A Cultural Health Index

for

Streams and Waterways

Applying the CHI framework to the

Hakatere (Ashburton River)

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Table of Contents

EXECUTIVE SUMMARY

The Cultural Health Index for streams resulted from a study to develop a tool to facilitate the input and participation of iwi into land and water management processes, in particular decision-making processes. The Index was developed in two stages from a successful collaboration between iwi and ecologists and based on cultural knowledge about stream health. The Index for streams has the potential to become an important diagnostic tool for iwi whereby stream health issues of concern to them are identified and insights gained from the detailed assessments underpinning the scores derived from applying the tool.

The next stage of the Cultural Health Index is to validate certain aspects and to determine the most effective way for iwi to implement this new tool and use the data obtained. Stage 3 of the project tests the Cultural Health Index:

1. Application to another river type; and
2. Application to another iwi – (in the North Island)

This report summarises the application of the CHI to another river type. The methodology that was used to develop the Index is described in Tipa Teirney 2002. Significantly, however, the Index was developed from research conducted on what are essentially, two single channel rain fed rivers in Otago. Given the range of other river types throughout the country it is important to know whether the Index is valid for other types of rivers. Whether the performance of the Index is affected by river type can be determined by repeating aspects of the earlier study on another river. The stream health indicators had resulted from interviews with kaumatua and kaimahi from across Te Wai Pounamu working in the areas of customary fishing, resource management and conservation. It is appropriate to conclude that they are applicable to the whole of the Kai Tahu rohe. The river chosen needed to be within their rohe as only one factor can be varied at a time in the study design. Given the work and cost involved only one other river type could realistically be included in the extension.

Te Runanga o Arowhenua has stated in many resource management forums around South Canterbury that the absolute necessity of freshwater to the lives of Kai Tahu made it a part of their spiritual and cultural existence. The spiritual affinity with freshwater continues and Kai Tahu still maintain an appreciation and respect for its life-giving properties. The Hakatere is one of the rivers of special significance to the whanau living in the South Canterbury area. The cultural association with areas within the Hakatere catchment have been recognised by the Crown in the Statutory Acknowledgement for Ö Tü Wharekai (the "Mäori Lakes"). The Statutory Acknowledgement confirms the continuing cultural association with the Hakatere, and in addition to the values described above, confirms the importance of the catchment as a mahika kai. The term 'mahika kai' literally means 'food works'. As stated in our earlier report "It is an all inclusive term that encompasses the ability to access the resource, the site where gathering occurs, the act of gathering and using the resource, and the good health of the resource".

We used the same study design for the Hakatere extension as for the Taieri and Kakaunui Rivers study (Tipa and Teirney 2003). Comparisons between the Hakatere and the

Taieri and Kakaunui River results are only valid if study design is the same. This is fundamental if we are to decide whether the CHI developed for the Taieri and Kakaunui can be applied to a different river type. At a more detailed level, a statistically robust design is required to analyse stream health indicators and mahika kai for Hakatere sites and to subsequently develop a CHI. Finally the study design provides for the application of Western scientific stream health and land use measures allowing comparisons between cultural and scientific measures and a broader perspective within which to interpret the CHI. Criteria for selecting the river included:

- River type had to be different to the Taieri and Kakanui Rivers. A river classification system assisted with the identification of a suitable candidate.[1];
- A river significant to Kai Tahu with traditional information available;
- Good access around the catchment;
- Access to existing 'western' stream health measures;
- Support from scientific organisations and resource management agencies able to assist with data collection; and
- Existing catchment management initiatives including research and community involvement.

The Hakatere was selected for this part of the study because it is a distinctly different river type than either the Taieri or Kakaunui Rivers.

As with the Taieri/Kakaunui Rivers study, the Hakatere study was designed to ensure that data for each of the indicators of stream health and mahinga kai could be subjected to statistically rigorous analysis during the determination of the CHI.

Indicators of cultural stream health used in this study were based on the original set developed for the Taieri and Kakaunui River studies (Tipa 1998, Tipa and Teirney 2003). Initially characteristics of a healthy waterway were identified from interviews with members of Kai Tahu whānui from the Taieri and Kakaunui area. Because we interviewed further Kai Tahu members from throughout the rohe we are confident that one set of cultural stream health indicators is applicable to all Kai Tahu runanga. Whereas mahika kai is an integral component of cultural stream health, it is treated as one of three components in the Cultural Health Index. The same set of mahika kai indicators were adopted as were used in the Taieri/Kakaunui study:

- Record mahika kai (bird) species
- Record mahika kai (plant) species
- Is access adequate to harvest mahika kai
- Would you return to this site in the future?

The original recording form was refined according to the changes made to indicators. Assessment of the cultural stream health and some mahika kai indicators was on a 1-5

[1] The team met with Ton Selder (NIWA) to discuss how the River Environment Classification (REC) could assist identification of a different river type see http://www.niwa.co.nz/ncwr/rec/ for more information on the REC.

rating basis as had been used in the Taieri/Kakaunui River study. For the sake of clarity improved descriptions were made for a number of the 1 and 5 rating categories.
The Arowhenua assessment team numbered six comprising two generations. Each rūnanga member used the recording form to complete a field assessment of stream health and mahika kai at each stream site. Data were gathered for 31 sites in the Hakatere catchment during the 2003/04 summer. The rating information from each of the recording sheets was collated into a spreadsheet for analysis.

Compiling the mahika kai information required access to historical as well as contemporary data. Lists of species that were traditionally harvested from the sites were compiled from interviews with rūnanga members and from the written record of Ngāi Tahu. As an iwi, Ngāi Tahu has access to substantial written records. Collection of this information could have taken significantly longer if Maori Land Court minute books and the records held by individual whānau members had had to be researched.

For contemporary data on plant and bird species, rūnanga members listed the mahika kai plant and bird species present in the vicinity of the site on the recording form. Because it was not possible for rūnanga members to directly observe all fish at each site, sampling was required to identify the presence of mahika kai fish species. Electric fishing was carried out at all sites, with fish species being identified and returned to the stream alive. At larger stream sites electric fishing was carried out along the river margins.

Investigating which of the 14 indicators contributed most significantly to the overall stream health measure revealed three mahika kai indicators to be so highly correlated that we consider them to be alternative measures of overall stream health. In the Taieri/Kakaunui study exactly the same relationship was revealed. The strength of the relationship reflects the value Otakou, Moeraki and Arowhenua Runanga place on mahika kai in evaluating cultural stream health.

To determine the most important contributing factors from the remaining 11 indicators, three different manipulations were tested against the overall stream health measure - correlation coefficients, stepwise multiple regressions and pre determined habitat categories combined with correlation coefficients. The stepwise multiple regression was found to give the best results for the Taieri/Kakaunui and Hakatere data. Accordingly we adopted that approach for the Hakatere study.

Water quality was by far the most important indicator of cultural stream health for the Taieri/Kakaunui and the Hakatere respectively, explaining 56% and 73.5% of the variability within the overall stream health measures. Correlation coefficients with the overall measure are also impressive being 0.75 and 0.86 respectively. The consistent prominence of water quality also reflects the value runanga place on mahika kai as an integral part of cultural stream health.

For the Hakatere a multiple regression value of 93% for the five most important indicators is impressive. Of the five indicators, water quality, channel modification and catchment landuse were in common with the Taieri/Kakaunui and the Hakatere.

Differences in the remaining two indicators suggest that we may not be able to adopt one set of five indicators for all rivers. However the Kahungunu/Tukituki River part of the study must be completed before decisions can be made about the indicators.

Significant positive relationships have been found between the Cultural Stream Health Measure for both the Taieri/Kakaunui and Hakatere and the western stream health measures, MCI and SQMCI. This is noteworthy given the CSHM is based on whole of catchment iwi perceptions and the MCI, the macroinvertebrate benthic stream communities. Similarly, consistently negative relationships were revealed between the CSHM and % developed land upstream of the sites for both the Taieri/Kakaunui and the Hakatere.

The nature of identical or similar features between the Taieri/Kakaunui and Hakatere discussed above indicates that the CSHM component of the CHI is just as relevant for braided, snow and rain fed rivers as for single channel, rain fed rivers. From runanga evaluations there is no doubt about the features that are fundamental to cultural stream health and these appear to be generic across river types.

Having completed Stages 1, 2 and 3 of the project we have developed a Cultural Health Index that, having completed this study we are confident can be applied in different river types. In each of the three catchments studied to date, runanga members were able to able to apply the indicators and/or gather the information needed to determine scores for the three components.

With the design of the Index, we have sought to reflect the values and practices that are central to the cultural identity of Maori because of the belief that Maori want to participate in freshwater management to achieve specific outcomes. One of the outcomes they seek is recognition and protection of their spiritual and physical association with freshwater resources. The values and practices that are described in preceding sections of this report and reflected in all three components of the Index are interrelated and collectively they represent:

- the world view that Maori bring to the process of resource management; and
- the distinctive identity, beliefs, traditions, knowledge and management practices that they wish to protect.

As a final comment, it is necessary to reflect on the development of the Cultural Health Index. The project to develop the Index was seen by Kai Tahu as a chance to exemplify to resource management agencies what partnership might mean and the benefits to be realised from Kai Tahu participation in freshwater management. The project to develop the Index is a practical example of how an agreed position can be negotiated between different parties. The project has consisted of three stages to date and for each the methodology, data collected, and the analysis of results has been transparently negotiated and shared between Maori, scientists and resource management agencies.

1.0 Background

1.1 INTRODUCTION

The Cultural Health Index for streams resulted from a study to develop a tool to facilitate the input and participation of iwi into land and water management processes, in particular decision-making processes. The Index was developed in two stages from a successful collaboration between iwi and ecologists and based on cultural knowledge about stream health. The Index for streams has the potential to become an important diagnostic tool for iwi whereby stream health issues of concern to them are identified and insights gained from the detailed assessments underpinning the scores derived from applying the tool.

The next stage of the Cultural Health Index is to validate certain aspects and to determine the most effective way for iwi to implement this new tool and use the data obtained. Depending on the results of the validation studies the tool may be implemented more widely and a process to facilitate that is being designed.

Stage 3 of the project tests the Cultural Health Index:

1. Application to another river type; and
2. Application to another iwi – (in the North Island)

For this extension to stage 3 the successful collaborative approach continued. Gail Tipa, Laurel Teirney and Colin Townsend's involvement ensured continuity with Stages 1 and 2 of the project, robust research design, consistency with the overall kaupapa, and an understanding of the "big picture" – to facilitate more effective participation by Maori. In response to the Ministry's priority to see the project extended to other river types and other iwi, it was important that the two extensions to the project sought involvement of personnel from local government and where possible CRIs. The purpose of this report is to document the outcomes of stage 3.1 Application of the CHI to another river type.

Further, consistent with the kaupapa of facilitating iwi participation in resource management, wherever possible Maori scientists were encouraged to assist with the collection of data using western measures[2]. A philosophy of enhancing iwi capacity has underpinned this programme, since its inception in 1998.

1.2 RELATIONSHIP TO THE MINISTRY FOR ENVIRONMENT STRATEGIC DIRECTION

The principal driver for this project when it started in 1998 was the Ministry for Environment's Environmental Performance Indicator (EPI), Programme the purpose of which was to develop a set of environmental performance indicators that enables resource managers to monitor progress towards achieving environmental goals (which are prescribed at a national, regional and local level).

[2] A Kai Tahu PhD student calculated the MCI scores.

Environment 2010 strategy details a set of national environmental goals that were adopted by the Government in 1994. Goals and proposed actions for nine priority issues represent the environmental outcomes sought from the implementation of the Resource Management Act 1991. The purpose of the Ministry for Environment's EPI Programme is to develop a core set of environmental performance indicators that will allow progress towards the key goals of *Environment 2010* to be tracked over time. Specifically, the Ministry contends that the EPI Programme will enable resource managers to assess:

- the state of the environment at national, regional and local levels;
- the impact of human activities on the environment;
- emerging trends; and
- the effectiveness of key legislation and policy, such as the Resource Management Act 1991, *Environment 2010*, New Zealand Coastal Policy Statement, and the statutory plans and policies of regional and district councils.

EPIs have the potential to be crucial to the practice of resource management, but the framework initially adopted by the Ministry threatened to reduce ecosystems to simplistic sets of natural resource components (e.g. air, freshwater, land, plants). Considerations fundamental to Maori, such as interactions within ecosystems were not well accommodated (Crengle, 1997). This represented a weakness in the overall indicators framework. Direction from Maori was needed to show how they might be directly involved in the development of EPIs. Eventually four Maori case studies were supported, to test the efficacy of Maori participation in the formulation of EPIs, one being the Taieri River EPI project[3].

The project to identify indicators that Maori use to assess stream health and to develop a Cultural Health index was initiated in response to a number of concerns about freshwater management voiced by members of Ngai Tahu whanui. Numerous catchments within the rohe of Ngäi Tahu experience both deteriorating water quality and mounting pressures on the quantity of water available to meet the needs of both instream and extractive uses. Ngai Tahu contend that these issues need to be addressed by resource managers because they are adversely impacting on the cultural association of Ngai Tahu with the affected freshwater resources[4].

Water quality remains a concern throughout the Ngai Tahu rohe, as there are still examples of point source water pollution caused by the discharge of effluent from sewage plants. These discharges, while having few apparent biological adverse effects, have significant adverse cultural effects that are not fully acknowledged. Of yet greater concern, however, particularly given the increase in dairying in the South Island, is the poor water quality resulting from non-point sources of pollution.

The Ministry for Environment's report, *Environmental Performance Indicators, Proposals for Air, Fresh Water and Land* (1997) reinforced these concerns by confirming that the focus of many of the water quantity monitoring regimes within New Zealand was

[3] The Taieri River EPI project commenced in 1998.
[4] Te Runanga o Ngai Tahu, 1999, *Freshwater Policy Statement,* Kai Tahu Ki Otago, 1996, Natural Resource Management Plan

the extent of extractions and how the level of extraction relates to the maximum sustainable yield. A concern, expressed on page 64 of the Ministry's Report, is the statement that spiritual issues, such as mauri, were not being addressed in the monitoring activities of regional councils. This served to reinforce the concerns of Maori who, in struggling to be heard in resource management forums, were faced with individuals within resource management agencies who did not fully appreciate Maori cultural and spiritual values in respect of freshwater.

Despite observing and voicing concerns about the poor health of freshwater resources within their rohe, the ability of Ngai Tahu to influence freshwater management has thus far been limited, as their role has been largely confined to one of advocacy. Maori have been consulted by resource management agencies as statutory plans and policies are formulated, but they have not been accorded the status of equal participants in decision-making forums. One of the outcomes sought from the identification of indicators and the development of the Cultural Health Index was a change to the nature of participation by Ngai Tahu in freshwater management within the Otago region.

The Taieri River Indicators Project, or Stage 1 of this project, was one of the four Maori case studies initiated with the support of the Ministry in 1997/98. The project was thus narrowly defined. Its focus was freshwater issues in the Taieri Catchment, specifically the previous lack of attention to the incorporation of Maori values in their management. It therefore sought to address what was perceived to be a shortcoming in the Ministry's proposed approach to the monitoring of freshwater resources by determining how Maori would go about assessing the health and wellbeing of these resources – should they become involved in data collection and monitoring. The Ministry supported a further project (Stage 2) from 2000 – 2003 which saw the Index developed. The current study represents Stage 3.

1.3 THE STAGES OF THE PROJECT COMPLETED TO DATE

As has been previously stated in reports by the authors the project started in 1998 because it was acknowledged by the Ministry for Environment that, in order for resource management agencies to recognise and provide for cultural values (as required by the Treaty of Waitangi and New Zealand's resource laws), Maori needed processes that enabled them to articulate their values with respect to a specific resource, and state their expectations of resource management agencies. In other words, the project was based on the premise that despite the best intentions of existing resource management agencies and their explicit commitment to recognise cultural values, tools to capture cultural knowledge, and the capacity to achieve such recognition were lacking and in need of development.

1.3.1 Stage 1 – Identifying Indicators

The purpose of Stage 1 was to identify the "indicators" that Ngai Tahu would use if they were asked to assess the health of freshwater resources. The project sought to move from a generic discussion of Maori values, beliefs and practices to articulate what these mean

in *practical* terms within a specific resource context, in this instance freshwater. This information was to be used to identify how the approach of Maori to assessing the health of waterways compares with that of non-Maori. All participants at this indicators identification stage were representatives of Ngai Tahu[5]. Although there was liaison with resource management agencies to ensure that they were aware of the case study, the latter were not active participants. The objectives of Stage 1 were to:

1. document the association of Ngai Tahu with the Taieri Catchment;
2. identify the indicators that Ngai Tahu use to assess the health of freshwater resources;
3. develop an assessment process that Ngai Tahu might use to record their observations of the condition of three sites in the Lower Taieri River[6];
4. determine the extent to which the environmental performance indicators for freshwater identified by the Ministry for Environment's work streams might also be relevant indicators for Maori spiritual and cultural values; and
5. recommend a methodology for assessing the health of a river from a Maori perspective.

Once approval to undertake the project had been obtained from Te Runanga Otakou[7], a number of methods were used to gather data. Interviews with kaumatua and members of Ngai Tahu whanui working within resource management throughout the rohe were the principal method of data collection employed. When, during the course of interviews, reference was made to written documents and reports, these were accessed and analysed. Because interviews were undertaken with individual kaumatua, hui and *hikoi* (fieldtrips) were also scheduled so that kaumatua and runanga members had the opportunity to collectively respond to questions and, on occasion, challenge each other's perceptions. At the conclusion of the interview process, a list of indicators was compiled that formed the basis of an assessment form used in the field by Ngai Tahu observers to assess the health of three sites in the Lower Taieri.

1.3.2 Stage 2 - Developing the Cultural Health Index

In May 2000 Te Runanga o Ngai Tahu was asked for a proposal to operationalise the indicators that had been generated in Stage 1. The Ministry was aware that a University of Otago research team was already considering issues of water management in the Taieri Catchment and indicated that collaboration with the University was a preferred course of action. An integral feature of Stage 2 was Ngai Tahu researchers and Ngai Tahu whanui collaborating with non-Maori researchers, principally Laurel Teirney (Joint Project Manager) and staff from the University of Otago's Zoology Department.

While Stage 1 of the project required Maori to identify indicators of stream health, Stage 2 sought to operationalise the indicators. Two significant extensions to the Taieri River

[5] A key component of the fieldwork was a series of interviews with kaumatua and individuals from across the rohe who work in the areas of natural resource management, customary fisheries and mahika kai. An initial interview schedule was prepared identifying individuals in each region (Murihiku, Otakou, Aoraki, and Otatahi) to be interviewed.

[6] Site selection was limited to the Lower Taieri because of the need for easy access to the sites for Dunedin based observers.

[7] Permission was sought from Te Runanga Otakou which is the kaitiaki runanga, within whose takiwa (area) the Lower Taieri River flows.

EPI project were agreed with the Ministry. Firstly, the Kakaunui catchment was included to enable the team to assess whether the approach to assessment and the indicators developed could be applied to more than one river. Secondly, whereas Stage 1 had been limited to the Lower Taieri, in Stage 2 sites were selected throughout the two catchments, from their sources to the sea.

The objectives of Stage 2 of the research were twofold[8]. Firstly, the indicators of cultural health[9] that were to be applied at selected sites from the headwaters to the lower reaches of the Taieri and Kakaunui Rivers were to be tested and confirmed. Secondly, the focus of Stage 2 was to develop a tool and a process that could be used by kaitiaki to assess the condition of freshwater resources.

1.3.3 Stage 3 - Determining whether the Index is applicable to rivers other than single channel rain fed rivers

This report describes part of Stage 3 that was undertaken in the Hakatere catchment during 2003/2004. Stage 1 and 2 development of the Cultural Health Index occurred in the Taieri and Kakaunui rivers, both lowland single channel rivers. The purpose of this study was to determine whether the Index is applicable to other types of New Zealand's rivers, for example braided rivers.

1.4 OBJECTIVES

The methodology that was used to develop the Index is described in Tipa Teirney 2002. Significantly, however, the Index was developed from research conducted on what are essentially, two single channel rain fed rivers in Otago. Given the range of other river types throughout the country it is important to know whether the Index is valid for other types of rivers. Whether the performance of the Index is affected by river type can be determined by repeating aspects of the earlier study on another river. The stream health indicators had resulted from interviews with kaumatua and kaimahi from across Te Wai Pounamu working in the areas of customary fishing, resource management and conservation. It is appropriate to conclude that they are applicable to the whole of the Kai Tahu rohe. The river chosen needed to be within their rohe as only one factor can be varied at a time in the study design. Given the work and cost involved only one other river type could realistically be included in the extension.

In Year 1, specific tasks undertaken included:

- Interviews with members of Te Runanga o Arowhenua working in resource management to confirm sites of significance to runanga members.
- The selection of sites along the length of the Hakatere River where the cultural health indicators were to be applied. Site selection was based on a consideration of values

[8] The objectives of Stage 2 were detailed in Tipa, Teirney (June 2002) *"Mauri and Mahinga Kai Indicators Project – Development of a Cultural Health Index"*.

[9] Ministry for Environment asked that Stage 2 specifically include indicators of mahinga kai.

of mauri and mahinga kai, stream order, land use, access, the availability of existing information and the statistical requirements of the project design[10].

- A field team comprising members of Te Runanga o Arowhenua was trained in how to apply the Index.
- Evaluation of each site by members of Te Runanga o Arowhenua using a form developed that was based on cultural health indicators.
- Collection of stream health data at each site using the Macro-invertebrate Community Index (MCI) which is a stream health assessment measure that is used by resource management agencies and western scientists.
- Electric fishing was undertaken to collect fish data for each site.

During Year 2 the data was analysed, the implications of the Hakatere data on the design of the CHI assessed, and this report on the study prepared.

[10] The advice of the University of Otago Stream Team was sought with respect to the number of sites that should be chosen along the two rivers. They advised that 50 sites would be a minimum - 30 on the Taieri (10 on the Upper, Middle and Lower Taieri) and 20 along the length of the Kakaunui. University of Otago staff also helped with the field visits to finalise site selection.

2.0 VALUES ASSOCIATED WITH THE HAKATERE CATCHMENT

Te Runanga o Arowhenua has stated in many resource management forums around South Canterbury that the absolute necessity of freshwater to the lives of Kai Tahu made it a part of their spiritual and cultural existence. The spiritual affinity with freshwater continues and Kai Tahu still maintain an appreciation and respect for its life-giving properties. The Hakatere is one of the rivers of special significance to the whanau living in the South Canterbury area. The values that are summarised in this section come from the words (in resource management forums) and the written reports from Te Runanga o Arowhenua.

2.1 CULTURAL VALUES

Among New Zealand Maori there is much diversity between iwi, *hapu* and whanau. Such tribal distinctiveness leads to a range of customary management practices, but as the general discussion of values that follows shows, there are many values and practices that are common to Maoridom. Arguably, it is the intangible values ascribed to freshwater that are difficult for resource managers and scientists to accommodate within existing management regimes where objective, scientific philosophies and techniques predominate. However a close and spiritual relationship with the freshwater does exist and is underpinned by significant cultural values of whakapapa, mauri, tapu and kaitiakitanga.

2.1.1 Whakapapa

Traditionally, life came into being when Maku mated with Mahoranuiatea, another form of water and begat Rakinui, the sky. Rakinui coupled with a number of wives, including Papatuanuku. From Raki's various unions came vegetation, animals, birds, the mountains and people and a host of departmental atua. Kai Tahu claim the same descendency from Raki and his wives. This shared whakapapa then, binds Kai Tahu to the lands, waters and the life supporting them. All things are considered to have mauri (life force) and to have a genealogical relationship with each other. People are therefore related to the natural world.

Whakapapa is the link to one another and to the beginning of time, and reinforces the belief that all things are from a common source (Te Runanga o Kai Tahu, 2001).

2.1.2 Mauri

Waterways are of particular significance, because their condition is seen as a reflection of the health of Papatuanuku, the Earth Mother (Crengle 1997). A waterbody with an intact mauri will sustain healthy ecosystems and support mahika kai.

The primary management principle for Te Runanga o Arowhenua is the protection of the mauri or life-giving essence of the Hakatere from desecration. Sadly, mauri is an extinguishable value. The loss of mauri is recognised by the degraded nature of the

resource and the loss of its life supporting capacity. Kai Tahu have stated in many forums that every effort should be taken to ensure that the mauri of a resource is not desecrated. From a resource management perspective it is important to realise that natural disasters cannot harm the mauri only those resulting from the actions of man (Massey University 1990). Belief in mauri and the need to protect it create an atmosphere of respect and fear of the consequences of deliberate defilement or desecration. Concepts such as *tapu*, *rahui* and *noa* (Gray 1995) are applied by Maori to protect the health of resources, including freshwater.

2.1.3 Kaitiakitanga

The members of Te Runanga o Arowhenua have a duty to protect the natural world they are part of. Preservation of the integrity of valued resources is an important aspect of the responsibilities of those tribal members who are identified as the kaitiaki. Kaitiakitanga is an inherent part of rangatiratanga. Without legal recognition of rangatiratanga, kaitiakitanga becomes difficult to put into effect (Te Runanga o Kai Tahu, 2001). "Traditionally kaitiaki are the many spiritual assistants to the gods, including spirits of deceased ancestors, who are the spiritual minders of the elements of the natural world" (Mutu 1994, 17). A complex system of cultural and spiritual practices, customs, and rules were utilised by kaitiaki to control the interactions of Maori and the natural world and thus ensure the sustainable management of the resource. The specific outcome sought by Te Runanga o Arowhenua with respect to the Hakatere is the continued use of resources to meet the needs of the present generation while protecting the overall health and availability of the resource to meet the needs of future generations.

2.2 KAI TAHU INDICATORS

Members of Te Runanga o Arowhenua we among those interviewed as part of Stage 1 to identify the indicators by which they assess stream health. The indicators identified represent a mix of physical attributes of waterways and other values that Kai Tahu ascribe to freshwater. The indicators listed in Table 1 confirm that are concerned with health throughout a catchment*, ki uta ki tai – from the mountains to the sea*, and as a set of indicators they reinforce the significance of holism.

The indicators identified represent the factors that kaumatua and Kai Tahu resource managers believe are conducive to a healthy river, with a strong vibrant mauri[11]. A waterbody with a healthy mauri will sustain healthy ecosystems, support cultural uses (including mahinga kai), and be a source of pride and identity to the people.

[11] Each interviewee was asked to describe what a healthy waterway looks like. They were also asked to explain how they would assess whether a river was healthy enough to be a source of food. Once the positive characteristics were identified interviewees were asked to identify the changes that contribute to

the poor health of a waterway. Each transcript was reviewed and the indicators that had been identified were derived.

TABLE 1: FREQUENCY OF INDICATORS IDENTIFIED BY KAUMATUA[12]	
INDICATOR	FREQUENCY
1. Place names[13]	3
2. Greasiness of water	3
3. Temperature of water	3
4. Smell	2
5. Unpleasant odours	4
6. Presence of riffles	9
7. Sound of winds in riparian vegetation	2
8. Sound of birds being present	2
9. Sound of current of waterway	4
10. Sound of flood flows	1
11. Flow in river visible	11
12. Riparian vegetation – overhang	8
13. Riparian vegetation in headwaters[14]	4
14. Presence or absence of activities in the headwaters	2
15. Colour	10
16. Presence or absence of sediment on the riverbed	8
17. Continuity of vegetation – from land, through riparian zone, to the waterway	4
18. Unnatural growths	1
19. Foams, oils and other human pollution	8
20. Flood flows	2
21. Willow infestation	1
22. Abundance and diversity of fish species[15]	14
23. Abundance and diversity of birdlife	14
24. Presence or absence of stock in the riparian margin and waterway	7
25. Changes to the river mouth	2
26. Unnatural sedimentation in channels	2
27. Loss of aquatic vegetation in the marine environment	1
28. The health of fish found in the waterway	3
29. The stomp test	1
30. Changes to the extent of the tidal influence	4

[12] This table is explained in more detail in *Taieri River Case Study (Tipa, October 1999).*

[13] *Place names:* by documenting traditional place names within an area and working with kaitiaki to find their meaning, it should be possible to describe the area, as it was perceived by those who first named the landscape. Three of the kaumatua interviewed were adamant that an assessment of river health should start with a comparison between the meanings of traditional place names and the present day health of the catchment.

[14] *Protection of headwaters:* kaumatua advised that the mauri is sourced from, and is strongest, in the headwaters, of a catchment. Protection of sensitive headwater areas in catchments was considered critical to the maintenance and recovery of the mauri of the river (in cultural terms) and maintenance and recovery of riverine habitats (in biological terms). Two indicators were specific to the health of headwaters.

[15] *Life within a river system:* those interviewed advised a healthy mauri causes resources to be abundant in a waterway and in a condition that is fit for Maori to gather and use. Two primary elements were identified as significant: species composition and populations of each species.

2.3 KAI TAHU ASSOCIATION WITH THE HAKATERE

The cultural association with areas within the Hakatere catchment have been recognised by the Crown in the Statutory Acknowledgement for Ö Tü Wharekai (the "Mäori Lakes"):

> *The creation of the O Tu Wharekai wetlands is associated with Tu Te Rakiwhanoa and his shaping of Te Wai Pounamu (the South Island) to make it habitable for humans. The O Tu Wharekai complex was created as Tu Te Rakiwhanoa arranged the debris in the Waka o Aoraki while forming the harbours and plains and heaping up mountains of the interior.*
>
> *For Kai Tahu, traditions such as this represent the links between the cosmological world of the gods and present generations, these histories reinforce tribal identity and solidarity, and continuity between generations, and document the events which shaped the environment of Te Wai Pounamu and Ngai Tahu as an iwi.*
>
> *The name O Tu Wharekai actually relates to the part of the complex known as the Maori Lakes. The other lakes and wetlands which make up the complex also have their own names. Important nohoanga (settlements) associated with seasonal mahika kai gathering and travel to and through this area included: Tutaewera, Hatere, Uhi, Matakou, Kirihonuhonu, Otautari, Punataka, Te Kiakia, and Tamatakou.*
>
> *The complex was a part of the seasonal trail of mahika kai and resource gathering, and hapu and whanau bonding. Knowledge of these trails continues to be held by whanau and hapu and is regarded as a taonga. The traditional mobile lifestyle of the people led to their dependence on the resources of the wetlands. Mahika kai resources taken from the area included: tuna (eels), weka, kaka, kereru, tui, pukeko and other waterfowl, aruhe, kiore, kauru, matai and pokaka.*
>
> *The tupuna had considerable knowledge of whakapapa, traditional trails and tauranga waka, places for gathering kai and other taonga, ways in which to use the resources of the wetlands, the relationship of people with the area and their dependence on it, and tikanga for the proper and sustainable utilisation of resources. All of these values remain important to Ngai Tahu today.*

> *The mauri of O Tu Wharekai represents the essence that binds the physical and spiritual elements of all things together, generating and upholding all life. All elements of the natural environment possess a life force, and all forms of life are related. Mauri is a critical element of the spiritual relationship of Ngai Tahu Whanui with the area.* [16]

The Statutory Acknowledgement confirms the continuing cultural association with the Hakatere, and in addition to the values described above, confirms the importance of the catchment as a mahika kai. The term 'mahika kai' literally means 'food works'. As stated in our earlier report "It is an all inclusive term that encompasses the ability to access the resource, the site where gathering occurs, the act of gathering and using the resource, and the good health of the resource".

Although the number of sites available to Kai Tahu in catchments along the eastern coast of the South Island has reduced and the abundance and diversity of mahika kai species also declined, mahika kai continues to play a vital role in the health and well-being of Kai Tahu. Kai Tahu contends that every effort must be taken to avoid the adverse effects of resource use and development on remaining mahika kai sites and resources. Further, a conscious effort is needed to ensure that steps are put in place to reverse the history of degradation of habitats and the alienation of Kai Tahu from an active role in freshwater management.

Prerequisites for the continued ability to gather mahika kai from the Hakatere are healthy populations of mahika kai species that are accessible to Maori and in a condition fit for cultural use. As Te Runanga o Arowhenua has stated in a recent report on the Hakatere mahika kai is the ultimate test of the adequacy of water quality and water quantity. Insufficient quantities of water and poor water quality can both render mahika kai useless, either through its non-availability and / or its unsuitability for human consumption. An absence of usable mahika kai, particularly in areas that have been utilised for generations is an indictment of those with responsibility for managing those resources. Mahika kai requires flows of sufficient quality and quantity to sustain healthy and abundant populations of plant, fish, and bird species.

16 Ngäi Tahu Claims Settlement Act 1998, Schedule 46: Statutory Acknowledgement for Ö Tü Wharekai (Hakatere Lakes)

3.0 APPLYING THE CHI FRAMEWORK TO THE HAKATERE - STUDY DESIGN

We used the same study design for the Hakatere extension as for the Taieri and Kakaunui Rivers study (Tipa and Teirney 2003). Design features for the Hakatere are described below. Comparisons between the Hakatere and the Taieri and Kakaunui River results are only valid if study design is the same. This is fundamental if we are to decide whether the CHI developed for the Taieri and Kakaunui can be applied to a different river type. At a more detailed level, a statistically robust design is required to analyse stream health indicators and mahika kai for Hakatere sites and to subsequently develop a CHI. Finally the study design provides for the application of Western scientific stream health and land use measures allowing comparisons between cultural and scientific measures and a broader perspective within which to interpret the CHI.

Accordingly, the following study design features will be described.

- choice of the Hakatere for inclusion in the study
- selection of sites in the Hakatere catchment
- refinement of appropriate cultural indicators of stream health
- refinement of the recording form used by the rūnanga assessment team
- data collection

3.1 RIVER SELECTION

Criteria for selecting the river included:

- River type had to be different to the Taieri and Kakanui Rivers. A river classification system assisted with the identification of a suitable candidate.[17];
- A river significant to Kai Tahu with traditional information available;
- Good access around the catchment;
- Access to existing 'western' stream health measures;
- Support from scientific organisations and resource management agencies able to assist with data collection; and
- Existing catchment management initiatives including research and community involvement.

3.1.1 River Type

The Hakatere was selected for this part of the study because it is a distinctly different river type than either the Taieri or Kakaunui Rivers. Whereas the Otago rivers are hill

[17] The team met with Ton Selder (NIWA) to discuss how the River Environment Classification (REC) could assist identification of a different river type see http://www.niwa.co.nz/ncwr/rec/ for more information on the REC.

country rain-fed single channel rivers, the Hakatere originates in the high country, comprising two branches fed by both snow and rain. Both branches and the mainstem below their confluence are braided. A variety of land uses takes place in all three catchments.

The Hakatere catchment covers an area of 1652 square kilometres. Two main branches and their principle tributaries originate in the ranges, the South Branch from Mt Arrowsmith and the North Branch from Godley Peak. After the South Branch emerges from the Upper Gorge is becomes braided in the low relief area of the Ashburton Lakes. Across the plains both branches and the mainstem below their confluence have braided gravel bedded channels. Tributaries vary from typical cobble and gravel bedded streams to streams that meander through farmland. A series of intensively managed spring fed drains and ditches are a feature below Highway 1. Before reaching the sea the Hakatere forms a lagoon that can remain closed for considerable periods at low flow.

3.1.2. Kai Tahu association with the Hakatere catchment

The significance of the Hakatere to the Arowhenua Runanga and Kai Tahu is documented in 2.2.

3.1.3 Support from research and management agencies/ access to "western stream health measures

The study design requires information including western stream health measures, catchment landuse and occurrence of fish species throughout the catchment. These measures were either available from or collected by the University of Otago and Environment Canterbury, the resource managers,

Determination of landuse using GIS database

Landuse upstream of each Hakatere site was derived from the GIS database in the same way as for the Taieri and Kakanui Rivers. Because landuse had been found to impact on the CSHM the collection of landuse data was warranted for the Hakatere. The GIS results provided a detailed picture of the land uses upstream of each site in categories such as tussock, grazed pasture, planted forest etc. Summing the landuse results for all sites provided landuse for the entire catchment. Details about the place of catchment land use in the Hakatere study are provided below (3.4.4).

Western stream health measures: *Macroinvertebrate Community Index (MCI)*

In the Taieri and Kakaunui study, macroinvertebrates were sampled at each site and the Macroinvertebrate Community Index (MCI) and the Semi Quantitative MCI (SQMCI) calculated. Both measures are used by regional councils and researchers as indicators of stream health. Comparisons with the Cultural Stream Health Measure (CSHM) provided important insights into both types of measures. During this study macroinvertebrates were sampled at all Hakatere sites by Environment Canterbury and analysed by Rose Clucas, a Kai Tahu PhD student who determined the MCI and the SQMCI. We used Otago Regional Council protocols to determine the MCI at all 31 stream sites.

Occurrence of fish species: fish sampling

Fish species were identified at each site throughout the Hakatere River by electric fishing carried out by Environment Canterbury.

3.2 SITE SELECTION

As with the Taieri/Kakaunui Rivers study, the Hakatere study was designed to ensure that data for each of the indicators of stream health and mahinga kai could be subjected to statistically rigorous analysis during the determination of the CHI. The study design also provided for the application of Western stream health assessment methods at all sites so that comparisons could be made between cultural and scientific measures, providing a broader perspective within which to view the CHI.

Stream sites on the Hakatere were selected according to the following criteria:

- stream size
- sites of traditional significance
- catchment land use.

3.2.1 Stream size

Analysis of the Cultural Stream Health Measures (CSHM) according to stream size for the Taieri and Kakaunui Rivers showed the CSHM is equally valid across stream sizes, from the headwaters to the lower reach sites. In cultural terms, site selection that includes all parts of the catchment is consistent with the ki uta ki tai (mountains to the sea) philosophy.

The same three stream size categories used in the Taieri/Kakaunui Rivers study were selected for the Hakatere.

- first and second order streams – the smallest or headwater streams
- third and fourth order streams – medium-sized streams that may be tributaries or the mainstem in the middle reaches
- fifth order and above streams – larger streams that may be major tributaries, or the mainstem in the lower reaches.

Whereas similar numbers of sites were selected in each category for the Taieri and Kakanui Rivers, relatively fewer (six) sites were selected from the larger stream category on the Hakatere. This is because the mainstem and both North and South Branches of the Hakatere are braided and consistent in nature, requiring fewer sites to account for natural variability within the data. Together with 17 sites selected on the more variable medium sized streams and eight sites on the small headwater streams, data were collected from a total of 31 sites on the Hakatere.

3.2.2 Sites of traditional significance - ki uta ki tai

Kai Tahu has adopted a holistic view of river systems from a 'Ki Uta, Ki Tai' (mountains to the sea) perspective[18]. Site selection, which is a crucial first step in implementing the Index, provides for recognition of ki uta ki tai. In this study, a member of Te Runanga o Arowhenua undertook a series of interviews with members of the runanga. Using data obtained from those interviews sites significance to whanau and hapu were identified. The sites selected are marked on Figure 1.

The Hakatere catchment can be divided into five areas:
1. the headwaters (which includes Ö Tü Wharekai);
2. the middle reaches of the catchment;
3. the lower floodplain;
4. the river mouth and lagoon areas; and
5. the coastal environment.

We chose sites in the first four of these areas, a the Cultural Health Index has not yet been developed for applicaton in the coastal environment.

Headwater and Ö Tü Wharekai
In the past Kai Tahu would have untaken more movement throughout the whole catchment. This part of the catchment was, and remains, an important mahika kai area in its own right. Trails enabled movement north / south and to the West Coast via Noti Raureka (Brownings Pass). Sites selected within this part of the catchment were:

1. Gentleman Stream
2. Ashburton South Branch - Inland Basin

Mid-Catchment
Members of Te Rünanga o Arowhenua confirmed that the tributaries of the mid-catchment Hakatere river system were often considered more productive mahika kai areas than the mainstem itself. This was attributed to the relative lack of habitat afforded mahika kai species, within the main river system, as compared to the tributaries. Sites selected within this part of the catchment were:

1. Stour River
2. Bowers Stream confluence
3. Bowers at Sharplin Falls
4. Taylors Stream
5. Taylors at Winslow
6. Ashburton North branch
7. Pudding Hill Stream at Koromako
8. Pudding Hill Stream

Lower Floodplain
Te Runanga o Arowhenua advised that the area, basically bounded by State Highway 1 to the west and the coast on the east was once covered by wetlands which represented significant mahika kai. Sites selected within this part of the catchment were:

1. Ashburton North Branch - Thompsons Track

[18] A scoping paper has been prepared by Kaupapa Taiao a unit within Kai Tahu Development Corporation.

2. Harding Creek
3. Greenstreet Stream
4. Ashburton South branch - Olivers Road
5. Ashburton North Branch - SH77
6. Ashburton River at SHI
7. Wheatstone Stream
8. Wheatstone Stream -Croys Road

River Mouth / Lagoon
The Ashburton Mouth, was a significant mahika kai. Sites selected within this part of the catchment were:

1. Ashburton River mouth

Coastal Environment
Although the Index is not applied to sites in the coastal area, it is acknowledged that the coastal environment, as with other coastal areas within Te Wai Pounamu, was traditionally an important food source for Kai Tahu.

The fact that many of the sites selected were traditional nohoanga and mahika kai is testament to the association of Te Runanga o Arowhenua with waterbodies throughout the catchment – kit uta ki tai.

3.2.3 Catchment land use

Land use within the Hakatere catchment is documented on the Geographic Information System (GIS). Categories include tussock, scrub, grazed pasture, indigenous forest, planted forest and bare ground. Predominant land uses include tussock in the headwaters and grazed pasture further downstream. Whereas scrub and indigenous forest cover only limited areas of the catchment, on the plains there is almost no indigenous vegetation and stream banks support thick growth of introduced species such as willows and poplars.
This mix of landuses is similar to the Taieri and Kakanui catchments.

Bare ground was one landuse category that highlighted a distinct difference in river type between the Hakatere and Taieri/Kakaunui Rivers. Bare ground incorporates mountain scree and gravel riverbeds and makes up 15% of the Hakatere catchment reflecting the gravel braided nature of the river. In contrast bare ground represents less than 1% of the Taieri and Kakanui catchment landuse. .

According to the study design we sought sites that could be replicated in each stream-order and land-use category. Whereas this had been achieved for the first and second order streams in the Taieri catchment a feature of the Hakatere is greater heterogeneity in catchment landuse. Accordingly all stream sites were located in a mix of landuses. However, measures of landuse above each site enabled relationships with the Cultural Stream Health Measure to be identified.

3.2.4 Finalising site selection

In the site-selection process, sites of traditional significance were first assigned within each of the stream-order categories. Of a total of 19 traditional sites, two were in small streams, 11 in medium sized streams and 6 in large streams. Remaining sites were selected to optimise variety and replication of land use. Figure 1 shows the location of sites selected in the Hakatere catchment together with details of stream size and traditional association.

Table 1. Hakatere (Ashburton River) site descriptions

Site No	Site Name	Topo map	Map reference	Stream order*
1	Gentleman Smith	J36	632394	4
2	Ashb Sth Br Inland Basin	J36	615345	5
3	Lambies Stream	J36	574307	4
4	Stour River	K36	704276	5
5	Woolshed Creek	K36	730289	3
6	Stony Creek	K36	767239	3
7	Caves Stream	K36	782244	2
8	Bowers Stream confl	K36	840276	3
9	Bowers at Sharplin Falls	K36	821299	3
10	Taylors Stream	K36	872307	4
11	Taylors at Winterslow	K36	851326	2
12	Carneys Rd Stream	K36	782244	2
13	Ashburton Nth Branch	K36	916325	5
14	Pudding Hill Stm at Koromako	K36	902364	3
15	Pudding Hill Stm	K36	912355	3
16	Ashburton Sth Br Mt Somers	K36	807202	4
17	Ashburton Sth Br Thompsons Track	K36	915173	4
18	Annandale	K36	931179	3
19	Ashburton Nth Br Thomsons Track	K36	964186	3
20	Harding Creek	K36	017200	3
21	O'Shea Creek	K36	967147	5
22	Greenstreet Stream	K37	033092	3
23	Ashburton Sth Br Olivers Rd	K37	018090	6
24	Ashburton Nth Br SH77	K37	079051	4
25	Laghmore Creek	K37	045010	1
26	Ashburton River SH!	K37	087988	6
27	Carters Creek	L37	104946	2
28	Wheatstone Stream	L37	114882	2
29	Wheatstone Stm Croys Rd	L37	128854	3
30	Ashburton River Mouth	L37	141832	6
31	Whiskey Creek (Upper catchment)	J36	494321	2

* Stream order assigned 1-6 has been paired for the small, medium and large stream categories - respectively 1+2, 3+4 and 5+ order.

3.3 REFINEMENT OF APPROPRIATE CULTURAL INDICATORS OF STREAM HEALTH

3.3.1 Selection of indicators of cultural stream health

Indicators of cultural stream health used in this study were based on the original set developed for the Taieri and Kakaunui River studies *(Tipa 1998, Tipa and Teirney 2003).* Initially characteristics of a healthy waterway were identified from interviews with members of Kai Tahu whānui from the Taieri and Kakaunui area. Because we interviewed further Kai Tahu members from throughout the rohe we are confident that one set of cultural stream health indicators is applicable to all Kai Tahu runanga.

A common set of cultural stream health indicators within Kai Tahu whanui enabled us to investigate whether a different river type (Hakatere) could be effectively evaluated by the indicators that emerged from the Taieri/Kakaunui study. The indicators used in the Taieri/Kakaunui study were refined on the basis of the results of that study. For instance, runanga assessments of river flow (hear) and water quality (odours) showed wide variety and were not well related to the overall health scores. Furthermore, assessments for sediment and riverbed condition were so similar that they were combined. These refinements left 14 indicators for the Hakatere study as shown in Table 2.

Table 2. Refinement of cultural stream health indicators for the Hakatere study

Indicators used in Taieri/Kakaunui study	Indicators used in Hakatere (Ashburton) study
Catchment land use	confirmed and unchanged
Riverbank condition	confirmed and unchanged
Riparian vegetation	confirmed and unchanged
Indigenous species	confirmed and unchanged
Use of the riparian margin	confirmed and unchanged
Riverbed condition	confirmed and unchanged
Use of the river channel	confirmed and unchanged
Use of the river (takes/discharges)	confirmed and unchanged
River flow (see)	confirmed and unchanged
River flow (hear)	Unable to be consistently evaluated
Water quality (odours)	Unable to be consistently evaluated
Water quality (appears polluted)	confirmed and unchanged
Water clarity	confirmed and unchanged
Sediment	Combined with river bed condition
Would you taste the water	confirmed and unchanged
Would you collect mahika kai	confirmed and unchanged
Would you eat fish	confirmed and unchanged
Describe the overall health of the	confirmed and unchanged

river at this site	

3.3.2 Mahika kai indicators

Whereas mahika kai is an integral component of cultural stream health, it is treated as one of three components in the Cultural Health Index. The same set of mahika kai indicators were adopted as were used in the Taieri/Kakaunui study:

- Record mahika kai (bird) species
- Record mahika kai (plant) species
- Is access adequate to harvest mahika kai
- Would you return to this site in the future.

Note: Identifying mahika kai (fish) required fish sampling techniques in addition to observation and therefore were carried out independently of the runanga team assessments.

3.4 REFINEMENT OF THE RECORDING FORM AND DATA COLLECTION

3.4.1 The recording form

The original recording form was refined according to the changes made to indicators described in 3.3.1. Assessment of the cultural stream health and some mahika kai indicators was on a 1-5 rating basis as had been used in the Taieri/Kakaunui River study. For the sake of clarity improved descriptions were made for a number of the 1 and 5 rating categories.

The recording form used for the Hakatere by the Arowhenua assessment team is included as Appendix 1.

3.4.2 Data collection

The Arowhenua assessment team numbered six comprising two generations. The function of team co-ordinator was carried out by one of the team who organised the field work and ensured the sites were assessed, recording sheets completed and data entered. A training day was held to inform the team about the project and familiarise them with the recording sheets. Sites of widely differing stream health were selected for their assessment.

Each rūnanga member used the recording form to complete a field assessment of stream health and mahika kai at each stream site. Data were gathered for 31 sites in the Hakatere catchment during the 2003/04 summer. The rating information from each of the recording sheets was collated into a spreadsheet for analysis.

Compiling the mahika kai information required access to historical as well as contemporary data. Lists of species that were traditionally harvested from the sites were compiled from interviews with rūnanga members and from the written record of Ngāi Tahu. As an iwi, Ngāi Tahu has access to substantial written records. Collection of this

information could have taken significantly longer if Maori Land Court minute books and the records held by individual whānau members had had to be researched.
For contemporary data on plant and bird species, rūnanga members listed the mahika kai plant and bird species present in the vicinity of the site on the recording form

3.4.3 Identifying mahika kai fish species

Because it was not possible for rūnanga members to directly observe all fish at each site, sampling was required to identify the presence of mahika kai fish species. Electric fishing was carried out at all sites, with fish species being identified and returned to the stream alive. At larger stream sites electric fishing was carried out along the river margins.

4.0 DETERMINING THE CULTURAL HEALTH INDEX FOR THE HAKATERE

4.1 THE COMPONENTS OF THE CULTURAL HEALTH INDEX

The two year period since the development of the Cultural Health Index and this extension to the Hakatere has enabled the project team to reflect on the design of the Index. From focus groups with members of Kai Tahu whanui around the rohe[19], interviews undertaken for a number of other river studies[20], and the interviews with members of Te Runanga o Arowhenua as part of this study, the project team is confident that the three components of the Cultural Health Index encapsulate some of the cultural values of Kai Tahu that impact on how they perceive stream health.

The Cultural Health Index for streams when applied to a specific site will result in a score such as A-1/3.25/4.87[21] It is necessary to understand what each part of the score represents.

Component 1: Site Status	Component 2: Mahika kai measure	Component 3: Stream health measure
A – 1	3.25	4.87

For example:

- A-1/3.25/4.87 describes a site of traditional significance that Maori will return to, the mahika kai values are above average, but the overall health of the stream is exceptionally good.

Component 1 - Site Status

The first component assesses the significance of the site to Maori and asks them to distinguish between traditional and contemporary sites. The first question requires a site to be classified:

A means the site is in an area of *traditional* significance to manawhenua; or

B means that the site may not recognised by manawhenua as being of traditional importance and has been included to enable other aspects to be considered e.g. it could be a site that is monitored by the regional council).

The second question asks whether Maori would return to the site in the future, believing that it is able to sustain the uses that the area has had in the past. If the runanga would return, the site is awarded a 1 and if not, a 0. Initially the focus was on mahika kai and the question asked was whether you would return to the site to gather kai. Feedback from the Arowhenua runanga suggested that this may be too narrow as some sites were used by whanau, hapu and iwi but were not all mahika kai. The question has therefore slightly different and asks if you would return and use the site as you did in the past. In

[19] In Otago, Canterbury, South Canterbury.
[20] See for example Rangitata River Values, Cultural Impact Assessment Project Aqua
[21] This is the CHI score for Bowen Stream (Sharplin Falls)

this way the continuity of a range of cultural practices is assessed including – but not limited to - mahika kai.

When the answers to the two questions are collated there are four possible combinations:

A-1	A-0	B-1	B-0
This is a traditional site, that Maori would return to and use as they did in the past.	This is a traditional site that Maori would not return to. It would not be used in the future.	This is a site that is not of traditional significance to Maori. However they would go to the site in the future.	This is a site that is not of traditional significance to Maori. Further they would not go to the site.

Component 2 - Mahika kai

The second component of the Index requires an assessment of the mahika kai values of a site. Inclusion of this component in the Index recognises that despite the many intangible qualities associated with the spiritual presence of a waterway which cannot be captured by a numerical value, mauri is tangibly represented by the physical characteristics of a freshwater resource, including: indigenous flora and fauna; fitness for cultural usage; and productive capacity. As stated in our earlier report "Productive capacity" includes the ability of the freshwater resources to yield mahika kai".

There are four parts to component 2 of the Index - the "mahika kai measure".

1. The first part requires the identification of mahika kai species present at the site. A list of plant, bird and fish species is prepared. A score, 1 - 5, is then assigned, depending on the number of species present. The following scores were assigned
    - 0 - 4 species present scores 1
    - 5 - 8 species present scores 2
    - 9 -12 species present scores 3
    - 13 – 15 species present scores 4
    - More than 15 species present scores 5

    This means of according 1 -5 scores differs from that used in the Taieri and Kakaunui study. In the earlier report the 1-5 rating was determined by the maximum number of species at the sites assessed. This approach has been questioned for three reasons:
    a) It was inappropriate for a degraded site to score highly simply because it was the "best of the worst".
    b) The previous system of scoring does not allow for comparisons between catchments.
    c) The previous means of deriving catchment specific 1 -5 scores for the number of species present is likely to be difficult for Maori to apply.
2. The second factor requires a comparison between the species present today and the traditional mahika kai sourced from the site. This was deliberately factored into the design of the Cultural Health Index to recognise that maintaining cultural practices, such as the gathering of mahika kai, is an important means of ensuring the transference of cultural values through the generations. Cultural continuity means that greater value is likely to be assigned to sites of traditional significance that continue to support the mahika kai species sourced in the past. A score, 1 - 5, is

assigned, based on the number of species of traditional significance that are still present:

- Non traditional site scores a 1;
- None of the species sourced in the past is present at the site scores 1;
- At least 50% of the species sourced in the past are still present at the site scores 3; and
- All species sourced in the past are still present at the site scores 5.

3. Mahika kai implies that Maori have physical and legal access to the resources that they want to gather. The third component of the mahika kai measure therefore requires a score of 1 -5 to be assigned to each site based on the ability to access the site, where 1 equals no access and 5 equals unimpeded easy access.
4. The fourth element in the mahika kai measure requires Maori to assess whether they would return the site in the future and use it as they did in the past: No - scores 1, Yes - scores 5. The four mahika kai elements are then averaged to produce a single score out of 5 – for example:

Mahika kai measure	
The four scores were:	
• species present	3
• traditional species compared to present	1
• access	5
• return in the future	5

Therefore the final score for the sites was 14/4 = 3.5

Component 3 - Cultural stream health

The third and final component of the Index is the cultural stream health measure. Of the indicators identified by kaumatua and kaimahi, five that could be defined objectively and most appropriately reflect runanga members' evaluations of overall stream health were included in the Stream Health Measure for the Taieri and Kakaunui Rivers. The stream health measure for those rivers was derived by averaging the 1-5 scores awarded to the five most important indicators identified (catchment land use, use of the riparian margin, manipulation of the river channel, flow and water quality) to give a final stream health measure from 1-5. The same process of deriving the cultural stream health measures for the Hakatere stream sites was used in this study.

4.2 IDENTIFYING CULTURAL STREAM HEALTH INDICATORS FOR THE HAKATERE

The measure of overall stream health has particular significance in deriving a cultural stream health measure. Overall stream health is a perception of what is considered healthy from a holistic perspective.. Therefore, the cultural stream health measure derived in this study must encapsulate and be closely related to the overall measure of what runanga members consider healthy from their point of view.

To determine he cultural stream health measure that best expresses stream health for the Hakatere, the most important contributing indicators must be identified. To do this we used two statistical methods and a combination approach:

- The use of correlation coefficients identifies how closely each indicator is correlated to overall stream health and reveals the most important indicators.
- A stepwise multiple regression reveals, in order of importance, the indicators that contribute most to overall stream health.
- We also applied an approach of assigning indicators to categories that represent the catchment and waterway we used for the Taieri/Kakaunui study.

It is important to compare the results of several methods to better understand overall stream health and have confidence that the method chosen for deriving the cultural stream health measure is the most appropriate. Selecting the indicators that best express stream health for the Hakatere from a cultural perspective involved the following steps:

A. From the list of indicators presented for the Hakatere in Table 2, identify and remove indicators that are equivalent to overall stream health.
   Then apply each of the three methods described above.
B. From correlations between each indicator and overall stream health, identify indicators that are most strongly correlated with 'overall stream health'
C. Perform a stepwise multiple regression analysis to determine which indicators together account for most of the variation in 'overall stream health' at a site.
D. Assign Hakatere indicator correlations to the categories used on the Taieri/Kakaunui study

Relationships between the runanga team's overall stream health assessments for the Hakatere and each of the 14 stream health indicators listed in Table 2 were investigated using correlation coefficients (Table 3). (A correlation coefficient of 0 means there is no relationship whereas a coefficient of 1.0 means the two factors are perfectly correlated)

Table 3. Correlation coefficients between overall stream health assessment and other indicators of cultural stream health

Indicator	Hakatere Correlation
Fish safe to eat	0.97
Would fish at this site	0.95
Water safe to drink	0.94
Water quality – pollution	0.86
Water clarity	0.83
Use of the river takes /discharges	0.76
River flow – visible	0.75
Catchment land use	0.70
Riparian vegetation	0.70
Riverbed condition/sediment	0.69
Riverbank condition	0.57
Use of the riparian margin	0.55
Changes to the river channel	0.47
Indigenous species on adjacent margins	0.43

Step A. Identify and remove indicators that are the equivalent of overall stream health

Indicators fish safe to eat, would go fishing and water safe to drink were found to be extremely highly correlated with overall stream health (correlation coefficients greater than 0.90; Table 3). This level of agreement indicates that the four types of value judgements are essentially the same , indicating that the Maori concept of overall stream health is strongly tied up with use of natural resources.

An identical result from the Taieri/Kakaunui study further reinforces the fact that such values are fundamental to an expression of cultural stream health for runanga throughout the Kai Tahu rohe.

Given the need to identify indicators that make an important contribution to the overall stream health measure rather than mirror it, the three alternative measures of cultural stream health were not considered further in this analysis. The remaining 11 indicators were subject to three different types of analyses.

Step B. Identify indicators that correlate most strongly with overall stream health

The correlation of each indicator to overall stream health is shown in Table 3.

Indicators from correlations:

(i) Water quality (0.86)
(ii) Water clarity (0.83)
(iii) Use of the river for takes and discharges (0.76),
(iv) River flow (0.75)
(v) Catchment landuse (0.70)

Apart from catchment landuse the other four indicators are all instream indicators. Similar types of indicators may themselves be highly correlated, as is the case with water quality and clarity (0.80+). If two indicators are measuring similar characteristics the inclusion of both in the cultural stream health measure may not be appropriate. . Additional information about the relationship between each indicator and overall stream health is needed to interpret these data.

Step C. Stepwise multiple regression of cultural stream health indicators

Step C involved a stepwise multiple regression of stream health indicators against overall stream health. Stepwise multiple regression is a procedure that selects a reduced set of indicators (from the 11 indicators considered in Step A) that best account for the variation in the overall health score. We compared the results for the three regression procedures By way of explanation, the first variable added is the one that explains the most variation, or has the highest correlation with overall stream health. This first variable (indicator)

will not explain all of the variation in overall stream health so another variable (indicator) is added that accounts for the next most residual variation. The procedure continues in this manner until a set of variables (indicators) are included in a model where each one explains a significant portion of the variation in overall stream health.

Our stepwise regression analysis yielded the five indicators below, given in order of importance. When these five factors are taken together they account for more than a very creditable 90% of the variation in overall stream health at the sites. The contribution each indicator makes to the variation in overall stream health is shown in brackets.

Indicators from multiple regression:
(i) water quality - pollution [73.5%]
(ii) catchment land use [7.1%]
(iii) clarity [5.4%]
(iv) bed condition/sediment [3.7]
(v) channel modification [2.9]

There are differences between the most important indicators identified from correlations with overall stream health and from multiple regression analysis. Water quality and water clarity were identified by both procedures but flow features predominated in the correlations whereas channel and catchment features were revealed from multiple regressions.

Step D. Assign Hakatere indicator values to Taieri/Kakaunui indicators

In the Taieri/Kakaunui analysis five indicator categories that span all aspects of the catchments and waterway were used. The indicator in each category that is most highly correlated with overall stream health is selected. Ordering the Hakatere results according to these categories sees the replacement of water clarity with catchment landuse as follows:

Indicators by Taieri/Kakaunui category:
Catchment scale: catchment land use [0.70]
(i) Riparian river-margin scale: riparian vegetation [0.55]
(ii) Instream physical characteristics: use of river - takes and discharges [0.76]
(iii) Instream flow: river flow - visible [0.75]
(iv) Instream water quality: water quality - pollution [0.86]

Instream indicators, water quality, flow and takes and discharges predominate using this approach.

4.3 SELECTING INDICATORS FOR THE CULTURAL STREAM HEALTH MEASURE (CSHM) OF THE HAKATERE

Identifying indicators in three different ways allows the calculation of three versions of the Cultural Stream Health Measure. With three sets of CSHM for each stream site comparisons can be made to identify which type of CSHM provides the best set of indicators for the Hakatere.

CSHM was calculated for each of the three versions at each site by taking the average runanga member score for each of the five indicators (each on a 1–5 scale), before calculating a grand mean for the five indicators together (again on a 1–5 scale).

Correlation CSHM includes the five indicators derived from Hakatere correlation coefficient analysis

Regression CSHM includes the five indicators derived from the Hakatere multiple regression analysis.

Taieri/Kakaunui CSHM is calculated using Hakatere scores assigned to the set of indicators used in the Taieri/Kakaunui study.

Having derived three versions of CSHM. we compared their relative performance according to related measures such as stream size, western measures of stream health and land use.

4.3.1 Relationship between cultural stream health measures & stream size

Is the cultural stream health component of the CHI appropriate for streams of different sizes and for the different rivers?
We found no significant correlation between any of the three versions of the CSHM and stream order (1–2, 3–4, 5+). This means that the tool developed is equally applicable to different rivers and streams of different size. This is fundamental because it means one method/tool can be used for streams whether small or large.

4.3.2 Relationship between cultural stream health measures and western measures of stream health

How does the cultural stream health component of the CHI compare to Western scientific measures of stream health?
The cultural stream health measure is the only component of the Cultural Health Index (CHI) that has western scientific counterparts. To place the cultural stream health component of CHI in a broader perspective, we compared it with two western scientific measures of stream health (see below). This comparison provides an effective way of identifying what iwi have to offer that is not currently incorporated into land and water resource management processes and decisions.

- *The Macroinvertebrate Community Index* (MCI), widely used by regional authorities and researchers to assess stream health is based on the presence or absence of certain types of invertebrate on the streambed, which differ in their ability to tolerate pollution. Healthy streams have high MCI values (120 or above) whereas unhealthy streams have a value as low as 80 or less.

- *The Semi-Quantitative Macroinvertebrate Community Index* (SQMCI) is a variant of the MCI that takes into account not only the presence or absence of invertebrates classified according to their pollution tolerance but also their relative abundance on the streambed. Healthy streams have high values (maximum value is 10) and unhealthy streams have lower values (minimum value is 0).

Table 4. Correlations between versions of CSHM and western stream health measures

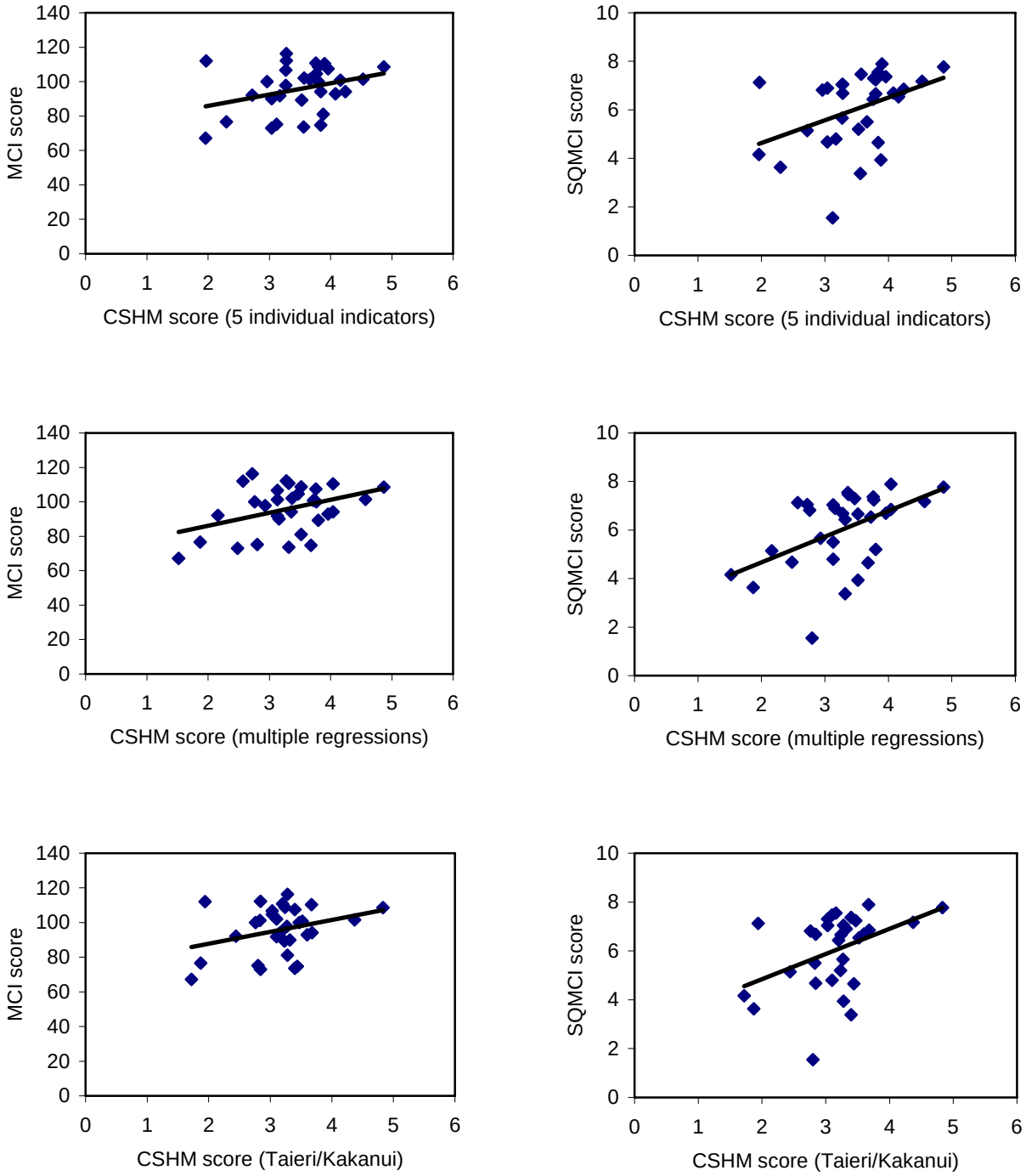
CSHM version	Correlation with MCI	Correlation with SQMCI
Correlation CSHM	0.32	0.40
Regression CSHM	0.40	0.49
Taieri/Kakaunui CSHM	0.32	0.42

All three versions of the CSHM were found to be significantly correlated with SQMCI: but only the regression CSHM was significantly correlated with MCI. These results indicate that each version of the cultural stream health measure, like its western scientific counterparts, successfully captures aspects of stream health. It is notable that the regression CSHM most closely matches the western counterparts.

The relationship between the MCI, and particularly SQMCI, and the cultural measure is particularly noteworthy. This is because these western measures are based entirely on stream invertebrates whereas the cultural measure has no invertebrate component but assesses stream health from a Maori perspective on the basis of a combination of catchment, river-margin and in-stream characteristics. Streams judged by runanga members to be in poor health turn out to possess a set of invertebrate species that are tolerant of poor water quality.

It is important to acknowledge that although the SQMCI and the CSHM correlated well, the cultural stream health measure is specifically designed to assess Maori values. While it represents a means of facilitating communication between resource managers and Maori, the SQMCI should not be seen as a surrogate for resource managers to consider the likely status of Maori values.

Figure 2. Relationships between the three versions of CSHM and western measures of stream health.



4.3.3 Relationship between cultural stream health measures and land use

What is the relationship between cultural and Western scientific stream health measures and patterns of catchment land use?
Research in New Zealand and elsewhere has established that land-use development in stream catchments, such as conversion from native vegetation to agriculture, can influence stream health by changing water chemistry, turbidity, temperature and the physical nature of the stream bed and banks, with consequences for stream life. It is therefore important to consider the relationship between the cultural stream health measure and land use in the stream's catchment, and to compare the performance of the cultural and Western scientific measures in this respect.

We used a Geographic Information System (GIS) to determine the percentage of developed land for each stream catchment, defining developed land as the sum of bare ground, urban, pasture, and pasture plus riparian willows. To check how well the cultural and Western scientific measures of stream health encapsulate the land-use effect we compare the relationships between the cultural stream health measure, MCI and SQMCI and land use (Figure 3).

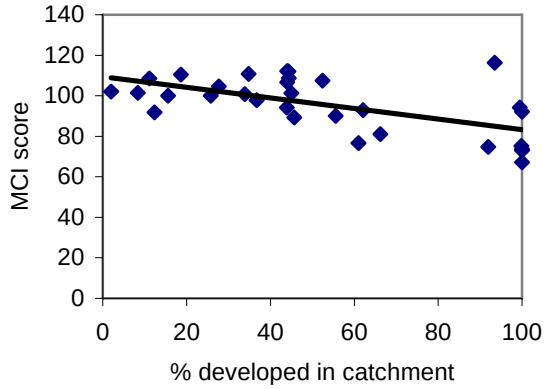
There were statistically significant negative relationships between percentage of developed land and each of the three variations of the cultural stream health measures. As percentage of developed land increased, the stream health measure scores decreased. Regression CSHM demonstrated the strongest relationship and correlation CSHM the weakest, but all three were statistically significant:

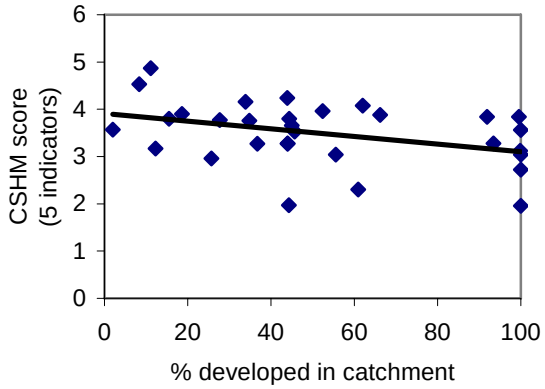
Regression CSHM (-0.53).
Taieri/Kakaunui CSHM (-0.40).
Corelation CSHM (-0.38)

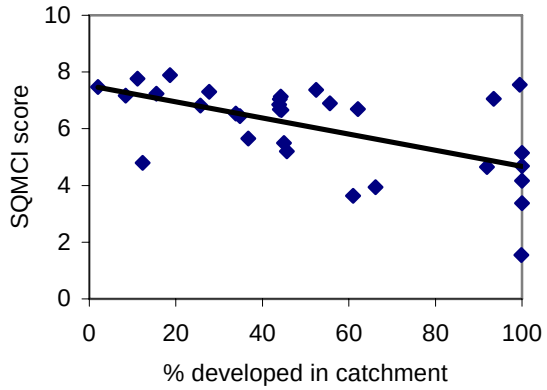
The western stream health measures, MCI and SQMCI were also strongly related to land development, and displayed the highest correlation coefficients of all (-0.61 and -0.58, respectively).

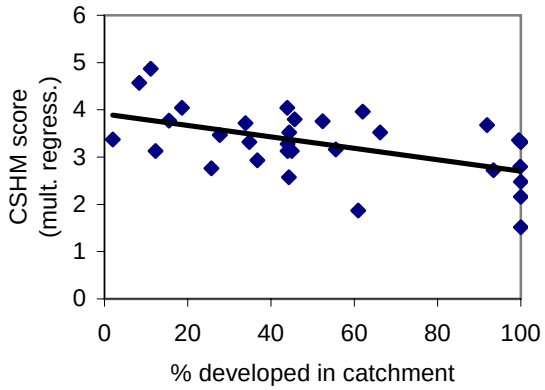
We conclude that the regression CSHM performs almost as well as the MCI and SQMCI in encapsulating the relationship between land development and stream health.

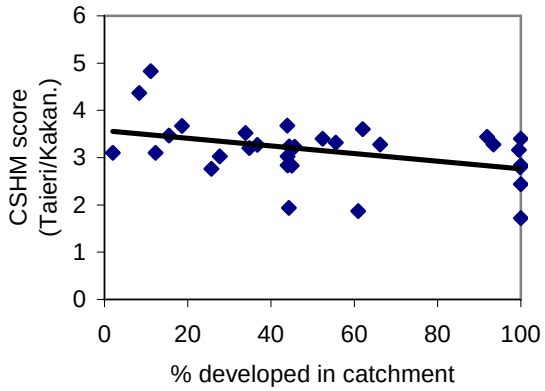
Figure 3. Relationships between three versions of CSHM, western stream health measures and percentage of developed land.











4.3.4 Selecting the best performing cultural steam health measure for the Hakatere

To identify the best performing version of the CSHM and the associated indicators of stream health for the Hakatere catchment we considered the following aspects of the study:

- Performance of CSHMs in describing the overall stream health measure
- Relationships between CSHMs and western stream health measures
- Relationship between CSHMs and landuse measures

Multiple regression-generated indicators explained an impressive 93% of the variability within the overall stream health measure for the Hakatere catchment. Such an analysis is not possible for the other two versions because they only generate correlation coefficients with the overall health measure.

Furthermore regression CSHM was more highly correlated with that western stream health measures SQMCI and MCI than the other versions of CSHM. Finally, the relationship between regression CSHM and percent of development in the catchment out performed the other versions of CSHM.

From these relationships it is clear that regression CSHM performs better that the other versions of CSHM accordingly to overall stream health, western stream health measures, landuse

Accordingly the CSHM indicators adopted in this report are those generated from multiple regression analysis:

(i) Water quality - pollution
(ii) Catchment land use
(iii) Water clarity
(iv) Riverbed condition/sediment
(v) Channel modification.

5.0 CHI COMPONENTS FOR THE HAKATERE A DIFFERENT RIVER TYPE TO THE TAIERI AND KAKAUNUI RIVERS

Comparing the Cultural Health Index scores for the Taieri/Kakaunui and the Hakatere involves a consideration of each of the three components of the Index; site status, mahika kai and cultura; stream health.

5.1 SITE STATUS

Runanga participants were able to identify sites that were of traditional significance. They also stressed the need to understand that "traditional significance" describes the area around a site – not just the site. This recognises that it was only possible for people to live in permanent settlements (at specific sites) if there were sufficient resources available from the surrounding environment to sustain a resident population. Permanent settlements were supported by a number of food gathering sites – many of which are water based. In deciding whether a site was traditional or non-traditional this wider interpretation is needed.

It was interesting that for some sites, members of the assessment team were not unanimous in their assessment of whether they would return to the site. However the assessment of the decision of the majority was always clear and able to be used as the final determinant of the score.

By comparing the scores for the first component of the Index we able to determine the percentage of sites traditional sites in the catchment that runanga believe are still capable of sustaining the cultural uses they had in the past.

Table 4: Number and percentage of traditional sites being accorded A-1 and A-0 status

Catchment	No. and % of the traditional sites scoring A-1 (Traditional site, that Maori would return to and use in the future).	No. and % of traditional sites scoring A-0 (Traditional site that Maori would not return to in the future).
Taieri	**4 of 16 sites (25%)**	**12 of 16 sites (75%)**
Kakaunui	**8 of 11 sites (72.7)**	**3 of 11 sites (27.3)**
Hakatere	17 of nineteen (89.5%)	2 of nineteen sites (10.5%)

While the above Table only considers the number and percentage of traditional sites, we are also able to identify the percentage of total sites that Maori believe they could return to and use in the future (i.e. the number of sites that score either A-1 or B-1).

Hakatere 21 of the 31 sites (67.7%) would be visited and used by Maori in the future.
Taieri 7 of the 30 sites (23.3%0 would be visited and used by Maori in the future.
Kakaunui 10 of the 16 sites (62.5%) would be visited and used by Maori in the future.

5.2 MAHIKA KAI

Information was available for all four indicators.

1. Number of species – As explained in 4.1 the Project Team is reviewing the way in which the scores of 1 -5 were assigned. At present the number of plant, bird and plant mahika kai species are counted and used to determine the score. We need to assess whether there is potential for any one category to distort the score e.g. if the site is surrounded by native bush with many mahika kai plant species present. While some contend that the focus should be stream health, this wider definition (i.e. counting the number of bird, plant and fish species) is consistent with the perspective that has been expressed by Maori that:
   - The mauri is reflected in the life supported within and around a waterway;
   - Mahika kai values include those in the water itself and those sustained by the water; and
   - The holistic perspective that Maori bring to freshwater management.
2 Traditional species present – what this measure has captured is the whanau patterns of gathering where certain sites were visited to gather particular species. Similarly, some streams in the middle and upper reaches of the Hakatere were prized eel fisheries. The absence of eels at these sites is a concern for those whanau traditionally gathering at these sites, regardless of the number of other mahika kai species that may be present.
3. Access – All members in the field were able to consistently score this measure. The scores for the mahika kai component of the Hakatere CHI score is, in part, due to the relatively easy access.
4. Using the site in the future - The scores for the mahika kai component of the Hakatere CHI scores, in part, are due to the fact that 67% of the sites scored highly for this indicator as runanga members will return to use the site in the future

In summary, runanga members were able to apply the indicators and/or gather the information needed to determine a score for component 2. The one area that we still want to consider is the way in which the 1-5 ratings are applied for the number of species present on site.

5.3 CULTURAL STREAM HEALTH

The two sets of cultural stream health indicators identified by correlations and regressions were identical. In contrast, there are differences in the two sets of indicators generated for the Hakatere. Water quality and water clarity are common to both sets of Hakatere indicators, but correlation-generated indicators included use of the river (takes and discharges), flow, and vegetation on the margins in the set whilst multiple regression-generated indicators added catchment land use, bed condition/sediment and channel modifications.

To compare Taieri/Kakaunui and Hakatere results the method of identifying the sets of indicators must be standardised. Given that multiple regression-generated Hakatere indicators performed better than sets generated by correlations or habitat categories (see 4.3), we adopted multiple regression analysis as the most appropriate method for comparing the two different river types.

Table 4. Comparison between Hakatere and Taieri/Kakaunui cultural stream health indicators generated by multiple regression analysis. (ns= not significant)

Hakatere		**Taieri/Kakaunui Rivers**	
Indicator	**% variability explained**	**Indicator**	**% variability explained**
Water quality	73.5%	Water quality	56%
Catchment land use	7.1%	Use of the riparian margins	10.8%
Water clarity	5.4%	Channel modification	5.5%
Bed condition/sediment	3.7%	Flow	4.4%
Channel modification	2.9%	Catchment land use	ns
Total variability explained	**92.6%**	**Total variability explained**	**76%**

The sets of cultural health indicators generated by multiple regression analysis for the Hakatere and the Taieri/Kakaunui are presented in Table 4. Water quality is the most important cultural stream health indicator for both types of rivers. It is also noteworthy that water quality scored the highest correlation coefficients for both the Hakatere and Taieri/Kakaunui. Relationships between water quality and fish safe to eat, would go fishing and water safe to drink (correlation coefficients; 0.81-0.89) further highlight the reason why water quality is such an important determinant of stream health. Catchment land use and channel modification, are also indicators shared in common between the two types of river. Indicators that were not shared by the Hakatere and Taieri/Kakaunui in the multiple regression analysis are water clarity and bed condition/sediment for the Hakatere and use of the river banks/margins and flow for the Taieri/Kakaunui. Whereas water clarity and bed condition are important determinants of stream health for the Hakatere, the use of the riparian and stream flow are more important for the Taieri/Kakaunui.

Combining the Taieri/Kakanui and Hakatere results, a total of seven indicators have been identified as making a significant contribution to overall stream health: water quality; flow; water clarity; bed condition/sediment; channel modification; use of riparian margin; and catchment landuse. This does not mean that the other indicators are not important, rather they do not make a statistically significant contribution to explaining the variability in the overall stream health scores.

Another way of comparing the cultural stream health indicators for the two river types is to investigate relationships between the CSHMs and the western measures of stream health, MCI and SQMCI. Very similar relationships were revealed (Figure 2 and Figure 3a in Tipa and Teirney 2003). The stronger relationship was between SQMCI and both the Hakatere and Taieri/Kakaunui CSHMs.

Further comparisons were made between the CSHMs for both river types and the percentage land development in the catchment. This time a negative relationship was revealed for both river types (Figure 3 and Figure 4c in Tipa and Teirney 2003).

The Hakatere is comprised of a mix of braided and non-braided main stem and tributaries that presented the opportunity to investigate whether braided sites were rated differently from the other sites and produced different CSHMs. We found that the CSHMs of braided stream sites fitted just as well into the various relationships as other sites. This provides further support for the conclusion that the CSHM component of the CHI is an effective measure for braided rivers.

6.0 CULTURAL HEALTH INDEX SCORES FOR THE HAKATERE

Cultural Health Index scores have been calculated for all sites in the Hakatere catchment. Te Runanga o Arowhenua holds all the scores and the background information that was collected to support the Index calculations. They are now in a position to interpret the scores and set management priorities for the Hakatere catchment.

Therefore this report does not contain all the Index calculations for the 30 sites assessed. This information belongs to Te Runanga o Arowhenua. As the kaitiaki runanga they have information that they can use in its discussions with stakeholders and the regional council.

The Index scores are set out below with a brief analysis of each score.

- Site 1 Gentleman Smith A-1 / 4.25 / 3.80
- Site 3 Lambies Stream B-0/ 2.0/ 3.13
- Site 9 Bowers Stream (Sharplin Falls) A-1/ 3.25/4.87
- Site 12 Carneys Stream B-0/0.75/ 1.87
- Site 15 Puddinghill Stream A-0/0.75/2.57
- Site 25 Laghmore Creek B-1/ 2.5/ 2.16

SITE 1 GENTLEMAN SMITH - A-1 / 4.25 / 3.80

The assessment confirmed that:

- This is a traditional site
- Because of the healthy condition of the site, runanga members would return to the site
- Its mahika kai values are very good
    - It scores highly for access. It was be easy for runanga members to access this site without assistance.
    - A reasonable range of mahika kai species were present.
    - This is a traditional site and all the species sourced traditionally are present today. Accordingly a 5 was assigned to this part of the mahika kai component.
    - It scores 5 because runanga members would not return to the site in the future.
- It received an average score for stream health:
    - Catchment 2.33
    - Modification 3.33
    - Clarity 4.66
    - Bed condition 4.5
    - Water quality 4.16

Of the 30 sites, this site scored the highest for component 2 – mahika kai values.

SITE 3 LAMBIES STREAM - B-0/ 2.0/ 3.13

The assessment confirmed that:

- This is not a traditional site
- Runanga members would not return to the site
- Its mahika kai values are only average
    - It receives an average score for access.
    - There is a limited range of mahika kai species present.
    - This is not a traditional site and therefore species sourced traditionally cannot be compared with those present today. Accordingly a 1 was assigned to this part of the mahika kai component.
    - It scores poorly because the majority of runanga members would not return to the site.
- It receives average scores for stream health:
    - Catchment 2.3
    - Modification 3.66
    - Clarity 3.16
    - Bed condition 3.33
    - Water quality 3.16

SITE 9 BOWERS STREAM (SHARPLIN FALLS) - A-1/ 3.25/4.87

The assessment confirmed that:

- This is a traditional site
- Runanga members would return to the site
- Its mahika kai values are average.
    - It receives a high score for access.
    - Because the site is unmodified, there is a good range of mahika kai species present.
    - It scores poorly because it was traditionally a significant site for eels and these are no eels present today.
    - It scores highly because runanga members would return to the site.
- It scores poorly for stream health, in fact it was one of the two poorest scoring sites for this component:
    - Catchment 4.5
    - Modification 5
    - Clarity 5
    - Bed condition 4.83
    - Water quality 5

  All scores are very high. Of the 30 sites assessed this received the highest score for component 3 – stream health.

SITE 12 CARNEYS STREAM - B-0/0.75/ 1.87

The assessment confirmed that:

- This is not a traditional site
- Runanga members would not return to the site in the future
- Its mahika kai values are negligible
    - It receives a poor score for access.
    - There is a very limited range of mahika kai species present,
    - This is not a traditional site and therefore species sourced traditionally cannot be compared with those present today. Accordingly a 1 was assigned to this part of the mahika kai component.
    - It scores poorly because the majority of runanga members would not return to the site.
- Scores below average were assigned for all the stream health indicators:
    - Catchment 1.0
    - Modification 1.33
    - Clarity 2.5
    - Bed condition 1.5
    - Water quality 3.0

Of the 30 sites this site received the lowest score for mahika kai and the second lowest for stream health.

SITE 15 PUDDINGHILL STREAM - A-0/0.75/2.57

- The site at Puddinghill Stream was traditionally used by whanau from Arowhenua, who travelled there gather mahika kai during appropriate seasons. The site is therefore classed as an "A".
- However its degraded condition means they would not return to use the site, hence component 1 scores A-0.
- The mahika kai measure score is negligible (0.75 out of 5) with all four factors receiving a low score.
    - The site is difficult to access.
    - There is not a great number of species and as stated, this site would not be visited in the future – in its current state.
    - The species gathered in the past are no longer present.
- The stream health measure (2.57) shows that the health of this site is in average condition.

SITE 25 LAGHMORE CREEK - B-1/ 2.5/ 2.16

The assessment confirmed that:

- This is not a traditional site
- However runanga members would return to the site
- Its mahika kai values are only average
    - It receives a high score for access.
    - There is a limited range of mahika kai species present.
    - This is not a traditional site and therefore species sourced traditionally cannot be compared with those present today. Accordingly a 1 was assigned to this part of the mahika kai component.
    - It scores highly because runanga members would return to the site.
- It receives slightly below average scores for all stream health indicators:
    - Catchment 2.0
    - Modification 2.0
    - Clarity 2.4
    - Bed condition 1.8
    - Water quality 2.6

This is likely to be an example of substitute mahika kai habitat. The determination to preserve a mahika kai culture is evidenced in the use of sites that have become substitute mahika kai sites as other traditional sites have been lost. Within South Canterbury as river flows have been appropriated for irrigation and other extractive uses, drains (in particular) have increased in value as mahika kai. Drains throughout South Canterbury, including the coastal areas between Timaru and the Rakaia, sustain an important eel fishery and continue to be fished today.

7.0 HOW THE INDEX RESPONDS TO MAORI ASPIRATIONS

Having completed Stages 1, 2 and 3 of the project we have developed a Cultural Health Index that, having completed this study we are confident can be applied in different river types.

7.1 RECOGNISING CULTURAL VALUES

In order to promote the Index as an evaluative tool grounded in the beliefs and values of Maori, it is necessary to reflect, firstly, upon how the Cultural Health Index recognises and provides for Maori values. In the paragraphs below we expand on observations in our earlier reports that the values common to Maoridom are recognised in the design of the Index and/or the process by which manawhenua apply the Index.

Whakapapa - the Index uses traditional knowledge (without disclosing it) and recognises interactions between, and the significance of, different parts of an ecosystem (e.g. relationship between physical characteristics and the mahika kai species present, or between individual physical characteristics of a waterbody such as water flow, water quality, catchment and riparian condition).

Mauri - the three components of the Index enable Maori to assess the present health of the river in a holistic manner.

Wahi Tapu and Wahi Taoka - sites that are assessed will be chosen by those individuals mandated as kaitiaki because the sites are significant due to their tapu or taoka status.

Rangatiratanga – application of the Index by manawhenua and use of the data collected formally recognises the rights of iwi to land, water and other natural resources within their tribal areas, which includes the right to access, use and manage resources.

Mahika kai – the mahika kai measure reflects the need to protect the diversity and abundance of species necessary for the cultural well-being of manawhenua, and safeguard the ability of manawhenua to gather and use these resources, thus enabling the transference of cultural values and practices between generations.

Taoka - the three components of the Index collectively recognise the intrinsic and the amenity values of resources, and the fundamental management principle – protection of the mauri of taonga.

Kaitiaki when applying the Index Maori will be fulfilling their inherited responsibilities to protect taoka for future generations.

Tikaka Maori the three components of the Index comprise indicators that Maori have confirmed are those that are used by Maori to monitor the state of the freshwater resources.

7.2 FULFILLING TREATY OBLIGATIONS

In advocating an increased level of participation in freshwater management and support for initiatives such as Cultural Health Index, Maori are likely to use the Treaty of Waitangi and the principles of the Treaty to support their argument for its implementation (Ellison J. pers com).

The Waitangi Tribunal has considered a range of issues that different iwi, including Kai Tahu, have raised as part of claims before the Tribunal. These relate to changes that have affected both the health of freshwater resources within tribal territories, and tribal associations with these resources. As a result a series of Treaty principles specific to freshwater can be found in the decisions of the Tribunal[22]. For example:

a. The Waitangi Tribunal has stated that the discharge of effluent or human waste is an affront to Mäori and it is irrelevant to argue that it has been treated to a high scientifically defined pure standard before it has been discharged into rivers. Non Maori, in particular those who share the use of freshwater and those who are charged with its protection, need to be aware of the mental and spiritual values held by Mäori in relation to water and the resources it supports (Motunui-Waitara Report 1989)
b. The Waitangi Tribunal also affirms that environmental consultation with iwi is a significant aspect of the partnership duty under the Treaty (Ngäi Tahu Report, 1991).
c. The Waitangi Tribunal has determined that the Mäori conception of waterways is holistic. The taoka value of freshwater encompasses the water itself, the resources within the waterbody, and its supporting environs (Te Ika Whenua Report, 1998).
d. The Waitangi Tribunal has stated that the spiritual and cultural significance of a freshwater resource to Mäori can only be determined by the tängata whenua who have traditional rights over the river (Kaituna Report, 1984).

Where resource management agencies have a statutory obligation with respect to the Treaty, they are obligated to 'give effect to' or 'take account of' those cultural values and practices that the Waitangi Tribunal and the Courts have confirmed by way of Treaty principle.

In theory, the definition of Treaty principles specific to freshwater advances the case of Maori seeking either participation as a partner in a collaborative management system or at least the incorporation of their perspective in freshwater management. Iwi consider tools such as the Cultural Health Index are necessary because statements of principle, by themselves, do not identify the changes in resource management practice that are required to ensure the practical application of these principles.

With respect to freshwater management a Treaty principle states that the spiritual and cultural significance of a freshwater resource to Mäori can only be determined by the tängata whenua who have traditional rights over the river (Waitangi Tribunal, Kaituna Report). This principle clearly supports the participation of Maori and the application of tools such as the Index which is by both as a mechanism that enables Maori to assess the health of sites of significance using an evaluative tool grounded in their beliefs and values (and affirmed by scientific measurements).

[22] See Crengle (1993), Crengle in Ministry for Environment (1997) and Tipa, Crengle, Davis, Allingham, Symon (2002).

8.0 CONCLUSIONS

8.1 COMPONENTS 1 AND 2 OF THE INDEX: SITE STATUS AND MAHINGA KAI

In each of the three catchments studied to date, runanga members were able to able to apply the indicators and/or gather the information needed to determine scores for components 1 and 2. As a result of feedback one of the indicators have been refined (i.e. with component 1 – whether the site supports cultural usage) and the method of scoring one indicator is being reviewed (i.e. the number of species on site).

From the data collected to date, it appears that these two components of the Index can be used to determine patterns of settlement and resource use within a catchment over time. It is possible to identify why parts of a catchment were used, are still used and will be used in the future. Barriers to continuation of cultural practices, in particular mahika kai, are also able to be identified.

Because we wanted to determine whether the indicators and components of the Index were applicable to a braided river we asked interviewees to identify any other indicators that they would prefer use to assess a braided river. Similarly, at each site, runanga members undertaking the assessments were asked to identify other indicators that they believed would have more accurately assessed the site. No new indicators were identified.

8.2 COMPONENT 3 OF THE INDEX : CULTURAL STREAM HEALTH

Investigating which of the 14 indicators contributed most significantly to the overall stream health measure revealed three mahika kai indicators to be so highly correlated that we consider them to be alternative measures of overall stream health. In the Taieri/Kakaunui study exactly the same relationship was revealed. The strength of the relationship reflects the value Otakou, Moeraki and Arowhenua Runanga place on mahika kai in evaluating cultural stream health.

To determine the most important contributing factors from the remaining 11 indicators, three different manipulations were tested against the overall stream health measure - correlation coefficients, stepwise multiple regressions and pre determined habitat categories combined with correlation coefficients. The stepwise multiple regression was found to give the best results for the Taieri/Kakaunui and Hakatere data. Accordingly we adopted that approach for the Hakatere study.

Water quality was by far the most important indicator of cultural stream health for both the Taieri/Kakaunui and the Hakatere respectively, explaining 56% and 73.5% of the variability within the overall stream health measures. Correlation coefficients with the overall measure are also impressive being 0.75 and 0.86 respectively. The consistent prominence of water quality also reflects the value runanga place on mahika kai as an integral part of cultural stream health.

For the Hakatere a multiple regression value of 93% for the five most important indicators is impressive. Of the five indicators, water quality, channel modification and catchment landuse were in common with the Taieri/Kakaunui and the Hakatere. Differences in the remaining two indicators suggest that we may not be able to adopt one set of five indicators for all rivers. However the Kahungunu/Tukituki River part of the study must be completed before decisions can be made about the indicators.

Significant positive relationships have been found between the Cultural Stream Health Measure for both the Taieri/Kakaunui and Hakatere and the western stream health measures, MCI and SQMCI.

This is noteworthy given the CSHM is based on whole of catchment iwi perceptions and the MCI, the macroinvertebrate benthic stream communities. Similarly, consistently negative relationships were revealed between the CSHM and % developed land upstream of the sites for both the Taieri/Kakaunui and the Hakatere.

The nature of identical or similar features between the Taieri/Kakaunui and Hakatere discussed above indicates that the CSHM component of the CHI is just as relevant for braided, snow and rain fed rivers as for single channel, rain fed rivers. From runanga evaluations there is no doubt about the features that are fundamental to cultural stream health and these appear to be generic across river types.

8.3 THE VALUE OF THE CULTURAL HEALTH INDEX

With the design of the Index, we have sought to reflect the values and practices that are central to the cultural identity of Maori because of the belief that Maori want to participate in freshwater management to achieve specific outcomes. One of the outcomes they seek is recognition and protection of their spiritual and physical association with freshwater resources. The values and practices that are described in preceding sections of this report and reflected in all three components of the Index are interrelated and collectively they represent:

- the world view that Maori bring to the process of resource management; and
- the distinctive identity, beliefs, traditions, knowledge and management practices that they wish to protect.

We commenced this project because of the belief that one of the barriers to participation of Maori in freshwater management within New Zealand has been the lack of tools to enable participation. However now Maori, (in this instance Kai Tahu), have access to such a tool. Kaitiaki runanga have reinforced their support for the Cultural Health Index and have mandated representatives to be trained in its application.

Regional Councils are now considering whether to apply the tool and give recognition to Maori values in freshwater management.

Interestingly, the Cultural Health Index has received positive feedback from non-Maori which has confirmed that other territorial communities and communities of interest are also seeking opportunities (and tools) that enable them to participate.

8.4 THE PROCESS OF DEVELOPING THE CULTURAL HEALTH INDEX

As a final comment, it is necessary to reflect on the development of the Cultural Health Index. The project to develop the Index was seen by Kai Tahu as a chance to exemplify to resource management agencies what partnership might mean and the benefits to be realised from Kai Tahu participation in freshwater management. The project to develop the Index is a practical example of how an agreed position can be negotiated between different parties. The project has consisted of three stages to date and for each the methodology, data collected, and the analysis of results has been transparently negotiated and shared between Maori, scientists and resource management agencies.

This philosophy that has always underpinned this project is the conviction that the cultural and spiritual association of Maori with freshwater has resulted in the accumulation of a body of knowledge spanning generations. If given the opportunity and the right tools, Maori could use this knowledge to enhance contemporary water management.

The Cultural Health Index is one tool that we believe demonstrates how traditional knowledge and practices and scientific approaches can be integrated for the betterment of resource management practice, Maori, the wider community and the environment.

Kua tawhiti ke te harereka, kia kore e haere tonu.
He tino nui rawa ou mahi, kia kore e mahi nui tonu.
We have come too far, not to go further.
We have done too much, not to do more

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My strength is not my own, but that of many

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University of Otago Stream Team

- Christoph Matthaei

Mainland Mapping

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