
	Step 2: Identify wāhi tapu/wāhi taonga
Part A – Assessment of taonga	Step 3: Assign significance of river/reach
	Step 4: Assess condition
	Step 5: Assess reversibility/potential for restoration
	Step 6: Assess risk based on known threats
Part B – Assessment of use	Step 7: Assess as being fit for cultural use
Part C – Assessment of indicators of attributes	Step 8: Apply indicators to assess health of river system.

Type of data collected

Recordings and transcripts, maps, photographs and diagrams, lists of reaches and wāhi taonga, species data, record and assessment sheets, and various other notes, planning papers and reports.

Designed for use by

Iwi and researchers or natural resource managers, in conjunction.

Places used

Murihiku

Considerations

The developer of the method notes that there are issues inherent in the approach, in that it may conflict with the Māori worldview. Participants in the Murihiku study raised concerns around the very concept of ranking rivers, stating that all waters are important and of high significance, and therefore a method of ranking is not required. This is likely to ring true for many iwi. As such, the method may not be acceptable or relevant to some, or even many, iwi and hapū. Decisions on using this approach need to rest with iwi and hapū.

References

Tipa (2010)

4.14 Tools, methods and frameworks not covered

Some tools, methods and frameworks were not able to be summarised as part of this report, due to time constraints. A list of these is provided in Table 4-8.

TABLE 4-8: OTHER TOOLS, METHODS AND FRAMEWORKS CONNECTED WITH MONITORING FRESHWATER FROM AN IWI AND HAPŪ PERSPECTIVE

Name or article title	Reference
Waiora, Wai Māori, Waitai, Waikino, Waimate: Māori perceptions of water and the environment	Douglas (1984)
The Waikōura Framework: a bicultural systems model for management of Lake Rotorua	Wilson-Rooy (2018)
Murihiku Cultural Water Classification System	Kitson et al. (2018)
Toreparu wetland assessment approach	Robb (2014)
Kaitiaki Tools	https://www.niwa.co.nz/freshwater/management-tools/water-quality-tools/kaitiaki-tools
Impacts of Bioaccumulative Contaminants in the Te Waihora Catchment on Mahinga Kai Gatherers: Data Report and Risk Assessment	Stewart et al. (2014)
Ngā Waihotanga Iho: Iwi Estuarine Monitoring Toolkit	Rickard and Swales (2009a), Rickard and Swales (2009b)
How the use of rāhui for protecting taonga has evolved over time	Maxwell and Penetito (2007)
Whakarongotai o te Moana, Whakarongotai o te Wā: Kaitiaki Information and Monitoring Framework Project Report	Baker (2018)

5 Indicators – range and commonalities

It is useful to compare attributes across the tools, to determine which aspects are common across the tools. This gives some indication as to matters iwi and hapū most often see as important in assessing freshwater from a kaupapa Māori perspective. Comparison across the tools also allows iwi and hapū to quickly look up whether a particular tool might cover the areas they are interested in monitoring, and therefore provides useful information for decision-making.

Table 5-1 provides an overview of the various indicators and attributes used in the tools, frameworks and methods included in this report. It allows a quick comparison of the range of indicators across the approaches, and those most commonly included in kaupapa Māori-based assessments. The far-right column shows how many times an indicator is used across the various tools, with colour coding of the highest to lowest number of times it appears (dark blue is high occurrence, blue is medium occurrence, and light blue is lower occurrence). Most of the tools described in this report are designed to be easily customised to local iwi and hapū priorities and needs, so it is important to remember that the indicators and attributes summarised in this table are indicative of current variants only, and that the tools themselves are generally very adaptable. Having said that, the table is useful for:

- Understanding which indicators are most commonly determined by iwi and hapū as important to assess
- Assisting iwi and hapū to decide between different tools and determine which might best suit their needs.

The reader will note that the most common aspects included as indicators in kaupapa Māori assessments covered in this report were:

- Mauri
- Iwi health and well-being
- Tikanga and cultural practices
- Sites of significance
- Fish and mahinga kai species presence/absence
- Species abundance
- Species health
- Food safety
- Access
- Availability of mahinga kai (links with species abundance above)
- Landscape-level habitat and catchment land use
- Riparian habitat and
- Water quality parameters (clarity, pH, temperature, dissolved oxygen etc)

These indicators come from five key areas: meta-physical aspects, cultural and social aspects, species information, mahinga kai aspects, and ecology, water quality and habitat aspects. This illustrates that monitoring plans that include mātauranga Māori

will need to cover a broad range of matters in order to meet iwi and hapū aspirations and understandings around what is important for monitoring.

TABLE 5-1: THE OCCURANCE OF ATTRIBUTES AND INDICATORS ACROSS VARIOUS KAUPAPA MĀORI ASSESSMENT TOOLS, METHODS AND APPROACHES. IN THE FAR RIGHT COLUMN, DARK BLUE INDICATES HIGH OCCURRENCE, BLUE IS MEDIUM OCCURRENCE, AND LIGHT BLUE IS LOWER OCCURRENCE

Attribute or indicator	Tool	Taonga Species Monitoring	Cultural Health Index (original version)	Mauri compass	Mauri model/Mauri-o-meter/Ngāti Mākino Model	Cultural Flow Preference Study	Wai Ora Wai Māori	Cultural Mapping - Rangitaane o Manawatu case study	National Monitoring Approaches and Indicators of Wetlands	Mauri of Waterways Kete	Waikato River Catchment Report Cards	State of the Takiwā	Mātauranga Māori Knowledge Networks	Significance Assessment Method	Number of tools using this attribute or indicator
Meta-physical aspects	Mauri			yes	yes	yes, but not as a direct measure	yes	yes	yes	yes			yes	yes	9
	Wairua and spiritural practices			yes	can do	yes	yes	yes					yes	yes	7
Unique aspects of the waterbody	Voice				can do	yes		yes					yes	implied	5
	Smell				can do		yes	yes					yes		4
	Special character				can do	yes					yes		yes	yes	5
Cultural and social aspects	Iwi health and well-being	yes, as an inherent element		yes	can do	yes	yes	yes		yes			yes	yes	9
	Tikanga and cultural practices	yes, as an inherent element	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes	yes	12
	Sites of significance	yes	yes		can do	yes	yes	yes	yes		yes	yes	yes	yes	11
	Significance of place or catchment		yes		can do	yes		yes			yes	yes	yes	yes	8
	Gut feeling about a place				can do	yes		yes							3
Species aspects	Stream insect measures			yes	can do			yes		yes					4
	Fish and mahinga kai species presence/absence	yes	yes	implied	can do	yes		yes	yes	yes	yes	yes	yes	yes	11
	Abundance (links with Mahinga Kai - Availability)	yes		yes	can do	yes	yes	yes	yes	yes	yes	yes	yes	yes	12

Attribute or indicator	Tool	Taonga Species Monitoring	Cultural Health Index (original version)	Mauri compass	Mauri model/Mauri-o-meter/Ngāti Mākino Model	Cultural Flow Preference Study	Wai Ora Wai Māori	Cultural Mapping - Rangitaane o Manawatu case study	National Monitoring Approaches and Indicators of Wetlands	Mauri of Waterways Kete	Waikato River Catchment Report Cards	State of the Takiwā	Mātauranga Māori Knowledge Networks	Significance Assessment Method	Number of tools using this attribute or indicator
	Growth rates	yes		yes							yes	yes		yes	5
	Species health	yes		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	12
	Invasive/exotic species				can do		yes	yes	yes		yes	yes	yes	yes	8
Mahinga kai	Food safety	yes		yes	yes	yes	yes	yes	yes (implied)	yes	yes	yes	yes	yes	12
	Water safety			yes	yes	yes		yes			yes		yes		6
	Access	yes	yes		can do	yes	yes	yes			yes	yes	yes	yes	10
	Availability (links with Species aspects - Abundance)	yes	yes	yes	can do	yes	yes	yes	yes		yes	yes	yes	yes	12
Ecology, water quality and habitat	Landscape-level habitat/catchment land use	Depends on the study	yes	yes	can do	yes	yes	yes	yes		yes	yes	yes	yes	12
	Riparian habitat	Depends on the study	yes	yes	can do		yes - implied	yes	yes (in wetland context)		yes	yes	yes	yes	11
	Water quality parameters e.g. clarity, pH, temperature, dissolved oxygen	Depends on the study	yes	yes	can do			yes		yes	yes		yes	implied	9
	Sediment issues	Depends on the study	yes		can do	yes		yes, including gravel extraction issues			yes		yes	yes	8
	Algae and plant issues	Depends on the study	yes		can do			yes			yes	yes	yes	implied	8
	overall degree of modification or health		yes			yes	yes				yes	yes	yes	implied	7
	habitat variability		yes		can do			yes		yes	yes				5

Attribute or indicator	Tool	Taonga Species Monitoring	Cultural Health Index (original version)	Mauri compass	Mauri model/Mauri-o-meter/Ngāti Mākino Model	Cultural Flow Preference Study	Wai Ora Wai Māori	Cultural Mapping - Rangitaane o Manawatu case study	National Monitoring Approaches and Indicators of Wetlands	Mauri of Waterways Kete	Waikato River Catchment Report Cards	State of the Takiwā	Mātauranga Māori Knowledge Networks	Significance Assessment Method	Number of tools using this attribute or indicator
Water quantity						yes				yes	yes		yes		4
Hydrology and geomorphology	Degree of hydrological modification				can do				yes			yes	yes		4
	Channel modification		yes		can do									yes	3
	Continuity of flow from source to sea				can do	yes				yes	yes			yes	5
Pollution	Sources of pollution				yes				yes	yes	yes				4
Potential for restoration				yes	can do	yes		yes			yes	can do		yes	7
Risk to site, waterbody or catchment					can do	yes		yes			yes			yes	5
Other								birdlife, ngahere taonga, rongoā			contact recreation, inter-generational response, navigation, fish passage	willingness to return to the site.	swimming (kaukau), ability to exercise rangatiratanga, fish passage	tauranga waka	5

6 Case studies

CASE STUDY:

Kanakana

Waikawa Whānau member Maddison Leith holding a kanakana caught during research into her kanakana population in the Waikawa River.

6.1 Taonga species monitoring – Kanakana in the Waikawa[31]

All information discussed in this section is sourced from Waikawa Whānau reports (Kitson et al., 2012, Kitson, 2017, Kitson et al., 2010).

WHY UNDERTAKE TAONGA SPECIES MONITORING?

Taonga species monitoring covers a number of different approaches, addressing different needs for different whānau, hapū and iwi. One common factor in taonga species monitoring across the country, however, is a desire amongst iwi members to understand what is happening to species that are important locally, how healthy the populations are and what the outlook for these species is in the future. This arises out of a drive to protect tikanga and mātauranga around these species, and to ensure that uri whakatupu are able to eat these species in the same way as our tupuna did. It is akin to the drive to protect our reo and tikanga, as the ability to harvest and serve these taonga species is an indicator of the health of our waters, our iwi and ourselves.

For Te Rūnanga o Awarua and Waikawa Whānau in Murihiku, the focus for taonga species monitoring is kanakana, or lamprey (*Geotria australis*), as kanakana are a taonga species to Ngāi Tahu. Those within the iwi with the knowledge of and responsibility for the kanakana harvest were deeply concerned about declines in

[31] Although the primary report author is from Te Āti Hau-nui-ā-Pāpārangi and would usually use the term *piharau*, kanakana is used for this case study as this is the word used by the whānau undertaking the work.

kanakana numbers. This prompted the instigation of a research programme to look at the Waikawa kanakana population.

WHAT ARE SOME OF THE ASPECTS INVESTIGATED?

The first research undertaken by the Waikawa Whānau investigated kanakana abundance, with experienced harvester Vincent Leith doing a total of 78 visual counts of kanakana numbers at Mangai Piri in the Waikawa River for an hour per night between July and October 2009. These counts were compared with rainfall, flow, and moon phase (Figure 6-1). The whānau also documented important indicators of a kanakana run.

The 2009 season was poor for kanakana, making the analysis of results difficult for the whānau. Vincent Leith observed that the low abundance was due to low water levels in the river preventing kanakana migrating upstream. Based on the harvester's knowledge of kanakana behaviour, the whānau also determined that counts would be better undertaken during the daily peak in the run – in this case in the early hours of the morning, as opposed to in the evening.

The research identified that iwi mātauranga indicators of kanakana runs are:

- rainfall and freshes – runs usually occur during rain or increased flow
- koau (shags) presence – koau hang around the river to catch kanakana
- dark nights – kanakana are more likely to run in dark moon phases
- fish colour – the blue of kanakana freshly returned from sea
- other tohu, such as water temperature and quality.

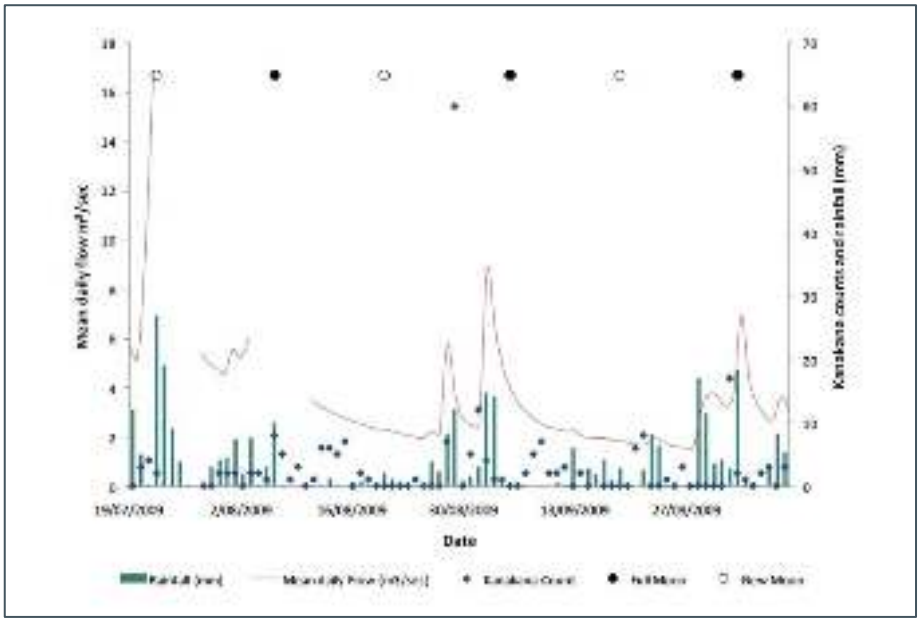


FIGURE 6-1: KANAKANA COUNTS, MEAN DAILY FLOW (M3/SEC), RAINFALL (MM) AND MOON PHASE OVER THE 2009 MONITORING PERIOD IN THE WAIKAWA RIVER. SOURCE: KITSON ET AL. (2010).

ANALYSIS

Following on from this research, the whānau wanted to test the relationship between the visual counts and fish numbers in the river. To do this, they used a DIDSON (Dual-Frequency Identification Sonar) acoustic camera. These cameras can detect fish at night and in low visibility water conditions.

Harvester Vincent Leith undertook seven, hour-long visual counts, this time in September 2010. Whānau set up the DIDSON to run continuously for 11 days during the same period. Water level, temperature, turbidity and conductivity were also measured, and of these level and temperature were later used in modelling.

Some practical matters made analysis difficult. For example, higher flows just prior to the beginning of the experiment triggered a kanakana run, and then there were no large runs during the monitoring period. The distance between DIDSON site and the count site created a lag, with a difference in numbers at the two sites meaning the first night of observations had to be discarded. The nightly monitoring was hard on the observer and led to fatigue. And lastly, it was difficult to find a site suitable to install the DIDSON.

Despite these challenges, the research found a good correlation between the different count methods (Figure 6-2). The whānau also found that water level, time of day and water temperature had strong relationships to the DIDSON counts, but not strong enough results to say when in particular monitoring should occur, other than dusk and dawn ought to be avoided.

The whānau concluded there are pros and cons to both methods. The DIDSON can provide continuous monitoring, but it is limited as to where it can be physically set up, is expensive (both in hireage and staff time) and requires more time to process the data. Harvest techniques are easy to analyse and support the continuation of key cultural activities such as mahinga kai, but may result in abundance overestimates (considering harvests occur during peak runs) or underestimates (if numbers are too high to count).

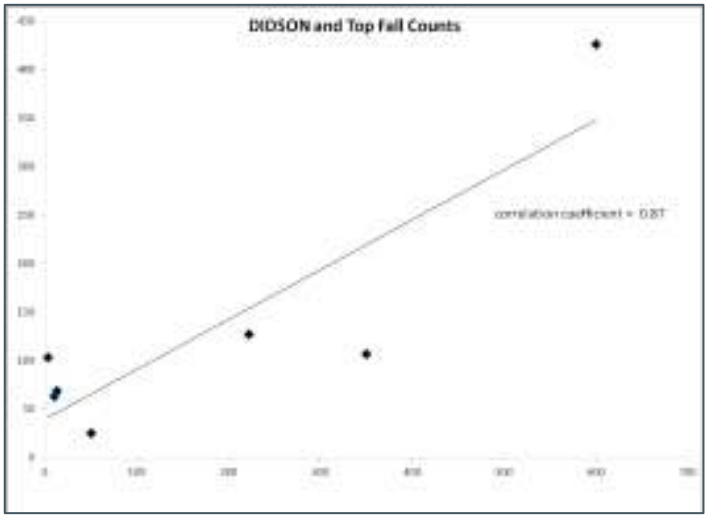


FIGURE 6-2: RELATIONSHIP BETWEEN THE OBSERVER COUNTS AND DIDSON COUNTS OF KANAKANA ON THE WAIKAWA RIVER BETWEEN 2ND AND 10TH SEPTEMBER 2010. SOURCE: J. KITSON ET AL. (2012).

In addition, the whānau completed a literature review to evaluate the suitability of different harvest techniques for use in monitoring. Considering health and safety, efficiency, and usability across a range of flows, they determined that the methods most suitable for adaption to monitoring are visual counts (hand picking of rocks method) and use of hinaki/fyke nets.

WHERE TO NOW FOR TAONGA SPECIES MONITORING IN WAIKAWA?

Te Rūnanga o Awarua and the Waikawa whānau have now launched another research project, in conjunction with NIWA and Kitson Consulting, to investigate habitat for maturing adult kanakana and where they choose to spawn, as well as habitat used by larval kanakana. To do this, they are tracking kanakana movements in the Waikawa using PIT tags, and undertaking pheromone sampling. This work is underway and results will be written up in the near future. However, the research undertaken to date is only some of what the whānau want to explore. Future research questions the whānau are looking at are:

- how well the DIDSON camera and the visual counts work in high flows
- how traditional harvest methods, particularly netting and manual collection, can be used as indices of kanakana abundance
- research on mātauranga and historical information on kanakana abundance, to compare with current abundance data
- distribution of kanakana in the wider Waikawa catchment.

COMMON FACTORS AND LEARNINGS FROM THIS CASE STUDY

- Taonga species monitoring relies heavily on the availability of iwi members with mātauranga of the species, its habitat needs and behaviours, and harvest practices for that species. This makes it even more pertinent to support and care for iwi members with this knowledge.
- Having iwi members with a background in science is helpful in planning research and analysing taonga species monitoring data.
- Taonga species monitoring is about utilising any and all methods that whānau determine appropriate, to answer questions that are important to whānau, about species that are important to whānau. It is whānau-driven for whānau purposes, and helps to ensure continuity of Māori practices for future generations.
- As with all experimental work, there are pros and cons to different methods, and the choice of method depends on the desired outcome.

CASE STUDY:

Mauri Compass

Ian Ruru undertaking a tuna survey as part of the Mauri Compass investigations.

6.2 Mauri Compass study in the Waipaoa River

WHY UNDERTAKE AN ASSESSMENT WITH THE MAURI COMPASS?

As with iwi across the motu, the state of the mauri is very important to Tairāwhiti tangata whenua. Notably, mauri is a compulsory value in the Tairāwhiti Resource Management Plan (freshwater). Te Aitanga a Māhaki iwi members were concerned about the mauri of their awa, the Waipaoa River, as well the status of tuna locally. To investigate these matters, they undertook an eel survey in 2008, and again in 2018, looking at 18 sites near the 12 marae of Te Aitanga a Māhaki. The surveys looked at growth (using otoliths), abundance (using unbaited fyke nets and electrofishing), health (using tuna condition), and how 'normal' the tuna were.

The Mauri Compass was then used to document the state of the mauri in the Waipaoa, and compare the changes between the two survey periods. The Mauri Compass offers a statistically robust means of assessing changes to a range of parameters important to iwi and hapū. It also allows for a visual presentation of data that provides the viewer with a quick and easy understanding of current state across a range of factors.

WHAT DID THEY FIND?

In the 10 year period between the two sampling events, Te Aitanga a Māhaki found a substantial and significant decrease across 10 of the 12 attributes that comprise the Mauri Compass (Figure 6-3 and Figure 6-4). For three attributes (Mahinga Kai, Eel Speices, and Eel Growth Rates) the decline was as high as 75%. Mahinga Kai and the four eel attributes were scored at the lowest value available, '1'. These poor scores are the result of a 90% decline in the number of eels caught during the field studies, from 955 in 2008 down to only 91 in 2018 (Figure 6-5). This decline, in turn, has reduced the connection tangata whenua have with the Waipaoa, reflected in a 33% decrease in the score for the Tangata Whenua attribute. The Wairua attribute remains static at '2' and can only improve if human sewage and mortuary waste is removed from the waterways. The Habitat, Biodiversity, Water Biology (Biohazards) and Water Chemistry (Chemical hazards) attributes have all declined, likely resulting in the detrimental decline of the quantity and quality of eels observed in the river.

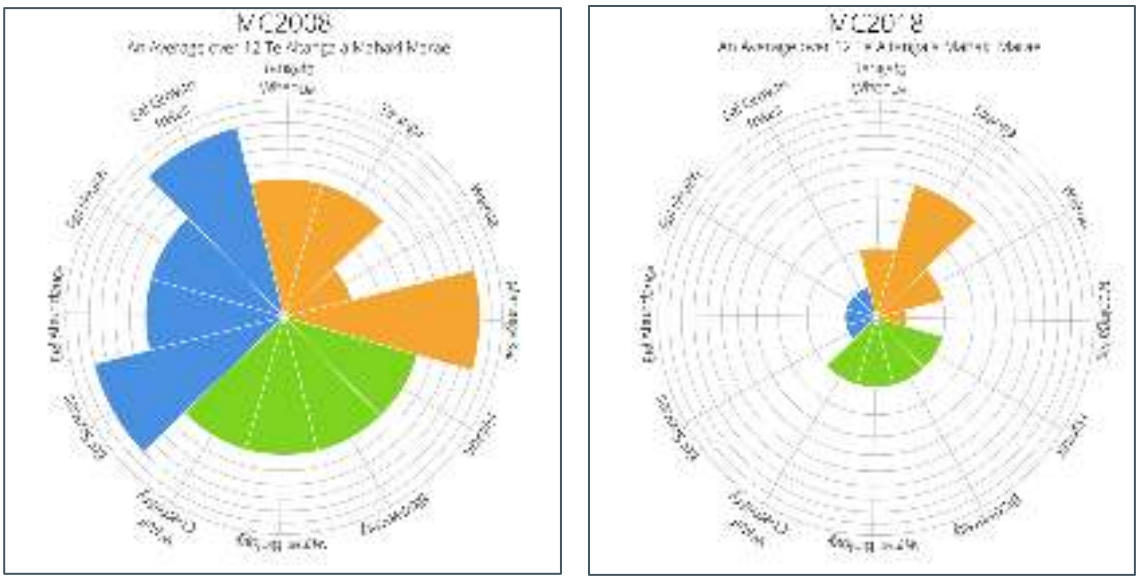


FIGURE 6-3: THE TWO MAURI COMPASS DASHBOARDS CLEARLY SHOW THE STARK DECLINE IN THE MAURI OF THE WAIPAOA RIVER BETWEEN 2008 AND 2018.

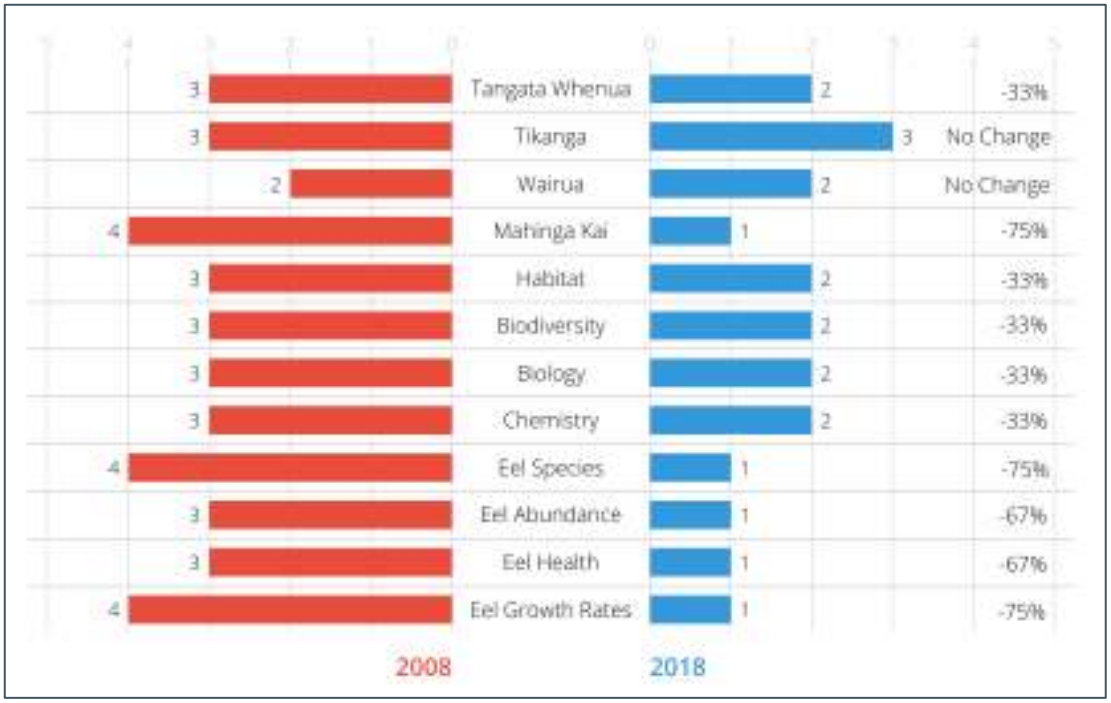


FIGURE 6-4: PERCENTAGE CHANGE IN MAURI COMPASS ATTRIBUTE SCORES FOR THE WAIPAOA RIVER BETWEEN 2008 AND 2018. SOURCE: IAN RURU

WHAT HAPPENED WITH THE RESULTS?

Te Aitanga a Māhaki were deeply concerned about these results, and have used the Mauri Compass to support their call for a ban on commercial eel fishing in the Waipaoa River until catches are back to their 2008 baseline levels. Ian Ruru's late father Bill Ruru, who led the original 2008 survey, often joked that he was sick of the sight of eels as a child because it was their staple diet growing up at Waituhi. He pointed out that in less than one generation, those traditions, tikanga (practices) and mātauranga (knowledge) had been lost. Ian Ruru says of the decline: "In 2008 we caught 353 longfins — but only 12 [in 2018]. For shortfins the numbers were 602, now down to 79. The implications for sustaining our 12 marae are huge."

The Mauri Compass is also providing Te Aitanga a Māhaki with a way forward, giving direction to the iwi about where to focus restoration efforts. As Ian Ruru states, "To stop the decline, Te Aitanga a Māhaki need to rebuild their eel stocks, improve the habitat and water quality and renew their traditions and connection with the Waipaoa. Only then will the mauri of the Waipaoa begin to thrive again." The iwi also aims to build numbers of tangata kaitiaki who will continue to monitor and intervene in the decline of the mauri of the Waipaoa. Ian Ruru says that primary school, intermediate, high school and diploma level programmes have worked well to build the capacity of Māhaki, and should continue.

The collaborative design process for the Mauri Compass led to other benefits. "The partnership between Te Aitanga a Māhaki and the Gisborne District Council has historically been strained, but tangible improvements through collaborative tools such as

the Mauri Compass bode well for a unified approach to improve the state of the Waipaoa environment and its communities," says Ian.

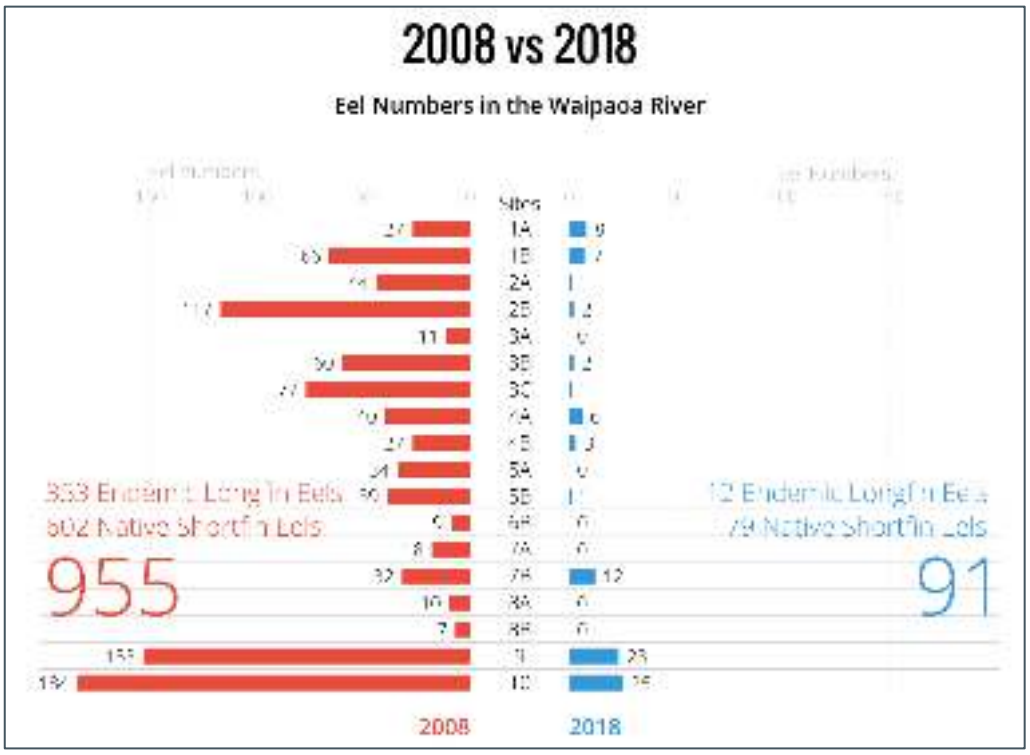


FIGURE 6-5: COMPARISON OF TUNA CATCH IN THE WAIPAOA RIVER IN 2008 AND 2018, SHOWING AN OVERALL DECLINE FROM 995 EELS CAUGHT IN 2008 TO JUST 91 IN 2018. SOURCE: IAN RURU

WHERE TO NEXT FOR THE MAURI COMPASS?

The Mauri Compass is currently being used in a number of situations across Te Tairāwhiti, including state of the environment reporting for the Waipaoa River, guidance for a landfill remediation at Te Pā o Kahu and assessing impacts on the surrounding waterways, and assessing effects on the mauri of the Makauri Aquifer from a recharge trial. Gisborne District Council is also using it to assess compliance with a condition in their wastewater consent, which is, "to improve the mauri and water quality of Tūranganui a Kiwa". It can be used in both marine and freshwater environments, and is adaptable to a range of projects and circumstances.

COMMON FACTORS AND LEARNINGS FROM THIS CASE STUDY

The Mauri Compass provides a statistically robust and visually accessible assessment of important aspects of the mauri of a waterbody. It can readily be employed to demonstrate changes in the state of a waterbody across time. It is based on species that are important to iwi and hapū, and could be adapted for species other than tuna in other areas, as appropriate. It utilizes tools from both Western and Māori knowledge systems and answers questions that are important to iwi and hapū, making that data usable for environmental advocacy, management and restoration.

CASE STUDY:

Tokiāhuru

The Tokiāhuru Stream, looking upstream, before the intake diverts water through to the Tongariro Power Scheme

6.3 The Tokiāhuru cultural flow preference study

Information discussed in this section is sourced from Ngāti Rangi Trust, including the report produced for this work (Hayes et al., 2014). Public information, including a short documentary about the project, can be found at http://www.ngatirangi.com/nrtgenesis-energy-agreed-flows.aspx

WHY UNDERTAKE A CULTURAL FLOW PREFERENCE STUDY?

Flow-setting in Aotearoa often uses the Instream Flow Incremental Methodology, or IFIM. This method, however, does not provide information on cultural values relating to flow, such as which flows are necessary for mahinga kai activities, or which flows give an ancestral river its voice back.

On the south-eastern side of Ruapehu lies the Eastern Diversion of the Tongariro Power Scheme. Until recently, this scheme diverted the entire flow of 26 tributaries of the Whangaehu River, for roughly 95% of the year. The diverted waters travelled through 22 intake structures, into an aqueduct and on to Moawhango Dam. From there they flowed north through to the Tongariro, on to Taupō and into the Waikato. They were not returned to the Whangaehu catchment.

After lengthy court battles, in 2010 Ngāti Rangi and Genesis Energy signed a relationship agreement that (amongst other things) sought to determine 'Agreed Flows' for four of the diverted waterbodies. The remaining waterbodies would still be subject to the original diversion regime.

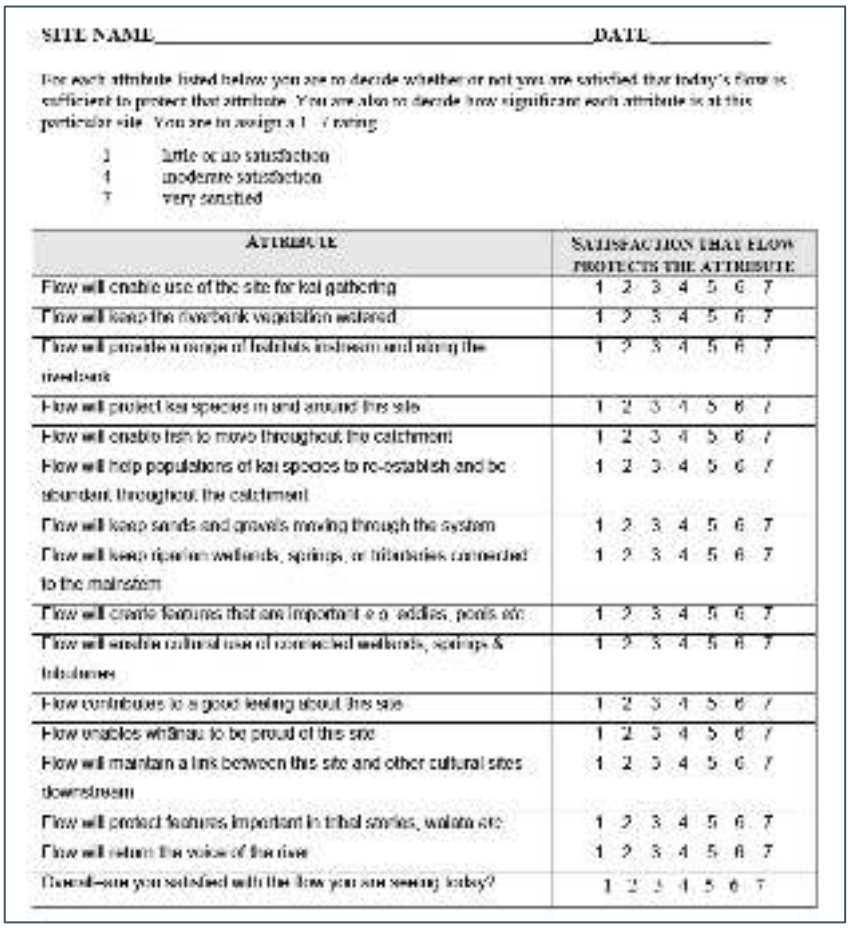
Agreed flows would cover all aspects of the rivers' requirements – cultural, ecological and spiritual – and would be worked out in good faith between the parties. In order to do this, the joint relationship group decided a method for quantifying cultural flow needs was required, to sit alongside any estimates of flow needs formulated from IFIM

assessments. Consequently, Ngāti Rangi Trust and Genesis Energy asked Gail Tipa to conduct a cultural flow preference study for the first of the four rivers, the Tokiāhuru.

WHAT WAS INVESTIGATED?

The first step in the process was to understand the cultural kōrero, values and uses around the Tokiāhuru and the wider catchment. Interviews were conducted with iwi members to capture this kōrero, using recordings and sketches on maps. This information was used to create a set of assessment questions that were specific to the awa and to the iwi, reflecting the matters of importance to Ngāti Rangi (Figure 6-6). The questions covered three categories – Cultural use, Hauora and cultural landscape, and Wai, and were ranked on a Likert scale of 1-7.

Following this, kaumātua and iwi members conducted field assessments of varying flows, from 82 L/s (which is 53% of the mean annual low flow of 156 L/s) through to a full flow of 143 L/s. Assessments were conducted at three different sites over four consecutive days. The assessment team were unaware of what flow level they were evaluating, as this was controlled by Genesis Energy hydrologists at the intake site, upstream of assessment sites.



SITE NAME_____DATE_____

For each attribute listed below you are to decide whether or not you are satisfied that today's flow is sufficient to protect that attribute. You are also to decide how significant each attribute is at this particular site. You are to assign a 1 – 7 rating

1 little or no satisfaction
4 moderate satisfaction
7 very satisfied

ATTRIBUTE	SATISFACTION THAT FLOW PROTECTS THE ATTRIBUTE
Flow will enable use of the site for kai gathering	1 2 3 4 5 6 7
Flow will keep the riverbank vegetation wetland	1 2 3 4 5 6 7
Flow will provide a range of habitats instream and along the riverbank	1 2 3 4 5 6 7
Flow will protect kai species in and around this site	1 2 3 4 5 6 7
Flow will enable fish to move throughout the catchment	1 2 3 4 5 6 7
Flow will help populations of kai species to re-establish and be abundant throughout the catchment	1 2 3 4 5 6 7
Flow will keep sands and gravels moving through the system	1 2 3 4 5 6 7
Flow will keep riparian wetlands, springs, or tributaries connected to the mainstem	1 2 3 4 5 6 7
Flow will create features that are important e.g. eddies, pools etc	1 2 3 4 5 6 7
Flow will enable cultural use of connected wetlands, springs & tributaries	1 2 3 4 5 6 7
Flow contributes to a good feeling about the site	1 2 3 4 5 6 7
Flow enables whānau to be proud of the site	1 2 3 4 5 6 7
Flow will maintain a link between this site and other cultural sites downstream	1 2 3 4 5 6 7
Flow will protect features important in tribal stories, waiata etc	1 2 3 4 5 6 7
Flow will retain the voice of the river	1 2 3 4 5 6 7
Overall—are you satisfied with the flow you are seeing today?	1 2 3 4 5 6 7

FIGURE 6-6: FORM USED IN THE NGĀTI RANGI TOKIĀHURU CULTURAL FLOW PREFERENCE STUDY

CHALLENGING FACTORS FOR THE TOKIĀHURU SITUATION

The Tokiāhuru assessments differ from other cultural flow preference studies for a number of reasons. The intake and affected stream reach is located in the Karioi Forest, which is a production forest with limited access for iwi members. Flows also had to be specifically released by Genesis for assessment. As such, only four days of assessments were able to be undertaken. For other cultural flow preference studies, whānau members had unimpeded site access and undertook numerous assessments across a longer time period, and through different seasons.

For the Tokiāhuru, this also meant only summer flows were assessed (and even these were below average summer flows), and no flood flows were evaluated. The lack of access over a long period also impacted on iwi connections to the area, with past uses not practiced for many years and knowledge of past uses restricted to a few iwi members only. Furthermore, the Tokiāhuru was, at the time, subject to a take that left the riverbed completely dewatered. This affected the underlying river environment, with some flow potentially being lost to the dry ground.

WHAT HAPPENED WITH THE DATA?

Tipa & Associates analysed the data to produce tables of averaged scores for each attribute at each flow level, as well as aggregated scores across the categories (see Table 6-1 and Table 6-2 for examples) which were grouped into bands (Table 6-3).

TABLE 6-1: AVERAGED SCORES FOR ATTRIBUTES AT THE 'ACCESS 31' SITE IN A CULTURAL FLOW PREFERENCE STUDY FOR THE TOKIĀHURU STREAM, ACROSS DIFFERENT FLOWS.

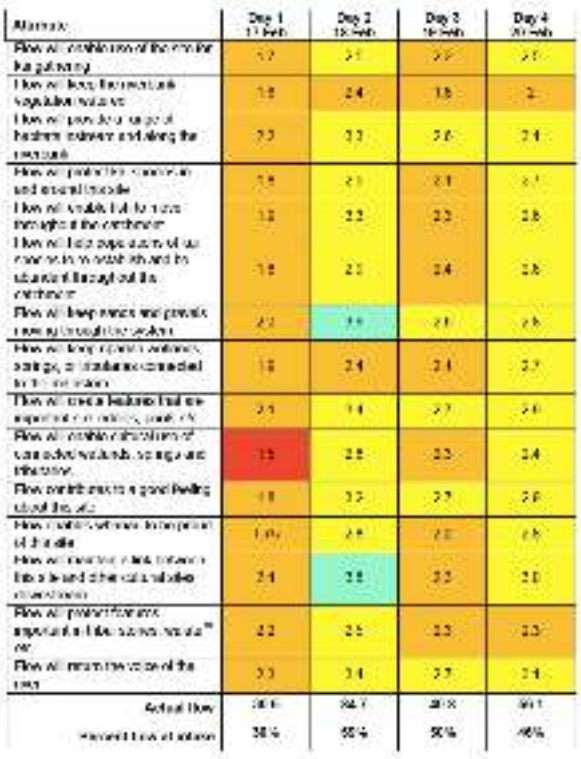


TABLE 6-2: AGGREGATE SCORES ACROSS THREE CATEGORIES AT ONE SITE FOR THE NGĀTI RANGI TOKIĀHURU CULTURAL FLOW PREFERENCE STUDY. NOTE THE FLOW IS ACTUAL FLOW AT THE SITE, WHICH DIFFERS FROM THE FLOW RELEASED AT THE INTAKE DUE TO LOSS TO GROUNDWATER.

Date	Wai	Use, including kai gathering	Landscape and well-being	Flow l/s
17.02.14	1.55	1.57	1.48	**11.1 l/s**
18.02.14	3.15	2.70	3.76	**81.8 l/s**
19.02.14	2.3	2.32	2.46	**29.3 l/s**
20.02.14	2.95	2.77	2.84	**57.9 l/s**

TABLE 6-3: BANDS FOR AVERAGED SCORES IN A CULTURAL FLOW PREFERENCE STUDY FOR THE TOKIĀHURU STREAM

Attribute score	Colour code	Preference
< 1.50		Very dissatisfied
1.51–2.5		Dissatisfied
2.51–3.5		Slightly dissatisfied
3.51–4.5		OK
> 4.51		Satisfied

Importance-performance analyses were also produced to determine which attributes were most important to Ngāti Rangi, and how well these were catered for by the various flows (Figure 6-7). Overall, there was fairly low satisfaction with the flows available, although the ratings increased with increased flow. In the aggregate scores, only one flow received an ‘ok’ rating, and that was given to on the day of the full flow release.

The Ngāti Rangi and Genesis Energy relationship group used this information in a decision-making matrix that also utilised an IFIM study for the Tokiāhuru and a report on sediment dynamics in the reach. Together, this matrix covered cultural, spiritual and ecological values for the affected area and helped the group determine a suggested flow for the river that could be discussed with the iwi rūnanga and the governance boards of both organisations. Of note is that, in this instance, the flow levels required for the Tokiāhuru using the cultural flow preference study and the IFIM were reasonably aligned.

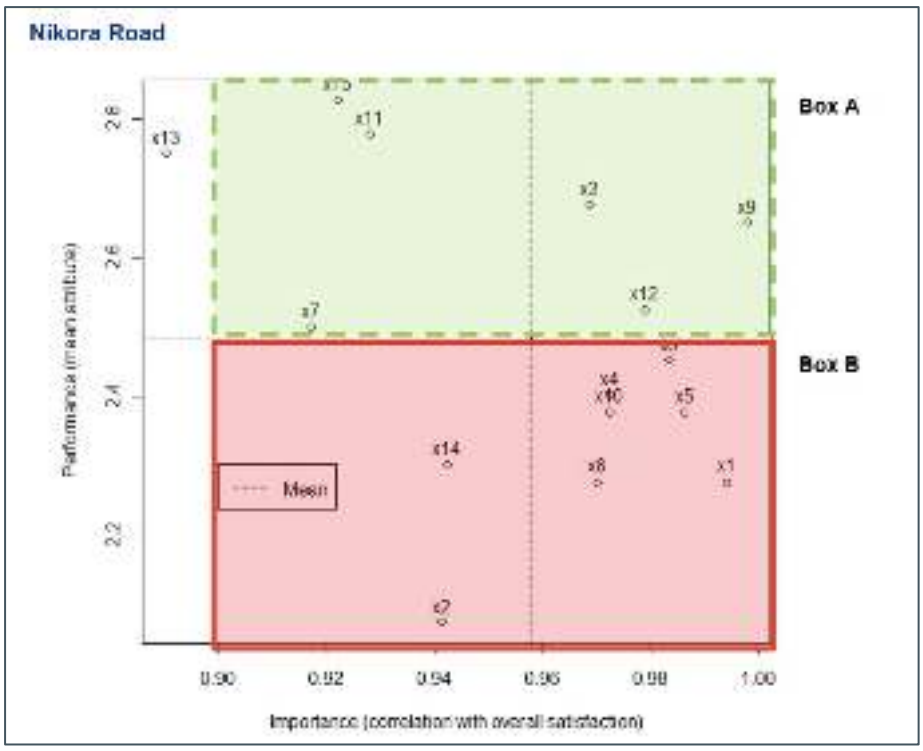


FIGURE 6-7: EXAMPLE OF AN IMPORTANCE-PERFORMANCE GRAPH FOR ATTRIBUTES IN A CULTURAL FLOW PREFERENCE STUDY FOR THE TOKIĀHURU STREAM. THE NUMBERS REPRESENT INDIVIDUAL ATTRIBUTES. PERFORMANCE IS CALCULATED ON MEAN SCORE AND IMPORTANCE BY CORRELATION BETWEEN ATTRIBUTE

WHERE TO NOW?

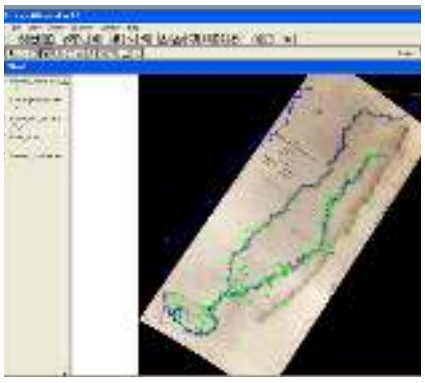
The Ngāti Rangi and Genesis Energy relationship group were aware there were uncertainties to the flow regime they were establishing, particularly around flow variability, periphyton build up and sediment starvation. As such, a monitoring programme was established to assess these aspects. Information from that monitoring has fed into the design of the flow assessments for two of the remaining three waterbodies. (The fourth has logistical issues yet to be resolved).

COMMON FACTORS AND LEARNINGS FROM THIS CASE STUDY

- Specific information, values and uses about waterbodies can be used to create site-specific and tangata whenua-specific assessments for a waterbody.
- These assessments provide data on a flow regime's ability to satisfy cultural needs and preferences and are complementary to information available through other modelling tools such as the IFIM.
- Access to sites allows (or affects) the transmission of knowledge.
- Cultural flow preferences studies can be used either as a mechanism to set flow regimes, or as an ongoing monitoring tool to assess iwi, hapū and whānau satisfaction with established flow regimes. Long term use of the tool would be likely to identify issues such as the need for flushing flows or sediment effects such as bed armouring.

CASE STUDY:

Cultural Mapping



Historic map showing digitised sites

6.4 Cultural mapping – Rangitaane o Manawatu

Information in this section was sourced from internal Rangitaane o Manawatu documents, which were used with permission.

WHY CULTURAL MAPPING?

Cultural mapping takes iwi kōrero and mātauranga, some of which is at risk of being lost, and transcribes it into a visual, digital form, captured in a database. It is important for recording iwi connections to place. Cultural mapping can provide both iwi and non-iwi (such as councils) with an easily understandable visual account of iwi relationships with, activities in and use of an area. Rangitaane o Manawatu undertook a comprehensive mapping project that not only documented iwi connections to place, but categorised these, assessed them according to current condition, threats and scope for restoration, and used this to determine a monitoring programme for their rohe.

WHAT APPROACH WAS TAKEN?

Rangitaane utilized all available sources to provide information for their mapping exercise. This included:

- Treaty of Waitangi Research Reports
- Office of Treaty Settlements Site Visits
- Local Government Archaeological reports
- Surveyors maps
- Native Land Court Records
- Ethnologists Records
- Waiata and Oral interviews

Historic maps were added to ArcGIS, a digital mapping and analysis tool. This allowed the project lead, Jonathan Procter, to digitise the information contained in the historic maps (see case study title photo).

WHAT WAS FOUND?

Once digitised, the sites were categorised by type and subtype (Figure 6-8), based on categories developed by Harmsworth (1997), for example:

Category	Example Sub-categories
Natural sites	Bush, clearing, dune, fossil forest, hill
Structures	Canoe mooring, kāinga, occupied location, urupā, whare
Natural resources	Cultivation, eel weir, karaka grove, kumara pits
Archaeological sites	Archaeological sites, burial caves, burials, middens

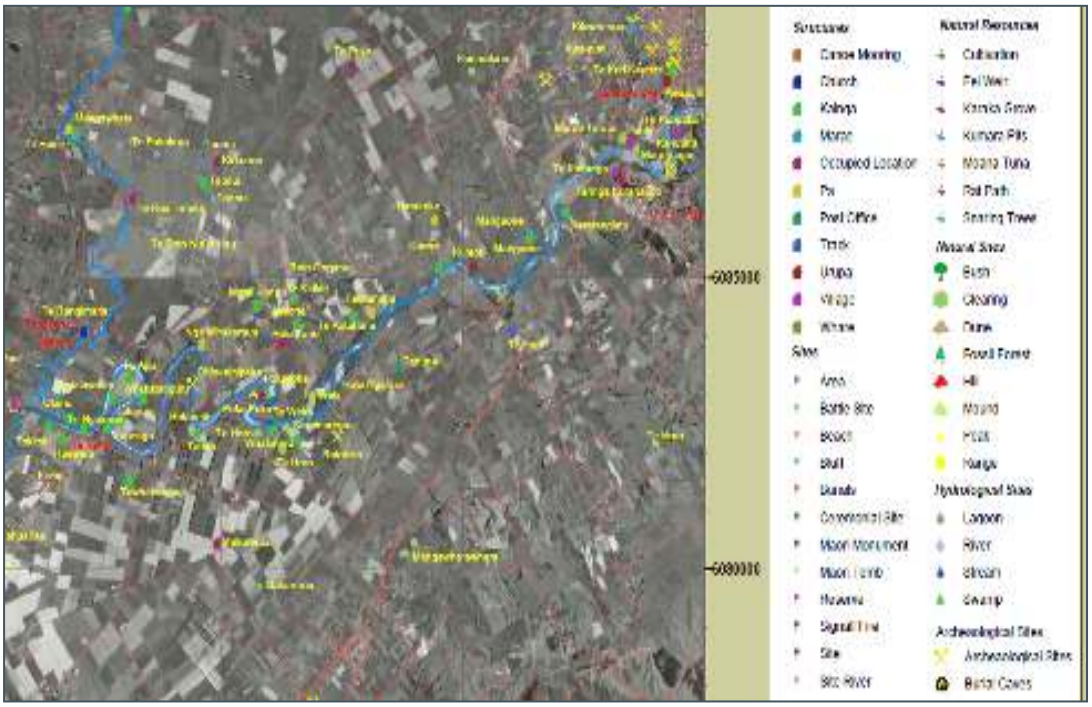


FIGURE 6-8: SCREEN SHOT SHOWING RANGITAANE O MANAWATU MAPPED SITES AND THEIR CATEGORIES AND SUB-CATEGORIES

Each site contains details such as a description, relevant documentation such as archaeological site visit forms, and photographs, where available. This resulted in an extensive amount of information collated in the one place. Once digitised and categorised, the information was used to create maps showing areas of high iwi connection to place (Figure 6-9).

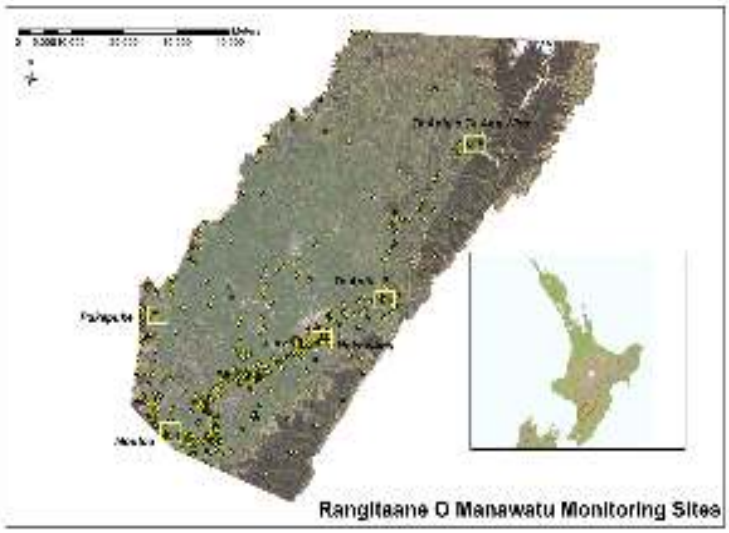


FIGURE 6-9: RANGITAANE O MANAWATU MONITORING SITES (YELLOW SQUARES). YELLOW DOTS ARE CULTURAL SITES.

Other work around the Rangitaane o Manawatu mapping project included utilising the information as part of Waitangi Tribunal Claims process and resource consent processes. Those aspects are not within the scope of this case study.

MAPPING AND MONITORING

The last step in this project was to determine a monitoring programme for the Rangitaane o Manawatu rohe, along with restoration and management priorities.

Stage one of this process was to determine monitoring sites. Rangitaane o Manawatu prioritised sites based on:

- historical value – was the site used in the past, and how (e.g. kāinga, bird-trapping site)
- current value – is it currently able to be used, or is it in another use, e.g. a paddock, alienated land, and
- future value – will Rangitaane be able to use it in future (e.g. might it come back under Treaty settlement).

Using this process, they arrived at five priority sites for monitoring (Figure 6-9)

Stage two involved assessing each of the five monitoring sites to determine what aspects to monitor. To do this, Rangitaane o Manawatu staff visited each site and conducted a pre-monitoring assessment, building on the knowledge of past uses from the GIS mapping work. Eight categories were assessed (Table 6-4). For example, in the vegetation category, at a site once used for harvesting tōtara logs for waka, staff determined firstly whether any bush remained to be monitored, then whether any tōtara of a size suitable for waka building were present. An assessment of risks to the site was made, for example evaluating surrounding land use and pest levels. The significance of each category for that site was determined based on past and present use, and priority

was a judgement based on future potential and the other scores gained under Assessment and Significance. ***Stage three*** involved using this table to decide what values and matters to monitor at each site (Table 6-5). Monitoring was conducted under atua realms.

For ***stage four***, Rangitaane o Manawatu adapted Gail Tipa and Laurel Teirney's Cultural Health Index to apply to all atua, covering the aspects they had decided to monitor at the pre-monitoring assessment (Table 6-6 and Table 6-7). At ***stage five***, monthly monitoring was undertaken, and ***stage six*** involved analysing, graphing and mapping the data from the monitoring. The result, when collated, was a ranking of where each monitoring site sat across all the atua domains, on a 'good-bad' scale (Figure 6-10), on a monthly basis.

TABLE 6-4: ASSESSMENT OF RANGITAANE O MANAWTŪ MONITORING SITE, MOUTOA/TE PEHU, AS AN EXAMPLE OF THE MATTERS EVALUATED

Main attribute/value categories	**Presence/absence in catchment/river**	**Assessment**			**Significance**		**Priority**
	Y/N	Current condition	Risk	Ability to restore	Existing value (high, moderate, low)	Historically (high, moderate, low)	1 = low 5 = High (1-5)
1. Vegetation	Y Harakeke	3	4	y	high	high	5
2. Animals, birds, fish, insects, other	Y Tuna/Mudfish	3	4	y	moderate	moderate	5
3. Whenua, land, soil	Y Wetland/Organic	2	4	y	moderate	high	4
4. Water	Y Wetland	2	3	y	high	moderate	4
5. Air	Not considered						
6. Wāhi taonga, Special places	Y	1	2	y	high	high	4
7. Wāhi tapu, Sacred sites	y	1	2	y	high	moderate	4
8. Wairua, Metaphysical	y	3	3	y	moderate	moderate	4

TABLE 6-5: VALUES AND MATTERS TO BE MONITORED AT TWO OF THE FIVE RANGITAANE O MANAWATU IWI MONITORING SITES, DETERMINED AFTER A PRE-MONITORING ASSESSMENT OF CURRENT CONDITION, RISK, ABILITY TO RESTORE, SIGNIFICANCE AND PRIORITY.

	Site	
	Moutoa/Te Pehu	**Te Apiti Te Ana O Whiro/Takapari**
Values to be monitored	Pa/Kainga Mahinga kai Kauhanga riri Pa Tuna Wai Repo/roto Tuna Inanga Whānaungatanga Ahuwhenua Awa Harakeke	Pā/kāinga Mahinga kai Kauhanga riri Wai Tuna Awa Ara Mauri Wairua Urupā
Iwi-determined monitoring programme	Wetland condition through the presence of and health of tuna and ika Water levels of roto Presence of tidal ika species Condition of harakeke using transects Condition of repo using transects Roto water condition Cultural Health Index	Transects of native forest Bird counts through transects of DOC reserve forests Presence of Taonga species (kōura, ika) Photos of past Kainga sites Gravel bed monitoring presence of Jasperite boulders Water/River Cultural Health Index

TABLE 6-6: THE ADAPTED CULTURAL HEALTH INDEX USED BY RANGITAANE O MANAWATU TO MONITOR IMPORTANT SITES.

Name of Waterway:	**Landholder:** DoC, Public, Private, Other
Catchment:	**Adjacent landuse** (circle as appropriate)**:** 1. Pasture 2. Horticulture 3. Native 4. Exotic forest 5. Scrub 6. Residential
Site Number:	

		7. Commercial 8. Industrial 9. Recreational		
Date:		**Site Status:** A Traditional B Non Traditional		
Time:		**Mahinga Kai:** 1 Present 2 Absent		
Coordinates:		**Future:** 1 Will return to manage 2 Wouldn't return		
Name:				
TANGAROA	Rating 1-5	Rating 1-5	Rating 1-5	Comments
1. Riverbank Condition				
2. Sediment on Riverbed				
3. Water Clarity				
4. Water Flow				
5. Water Quality				
6. Shape and Form of River				
7. Insect Life (method, no. & species)				
8. Fish (method, no. & species)				
TANE MAHUTA	Rating 1-5	Rating 1-5	Rating 1-5	Comments
9. Riparian Vegetation				
10. Catchment Vegetation				
11. Bird Life (method, no. & species)				
12. Ngahere/Taonga				

13. Pest plants/animals				
HAUMIA TIKETIKE and RONGO MATANE				
14. Mahinga Kai (no. & species)				
15. Rongoa (no. & species)				
TUMATAUENGA	Rating 1-5	Rating 1-5	Rating 1-5	Comments
16. Use of River				
17. Use of River Margins				
18. Access to River				
19. Cultural Site	(Yes/No) Type			
TAWHIRI MĀTEA	Rating 1-5	Rating 1-5	Rating 1-5	Comments
20. Smell of River				
21. Weather				
OVERALL HEALTH – ORA	Rating 1-5	Rating 1-5	Rating 2-5	Comments
22. Feeling in puku				

TABLE 6-7: EXAMPLES OF NOTES FOR RANGITAANE O MANAWATU ASSESSORS USING THE ADAPTED CULTURAL HEALTH INDEX TO MONITOR IMPORTANT SITES. THESE COVER TWO ATUA, WHEREAS SIX WERE INCLUDED IN THE FULL ASSESSMENT

TANE MAHUTA	
9. Riparian Vegetation	Q ~ Is there vegetation present within 20m of a stream or 50m of a river. And does it shade the waterway? 1 ~ Little or no riparian vegetation – neither exotic or native 5 ~ Complete cover of mainly native vegetation

10. Catchment Vegetation	Q ~ What is the mix of Pasture, Horticulture, Native, Exotic Forestry, Other? 1 ~ Only one or two types of exotic vegetation 5 ~ Wide variety of native or native/exotic vegetation
11. Bird Life (Manu)	Outline sampling method i.e. Observation over sampling time i.e. Observation over 10 minutes. Note species and relative numbers. Is the bird song weak or strong?
12. Ngahere Taonga	Note main plant species. Are there opportunities for timber, fruit, or fibre harvest? Are trees seeding? Do plants have special characteristics/properties? Do areas include rocks/stone that has been used for cultural use? e.g. pakohe (argillite).
13. Pest plants/animals	Note species and negative effects. Has any control taken place? If so has it been successful?
HAUMIA/RONGO	
14. Mahinga Kai	Note plant, animal, fish, bird species. Are they harvestable both in quality and quantity?
15. Rongoä	Note plant species. Are they harvestable both in quality and quantity?

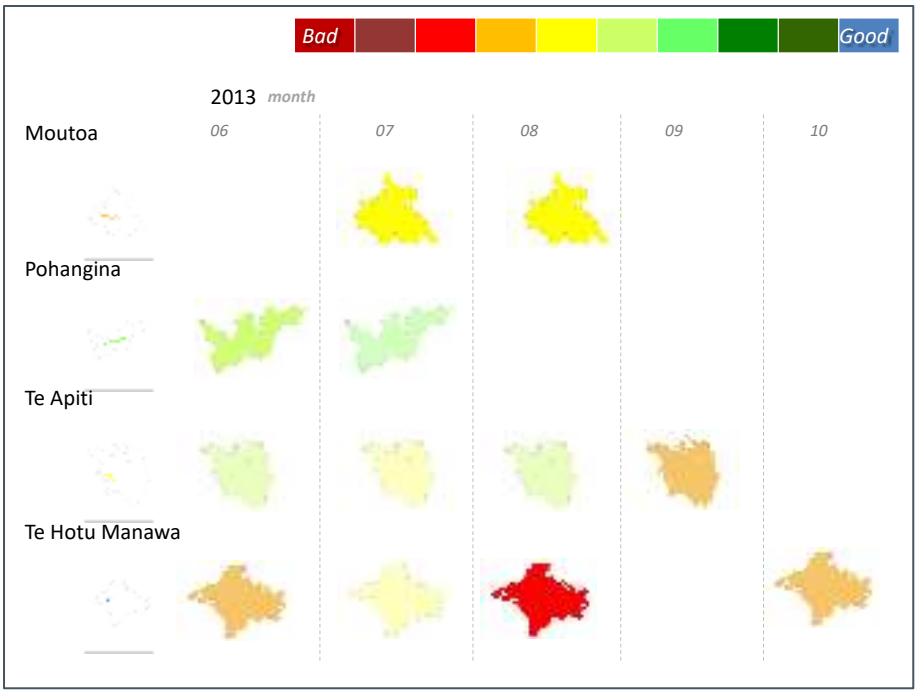


FIGURE 6-10: MONTHLY MONITORING RESULTS COMBINING DATA FROM SIX ATUA DOMAINS AT RANGITAANE O MANAWATU MONITORING SITES

HOW DOES THIS APPLY TO FRESHWATER MONITORING, THE NPS-FM, AND REQUIREMENTS ON COUNCILS?

The Rangitaane o Manawatu mapping and cultural monitoring project is designed to help the iwi answer monitoring questions that are important to them, about places that are important to them. It outlines clearly what matters the iwi have determined need to be monitored, and is ideal for providing the council in this rohe with the direction and information they need to meet their obligations under the NPS-FM around including mātauranga Māori in monitoring plans, in conjunction with Rangitaane o Manawatu as the project designers and owners of the intellectual property.

The monitoring design covers a vast range of parameters across all atua domains. This is a clear demonstration that for iwi, 'freshwater monitoring' often includes a number of parameters that traditional council monitoring may have considered beyond scope. This may help councils understand the perspective that iwi bring to the table when discussing and determining monitoring programmes.

7 Use of kaupapa Māori tools, frameworks and methods by region

A survey of regional councils and territorial authorities sought to capture information on which tools, frameworks and methods are being used or have been used in which regions. The survey focused on tools that councils themselves are using with iwi partners. As such, the results do not necessarily capture instances where iwi are using tools and councils are unaware of that work, however, where possible data was added in to augment the survey responses. This information is presented in Figure 7-1.

The most widely used and adapted tool was the Cultural Health Index, with 12 out of 16 regions reporting its use. The CHI is closely followed by cultural mapping, which is known to be used in 11 of the 16 regions. The Māori environmental performance indicators for wetland condition and trend is widespread, but does not seem to be have used greatly since its development. Taonga species monitoring is relatively common, with half of all regions undertaking some form of individual species monitoring.

The Waikato and Bay of Plenty regions used the widest range of tools. This is possibly a reflection of the number of research institutes who are involved in kaupapa Māori tool development that are located in or nearby these areas, such as The University of Waikato, NIWA and Manaaki Whenua. It may be helpful for research institutions to actively pursue relationships with iwi in more remote areas of the country, in order to support local development of tools, frameworks and methods in those areas too.

FIGURE 7-1: THE USE OF KAUPAPA MĀORI MONITORING TOOLS, FRAMEWORKS AND METHODS BY REGION

8 Conclusions and recommendations

8.1 Conclusions

There are a range of tools, frameworks and methods available to iwi and hapū, and their council partners. These range from decision-making tools, to digitally-based assessments, to mapping approaches for understanding and recording cultural knowledge, preferences and monitoring requirements, to research around important species, through to kaupapa Māori assessments of the state and health of a waterbody. Most of these tools, frameworks and methods are able to be adapted to suit local priorities, preferences and protocols. Many are inter-related. The various approaches can be used in tandem to meet different aspects of kaupapa Māori-based monitoring needs. Given the developments in recent years and the resourcing now being put into mātauranga Māori-based assessment approaches, it is likely that even more tools, frameworks and methods will become available in the near future.

8.2 Recommendations

The authors would like to make the following recommendations regarding this report and its contents:

8.2.1 Distribute report to iwi partners

Although this report is primarily produced as a means for regional councils to understand what kaupapa Māori assessment tools, methods and approaches currently exist, iwi and hapū may also find the information useful. There are numerous demands on the time and resources of iwi and hapū, and the luxury of researching all existing approaches to cultural monitoring is not one available to many tāngata whenua. It is hoped that this report will short-cut that process for iwi and hapū, and provide a useful overview of the cultural monitoring options they may wish to explore. It is recommended that councils provide copies to iwi partners in their regions.

8.2.2 Test the appetite for a national iwi-run database

One difficulty facing iwi and hapū is capacity, both in resourcing and in technical expertise to administer databases and GIS systems. One potential solution to this is to create a national database for cultural monitoring information, supported with government resourcing. Tools like Takiwā, the Wai Ora Wai Māori app and the Mauri Compass all had or have digital systems already created that could fill this need, or go towards filling this need. Alternatively, a new, purpose-built database could be designed. Constructing any such database to easily integrate with platforms such as LAWA (Land, Air, Water Aotearoa) would enable outputs from cultural monitoring to be afforded the same status and accessibility as other monitoring data, in situations where iwi and hapū desire for that information to be available publicly.

Decisions around what content was included in the database would need to be made by iwi and hapū, in particular to avoid a situation where particular approaches were

determined centrally to be 'the' way to do mātauranga Māori-based monitoring. Ideally, a database that was able to incorporate a range of tools and methods would be best, enabling iwi to select, use and input only the data they wish to incorporate.

Protection for intellectual property would, obviously, also need to be incorporated into any such national database, in order to safeguard local mātauranga and the intellectual property of the tools' creators. There may be limited appetite amongst iwi for the database to be administered by a government agency; an iwi-run database may receive greater support. The concept of a national, iwi-run database for cultural monitoring information should be floated with iwi and hapū, to test whether it would meet tāngata whenua needs, and whether there is a desire for such a system.

8.2.3 Wānanga

As stated throughout this report, in order for mātauranga Māori to be included in monitoring plans, there are a number of considerations that need to be deliberated upon and discussed between councils and iwi and hapū. Some of these include:

- the suitability or otherwise of various tools and methods for particular rohe and iwi or hapū
- the role of councils in supporting the use of mātauranga Māori in council monitoring plans
- the role of iwi and hapū in undertaking kaupapa Māori assessments of the environment
- resourcing and capacity issues
- matters of intellectual property and
- the protection of sensitive information.

Wānanga to discuss these issues would be helpful. We suggest hearing from a range of people as part of the wānanga, including experts in intellectual property law (and particularly Māori intellectual property law), experts on kaupapa Māori assessment tools (such as the various developers of the tools in this report), and iwi members currently undertaking kaupapa Māori-based research (both those working alongside councils and those undertaking monitoring and research for their own purposes, needs and aspirations). It may be useful to also hear from iwi authorities, to understand the wider governance context and iwi perspectives.

8.2.4 Research with iwi partners

Since the appearance of the first cultural monitoring tools in the early 2000s, there has been minimal inclusion of mātauranga Māori methods in council monitoring programmes. There are several possible reasons for this, including those outlined in Section 1:

- Overcoming historical tension and conflict
- Lack of capacity and resourcing, for both parties
- Difficulty getting 'buy-in' for institutional change

- Uncertainty about who to engage with
- Internal politics
- Lack of capability/capacity to understand Māori values
- Lack of capability/capacity to implement Māori values

Conducting research into 1) the difficulties councils face in including mātauranga Māori in their monitoring processes, 2) the barriers iwi and hapū encounter in their efforts to have mātauranga included, and 3) the solutions to those issues would provide a useful pathway forward. It would assist councils in fulfilling their NPS-FM obligations, and help iwi and hapū to meet their aspirations around recognition of mātauranga Māori, tikanga, and Māori perspectives in monitoring and research programmes.

References

AGRAWAL, A. 1995. Dismantling the Divide Between Indigenous and Scientific Knowledge. *Development and Change,* 26**,** 413-439.

AHURIRI-DRISCOLL, A., HUDSON, M., FOOTE, J., HEPI, M., ROGERS-KOROHEKE, M., TAIMONA, H., TIPA, G., NORTH, N., LEA, R., TIPENE-MATUA, B. & SYMES, J. 2007. Scientific Collaborative Research with Māori Communities: Kaupapa or Kūpapa Māori? *AlterNative: An International Journal of Indigenous Peoples,* 3**,** 60-81.

ALLEN, W., FENEMOR, A., KILVINGTON, M., HARMSWORTH, G., YOUNG, R. G., DEANS, N., HORN, C., PHILLIPS, C., MONTES DE OCA, O., ATARIA, J. & SMITH, R. 2011. Building collaboration and learning in integrated catchment management: the importance of social process and multiple engagement approaches. *New Zealand Journal of Marine and Freshwater Research,* 45**,** 525-539.

AWATERE, S. & HARMSWORTH, G. R. 2014. Ngā Aroturukitanga tika mō ngā Kaitiaki: Summary review of mātauranga Māori frameworks, approaches, and culturally appropriate monitoring tools for management of mahinga kai. *Landcare Research Contract Report LC1774.*

AWATERE, S., ROBB, M., TAURA, Y., REIHANA, K., HARMSWORTH, G. R., TE MARU, J. & WATENE-RAWIRI, E. 2017. Wai Ora Wai Māori–a kaupapa Māori assessment tool.

BAKER, M. 2018. Whakarongotai o te Moana, Whakarongotai o te Wā: Kaitiaki Information and Monitoring Framework Project Report. Waikanae: Te Ātiawa ki Whakarongotai.

COFFIN, A. 2015. Mātauranga Māori Networks. Hamilton University of Waikato.

DOUGLAS, E. M. K. 1984. Waiora, Wai Māori, Waitai, Waikino, Waimate: Māori perceptions of water and the environment. *Occasional Paper.* Hamilton, New Zealand: University of Waikato.

DURIE, M. H. 2005. Indigenous knowledge within a global knowledge system. *Higher Education Policy,* 18**,** 301–312.

ENVIRONS HOLDING TRUST 2014. Implementing collaborative freshwater management: a hapū perspective. *Te Uri o Hau Kaitiakitanga o Te Wai* Whangarei: Environs Holding Trust.

HARMSWORTH, G. R. 1997. Maori values and GIS: the New Zealand experience. *GIS Asia Pacific: The Geographic Technology Publication for the Asia Pacific Region.*

HARMSWORTH, G. R. 1998. Indigenous values and GIS: A method and framework. *Indigenous Knowledge and Development Monitor.,* 6**,** 3-7.

HARMSWORTH, G. R. 2001. A collaborative research model for working with iwi: discussion paper. Contract Report LC 2001/119 for the Foundation for Research, Science and Technology (FRST). Palmerston North: Landcare Research.

HARMSWORTH, G. R. 2002. Maori environmental performance indicators for wetland condition and trend. *Coordinated monitoring of New Zealand*

wetlands, Phase 2, Goal 2. Palmerston North: Landcare Research Palmerston North.
HARMSWORTH, G. R. 2005. Good practice guidelines for working with tangata whenua and Māori organisations: consolidating our learning. Contract report LC 0405/091 for the ICM web site. Landcare Research
HARMSWORTH, G. R., AWATERE, S. & PAULING, C. 2013. Using mātauranga Māori to inform freshwater management. *Integrated Valuation and Monitoring Framework for Improved Freshwater Outcomes (C09X1003).* Landcare Research.
HARMSWORTH, G. R., PARK, M. & WALKER, D. 2005. Report on the development and use of GIS for iwi and hapū: Motueka case study, Aotearoa-New Zealand. Web site: Landcare Research.
HARMSWORTH, G. R., YOUNG, R. G., WALKER, D., CLAPCOTT, J. E. & JAMES, T. 2011. Linkages between cultural and scientific indicators of river and stream health. *New Zealand Journal of Marine and Freshwater Research.*
HAYES, J. W., TIPA, G., ALLEN, C. & SHEARER, K. 2014. Cultural flow preference assessment and hydraulic habitat modelling to inform an agreed flow regime on the Tokiahuru Stream. Prepared for Genesis Energy. Cawthron Report No. 2510. Nelson: Cawthron Institute.
HUGHEY, K. & TAYLOR, K. 2009. Te Waihora/Lake Ellesmere: state of the lake and future management. Christchurch: EOS Ecology.
HUGHEY, K. F. D. & BOOTH, K. L. 2012. Monitoring the state of New Zealand rivers: How the River Values Assessment System can help. *New Zealand Journal of Marine and Freshwater Research,* 46**,** 545-556.
JEFFERIES, R. & KENNEDY, N. 2009a. Māori outcome evaluation: A kaupapa Māori outcomes and indictors, framework and methodology. Hamilton, New Zealand: IGCI, The University of Waikato.
JEFFERIES, R. & KENNEDY, N. 2009b. Ngä Mahi: Kaupapa Mäori Outcomes and Indicators Kete. *Planning Under a Cooperative Mandate (PUCM).* Hamilton: University of Waikato.
JEFFERIES, R. & KENNEDY, N. 2009c. A Report to Iwi on the Kaupapa Māori Environmental Outcomes and Indicators Kete. *Planning Under a Cooperative Mandate (PUCM).* IGCI, The University of Waikato.
JOLLANDS, N. & HARMSWORTH, G. R. 2007. Participation of indigenous groups in sustainable development monitoring: Rationale and examples from New Zealand. *Journal of the International Society for Ecological Economics.*
JOSEPH, R. 2008. Te hau mihi ata Mātauranga Māori and Science – cross-cultural dialogue. Hamilton: University of Waikato.
KAPA, M. & CLARKSON, B. 2009. Biological flora of New Zealand 11. Eleocharis sphacelata, kuta, paopao, bamboo spike sedge. *New Zealand Journal of Botany.*
KENNEDY, N. & JEFFERIES, R. 2009a. Environmental performance outcomes and indicators for indigenous peoples: Review of literature. PUCM Māori Report 5. IGCI, The University of Waikato: Hamilton, New Zealand.
KENNEDY, N. & JEFFERIES, R. 2009b. Kaupapa Māori framework and literature review of key prinicples. *PUCM Māori Report.* IGCI, The University of Waikato.

KENNEDY, N. & JEFFERIES, R. 2009c. Kaupapa Māori framework and literature review of key prinicples. PUCM Māori Report 4. Hamilton, New Zealand: IGCI, The University of Waikato.
KITSON, J. 2017. Protection of kanakana spawning and rearing habitats in the Waikawa River: MBIE Project Mana Whenua Summary. Murihiku: Te Ao Mārama.
KITSON, J., LEITH, V., WHAANGA, D., HAY, J., QUARTERMAN, A., LEDINGTON, S. & PAULING, C. 2012. Kanakana Harvest Mātauranga: Potential tools to monitor population trends on the Waikawa River, Southland/Murihiku (A Scoping Project). *Final Technical Report for Nga Pae o Te Maramatanga.*
KITSON, J., TE AO MARAMA INCORPORATED & WAIKAWA WHĀNAU 2010. Waikawa Kanakana Research 2009 : Monitoring observations and recommendations for future monitoring and research. . Invercargill, New Zealand Te Ao Marama Inc.
KITSON, J. C., CAIN, A. M., JOHNSTONE, M. N. T. H., ANGLEM, R., DAVIS, J., GREY, M., KAIO, A., BLAIR, S.-R. & WHAANGA, D. 2018. Murihiku Cultural Water Classification System: enduring partnerships between people, disciplines and knowledge systems. *New Zealand Journal of Marine and Freshwater Research***,** 1-15.
KUSABS, I., HICKS, B., QUINN, J. & HAMILTON, D. 2015a. Sustainable management of freshwater crayfish (kōura, Paranephrops Planifrons) in Te Arawa (Rotorua) lakes, north island, new Zealand. *Fisheries Research.*
KUSABS, I., QUINN, J. & HAMILTON, D. 2015b. Effects of benthic substrate, nutrient enrichment and predatory fish on freshwater crayfish (kōura, Paranephrops planifrons) population characteristics in seven Te Arawa (Rotorua) lakes, North Island, New Zealand. *Marine and Freshwater Research.*
KUSABS, I. A., HICKS, B. J., QUINN, J. M., PERRY, W. L. & WHAANGA, H. 2018. Evaluation of a traditional Māori harvesting method for sampling kōura (freshwater crayfish, Paranephrops planifrons) and toi toi (bully, Gobiomorphus spp.) populations in two New Zealand streams. *New Zealand Journal of Marine and Freshwater Research***,** 1-23.
MAXWELL, K. & PENETITO, W. 2007. How the use of rāhui for protecting taonga has evolved over time. *Mai Review.*
MEAD, H. 2012. Understanding Mātauranga Māori. *In:* BLACK, T., BEAN, D., W, C. & W, N. (eds.) *Conversations on Mātauranga Māori.* Wellington: NZQA.
METGE, J. & KINLOCH, P. J. 1978. *Talking past each other: problems of cross-cultural communication,* Wellington, Victoria University Press.
MINISTRY FOR THE ENVIRONMENT 1997a. Environmental Indicators: Proposals for Air, Fresh Water and Land. Wellington: Ministry for the Environment.
MINISTRY FOR THE ENVIRONMENT 1997b. The State of New Zealand's Environment. Wellington: Ministry for the Environment.
MINISTRY FOR THE ENVIRONMENT 1998a. Environmental Performance Indicators: Proposals for terrestrial and freshwater biodiversity. Wellington: Ministry for the Environment.
MINISTRY FOR THE ENVIRONMENT 1998b. Māori Environmental Monitoring: Prepared for the Ministry for the Environment by a panel of independent

Māori. *Part of a series of environmental performance indicators reports.* Ministry for the Environment.
MINISTRY FOR THE ENVIRONMENT 1999. Environmental Performance Indicators: Māori Input into the Environmental Performance Indicators Programme. Wellington: Ministry for the Environment.
MINISTRY FOR THE ENVIRONMENT AND STATISTICS NEW ZEALAND 2015. New Zealand's Environmental Reporting Series: Environment Aotearoa 2015: Data to 2013. Wellington: Ministry for the Environment (MfE) and Statistics New Zealand (StatsNZ),.
MOORFIELD, J. 2011. *Te Aka Māori-English, English-Māori Dictionary and Index,* New Zealand Longman/Pearson Education
MORGAN, T. K. K. B. 2006a. Decision-support tools and the indigenous paradigm. *Proceedings of the Institution of Civil Engineers-Engineering Sustainability.* Thomas Telford Ltd.
MORGAN, T. K. K. B. 2006b. Waiora and cultural identity: Water quality assessment using the Mauri Model. *AlterNative: An International Journal of Indigenous Peoples.*
MORGAN, T. K. K. B. Translating values and concepts into a decision-making framework: application of the Mauri model for integrated performance indicator assessment. National Workshop, 2007 Wisconsin, USA. Roundtable on sustainable forests: A partnership for the future.
MORGAN, T. K. K. B. 2015. How can Mātauranga Māori contribute to the Rena disaster response? Contract 12RF01 Final Report. Auckland, New Zealand: Auckland University.
MORGAN, T. K. K. B., FA'AUI, T. N. & MANUEL, R. D. 2013. Decision making at the interface: Mauri and its contribution to the Rena recovery. *http://www.mauriometer.com/userfiles/Decision%20making%20at%20the%20Interface%20Mauri%20and%20its%20contribution%20to%20the%20Rena%20Recovery.pdf.* SCANZ.
MORRIS, B., VAN SCHRAVENDIJK-GOODMAN, C., WILLIAMS, J. & ORMSBY, G. 2013. Identifying Traditional Whitebait Stands in the Lower Waikato River: A Joint Spatial Analysis Project. Waikato Regional Council.
MURU-LANNING, M. 2012. Māori Research Collaborations, Mātauranga Māori Science and the Appropriation of Water in New Zealand. *Anthropological Forum,* 22**,** 151-164.
NELSON, K. & TIPA, G. 2012. Cultural indicators, monitoring frameworks & assessment tools. *Report for the Wheel of Water Project.* Christchurch, New Zealand: Tipa & Associates.
NEW ZEALAND GOVERNMENT 2017. National Policy Statement for Freshwater Management 2014: Updated August 2017 to incorporate amendments from the National Policy Statement for Freshwater Amendment Order 2017. Wellington: Ministry for the Environment.
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT 1993. OECD core set of indicators for environmental performance reviews. *Environment Monograph No. 83*. Paris, France: OECD.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT 1997. OECD environmental performance reviews: a practical introduction. *Environment Monograph GD (97) 35*. Paris, France: OECD.

PAULING, C. 2003. Ki Uta Ki Tai: Mountains to the Sea Natural Resource Management: A scoping document for developing Mountains to the Sea Natural Resource Management Tools for Ngāi Tahu. Christchurch: Te Rūnanga o Ngāi Tahu.

PAULING, C. 2004. State of the Takiwā - Cultural Monitoring and Reporting on the Health of our Environment: A scoping document for developing a culturally based environmental monitoring and reporting system. Christchurch: Te Rūnanga o Ngāi Tahu.

PAULING, C. Making Mātauranga Matter: The Role of Cultural Monitoring and Health Assessment in Water Management. Critical and Sensitive Research Issues Symposium (CSRI) 2010, Tangaroa Ki Uta, Tangaroa Ki Tai: Water, Our Future, 2010 Christchurch.

PAULING, C., LENIHAN, T., RUPENE, M., TIRIKATENE-NASH, N. & COUCH, R. 2007. State of the Takiwā-Te Ähuatanga o Te Ihutai. Cultural Health Assessment of the Avon-Heathcote Estuary and its Catchment. Christchurch, New Zealand.

PAULING, C., MATTINGLEY, B. & AITKEN, J. 2005. Te Ahuatanga o Te Waiau – Cultural Health Baseline Report 2005. Te Rūnanga o Ngāi Tahu and the Ministry for the Environment.

PIHAMA, L. 2012. Kaupapa Māori theory: transforming theory in Aotearoa. *He Pukenga Korero,* 9**,** 5-14.

RAINFORTH, H. 2008. Tiakina Kia Ora: Protecting Our Freshwater Mussels. Wellington: Victoria University of Wellington.

RAINFORTH, H. 2014. A difficult convert? Combining cultural assessments and the IFIM to determine flow setting. *The Joint conference for the New Zealand Hydrological Society, New Zealand Freshwater Sciences Society and IPENZ Rivers Group: Water Symposium Integration: The Final Frontier.*

RICKARD, D. & SWALES, A. 2009a. Field trials of Ngā Waihotanga Iho. *Water and Atmosphere.*

RICKARD, D. & SWALES, A. 2009b. Ngā Waihotanga Iho—the estuarine monitoring toolkit for iwi. *New Zealand Coastal Society Coastal News.*

ROBB, M. 2014. When two worlds collide: Mātauranga Māori, science and health of the Toreparu wetland. Hamilton: University of Waikato.

ROBB, M., HARMSWORTH, G. R. & AWATERE, S. 2015. Māori values and perspectives to inform collaborative processes and planning for freshwater management. *Landcare Research Contract Report LC2119.*

ROYAL, T. A. C. 2012. Politics and knowledge: Kaupapa Maori and matauranga Maori. . *New Zealand Journal of Educational Studies,* 47**,** 30–37. .

SELBY, R., MOORE, P. & MULHOLLAND, M. (eds.) 2010. *Māori and the environment: Kaitiaki,* Wellington: Huia Publishers.

SMITH, L. 2012. *Decolonizing methodologies: research and indigenous peoples,* London and New York, Zed Books.

STEWART, M., TIPA, G., WILLIAMS, E., HOME, M., OLSEN, G. & HICKEY, C. 2014. Impacts of Bioaccumulative Contaminants in the Te Waihora Catchment on

Mahinga Kai Gatherers: Data Report and Risk Assessment. Te Waihora Management Board & Environment Canterbury Regional Council.
TARANAKI DISTRICT COUNCIL 2007. A cultural health index for Reservoir Creek. Indicators for recognising and expressing Tangata Whenua ki Whakatu values. Rotorua: TDC, Stratford, New Zealand.
TAURA, Y., REIHANA, K., AWATERE, S., HARMSWORTH, G. R. & FORREST, E. 2018. Wai Ora Wai Maori – a kaupapa Maori assessment tool for Ngati Tahu-Ngati Whaoa. *In:* WHENUA, L. R. M. (ed.). Hamilton: Landcare Research Manaaki Whenua.
TE RŪNANGA O NGĀI TAHU 2001. Ngāi Tahu Vision 2025. Christchurch: Te Rūnanga o Ngāi Tahu.
TIPA, G. 1999. Māori environmental indicators: Taieri River case study. Wellington, New Zealand: Ministry for the Environment.
TIPA, G. 2009. Exploring indigenous understandings of river dynamics and river flows: a case from New Zealand. *Environmental Communication.*
TIPA, G. 2010. Consideration of a significance assessment method for tangata whenua river values. *In:* HUGHEY, K. F. D. & BAKER, A. J. M. (eds.) *The River Values Assessment System.* Christchurch, New Zealand: Lincoln University.
TIPA, G. 2012. Environmental flow assessments: a participatory process enabling Māori cultural values to inform flow regime setting. *In:* B. JOHNSTON, L. HIWASAKI & KLAVER, I. (eds.) *Water, a cultural diversity & global environmental change: emerging trends, sustainable futures. .* California, USA: UNESCO International Hydrological Programme; Research Institute for Humanity and Nature (RIHN); UNU-IAS Traditional Knowledge Initiative; Centre for Political Ecology.
TIPA, G. 2013. Cultural values, flow and water management issues for the Waikirikiri / Selwyn – Te Waihora catchments. Canterbury: Environment Canterbury Regional Council.
TIPA, G. & NELSON, K. 2011. Environmental flow assessments: a participatory process enabling Maori cultural values to inform flow regime setting. *Water, Cultural Diversity, and Global Environmental Change.* Springer.
TIPA, G. & NELSON, K. 2012. Identifying cultural flow preferences: Kakaunui River case study. *Journal of Water Resources Planning and Management.*
TIPA, G. & SEVERNE, C. 2010. Including Mātauranga Māori in environmental flow setting decisions. *NIWA Report HAM.* Wellington, New Zealand: NIWA, Ministry for the Environment.
TIPA, G. & TEIRNEY, L. 2003. A Cultural Health Index for streams and waterways: indicators for recognising and expressing Māori values. Wellington, New Zealand: Ministry for the Environment.
TIPA, G. & TEIRNEY, L. 2006a. A cultural health index for streams and waterways: a tool for nationwide use. Wellington, New Zealand: Ministry for the Environment.
TIPA, G. & TEIRNEY, L. 2006b. Using the Cultural Health Index: How to assess the health of streams and waterways. Wellington, New Zealand: Ministry for the Environment.

TIPA, G. & WELCH, R. 2006. Comanagement of Natural Resources: Issues of Definition From an Indigenous Community Perspective. *The Journal of Applied Behavioral Science,* 42**,** 373-391.

TOWNSEND, C., TIPA, G., TEIRNEY, L. & NIYOGI, D. 2004. Development of a tool to facilitate participation of Maori in the management of stream and river health. *EcoHealth.*

WALKER, D. 2009. Iwi estuarine indicators for Nelson. *Prepared for Nelson City Council. Tiakina te Taiao occasional report. FRST Envirolink report.* Nelson City Council, Tiakina te Taiao.

WILLIAMS, D. 2001. Mātauranga Māori and Taonga: the nature and extent of Treaty rights held by iwi and hapū in indigenous flora and fauna, cultural heritage objects, valued traditional knowledge. Wellington: Waitangi Tribunal.

WILLIAMS, E., BOUBÉE, J., JAMESON, J., HORTON, P., POTANGAROA, J., BAKER, C., STEWART, M., ZERNACK, A. & CROW, S. 2014. Glass eel recruitment, species separation trials and juvenile eel surveys. *Rangitaane Tuna Aquaculture – Year 1 Review of Activities.* Te Ohu Tiaki o Rangitaane Te Ika a Maui Trust.

WILLIAMSON, B., QUINN, J., WILLIAMS, E. & VAN SCHRAVENDIJK-GOODMAN, C. 2016. Pilot Waikato River report card: methods and technical summary. *Prepared for Waikato River Authority. Hamilton, NIWA.* Hamilton: Waikato River Authority, NIWA.

WILSON-ROOY, M. 2018. *The Waikōura Framework: a bicultural systems model for management of Lake Rotorua.* Master of Public Health Masters, University of Otago.

YOUNG, R. G., HARMSWORTH, G. R., WALKER, D. & JAMES, T. 2002. Linkages between cultural and scientific indicators of river and stream health. Nelson: Landcare Research, Tasman District Council, Tiakina te Taiao, Cawthron Institute.