



STATE OF THE TAKIWĀ

Cultural Monitoring and Reporting
on the Health of our Environment



Te Āhuatanga o Te Waiau

Cultural Health Baseline Report 2005



Ministry for the
Environment
Manatū Mō Te Taiao





www.ngaitahu.iwi.nz

mō tātou, ā, mō kā uri ā muri ake nei

for us and our children after us



This report was produced using Takiwā 1.0 – a database developed by Te Rūnanga o Ngāi Tahu and Environmental Science and Research and supported by the Ministry for the Environment



www.esr.cri.nz



Ministry for the
Environment
Manatū Mō Te Taiao

www.smf.govt.nz

Cover Photographs:

Centre – Redcliff Wetland, with the Waiau River and Hunter Mountains in the distance.
Photograph by J. Aitken

Bottom (Left to Right) – Upper Waiau River at Queens Reach; Monitoring Team at 14 Mile Creek Lake Te Anau; and Matatarawae/Te Waewae Lagoon.
Photographs by C. Pauling

Ngā Mihi / Acknowledgements

Ko Takitimu te Mauka
Ko Waiau te Awa
Ko Murihiku te Whenua
Ko Kāi Tahu, Kāti Mamoe, Waitaha te iwi
Tihei Mauri Ora!

Kaore e poto nei kā mihi ki kā atua,
Kā mātua o mātou te ira tākata.
Ki a Takaroa, Raki e tū nei,
mehoki ki te hakui o manaaki, ko Papatuānuku.
Kā whakawhetai mo kā hua ora kua whākaitia nei e mātou,
Tēnā koutou katoa.

Tēnā rawa atu koutou i ruka i ō tātou tini aitia
e hikahika mai nā i ruka i kā marae maha puta noa i te motu.
Kei te mihi atu, kei te taki atu.
Rātou ki a rātou, tātou ki a tātou.
Tēnā anō tātou katoa.

Mihi rā ki te manawhenua, te ahi kaaroa o Murihiku.
Ka nui ōu koutou manaaki, ōu koutou mana i te whenua i reira.
Kei te mihi mahana ki a koutou, kei te mihi, kei te mihi, kei te mihi.

Ka huri ki kā roopu whakahaere i whakaurua i tēnei kaupapa.
Tēnā koutou i ōu koutou awhina, i ōu koutou tautoko ki tēnei mahi
whakahirahira o tātou.

E tika ana te kōrero i o mātou tūpuna e pā ana ki tō tātou mahi
he mahi kai hoaka, he mahi kai takata

Nō reira, rau rakatira mā,
tēnā koutou, tēnā koutou, tēnā koutou katoa.

Te Rūnanga o Ngāi Tahu would like to acknowledge all those that
helped out in this project and the completion of this report.

To our mountains, rivers, lands and our ancestors gone before us.

To the people who continue to guard over and protect the lands of
Murihiku, the hapu, whānau and papatipu marae who gave their
hospitality and demonstrated their prestige and dignity.

And to all the organisations that were involved in making the project a
success, namely Oraka-Aparima Rūnaka, Waihopai Rūnaka, Awarua
Rūnanga, Hokonui Rūnaka, Tipa & Associates, Environmental Science
and Research, Envirolink, Te Waiau Mahika Kai Trust, Environment
Southland, Manaaki Whenua Landcare Research, NIWA, Meridian
Energy and of course the Ministry for the Environment.

Thank you, thank you, thank you.

Rārangi Ūpoko / Contents

Ngā Mihi / Acknowledgements	3
Rārangi Ūpoko / Contents.....	5
Whakarāpopotanga / Executive Summary.....	7
1 Te Whakatūwheratanga / Introduction	9
1.1 Tāhuhu Kōrero / Background	10
1.1.1 What is State of the Takiwā?.....	10
1.1.2 Ngā Take / Major Drivers for SoT	11
1.2 Developing the Pilot Project.....	12
1.2.1 Ngā Whāinga / Project Aims.....	13
1.2.2 Ngā Whakaputanga / Project Outcomes	13
2 Te Puna / Takiwā Database and Monitoring Forms.....	15
2.1 The Takiwā Database	15
2.1.1 Technical Features.....	15
2.1.2 Resource Finder Module	16
2.1.3 Site Evaluation Module.....	16
2.2 Takiwā Monitoring Forms.....	18
2.2.1 Development of the Forms.....	18
2.3 Takiwā Reporting Functions	19
3 Te Kauneke / Data Collection Methodology.....	21
3.1 Planning the Fieldwork - The Monitoring Plan	21
3.1.1 The Monitoring Team	22
3.1.2 The Monitoring Sites	22
3.2 Data Collection Methodology	24
3.2.1 Takiwā Site Assessments	24
3.2.2 Cultural Health Index – Waterway Assessment	25
3.2.3 E.Coli Water Testing	27
4 Te Āhuatanga o Te Waiau / State of the Waiau.....	29
4.1 Location and Natural Features of the Waiau	29
4.2 Historical Overview of the Waiau	30
4.2.1 Ngāi Tahu Association with the Waiau.....	30
4.3 Past and Present Research in the Waiau.....	33
4.3.1 Historical Records and Accounts.....	33
4.3.2 Contemporary Research & Environmental Monitoring	33
4.3.3 Other Information Sources	34
4.4 Site by Site Baseline Assessments.....	35
4.5 Analysis and Discussion	61
Cultural Health Index Scores and Comparison.....	62
E.coli Results and Comparison	63
Native Vegetation Dominance	64
Catchment Health vs River Channel Health.....	65
5 Te Whakamutunga / Conclusion	67
Tohutoro / References	69
Āpitihanga / Appendices	73
Appendix A – State of the Takiwā Project Milestones	75
Appendix B – Takiwā Monitoring Forms	77
Appendix C – Waiau Field Work Site Assessment Data	79
Appendix D – Waiau Field Work Monitoring Plan	81
Appendix E – New Zealand Water Guidelines for E.coli & MPN Coliform Tables....	83
Appendix F – A Selection of Research Reports to the Waiau River Working Party.	85
Appendix G – Environment Southland Monitoring Sites in the Waiau Catchment.	87

Whakarāpopotanga / Executive Summary

Te Rūnanga o Ngāi Tahu is proud to introduce the first State of the Takiwā report to be completed in the world!!

This report has been many years in the making and represents the realising of a long-standing vision by Ngāi Tahu Whānui for a tribally lead environmental monitoring and reporting system, appropriately named - State of the Takiwā.

State of the Takiwā, or 'SoT' for short, is an environmental monitoring approach that attempts to integrate Māori cultural values and western science measures in the gathering and reporting of information about the health of the environment and to understand changes over time.

It is aimed at assisting tāngata whenua to gather information, assess and report on the cultural health of significant sites, natural resources and the environment within their particular takiwā, and to make better decisions on how to manage these into the future.

This report specifically outlines the results of the SoT pilot study undertaken in the Waiau River Catchment, Southland in March 2005, as part of the Ministry for the Environment funded Sustainable Management Fund project 'State of the Takiwā – Cultural Monitoring and Reporting on the Health of our Environment'.

Importantly, this report presents critical 'baseline' information that is aimed at capturing the current cultural health of the 12 sites assessed within the pilot study. However, it also attempts to display information on past health and other measures of the state of these sites to understand significant changes over time.

Overall, the pilot Takiwā assessment found that the Waiau catchment was in a state of good cultural health. The results showed that the upper catchment, around Te Anau, the tributary sites in the Jericho Block and sites at the mouth, overlooking Te Waewae Bay, were in a healthier state than those sites in the mid-catchment or near settlements.

Positive features of the higher scoring sites related to their relatively unmodified nature, native vegetation dominance, good access and potential for mahinga kai. The lower scoring sites, however, were associated with the negative impacts of settlement, agriculture, pests, weeds, as well as the loss of river flow as a result of hydro-generation.

Results of the E.coli testing undertaken further highlighted these negative impacts as well as the need for ongoing monitoring to understand continuing changes. This is particularly important in the face of new threats such as the Didymo Algae.

It is envisioned that this report will be the first of many more, with regular monitoring and reporting being undertaken in subsequent years to gain a fuller picture of the State of the Takiwā.

1 Te Whakatūwheratanga / Introduction

State of the Takiwā is an environmental monitoring approach being developed by Te Rūnanga o Ngāi Tahu as part of their 'Ki Uta Ki Tai - Mountains to the Sea Natural Resource Management' framework outlined in the tribal vision, Ngāi Tahu 2025¹.

Its overarching aim is to develop an easy to use environmental monitoring system for the gathering, storage, analysis and reporting of information on the cultural health of the environment by tāngata whenua that in turn will assist them in managing the environment into the future.

To realise this vision, Te Rūnanga o Ngāi Tahu applied to the Ministry for the Environment's Sustainable Management Fund in late 2003 where they were successful in gaining funding for a pilot project and field study.

The SoT pilot project was initiated in July 2004 and primarily involved the development of a specialised monitoring tool and the testing of this tool through a field study, undertaken within the Waiau River catchment, Southland in March 2005.

The pilot field study collected data from 12 sites within the Waiau catchment. This data included State of the Takiwā site assessments using the specially developed form, Cultural Health Index waterway assessments and the collection and testing of water samples for the presence and analysis of E.coli and faecal coliforms.

The field-collected data was subsequently loaded into the Takiwā database to enable some basic analysis and comparison with previous monitoring and data, which were all combined to produce this 2005 baseline report.

Specifically, the report is structured in the following way:

- Section 1 begins the report with a brief background to the project and pilot study, outlining the major drivers, aims and objectives.
- Section 2 gives an overview of the Takiwā Database and Monitoring Form developed during the project and used to produce the report.
- Section 3 outlines the process and methods of data collection within the pilot study.
- Section 4 gives the results of the pilot study, displaying site by site results of the cultural assessments, along with a discussion of the general state of the Waiau River catchment. The section begins with a brief overview of the Waiau and existing information on the catchment.
- Finally, the report is concluded with a summary of major points of the study.

1.1 Tāhuhu Kōrero / Background

In 1997, the Ministry for the Environment developed New Zealand's first State of the Environment Report² and since then has funded the development of monitoring indicators to assist the continued monitoring of environmental health and effects. Most environmental monitoring in New Zealand is carried out by Regional Councils, such as air and water quality and land management monitoring. Even though tools have been developed and regular monitoring undertaken, these tools and activities have struggled to include Māori cultural values in both their monitoring programmes and final reporting.

During the discussions in developing Te Ao Tūroa / The Natural Environment section of the Ngāi Tahu 2025 vision document, tribal members raised the idea that Ngāi Tahu should develop their own monitoring and reporting programme. The objective behind this idea was to ensure that Ngāi Tahu Whānui could build robust and defensible information about the health of the environment that could in turn be used to assess the effectiveness of both internal Ngāi Tahu policy and practices as well as those of external agencies, such as Local Territorial Authorities.

1.1.1 What is State of the Takiwā?

In simple terms, 'State of the Takiwā' describes a culturally based environmental monitoring and reporting system that is aimed at allowing tāngata whenua to be able to gather information, assess and report on the cultural health of significant sites, natural resources and the environment within their respective takiwā.

State of the Takiwā is a play on words from the conventional, largely western science based approach to environmental monitoring called 'State of the Environment Reporting'. The difference of course is that State of the Takiwā is an approach that attempts to take into account Māori cultural values, such as mauri and mahinga kai, as well as standard scientific measures of environmental health.

Ngāi Tahu 2025 defines State of the Takiwā as 'An environmental monitoring and reporting approach that integrates Mātauranga Māori and Western Science to gather information about the environment and to establish a baseline for the creation of policy and improvement of environmental health. A programme developed as an alternative to conventional state of the environment reporting used by the Ministry for the Environment that takes into account tāngata whenua values'³.

Central to the approach is the gathering of information from the field on the health (or if you like, the mauri or state) of the environment and the collation of this information into a database from which analysis is possible and reports can be prepared. It is envisioned that such reports could be used to help measure the success of, and inform policy and planning as well as complementing the work of key environmental agencies and in particular the monitoring of resource consents and other activities.

1.1.2 Ngā Take / Major Drivers for SoT

Māori have historically, and continue to, collect a range of valuable environmental information⁴. However, due to the largely oral nature of this information it is not recorded in a form that is readily accessible, useable or defensible in a modern context. In addition to this, there are also obvious language barriers that can create issues when communicating cross-culturally.

Valuable signals, sometimes referred to as *tohu*, which are often indicative of changes to the environment, in particular, ecosystem and species health, and of much historical importance are not in a form that can be used readily in resource management decision-making, particularly by key agencies who struggle to understand cultural information.

For example, traditional places names are often sources of descriptive information about the natural phenomenon of an area, the weather, or resources found at that location. They may also recollect important historical events⁵. In these ways they hold valuable clues to past environmental condition as well as changes over time, but can be difficult to understand by those who do not understand Te Reo Māori.

The usually oral nature of the information disadvantages Māori in resource consent and other application processes as the information is not in the form usually presented in hearings and often not given the same weighting as more conventional information.

What is required is a process to systematically record, collect, collate and report information on the 'state of the takiwā' on an on-going basis, which will allow *tāngata whenua* to better manage its resources, now and in the future, and potentially offer approaches that can be used by other groups and agencies.

The objective behind this idea is to ensure that *tāngata whenua* can build robust and defensible information systems that record the health of the environment and can in turn be used to assess the effectiveness of both internal policy and practices as well as those of external agencies, including local councils who have statutory responsibilities to undertake monitoring and report on the state of the environment.



1.2 Developing the Pilot Project

With the aspirations of its tribal members in mind, Te Rūnanga o Ngāi Tahu, through the work of its Environmental Unit, Kaupapa Taiao, looked for ways to bring this vision into life and identified the Sustainable Management Fund as one possible avenue. This took into account previous work that had been successfully completed through the fund including the Iwi-SHMAK kit⁶, Cultural Health Index⁷, Wetlands Monitoring⁸ and the Kaimoana Monitoring Guidelines⁹.

Ngāi Tahu then undertook a scoping exercise and produced a report for State of the Takiwā¹⁰ that was sent out to all Papatipu Rūnanga and which advocated the idea of pursuing external funding to complete a pilot project.

Kaupapa Taiao staff also worked on developing relationships with key Crown Research Institutes, to gain their assistance and further opportunities for developing such a system.

In mid 2003, Kaupapa Taiao met with staff from Environmental Science and Research (ESR) and became aware of the work they had done on the Water Information New Zealand (WINZ) database¹¹. Through these discussions the possibility of developing a project to make State of the Takiwā a reality was identified.

In December 2003, a joint expression of interest was put into the Sustainable Management Fund and in March a full application was submitted. Consultation for the application took place with Environment Southland, Environment Canterbury, Manaaki Whenua Landcare Research and NIWA, where letters of support and offers of in-kind support were gained from them to support the pilot project.

Environment Southland offered advice in developing the monitoring programme and access to information on existing data for the Waiau.

Landcare Research offered expertise in developing the monitoring tool, while ESR took the lead in developing the Takiwā database.

Gail Tipa, co-author of the Cultural Health Index was involved in reviewing the scoping document and project application as well as providing oversight and advice throughout the project, particularly on developing the monitoring tool.

John Aitken, co-founder of Envirolink Southern Community Laboratories was also contacted and agreed to support the project with training and implementation of E.coli water testing procedures.

Once confirmation of the success of the project application was received, Ngāi Tahu assessed which region within the takiwā (tribal area) would be most suited for a pilot exercise. Due to the positive feedback given to the scoping document by the rūnanga from Murihiku as well as the support given to the project by Environment Southland - the Murihiku or Southland region was chosen for the pilot exercise. Murihiku also offered a great range of sites, issues and challenges for the project.

The Papatipu Rūnanga involved in the project were:

- Hokonui Rūnaka (based in Gore)
- Awarua Rūnanga (based in Bluff)
- Waihopai Rūnaka (based in Invercargill)
- Oraka-Aparima Rūnaka (based in Riverton & Colac Bay)

Te Ao Marama, a resource management consultancy owned and run by the four rūnanga above and funded by the Councils in Southland also provided in-kind support and liaison advice to the project.

The Te Waiau Mahika Kai Trust, a private Ngāi Tahu Trust that own and run the Te Koawa Tūroa o Takitimu/Jericho Farm restoration centre, situated near Redcliff between Blackmount and Mararoa in the Waiau Valley, also provided support for the project, in particular hosting the monitoring team during the data collection exercise.

1.2.1 Ngā Whāinga / Project Aims

The major aims of the project were to:

- Undertake a review of existing monitoring activities, tools and information within New Zealand;
- Identify the information most needed by iwi, hapū and whānau;
- Make this information available for use by iwi, hapū and whānau through an easy to use database;
- Design an appropriate recording, storage, analysis and reporting system for cultural monitoring programmes; and
- Test the monitoring and reporting system by working with Papatipu Rūnanga in one region to identify sites and targets, design a monitoring programme, gather data from the field and produce a State of the Takiwā Report for that region.

1.2.2 Ngā Whakaputanga / Project Outcomes

The major outcomes of the project included:

- Development of the Takiwā Database that includes the following modules:
 - A Resource Finder (RF) Database of existing monitoring indicators, standards, tools and databases for iwi to select the most appropriate data resources held by agencies such as central and local government or CRI's, and to select the most appropriate indicators for particular sites and monitoring needs.
 - A Site Evaluation (SE) Database for storing, analysing and reporting on monitoring data collected by monitoring activities.
 - Printable Site Evaluation/Monitoring Forms
 - Statistical and Reporting Functions
- Development of a pilot State of the Takiwā report for one region that can provide important cultural monitoring information to help assist both local rūnanga/hapū with resource consent monitoring and local territorial authorities with recognising and providing for cultural values.

An outline of the project milestones is included as Appendix A.

2 Te Puna / Takiwā Database & Monitoring Forms

The Takiwā Database and Monitoring forms developed as part of the State of the Takiwā project and used during the pilot study have been an important factor in the development of this report. It was through the development and testing of this tool that the data presented in Section 4 was gathered and subsequently analysed.

To fully appreciate and understand this data, it is important to outline how the Takiwā database and monitoring forms are structured and were developed. The following sub-sections therefore give an overview of the key features of the database and monitoring forms and how these helped to create this report.

2.1 The Takiwā Database

The primary aim of the Takiwā database is to make information available to tāngata whenua to help them identify the current or changing quality of a particular site, and to know where to go to get more such information.

The database has two main modules, one being a database of reference material relating to monitoring tools, standards and reports (called Resource Finder, see section 2.1.2 below) and the other being a database for storing, analysing and reporting data collected on particular sites (called Site Evaluation, see section 2.1.3). The database also includes printable monitoring forms for data collection and standard queries for producing reports.

2.1.1 Technical Features

Takiwā is written in Microsoft Access 2002 and is presented as a Runtime application linked to a physically separated database. The whole system can be run on a PC or network without the need to purchase further Access licenses.

The database application is password protected, and all data entries are automatically stamped with the initials of who created it and when, and who last modified it. The database also has facilities for creating dated backup copies of the data tables, which can be stored remotely to ensure the safety of the data.

A Helpfile is included that is written in a flexible format using RoboHelp documentation software. By pressing F1 within the database, context-sensitive help is shown on-screen in an HTML-Help format. The Helpfile is available on the installation CD-ROM as a formatted Word document, which makes up part of the Takiwā user manual. The manual also includes a background to the database, its content, functions and use.

Takiwā has a bi-lingual interface that can display key headings in either Te Reo Māori or English, depending on the current user's preference.

2.1.2 Resource Finder Module

Resource Finder (RF) is primarily a means of finding out what others have recorded about environmental matters that could be of value to the database user - when there is a desire to evaluate the environmental condition of a particular site.

It aims to answer questions such as:

- What are likely to be the key issues with this sort of site?
- What is important to measure here?
- Are there recognised standards or guidelines?

The screenshot shows the 'Resource Information Finder' window. On the left, there is a tree view under 'Aspect' with categories like Coastal water, Forest, Freshwater, General, Groundwater, Kaimoana, Lake, River or Stream, Sandy beach, and Shingle beach. Below this is a 'Measures for Aspect' section with a table showing 'Non-Specific' and 'General' measures. The main area is divided into 'References for Measure' and 'Components for Measure'. The 'References for Measure' table lists 'Env Waikato, Inland Waters', 'Freshwater Biodata Information System NIWA', and 'Freshwater quality indicator'. The 'Components for Measure' table is empty. Below these is a 'Measure Details' section with fields for Name, Author, Year, Web Address, Non-web Details, Work done by, Ref held by, Description, and NZ Region. The 'Year' field has a dropdown menu showing '2004'. The 'Web Address' field contains two URLs. The 'NZ Region' dropdown shows 'Waikato'. At the bottom, there are buttons for 'Print', 'More buttons', and 'Components'.

Figure 1. Takiwā Resource Finder Module

It is a relatively simple database that lists a number of different environmental aspects (eg land, freshwater, marine, air) and what sort of environmental information is available about it. This structure is shown in the figure above. The data is mainly non-location specific, but tries to identify what are the typical indicators, standards or measures that can be used for identifying the quality of such an area, and organisations/web resources where this information can be found or requested.

2.1.3 Site Evaluation Module

The primary aim of this database is to record in a systematic manner the impressions of site quality gathered by people over the years. This will ensure the information is not lost, and that it is both available to contribute to a 'State of the Takiwā' evaluation and as a basis to support submissions, policy or discussions regarding a particular area.

This database identifies environmental monitoring sites and records details from both present-day visits by participants as well as historical information. Data gathered is in a combination of reasoned multi-choice evaluation of criteria (eg variety of fish present: 1 = poor -- 5 = good), and ad-hoc comments of visitor impressions.

This is the core of the Takiwā database. Here you can enter details, based on the Takiwā Monitoring Forms (see section 2.2 below), to describe a geographically-defined site and then assess its environmental and other qualities in a consistent fashion over time. The structure of the database ensures that, in the future, the data can be interrogated to answer such questions as:

- Has quality improved or deteriorated over the years?
- How many sites of interest exist in different areas?
- How much information is available on that area?
- Who has visited it (for assessment) and when?
- Have native birds, plants, etc improved or deteriorated in abundance over the years?
- At which sites have people seen tui, pukeko, or any other listed taonga?
- How have their presence changed over the years?
- Have we sufficient evidence in this database (eg. records of lots of visits) to show that site x is of ongoing cultural interest to us, and therefore shouldn't succumb to development proposal XX.

Figure 2. Takiwā Site Evaluation Module

The Site Evaluation module includes a section labelled 'journal' where important historical information and references about a particular site can be stored. A further feature is the image portal where an unlimited number of photographs or other diagrams (.jpg, .gif or .bmp format) can be associated with the site.

In order to grade and compare sites and visits, three index calculations have been included within the database. The three indices currently available are a Health Assessment Index, an Abundance Index and the Cultural Health Index (see sections 3.2.1 and 3.2.2 for more information).

At this stage the Health Assessment and Abundance indexes are tentative, and to help with index optimisation they have an A and B option, which have significant flexibility for the user to change the weightings of the various factors – such as species rareness.

All indexes can be recalculated for either the current questionnaire, or for all questionnaires in the database.

2.2 Takiwā Monitoring Forms

The aim of the Takiwā monitoring forms are to record observations and assessments by tāngata whenua for a particular site and at a particular time relating to key cultural values and indicators of environmental health, such as mahinga kai.

The forms were developed through discussion with both tangata whenua and monitoring experts and by reviewing previously developed monitoring tools, such as the Cultural Health Index.

Feedback dictated that the monitoring forms needed to be simple, rather than being overly complicated or abstract and that the forms should attempt to capture the cultural information and values about a site, which is normally internalised during mahinga kai (food gathering) or similar activities and often called 'anecdotal information'.

The overall goal of the data collection and storage achieved by the form and database was to make this important information more defensible, accessible, useable and quantitative.

2.2.1 Development of the Forms

Firstly, forms and indicators from existing toolkits (listed below) were investigated and used to identify relevant formatting as well as the type of questions that could be used to capture appropriate information in relation to cultural values and indicators.

- Sample Data Record Sheet from the Kaimoana Monitoring Guidelines
- Cultural Steam Health Assessment Form
- Site Register and Monitoring Forms from the SHMAK Kit
- Māori Indicators Wetland Monitoring Form
- Forest Monitoring and Assessment Kit Site Assessment Form¹²
- NIWA Freshwater Fish Database Form¹³

From these tools and the discussion with tangata whenua, the following indicators were identified as being most important to include in the main Takiwā monitoring form:

- Heritage/Site Significance;
- Overall health/state of a site;
- Levels of modification/change at a site,
- Suitability of the site for harvesting mahinga kai,
- Access issues in relation to the site;
- Presence, abundance and diversity counts for taonga (valued) bird, plant and fish species, other culturally significant resources as well as pest and weed species; and
- Willingness to return to the site for harvesting mahinga kai.

Other details that were seen as being important to record were in relation to general visit and site details (date, time, weather conditions, site location, legal protection etc). This was achieved by the development of two separate but interdependent forms – The Site Definition and Visit Details Form. The visit details form also includes prompts to ensure photographic references were recorded for a site. Examples of the forms are shown in Appendix B.

2.3 Takiwā Reporting Functions

The final critical feature of the Takiwā database is the printable query and reporting function. This function allows users to print a range of reports by simply selecting the type of report (from a range of options) and pushing a print button within the database. These reports can also be exported to Word or Excel to assist in report writing or graphic representations of the data.

This is made possible through a 'Print Centre' that offers a range of different reports for sites, visits and questionnaires, as shown in the figure below. The print centre is accessed through buttons on both the Takiwā Main screen and on the Site Evaluation screen.

When a user is in the print centre, it already knows which Site, Visit and Questionnaire were last used on the Site Evaluation screen, and these are listed, with the last one viewed being already selected.

Figure 3. Takiwā Report 'Print Centre'

Each report option displays a range of information from the data collected by each of the Takiwā forms and entered into the database. They conveniently show information such as the site name, traditional species, current species and the index scores or grades for the site.

Examples of the print reports are included in Appendix C as part of the full set of data collected during the Waiau field study.

3 Te Kauneke / Data Collection Methodology

The data collection undertaken within the pilot study and for this report was conducted between the 2nd and the 4th of March 2005 at 12 sites situated from the source of the Waiau River at Lake Te Anau to its meeting with the sea at Te Waewae Bay.

The monitoring team consisted of members from the four Papatipu Rūnanga o Murihiku and staff from Te Rūnanga o Ngāi Tahu, Environment Southland, Te Waiau Mahika Kai Trust and Envirolink Southern Community Laboratories.

The data collection primarily involved cultural health assessments of the 12 sites using the Takiwā monitoring form. This was further complemented by the use of the Cultural Health Index at 9 river sites (excluding the two Lake Te Anau sites and the Te Waewae Lagoon site) and the collection and testing of water samples from 9 sites (excluding two tributary sites and the lagoon site) for the analysis of E.coli and faecal coliforms.

The following section gives an overview of the methods used and process undertaken to collect data at each site.

3.1 Planning the Fieldwork – The Monitoring Plan

All fieldwork was guided by a comprehensive monitoring plan that outlined the steps to be taken in gathering field data as well as the key issues to be aware of in doing so. Each member of the monitoring team was given a copy of this to assist them.

The plan included:

- A background to the field work, the aims and expected outcomes;
- An explanation of the area and sites to be assessed;
- A timetable and schedule of activities;
- The data collection methods;
- A budget;
- Health and Safety considerations – including information on weather conditions and biosecurity issues associated with Didymo Algae;
- Maps, Assessment forms and other important information.

A full version of the monitoring plan is included as Appendix D.

The planning for the field work also involved organising travel, accommodation and provisions for the monitoring team, which was assisted greatly by the local tangata whenua from Oraka-Aparima Rūnaka and staff from Te Waiau Mahika Kai Trust.

3.1.1 The Monitoring Team

The following people were involved in the monitoring fieldwork:

- Craig Pauling – Te Rūnanga o Ngāi Tahu
- John Aitken – Envirolink Southern Community Laboratories
- Rodney Trainor – Waihopai/Hokonui Rūnaka
- Sue Somerville – Waihopai Rūnaka
- Stewart Bull – Oraka-Aparima Rūnaka
- Robert Warren – Oraka-Aparima Rūnaka
- Neil Herrick – Oraka-Aparima Rūnaka
- George Ryan – Awarua Rūnaka
- Jane Kitson – Environment Southland
- Michelle White – Environment Southland
- Robert Guyton – Te Waiau Mahika Kai Trust
- Ellen Suddenby – Oraka-Aparima (Accommodation and Kai)

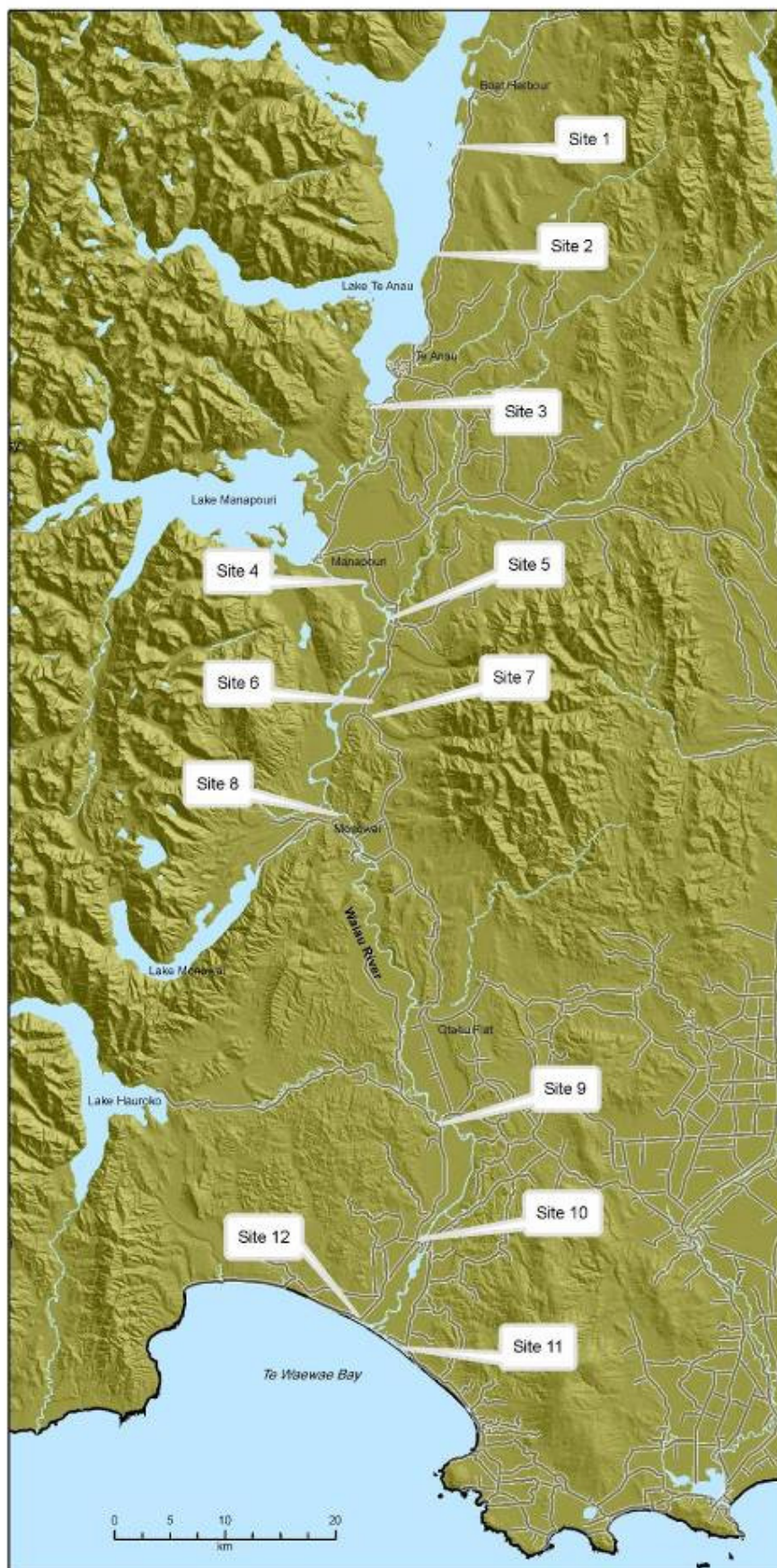
3.1.2 The Monitoring Sites

The field work and data collection focussed largely on sites along the main Waiau river channel. However, sites were chosen from within the entire catchment to gain a good mix of traditional sites, ecosystem types and land use issues. The sites were also purposely selected to represent a 'Ki Uta Ki Tai' or mountains to the sea philosophy, being spread from the river's source in Te Anau to its mouth at Te Waewae Bay. The Redcliff and Jericho sites were the only tributary sites, while the Nine and Fourteen Mile sites, situated along the edge of Lake Te Anau and the Te Waewae Lagoon site were the only non-river sites.

The 12 sites assessed during the fieldwork were:

1. Te Anau-14 Mile Creek Campsite – Hikaroa/Tihaka
2. Te Anau - 9 Mile Creek Nohoanga – Te Ana-au
3. Upper Waiau River - Queens Reach Nohoanga – Wairoa
4. Manapouri - Home Creek
5. Mararoa Weir - Maraeroa
6. Redcliff Stream - Te Koawa Tūroa o Takitimu/Jericho Farm
7. Jericho Stream - Te Koawa Tūroa o Takitimu/Jericho Farm
8. Monowai Power Station – Monoao/Manokiwai
9. Clifden Caves/Bridge – Te Ana Whakairo
10. Tuatapere Domain – Ka Karehu o Tamatea
11. Waiau Mouth (East Bank) – Te Waewae Lagoon/Matatarawae
12. Waiau Mouth (West Bank) – Papatotara/Te Tua a Hatu

The location of the monitoring sites is shown on the map of the Waiau River on the following page.



Location of the Waiau River Pilot Study Monitoring Sites

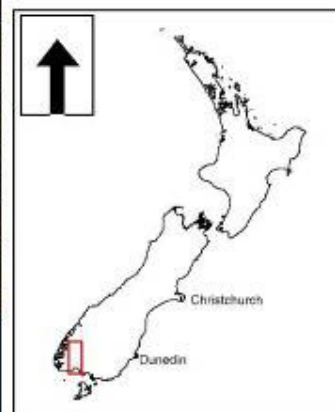


Legend

- Roads
- Main Rivers and Lakes

Site Description

- Site 1. Te Anau 14 Mile Creek
- Site 2. Te Anau 9 Mile Nohoanga
- Site 3. Queens Reach Nohoanga
- Site 4. Home Creek Mouth
- Site 5. Mararoa Weir
- Site 6. Redcliff
- Site 7. Jericho Streams
- Site 8. Monowai Power Station
- Site 9. Clifden Cave/Bridge
- Site 10. Tuatupere Domain
- Site 11. Waiau Mouth East - Te Waewae
- Site 12. Waiau Mouth West - Papatotara



3.2 Data Collection Methodology

The field work involved three major types of assessment:

1. Takiwā Site Assessments (all 12 sites)
2. Cultural Health Index – Waterway Assessments (9 Sites – excluding the 2 lake edge sites at Te Anau and the Mouth Lagoon Site)
3. E.Coli Water Testing (9 sites - excluding the 2 Jericho Block sites and the Mouth Lagoon site)

The specific details of each type of assessment are outlined in the subsections below.

The process followed for assessment at each site involved the following steps:

- The monitoring team firstly gathered together so that any appropriate mihi, karakia and/or kōrero can be given.
- The team then completed the Site Definition and Visit Details forms, including obtaining GPS coordinates and photographic records for the site.
- Each member of the monitoring team then completed their own Takiwā site assessment form.
- The team then came back together to complete the Cultural Health Index water quality form and gather the water sample for E.coli testing (where applicable).
- Before departing, a general kōrero/discussion was held about the site visit and the travel details for the next site and/or activity.

3.2.1 Takiwā Site Assessments

The basis for the data collection was the assessment of sites using the three Takiwā site assessment forms. The structure of these forms are outlined in Section 2.2 and included in Appendix B.

The Takiwā assessment involves three simple steps, one for each form.

The first step of the Takiwā site assessment involves completing the Site Definition form. This involves recording information on the site name, referring to both traditional and current names, the location, legal protection issues, and the traditional significance and condition of the site. This includes recording the exact geographical details using a GPS receiver.

In the second step, visit specific details such as the individuals involved, the date, time, weather conditions and other information relevant to the visit, including photographic records are then recorded on the Visit Details form.

These first two steps in the process are completed collectively by the monitoring team. This is to ensure that site and visit details are consistent across the group. Further, the GPS and photographic references for the site allow for repeatability and comparison with future records taken.

The third step in the process involves individual members of the monitoring team completing their own site assessment form.

The first part of the site assessment form involves ranking the following aspects of site health using a sliding 1 to 5 scale. In all cases 1 is the least or worst score and 5 is the highest or best score.

- Overall state/health of the site
- Levels of modification/change at the site,
- Suitably for harvesting mahinga kai,
- Access issues; and
- Willingness to return to the site for harvesting kai (this is simply a yes or no answer)

These questions serve to give an indicative score or grade for the overall health of the site (the Health Index Score – see section 2.1.3).

The second part of the form involves undertaking abundance and diversity counts for taonga bird, plant and fish species, other resources (such as stone, bone or driftwood) as well as pest and weed species.

This is simply achieved via visual and aural identification of individual species along with a weighting given to their relative abundance (few/some/many) at the site. Species may also be identified through faecal deposits found at the site.

The assessment of fish species is ideally achieved through electric fishing, torchlight or trapping, but where this is not possible the assessment form allows users to indicate a 'Not applicable' result. This can also occur where the site is not associated with any water habitat.

The assessment of taonga plant species also includes a question to indicate the relative dominance of the taonga species versus exotic or weed species at the site. This is represented as a percentage of the total area covered by the taonga plants.

This second part of the form serves as a record of the species present at the site and allow for the analysis of changes from the past as well as into the future. This is particularly pertinent where threatened species or pests and weeds are present. This part of the form also allows for a grade or score (the Abundance Index) to be calculated to demonstrate floral and faunal health at the sites.

3.2.2 Cultural Health Index – Waterway Assessment

The methodology for the Cultural Health Index (CHI) is very similar to the Takiwā site assessment, where a form is completed relating to a number of ranking questions along with the identification of valued bird, plant and fish species. The major difference is that the Cultural Health Index is focussed solely on assessing the cultural health of the waterway at a particular site, rather than the entire site. Other obvious differences are the exclusion of assessments for pest and weeds and other resources.

While the CHI can be done individually, in the pilot exercise it was completed as a group. This was to allow some link with the collection and subsequent testing of water samples for E.coli.

Another difference in the CHI is the grading and scoring system associated with it. A summary to calculating the Cultural Health Index is outlined below:

The CHI has three components - Traditional association, mahinga kai and stream health. To derive the index at a particular stream site, first iwi association is identified, then mahinga kai values are assessed, and finally cultural stream health is evaluated. Almost all the necessary data for these measures are derived from the recording forms.

Component 1: Stream sites are classified according to traditional association and intention to use in the future.

- *Is there a traditional association between tangata whenua & the site?*
Sites of traditional significance are assigned an 'A'. Sites that do not have a traditional association are assigned a 'B'.
- *Would Māori come to the site in the future?*
Whether the tangata whenua would return to the site or not is also recorded. If the tangata whenua would return, the site is awarded a 1, and if not, a 0.

Component 2: Sites are evaluated for the following mahinga kai features. Each feature is rated 1-5 and the mahinga kai score is the average of the four 1-5 ratings (1 is poor and 5 is the highest mahinga kai rating).

- *How many mahinga kai species are present?*
This requires identifying the mahinga kai species that are present now.
- *Are the mahinga kai species that were gathered in the past still here?*
This enables a comparison between the mahinga species that were gathered historically with the species that are present now.
- *Are the mahinga species accessible for gathering?*
Accessibility includes physical access and legal access.
- *Would Māori come to the site in the future?*
This component is the same as the second part of component 1 above. If the tangata whenua would return, the site is awarded a 5, and if not, a 1.

Component 3: Sites are evaluated for cultural stream health, based on a set of five indicators that effectively encapsulates overall stream health (as outlined on the recording form). The average score for all included indicators provides the cultural stream health measure (1 is poor and 5 is the highest cultural stream health rating).

Overall index: The overall three-part Cultural Health Index is expressed as shown in terms of the three components. For example, a stream may be given an index of:

A-0 / 2.1 / 4.2

where:

- A identifies the site as traditional (rather than a B for non-traditional)
- 0 indicates that Māori would not return to this site in the future (1 indicates they would return)
- 2.1 is the mahinga kai score (score of 1-5)
- 4.2 is the overall evaluation of stream health (score of 1-5) ¹⁴.

3.2.3 E.Coli Water Testing

The E.coli water testing carried out in the fieldwork involved three assessments, using two water samples from each site.

1. The first (using the first water sample) involved an 'in the field' method for detection and semi-quantitative enumeration of E.coli in river water;
2. The second (using the second sample) involved laboratory analysis to fully quantify the E.coli in the sample; and
3. The third involved further laboratory analysis of the second sample to identify the main source of any E.coli present in the river water, through antibiotic resistance analysis.

3.2.3.1 Rationale and Background

Faecal Coliforms are a group of bacteria that include E.coli. Members of the coliform group also include other bacteria that may be found in the soils, and also in the intestines of birds. A positive faecal coliform result therefore indicates the possibility of faecal contamination, but is not totally reliable.

The presence of E.coli, however, indicates contamination with faecal material from the intestinal tract of a mammal or birds. As a general rule, the drinking water standard uses the detection of 1 E.coli in 100ml of water as rendering it unfit for human consumption¹⁵. There are also standards for shell-fish gathering and contact recreation¹⁶ (see Appendix E).

Drinking water supplies susceptible to contamination with sewage or other excreted matter may cause outbreaks of diarrhoea or intestinal infections. Kaimoana gathered near faecally contaminated water may also contain intestinal pathogens because shellfish filter and concentrate organisms inside their body.

It is sometimes difficult to detect bugs like campylobacter that cause health problems, because they occur in very low numbers. Instead we rely on tests that will reveal the presence of bugs associated with faeces (such as E.coli and faecal coliforms) that show contamination of the water, but do not usually cause harm themselves.

A further piece of analysis that can be carried out with E.coli is the detection of antibiotic resistance. Antibiotic resistance in E.coli is a strong indication that the E.coli has previously been exposed to antibiotics, or has acquired the antibiotic resistance factor by association with an E.coli containing the factor.

Specific antibiotics (eg. Apramycin) are uniquely associated with the agricultural use of antibiotics, and the detection of this resistance indicates agricultural origin of the E.coli. Resistance to other antibiotics used solely by humans can therefore indicate contamination from human effluent and so on. Moreover, a sample showing no resistance or 'sensitivity' indicates the contamination is from a natural source, such as a bird or from the soil.

3.2.3.2 Materials and Reagents

- Portable 37°C incubator
- UV Black Light
- Transparent plastic (Kahn) tubes and stoppers
- Plastic disposable pipettes (use once and discard)
- Sample collection containers
- Nissau "Blue" Detection Kits for Coliform and E.coli in fresh water
- MPN (Most Probable Number/McGrady) E.coli conversion table
- Polystyrene boxes and icepacks for the posting of lab samples

3.2.3.3 Method

- **Step 1:** Take one 110 ml and one 100ml sample of water from the river using established methods for sample collection.
- **Step 2:** Keep the samples chilled until testing and transported to a base or lab for analysis. Package the 100ml sample in the Polystyrene box and send to laboratory.
- **Step 3:** Plug in incubator and allow to reach correct temperature (37°C)
- **Step 4:** Empty contents of Nissau reagent sac into the 110ml sample container with the collected sample. Allow to completely dissolve.
- **Step 5:** Using the disposable pipette, dispense 1 ml of the processed sample from the container into each of 10 plastic (Kahn) tubes. (i.e. 10ml total)
- **Step 6:** Cap the Kahn tubes using the disposable caps.
- **Step 7:** Place the sample container and the 10 (1ml) Kahn tubes into the incubator. Incubate for 24 hours
- **Step 8:** After 24 hours remove the samples from the incubator and examine using the black light. A positive sample for E.coli is signalled when the tube fluoresces a grey- blue colour.
- **Step 9:** Record the number of positive tubes and derive semi-quantitative number of E.coli using MPN table.

Most Probable Number (MPN-McGrady) tables enable the user to derive a semi-quantitative approximation of the numbers of E.coli per 100ml of water. As a means of developing useable data, the MPN method provides a consistent evaluation when used over a period of time and, in various modes, and is the preferred laboratory method for coliform and E.coli numeration¹⁷.

The MPN tables are shown in Appendix E along with the current New Zealand guidelines for drinking water and microbiological water quality.

4 Te Āhuatanga o Te Waiau / State of the Waiau

The Waiau is a river of international, national and regional importance. Its catchment drains from some of the world's most important wilderness areas, it is a major source of hydroelectric power generation for New Zealand's national energy grid and it also has a central place in the regional history and development of Southland for both Māori and Pakeha.

These are just some of the reasons why this catchment was chosen by the tangata whenua to be the target area for the pilot of the State of the Takiwā cultural health assessment. In particular, its history as a mahinga kai (food gathering area) and the successive effects of farming, mining, forestry, tourism, hydro-electric power generation and most recently the algae *Didymosphenia geminata*¹⁸ made it an ideal catchment for the pilot study.

The following section of the report begins with a brief overview of the Waiau River, its location, history and traditional significance. It also includes an outline of the previous research undertaken in the catchment. This is followed by the results of the pilot exercise outlining the site by site assessments and concluded by a general discussion of overall cultural health and state of the catchment.

4.1 Location and Natural Features of the Waiau

The Waiau River is situated in Western Southland, flanking the eastern boundary of the magnificent Fiordland area and bounded to the east by the Livingstone, Takitimu and Longwood ranges. The river flows from its main source in Lake Te Anau, into Lake Manapouri, then meets with the Maraora River and travels on through a mixture of native bush covered hill country and pasture to its meeting with the sea at Te Wae Wae Bay¹⁹ (see the site location map shown on page 21).

The Waiau has a vast catchment, and is fed by 5 glacial lakes and a number of major tributaries, including (from North to South) the:

- Clinton, Eglington and Upukeroroa Rivers (feeding Te Anau);
- Spey and Grebe Rivers (feeding Manapouri);
- Mavora Lakes (Manawapopore and Hikuraki), Mararoa (Maraeroa) and Whitestone Rivers;
- Borland Burn;
- Lake Monowai (Monoao) and Monowai River;
- Wairaki River;
- Dean Burn (Waiharakeke);
- Lill Burn;
- Orauea River; and
- Alton Burn.

Prior to the construction of the Mararoa Weir and other hydro-power developments in the 1970's, the Waiau was one of New Zealand's largest rivers. Its mean pre-control flow at Tuatapere was approximately 501 cumecs versus a mean post-control flow of 165²⁰. These large flows made it an obvious target for hydro-power generation, for which plans were first discussed as early as 1904²¹.

As well as the quality and quantity of its water, the Waiau is also well known for its other natural features, namely forests, minerals and fisheries. In previous times, a booming sawmilling trade targeted the formally abundant Podocarp forests (including Rimu, Kahikatea, Matai, Totara and Miro), while both gold and coal have been taken from the valley. An extensive commercial eel fishery has also operated in the catchment as well as a wide range of tourist and recreational activities, focussed on exotic sports fishing, hunting, boating and tramping.

On a catchment wide basis, the dominant vegetation cover is native forest (39%), being mainly mountain beech concentrated in the west, followed by tussock pasture (31%) and exotic pasture grasses (16%). Water bodies account for 7% of the total area, while the remainder is covered by alpine vegetation (1%), scrub (5%), swamp (0.3%), exotic forest (0.4%) and permanent ice and rock (0.4%)²².

4.2 Historical Overview of the Waiau

For the descendants of Ngāi Tahu, Kāti Mamoe and Waitaha, the Waiau has always been a place of immense cultural significance, not only as a mahinga kai but also for its place in the earliest traditions of their people. Up to 200 species of plants, birds and fish were known to have been harvested from the catchment²³. It was also a major travelling and trade route between Te Ara a Kiwa (Foveaux Strait) and Te Tai Poutini (the West Coast)²⁴.

Due to its place in the whakapapa, history and traditions of Waitaha, Kāti Mamoe and Ngāi Tahu, the river was included as a Statutory Acknowledgement²⁵ in the Ngāi Tahu Claims Settlement Act 1998. This is reproduced below in section 4.1.1 below.

The area surrounding the Waiau was also a 'hot-spot' of early contact between Māori and Pakeha, due initially to the sealing and whaling trades. Overtime, however, the Waiau River catchment has also been a place of farming, mining, forestry, tourism, fishing, and hydro-electric power generation, most of which continue to the present day²⁶.

4.2.1 Ngāi Tahu Association with the Waiau

The Waiau River features in the earliest of traditional accounts, and was a place and resource well known to the earliest tūpuna (ancestors) to visit the area. Rakaihautū and his followers traced the Waiau from its source in Te Ana-au (Lake Te Anau) and Motu-ua or Moturau (Lake Manapouri), to its meeting with the sea at Te Wae Wae Bay.

The waka Takitimu, under the command of the rangatira (chief) Tamatea, was wrecked near the mouth of the Waiau River and the survivors who landed at the mouth named the river "Waiau" due to the swirling nature of its waters. Tamatea and his party made their way up the river to Lake Manapouri where they established a campsite. The journey of Tamatea was bedevilled by the disappearance of Kaheraki who was betrothed to Kahungunu, a son of Tamatea, Kaheraki strayed away from the party, and was captured by the Maeroero (spirits of the mountain).

For Ngāi 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 Ngāi Tahu as an iwi.

The Waiau has strong links with Waitaha who, following their arrival in the waka Uruao, populated and spread their influence over vast tracts of the South Island. They were the moa hunters, the original artisans of the land. There are remnants of Waitaha rock art associated with the river. Surviving rock art remnants are a particular taonga of the area, providing a unique record of the lives and beliefs of the people who travelled the river.

There is also a strong Ngāti Mamoe influence in this area of the country. Ngāti Mamoe absorbed and intermarried with the Waitaha and settled along the eastern coast of Te Wai Pounamu. The arrival of Ngāi Tahu in Te Wai Pounamu caused Ngāti Mamoe to become concentrated in the southern part of the island, with intermarriage between the two iwi occurring later than was the case further north. The result is that there is a greater degree of Ngāti Mamoe influence retained in this area than in other parts of the island. These are the three iwi who, through conflict and alliance, have merged in the whakapapa (genealogy) of Ngāi Tahu Whānui.

Numerous archaeological sites and wāhi taonga attest to the history of occupation and use of the river. These are places holding the memories traditions, victories and defeats of Ngāi Tahu tūpuna. The main nohoanga (occupation site) on the Waiau was at the mouth and was called Te Tua a Hatu. The rangatira (chief) Te Wae Wae had his kainga nohoanga on the left bank of the Waiau River mouth.

The Waiau, which once had the second largest flow of any river in New Zealand, had a huge influence on the lives and seasonal patterns of the people of Murihiku, over many generations. The river was a major mahinga kai: aruhe (fernroot), ti root, fish, tuna (eels), shellfish and tutu were gathered in the summer, a range of fish were caught in the autumn, kanakana (lamprey) were caught in the spring, while the people were largely reliant during winter on foods gathered and preserved earlier in the year. Rauri (reserves) were applied to the mahinga kai resources, so that people from one hapū or whānau never gathered kai from areas of another hapū or whānau. Some 200 species of plants and animals were utilised by Ngāi Tahu as a food resource in and near the Waiau.

The tūpuna 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 Waiau, the relationship of people with the river and their dependence on it, and tikanga for the proper and sustainable utilisation of resources. All of these values remain important to Ngāi Tahu today.

Place names provide many indicators of the values associated with different areas, including Waiharakeke (flax), Papatotara (totara logs or bark), Kirirua (a type of eel found in the lagoon), Te Rua o te Kaiaimio (a rock shelter that was a "designated meeting place" for the local Māori, similar to a marae) and Ka Kerehu o Tamatea – ("charcoal from the fire of Tamatea" – black rocks near old Tuatapere ferry site).

The Waiau River was a major travelling route connecting Murihiku and Te Ara a Kiwa (Foveaux Strait) to Te Tai Poutini (the West Coast), and as such was an important link between hapu and iwi. Pounamu on the West Coast, and summer expeditions to Manapouri (Motu-ua or Moturau) for mahinga kai were the main motivations for movement up and down the Waiau. Mokihi (vessels made from raupo) were utilised for travel down the river and were a very effective and common mode of travel, making transportation of substantial loads of resources possible.

The tūpuna had an intimate knowledge of navigation, river routes, safe harbours and landing places, and the locations of food and other resources on the Waiau. The river was an integral part of a network of trails which were used in order to ensure the safest journey and incorporated locations along the way that were identified for activities including camping overnight and gathering kai. Knowledge of these trails continues to be held by whānau and hapū and is regarded as a taonga. The traditional mobile lifestyle of the people led to their dependence on the resources of the river.

The Waiau was once a large and powerful river, up to 500m across at the mouth, narrowing to 200m further upstream. The water flow from the Waiau River was an important factor in the ecological health and bio-diversity of the coastal resources.

The mauri of the Waiau 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 Ngāi Tahu Whānui with the river²⁷.

Today, the cultural significance of the Waiau remains strong, despite the mahinga kai resources being greatly diminished. The only traditional foods still available for harvest (apart from fernroot) are of aquatic origin, dominated by the Tuna. But even these species continue to be under threat from the ongoing effects of deforestation, intensifying land use and hydro-generation²⁸.

Restoration projects, such as the Te Waiau Mahika Kai Trust's – Te Koawa Tūroa o Takitimu centre, based on the former Landcorp farm in the Jericho Block are examples of the continuing importance of the area²⁹.

4.3 Past and Present Research in the Waiau

Due to its unique history, the Waiau has been a plethora of research activity. From the journeys and lives of early explorers, Crown agents and settlers to the modern monitoring programmes of Environment Southland, Meridian Energy, the Department of Conservation, NIWA and the Southland Fish and Game – there exists a large body of information to help understand the past and present state of the Waiau River. The sub-sections below outline some of the most significant information important to this study.

4.3.1 Historical Records and Accounts

Perhaps the most important source of historical information about any place is that held by 'locals'. Such traditional, local or anecdotal knowledge is often inter-generational and holds important insights into the changes and events that have affected an area.

The life and work of Syd Cormack is amongst the most important sources of such information, particularly in regards to Māori history and knowledge of the Waiau. He is mentioned as a source in numerous texts about the Waiau catchment, as well as having produced his own publications and manuscripts³⁰.

Archaeological work, like that of Atholl Anderson, is also an important record of Māori life in the Waiau Valley, particularly in regard to the natural resources and traditional species utilised by Māori that survive in middens³¹.

The journals and publications of the first Europeans to visit the area are an important source of information about the state of the Waiau River around the time of contact and what it must have been like for Māori. The documented journeys of Captain Cook³², John Boulton³³, Nairn and Stephen³⁴, Mantell³⁵, Shortland³⁶, McKerrow and Goldie³⁷ and the more recent by Herries Beattie³⁸ tell of a densely forested valley, sometimes referred to as 'terra incognita'³⁹.

General historical publications, such as those covering Otago and Southland, in particular those by McNab⁴⁰, F.G. & J. Hall-Jones⁴¹ and Miller⁴² provide a record of the changes to the Waiau catchment over time, as do the local histories such as those written on Papatotara⁴³, Monowai⁴⁴, Manapouri⁴⁵ and Te Anau⁴⁶.

4.3.2 Contemporary Research & Environmental Monitoring

There are two primary sources of contemporary information about the present State of the Waiau. The first is the large and varied body of research commissioned and held by Meridian Energy (formally part of ECNZ), produced to understand the effect of their power-generation activities on the catchment, and the second is the data and records of the ongoing environmental monitoring of the river by Environment Southland (formally the Southland Regional Council).

Other important sources of contemporary information include NIWA, Fish and Game and the Department of Conservation.

4.3.2.1 Meridian Energy/Waiau Working Party Research

The Meridian Energy research, done for the Waiau River Working Party, a committee set up as part of the initial hydro developments, includes regularly updated scientific reports on shoreline vegetation, beach sediments, macrophytes, and fish habitat in Lakes Te Anau and Manapouri, native fish passage in relation to control structures, and periphyton, macrophyte, macro-invertebrate, trout and bird populations and river channel morphology in the upper and lower catchments. There are also other reports on Māori cultural, spiritual and historical values, mahinga kai, general history, tourism and recreation, as well as reviews of historic bird, fish, periphyton and invertebrate populations, hydrology and geomorphology.

Much of the research has been carried out by leading New Zealand experts or research institutes, including NIWA and Manaaki Whenua. Some of these reports date back to the early 1970's, or have been ongoing since the 1980's and 90's. They therefore represent an important record of the post-control changes within the catchment.

A selected list of these reports is included as Appendix F.

4.3.2.2 Environment Southland Monitoring

The work of Environment Southland provides an equally important record. Its ongoing programme of monitoring in the Waiau produces regular data on rainfall, river flow and levels, surface and ground water quality, and water, soil and air temperature. One record dates back to 1940, some as far back as the 1960's, others began in the 1970's and 80s, while the majority have been going since the mid to late 1990's and beyond. Most records are ongoing and are collected via 19 individual monitoring sites spread throughout the catchment⁴⁷.

All records are available through the internet or are produced in regular State of the Environment and Compliance Monitoring reports. One report in particular - the Waiau Catchment Water Quality Review 1993⁴⁸ – provides a wonderful overview of the State of the Waiau catchment for that year, along with concise historical notes.

This monitoring information for the Waiau is included as Appendix G.

4.3.3 Other Information Sources

The National Institute of Water and Atmospheric Research (NIWA) also undertake regular monitoring within the Waiau catchment and hold records in relation to water quality and quantity, invertebrates, periphyton and native fish distributions and populations. This information is accessible through the internet on their FBIS database website⁴⁹.

The Southland Fish and Game also undertake regular monitoring of fish populations, while the Department of Conservation produce regular reports on native freshwater fish, birds and vegetation in the catchment.

4.4 Site by Site Baseline Assessments

The following section outlines the results from the pilot study on a site-by-site basis. Each site visited is presented in a consistent format including:

- Site name, location and brief description;
- Historical information about the site;
- Complementary data from other sources in relation to the site;
- 2005 site assessment information including Takiwā health and species abundance scores, species present, CHI score and E.coli figures; and
- A site summary including any issues and actions for the site.

The Takiwā health scores given are all out of five. For the abundance scores, based on the quantity and abundance of native species vs. pests and weeds present at a site, a higher score is better.

Figures are also given that compare the number of traditional species with the number of these species still present at sites.

The E.coli and faecal coliform results are per 100mls.

14 Mile Campsite – Lake Te Anau

Location: 14 Mile Campsite is situated on the eastern edge of Lake Te Anau, approximately '14 miles' from the Te Anau Township, between the lake and the main Te Anau-Milford Highway and opposite Centre Island. The monitoring site is located within a DoC campsite in this area.

Description: The 14 Mile Campsite is a sheltered site on the edge of Te Anau, surrounded by a magnificent wood of Mountain Beech that almost touches the lake. A thin stoney 'beach' separates the forest from the lake, with a border of Tutu bushes running between. The campsite is well used by tourists who camp in a random fashion amongst the trees, where they can find enough flat, open space - which is scarce. Views to Centre Island and further to the bush clad western edge of Te Anau greet the campers at all times.



Historical: The campsite is near the traditional site known as Kaukaha, meaning strong swim. Kaukaha was the spot where, the chief Hikaroa (also the name for Henry Creek) set off on his famous swim across the widest part of Te Anau. He rested at Tihaka (Centre Island) before making it to an island in the Doubtful group, named Te Kaukaroa or the long swim (Beattie 1955). The area later became part of an early farm run known as Te Anau Downs, purchased by brothers John and Henry Hodge in 1860. They built their original homestead and stockyards at the mouth of Henry Creek, the remains of which can still be seen, but moved it to nearby Boat Harbour in 1869, a more obvious outlet for their wool (Hall-Jones 1983).



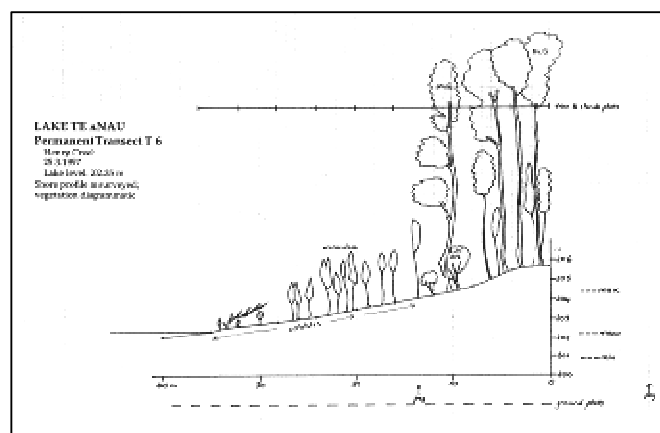
Te Anau Downs Homestead at Boat Harbour taken in 1869.

Source: Hall-Jones (1983), p26.
Original: Alexander Turnbull Library.

Complementary Data

Shoreline Vegetation Profile taken at Henry Creek in 1997.

Source: Johnson et al (1998).



Hikaroa – Kaukaha – Tihaka



Fourteen Mile Site in 2005 – lakeside (left) and landside view (right)

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	4	Nice site with great views.
Degree of modification:	3	Just the campsite itself.
Access for harvesting:	4	Easy to find off main road.
Willingness to harvest:	3	Limited especially in the deep lake environment
Would you return?	Yes	

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Plant	Beech	> > >	Other	Driftwood	> >
Plant	Lancewood	> >	Other	Riverstone	> > >
Plant	Manuka	>	Pest	Lupin	>
Plant	Matakouri	>			
Plant	Tutu	> >			
Fish	Not applicable	>			

% of site covered by taonga plants: 95%

Taonga Species Comparison: 6 Current vs 24 Traditional

Cultural Stream Health Assessment: Not applicable at this site (being a lake edge site)

Health Assessment Index: 3.5

Abundance Index: 28

E.coli notes: Coliform count = 10
E.coli count = 1

Cultural Health Index Score: B-1 / 3.2

Site Summary: The 14 Mile site ranked in the mid to top range of all the sites assessed. The positive aspects of the site were its ease of access and the almost total dominance of native vegetation. However, a negative aspect was the frequency and number of campers that stay at the site and the risk they pose in terms of contamination of the lake. While there were few weeds present, the campers could also pose a threat here. The E.coli and coliform results for the site were not high, but alarming none the less, as the presence of just 1 E.coli means the lake water would be unsafe to drink by New Zealand standards and demonstrates the harm camping can have on the lake.

Overall this site was of medium to good cultural health and value.

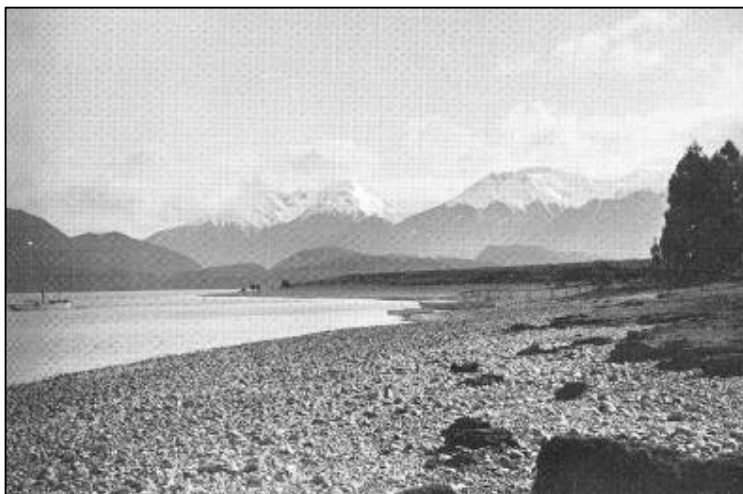
Issues and Actions: Properly managing the campers and the risks they pose is amongst the most important follow up actions for this site. Controlling the few weeds may also be important to stop them spreading any further. Retesting, E.coli at the site would also be important to ensure the quality does not deteriorate or test how widespread the contamination may be.

9 Mile Nohoanga – Lake Te Anau

Location: Nine Mile Nohoanga is situated on the eastern edge of Lake Te Anau, approximately '9 miles' from the Te Anau Township, sitting between the lake and the main Te Anau-Milford Highway. It is opposite Deadmans Point and the Te Ana-au Glow Worm Caves.

Description: The Nine Mile Nohoanga is an open site, just off the main highway. It has a small sheltered camping area surrounded by a mixture of native scrub and exotic weeds, before opening open again to a small bay on the lakes edge.

Historical: The site of the nohoanga is not the precise location of any traditional site, but again the whole area being well used and occupied by ngā tūpuna. The presence of a range of archaeological sites in the area attests to this. The nearby Te Ana-au (glow worm cave) meaning current of water in a cave is also known by an older name, Te Ana-hinatore, meaning phosphorescent cave, signifying that it was well known to ngā tūpuna.



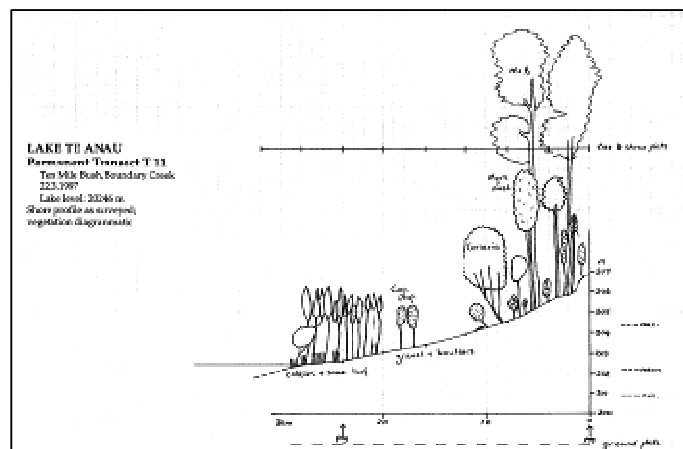
Site of the Broderick Jetty and Boathouse on the eastern shore of Te Anau – taken sometime in the 1890s.

Source: Hall-Jones (1983), p55.
Original: Natural Museum

Complementary Data

Shoreline vegetation profile from the vicinity of the 9 mile site observed in 1997.

Source: Johnson et al (1998).



Te Ana-au – Te Ana-hinatore



Nine Mile site in 2005 – lakeside view, showing bay (left) and view across to Te Ana-au (centre), and the inland view, showing nohoanga area (right).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	4	Nice site, but a bit open and exposed.
Degree of modification:	3	Only the road being nearby and the weeds present.
Access for harvesting:	4	Literally a step off the road!
Willingness to harvest:	3	Limited especially in deep lake environment
Would you return?	Yes	

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Plant	Bracken Fern	> >	Pest	Apricot	>
Plant	Coprosma sp	>	Pest	Briar	>
Plant	Kowhai	> >	Pest	Broom	> >
Plant	Manuka	> > >	Pest	Cotoneaster	>
Plant	Tutu	>	Pest	Honeysuckle	>
Fish	Not applicable	>	Pest	Lupin	>

% of site covered by taonga plants: 70%

Taonga Species Comparison: 6 Current vs 27 Traditional

Cultural Stream Health Assessment: Not applicable at this site (being a lake edge site)

Health Assessment Index: 3.5

Abundance Index: 13

E.coli notes: Coliform count = 70
E.coli count = 4

Cultural Health Index Score: B-1 / 3.0

Site Summary: The Nine Mile site again ranked in the mid range of all the sites assessed. Like the 14 Mile site, a positive aspect of this site was its ease of access, but this time because of it being a Ngāi Tahu nohoanga, it presented better opportunities to explore and enjoy the Lake, including the nearby Te Ana-au. The negative aspects of the site were the many weed species that were present and the open, exposed nature of the site. The E.coli and coliform results were again alarming, with higher counts here than at the 14 Mile Site, but overall not high enough to cause great concern, and is probably again related to camping.

Overall this site was of medium cultural health and value, with the added bonus of the nohoanga giving it potential for future use.

Issues and Actions: Properly identifying the nohoanga site would be a welcome improvement to the site and potentially enhance the use of the site by tribal members. There should also be some close attention paid to keeping an eye on the weeds species present at the site and the nature and extend of the E.coli problem. Ongoing monitoring of this site would be beneficial to achieve this.

Queens Reach – Upper Waiau River

Location: Queens Reach is a small section of the Upper Waiau River, approximately one third of the way between Lakes Te Anau and Manapouri, near horseshoe bend. The monitoring site is situated within a DoC Scenic Reserve/Camping Area on the site of the Ngāi Tahu Nohoanga. The reserve is accessed from Queens Reach Road, a short drive from Te Anau township.

Description: The Queens Reach site is dominated by beech forest, mānuka, other native shrubs / scrub and open tussock / grasslands. The river flows in majestic bends through the whole area of the reserve. A boat ramp is located just at the entrance of the reserve just off Queens Reach Road. At the monitoring site, an open area of grass extends back from the gravel road towards the river and is surrounded by mānuka, kowhai, tāwhiri and other shrubs. Across the river, the dominant beech forest is ever present.



Historical: Queens Reach is not an exact site of traditional occupation or use, but it is near the traditional site known as Te Kutuawa o Tuawhea, which refers to the drowning of the chief Tuawhea near the outlet of Te Anau). The entire Upper Waiau River area, known as Wairoa, meaning long (roa) river (wai) and referring to its many bends, is a well known mahinga kai area. Lake fish species, including the now extinct Upokerora/Grayling were caught here as well as many locally extinct ground birds, including the Takahe. Eels were known to be caught using 'pa tuna' or weirs along this stretch of the river (Puentener & Corry, Mitchell & Davis). This traditional significance was recognised through the Ngāi Tahu Claims Settlement Act 1998 with the creation of a Nohoanga (campsite) within the Doc Reserve at Queens Reach. The Te Anau Township is a major base of the booming recreation and tourism that happens in the area. Like Manapouri, early farm runs, followed by settlements were established at Te Anau before 1900 (Day 1993).

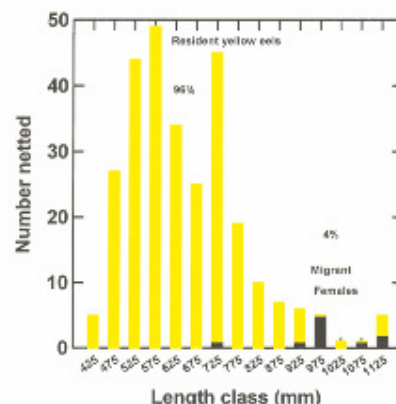


Water colour of Lake Te Anau by WM Hodgkins around 1863, showing Lake Henry in the foreground. Source: Hall-Jones (1983), p33.

Complementary Data

Eels netted in Te Anau in 2002 and transferred.
Data from Spooner-Kenyon 2002.

Source: NIWA 2004, p25.



Te Kutuawa o Tuawhea – Wairoa



Queens Reach Site in 2005 – downstream (left) and upstream (right)

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	5	A beautiful site – tino pai rawa!!
Degree of modification:	4	Seems largely unmodified.
Access for harvesting:	5	Great – gravel road and easy to find
Willingness to harvest:	5	Love to!!
Would you return?	Yes	

Species Abundance

Type	Species	Abundance
Bird	Bellbird	> >
Bird	Fantail	>
Bird	Grey Warbler	> >
Plant	Beech	> > >
Plant	Bracken Fern	>
Plant	Coprosma sp	> >
Plant	Flax	>
Plant	Kowhai	>
Plant	Lemonwood	> >
Plant	Manuka	> > >

Type	Species	Abundance
Pest	Daises	> >
Pest	Grass	> > >
Pest	Wildcat	>

% of site covered by taonga plants: 95%

Taonga Species Comparison: 10 Current vs 29 Traditional

E.coli notes: Coliform count = >201
E.coli count = 1

Cultural Stream Health Assessment

Catchment Land Use:	4
River Margins:	5
River Channel:	5
River Flow:	4
Water Quality:	4
Overall River Health:	4

Health Assessment Index: 4.55

Abundance Index: 34

Cultural Health Index Score: B-1 / 3.8 / 4.4

Site Summary: The Queens Reach site was the highest scoring site of all the sites assessed!! The largely unmodified nature of the area, the appearance and flow of the river and the almost total dominance of native vegetation made this site a real winner. Added to this were the ease of access to the site and the presence of the Ngāi Tahu Nohoanga. This meant the monitoring team felt some safety in visiting the site and it also offered opportunities for future excursions. The E.coli result was also low, but of concern if the water was to be used for drinking. Of more concern was the presence of a number of mammalian pests, including a wildcat that was noticed during the visit. Overall this site was of high cultural health and value. The added bonus of the nohoanga combined with the natural features of the site holds great potential for the future.

Issues and Actions: Properly identifying the nohoanga site would be a welcome improvement to the area and potentially enhance the use of the site by tribal members. There should also be some close attention paid to controlling pests at the site to ensure native bird populations can continue to flourish.

Home Creek – Manapouri

Location: Home Creek is a small tributary that enters the Waiau River just downstream of the Manapouri Township. The monitoring site was located at the mouth of the creek where it joins the Waiau, accessed from View Street. A water sample was gathered from further upstream, at the boat jetty opposite the township.

Description: The Home Creek site is very sheltered, being well shaded by mature riparian vegetation on all banks. Where Home Creek enters the Waiau, the creek has formed a strange muddy delta, obviously flowing from further upstream. On this northern bank of the Waiau, the riparian zone is almost totally covered by Willows, while on the opposite bank beech is almost 100% dominant. An unpleasant smell was evident at the site, which was made clear by a sign near the small road bridge crossing Home Creek which stated human effluent is discharged upstream!!



Historical: Home Creek is not mentioned as a traditional site, but again the general area around Moturau (Lake Manapouri) was extensively used by ngā tūpuna. Many sites in the area including, Te Okioki (Surprise Cove), Te Rakatu (Garnock Burn), Whitiaka Te Ra (pā site), Te Maui (North Arm), Huatea (South Arm) and Waiwaiata (Iris Burn) are a testament to this use, each with its own significance (Puentener & Corry). Fisheries as well as forest ground birds were an important feature of the traditional mahinga kai of the area (Mitchell & Davis). Manapouri is another important place of European Settlement in the catchment. A farm run was set up at Manapouri in 1854, while further settlement and subdivision followed in the 1890's, followed by the slow but steady development of tourism. The Manapouri power developments began to be talked about in the early 1960's, but with much public outcry, which has continued into recent times (Day 1993).



1852 Sketch of the homestead at Manapouri Station, situated near Home Creek, by CD Barraud.

Source: Hall-Jones (1983), p18.

Complementary Data

Freshwater fish records for Home Creek, January 2003.

Source: Boubée et al (2003).

FRESHWATER FISH DATABASE FORM										15077		
Date	10/01/2003		River/also contain: Waiau R					Catchment number		747.470		
Time	day		Sampling locality					Home Creek				
Observer	Job		Access					Access		195		
Organization	NIWA		NO. 200		443		Count		20013		20023	
Fishing method	seif		Area fished (m ² or ha, non-use)		55		Number of electric fishing poles		1		Total number	
HABITAT DATA												
Water	Colour		Temp		pH		Clarity		Temp		pH	
	Average depth (m)		4.8		Average depth (m)		6.4		Average depth (m)		1.6	
Water type (%)	20%		Flow		Pool		Flow		Flow		Flow	
Substrate	Mud		20		Sand		80		Grass		20	
Plant	Duckweed		Vetiver		Vetiver		Vetiver		Vetiver		Vetiver	
Canopy	Native		Forest		Forest		Forest		Forest		Forest	
Flotation	Native		Forest		Forest		Forest		Forest		Forest	
Flotation	Native		Forest		Forest		Forest		Forest		Forest	
Type of fishery: Freshwater												
Habitat: Freshwater												
Fish Data												
Species												
Salmo trutta												
Anguilla dieffenbachii												

Motu-ua – Moturau



Home Creek in 2005 - downstream (left), showing 'muddy delta' and upstream (centre), showing mouth of creek and the view towards Lake Manapouri and the jetty where the water sample was collected. Private access and public health warning signs at the site (right).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	1	Raw sewage is being pumped in further upstream!!
Degree of modification:	2	Willows & sedimentation obvious and tourist development
Access for harvesting:	1	Private Road - Meridian
Willingness to harvest:	1	Smell of stagnant water/mud – due to sewage??
Would you return?	No	

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Plant	Beech	> >	Pest	Willow	> > >
Fish	Not applicable	>			

% of site covered by taonga plants: 50%

Taonga Species Comparison: 2 Current vs 22 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	2
River Margins:	1
River Channel:	1
River Flow:	2
Water Quality:	1
Overall River Health:	2

E.coli notes: E.coli = 1* (*taken from upstream)

Health Assessment Index: 1.27

Abundance Index: 1

Cultural Health Index Score: B-0 / 1.0 / 1.4

Site Summary: The Home Creek site scored very poorly and was actually the worst of all sites assessed!! The biggest contributor to this grading was the obvious degradation caused to the area by the discharge of human effluent into Home Creek, with the muddy delta at the mouth of the creek giving physical evidence of this. The total dominance of Willows on the northern bank also figured poorly in the overall assessment of the site, as did the access issues related to the private road. Unfortunately, no water sample was gathered for this site, but instead was gathered further upstream at the Boat Jetty, which returned a result of 1 E.coli.

Overall this site was of very poor cultural health and of almost no cultural value, due to the discharge of human effluent. This site demonstrates the negative impacts urban settlement, no matter the size can have on the cultural health of an area.

Issues and Actions: Investigating alternative treatment and disposal options for the discharge of human effluent into Home Creek could go some way to cleaning up this site. However, it would take a long time to repair the immediate damage caused at the mouth of the creek, if it could actually be restored at all in the eyes of those in the monitoring team.

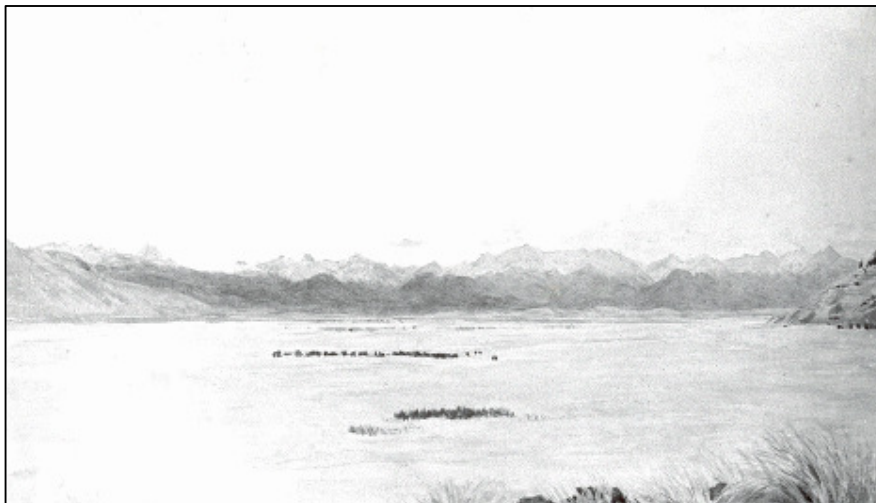
Mararoa Weir

Location: The Mararoa Weir is located just downstream of the confluence of the Maraeroa (Mararoa) and Waiau Rivers, controlling the outflow of water from Lake Manapouri and diverting water from the Mararoa for power generation. The monitoring site was situated just downstream of the weir, below the Duncraig Road Bridge crossing the Waiau.

Description: The Mararoa Weir site is extraordinary, due to the weir itself. A mean engineering feat, it creates a surreal outlook to the site with the concrete of the weir being in stark contrast to the surrounding landscape. The area around the rivers is open but surrounded by large mountains further back on all sides. Some beech forest remains on the western bank but the area is generally scrub, exotic grasses and woody weeds, including gorse and broom. The Didymo algae was present at this site being very noticeable in the slow flowing river.



Historical: The Mararoa or properly the Maraeroa was an important traditional site used extensively by ngā tūpuna, primarily as a mahinga kai, where both Tuna/eels and Kanakana/lampreys were taken. The confluence of the Waiau and the Maraeroa was also an important resting point along the Ara Pounamu – or Pounamu Trail that took people to the Mavora Lakes – Hikurangi and Manawapopore and further north to Milford Sound and the West Coast. The traditional name for the Mararoa River, Maraeroa, means a long (roa) courtyard (marae) referring to the long, flat nature of the river valley (Puentener & Corry). The Mararoa is of course most famous for the weir, which was constructed in 1976 as part of the Manapouri power developments. The general area around Mararoa has been dominated by large sheep stations and farm runs for the past 100 plus years.



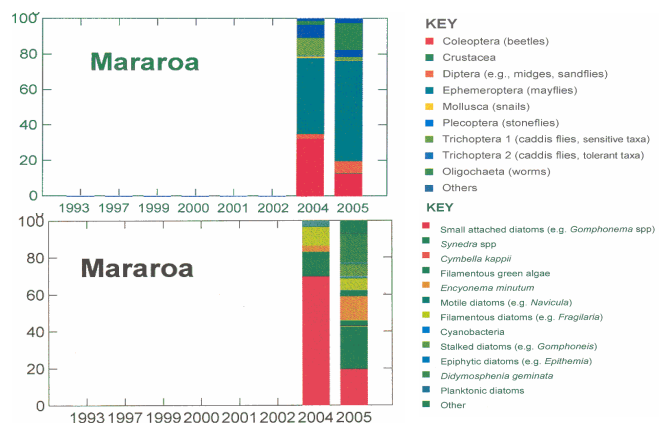
The Mararoa Plain by J.C. Richmond (Hocken Library).

Source: McDonald (1972)

Complementary Data

Invertebrate (top) and Periphyton (bottom) compositions (%) for the Mararoa Weir Site 1993-2005.

Source: Kilroy et al (2005).



Maraeroa



Mararoa Site in 2005: Downstream showing beech forest on opposite bank (left), upstream showing Mararoa weir passed the bridge (centre), and the extent of Didymo algae (right).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	3	Some Beech present but riparian zone mostly weeds- unkept looking
Degree of modification:	1	Weir 100m upstream = reduced flow. Bridge and stopbanks present.
Access for harvesting:	2	Not easily accessible by boat & no trespass sign on gate to control access
Willingness to harvest:	2	Limited species and possibilities
Would you return?	No	

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Plant	Beech	> >	Pest	Algae	> > >
Plant	Bracken Fern	>	Pest	Broom	> > >
Plant	Flax	>	Pest	Gorse	>
Fish	Bullies	> >	Pest	Grass	> > >
Fish	Elver	>	Pest	Willow	> >

% of site covered by taonga plants: 15%

Taonga Species Comparison: 5 Current vs 15 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	1
River Margins:	3
River Channel:	2
River Flow:	1
Water Quality:	3
Overall River Health:	3

Health Assessment Index: 1.91

Abundance Index: 7.5

E.coli notes: E.coli = 20-35* (*estimated)
No. Tubes Positive = 2/10

Cultural Health Index Score: A-0 / 2.0 / 2.2

Site Summary: The Mararoa site scored very poorly and ranked as was one of bottom three sites of all those assessed. The major factor in this poor grading was the obvious impediment of natural flow – being the weir itself. However, this wasn't the only aspect of the site that drew negative responses. The Didymo algae was more apparent at this site than at any other, where it was seen totally smothering most of the stones in the bed of the river. The slow flowing nature of this section of the river, due again to the weir, further exacerbated the sight of the algae. Many of the most well known wood weeds were also present including broom, gorse and willow, which added to the poor showing of this site. One positive about the site was the beech forest on the western bank and the presence of large numbers of bullies at the rivers edge. Overall this site was of low to poor cultural value and health. This site represented the worst features of the impacts that hydro-generation has on this catchment.

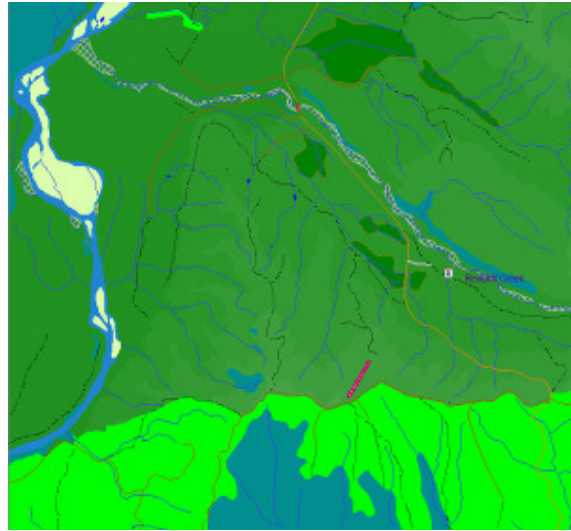
Issues and Actions: There seems that there is very little that could be done to improve this site. At the least it would be important to monitor and/or manage the Didymo algae closely at this site - to stop its spread into the lakes and the upper Waiau catchment. There may be some potential for fisheries at this site but only with some weed control and/or restoration to improve the general outlook of the site.

Redcliff Creek

Location: The Redcliff Creek runs along the northern side of the Redcliff Valley flowing into the Waiau River approximately 5kms downstream of the Blackmount-Redcliff Road. The monitoring site is located near the boundary of the Jericho Block and the adjoining DoC reserve, approximately 1km up stream from the main road.

Description: At the site, Redcliff Creek offers superb views, particularly downstream towards the Waiau River and the Hunter Mountains. The Creek hugs the extreme northern edge of the valley, and as such is sheltered under a steep and towering bush clad escarpment on the northern bank, which makes up the neighbouring DoC reserve. A feature of this area is that it is home to a pair of local Karearea/NZ Falcons that fly above the valley checking their domains and keeping guard over the restoration efforts of the Mahika Kai Trust. The southern bank of the creek is less impressive, being covered with a mixture of thick exotic weeds and native riparian shrubs. This makes getting to the monitoring site difficult and impossible by any form of transport, other than by foot – which, of course, has its own advantages!!

Historical: The Redcliff Creek is not recorded as a traditional site of any major significance, but rather the whole area would have been important on the journeys of ngā tūpuna. The restoration efforts of Te Waiau Mahika Kai Trust and it being the boundary of the former Landcorp Farm are significant as is the presence of the DoC reserve that protects the northern river terrace (escarpment) and the habitat of the resident Karearea/NZ Falcons. Also of note in the Redcliff area, is the development of exotic pine plantations on the upper terrace above the escarpment that will at some time in the future be harvested, and may cause concern to the restoration efforts.



The Coach in the Redcliff Valley on the road to Lake Manapouri.

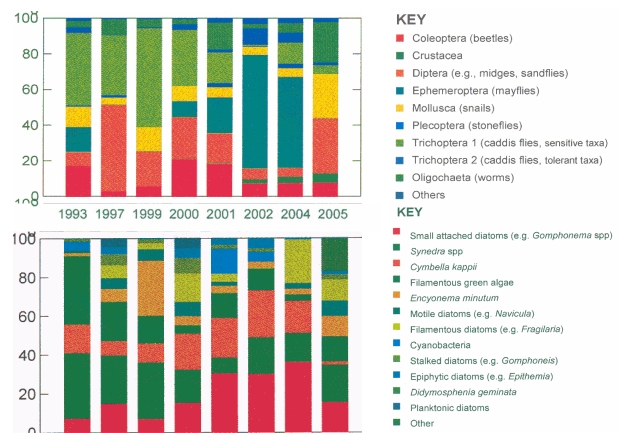
(Otago Witness 23 August 1911 p 44).

Source: McDonald (1972).

Complementary Data

Invertebrate (top) and Periphyton (bottom) compositions (%) for the Redcliff Creek 1993-2005.

Source: Kilroy et al (2005).



Te Koawa Tūroa o Takitimu



Redcliff Site in 2005: Downstream (left), at site, showing the 'escarpment' (centre) and upstream (right).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	4	DoC reserve escarpment intact, but many weeds present on southern bank
Degree of modification:	4	Only through the infestation of exotic weeds – but not dominant – yet!!
Access for harvesting:	3	A decent walk to site via thick scrub. No established track or vehicle access
Willingness to harvest:	4	Definitely worth a go!!
Would you return?	Yes	

Species Abundance

Type	Species	Abundance
Bird	NZ Falcon	> >
Bird	Shag	>
Plant	Bracken Fern	> >
Plant	Broadleaf	> > >
Plant	Cabbage Tree	> >
Plant	Flax	>
Plant	Kohuhu	> > >
Plant	Kowhai	>
Plant	Tutu	>

Type	Species	Abundance
Other	Riverstone	> > >
Pest	Broom	> > >
Pest	Gorse	> > >
Pest	Monkey mustard	> >

% of site covered by taonga plants: 80%

Taonga Species Comparison: 9 Current vs 16 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	4
River Margins:	4
River Channel:	4
River Flow:	4
Water Quality:	4
Overall River Health:	4

E.coli notes: Not done for this site

Health Assessment Index: 4.00

Abundance Index: 24.5

Cultural Health Index Score: B-1 / 3.5 / 4.0

Site Summary: The Redcliff site ranked as was one of the top three sites of all the sites assessed. The largely unmodified nature of the catchment, its relationship to the Takitimu Mountains and its place within the Jericho restoration project gave it a high cultural value and health rating. But most impressive at this site was the steep and towering bush clad escarpment extending as far as the eye could see, along with the presence of the resident Karearea. Seeing these birds displaying their aerial mastery was very special and something to cherish and protect. Less impressive were the weeds that have gained some holding on the southern side of the creek. While no fish were seen on the visit or caught in the traps set – they are present and this holds lots of potential for the area. Overall this site was of high cultural value and health, again with plenty of future potential this time due to the protected DoC reserve.

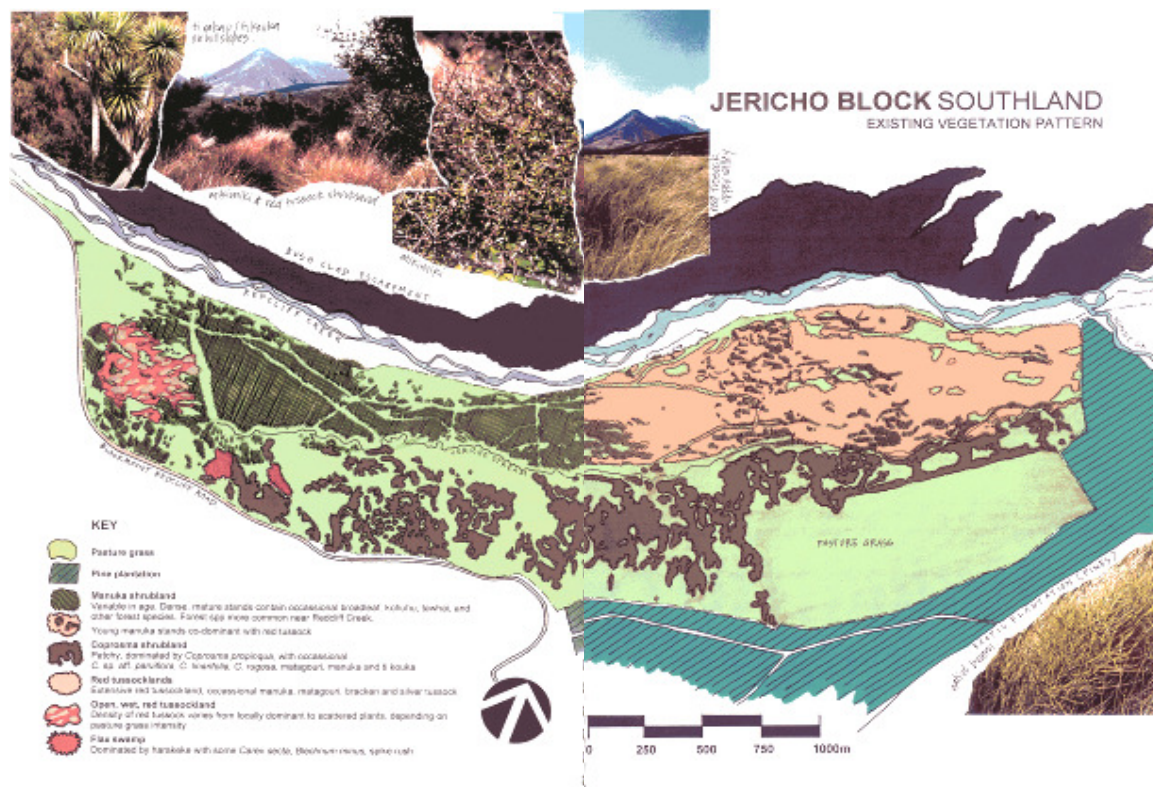
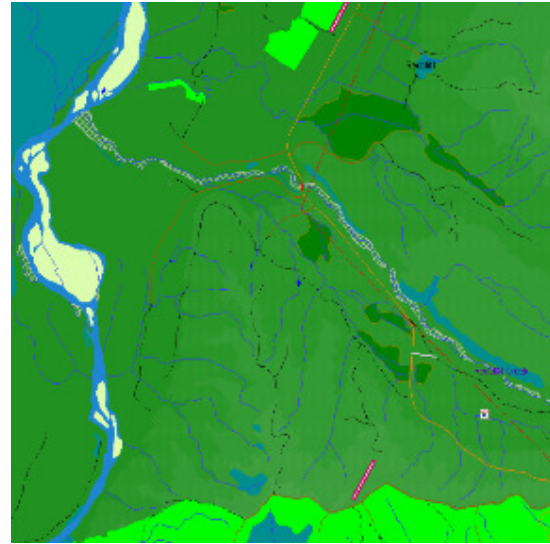
Issues and Actions: Continuing the restoration in the valley will definitely be of benefit to the site and creek. Therefore carrying out further monitoring and research will be important to see any changes. Doing something about the weeds is probably the biggest issue, to ensure they do not become dominant. But perhaps of more concern is the potential of the future clearing of the pine plantation on the upper terrace above the DoC reserve. A watching brief needs to be kept on these developments, with an eye to ensuring it will not disturb or threaten the Karearea or any plans for translocations by the Trust.

Jericho Stream

Location: The Jericho Stream, which runs along the southern side of the Redcliff Valley floor, is located on the Jericho Block, a former Landcorp farm situated between Otukaramea (Blackmount) and Manapouri, just to the north of Blackmount Forest. The property is now owned by the Te Waiau Mahika Kai Trust and is accessed straight off the Blackmount-Redcliff Road. The monitoring site is located up the stream approximately 1km from the main road/buildings.

Description: The Jericho stream is an idyllic site, being in the middle of the valley, with outstanding views of the Takitimu Range, directly upstream to the east and views towards the Waiau River and the Hunter Mountains downstream to the north-west. The remains of the former Landcorp farm are slowly giving way to the restoration efforts of the Trust, with young natives beginning to pop their heads above the exotic grasses all around. The stream itself is small and slender, being easily leapt in most places, but with a steady flow and clean fresh appearance. The grass/scrub lands are home to the native fernbird – Mātā which can be seen and heard most days.

Historical: The Jericho Stream is not recorded as a traditional site of any major significance, although it is likely that ngā tūpuna travelled through the area and utilised what they needed to sustain them on their journey to the Sounds and West Coast in search of Pounamu. Its major historical note is its recent transformation from a Landcorp Farm returning full circle into a place of native regeneration and mahinga kai restoration by the tangata whenua.



Vegetation Cover in the Jericho Block in 2001. Source: Lucas Associates (2001).

Te Koawa Tūroa o Takitimu



Jericho Stream in 2005: upstream (left) and downstream (right).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	4	Whole area previously farmed - now being restored to natives
Degree of modification:	3	Stream has been modified downstream of inspection site.
Access for harvesting:	3	Fair walk to site from accommodation buildings/road – walking track only
Willingness to harvest:	5	Habitat may not support many species at present
Would you return?	Yes	

Species Abundance

Type	Species	Abundance
Bird	Fernbird	>
Bird	Grey Warbler	> >
Plant	Carex sp	> >
Plant	Coprosma sp	> >
Plant	Flax	>
Plant	Kanuka	> > >
Plant	Toetoe	>
Plant	Tussocks	>
Plant	Tutu	>
Fish	Bullies	>
Fish	Whitebait	>

Type	Species	Abundance
Pest	Gorse	>
Pest	Grass	> > >
Pest	Lotus major	> > >
Pest	Red Clover	> > >

% of site covered by taonga plants: 80%

Taonga Species Comparison: 11 Current vs 21 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	3
River Margins:	4
River Channel:	3
River Flow:	4
Water Quality:	5
Overall River Health:	4

E.coli notes: Not done for this site

Health Assessment Index: 3.91

Abundance Index: 28

Cultural Health Index Score: B-1 / 3.5 / 3.8

Site Summary: The Jericho site also ranked as was one of the top three sites of all the sites assessed. Again, the unmodified nature of the upper stream and catchment, as well as its relationship to the Takitimu Mountains and its place within the Jericho restoration project gave it a high cultural value and health rating. The views and regenerating natives were stand out features of the site, along with the bird and fish life present and readily seen. The only negative aspect of the site was the modification of the stream, downstream of the monitoring site, where the natural stream course has been altered, creating an unnatural looking pond, resembling a farm long-ditch. Furthermore, although the stream had great natural values, at present its mahinga kai opportunities are limited – with the stream being very small and the plant and bird life not yet fully regenerated – much potential though. Overall this site was of high cultural value and health, with plenty of future potential due to the intensive restoration taking place.

Issues and Actions: Continuing the restoration will definitely benefit the site and stream and provide future opportunities for harvest as well as wānanga. In this respect regular ongoing monitoring utilising the Takiwā system, along with other forms of data collection and research will be critical to record the positive effects of the restoration. A telling indicator will be simply repeating the reference photographs taken during the pilot study to see the growth of the natives. Looking at doing something with the 'artificial pond' downstream of the site may also be important, especially for fisheries value.

Monowai Power Station

Location: The Monowai Power Station is located at the confluence of the Monowai and Waiau Rivers. The Blackmount Forest sits across the river to the north-east. A human-made channel diverts water from the Monowai, draining from Lake Monowai, through the power station situated right next to the natural mouth of the Monowai River. The monitoring site centred on the boat ramp situated, further downstream. The site is approximately 50kms inland from the mouth.



Description: The Monowai site is surrounded by mature native beech forest, mainly mountain beech, on the north-eastern bank. Here the sounds of Korimako/bellbirds and Riroriro/grey warblers are ever present. However, the striking feature of the site is the quaint looking power station, built into the steep river terrace on the western bank. The Monowai River is also evident flowing over a built up gravel bar directly in front of the power station. A grassed area, complete with ornamental Silver Birches, other exotics and a goat, sits between the power station and the boat ramp, which forms the end of Turbine Road.

Historical: Monowai, or rather Manokiwai is known as a traditional mahinga kai site, where in particular, kanakana/lampreys were gathered. Manokiwai is an old name for Lake Monowai that refers to a white worm that was used for the bobbing of eels there (S. Cormack in Puentener & Corry p14). Another traditional name for the area is Monoao, which refers to the dracophyllum grass that grew there. (Puentener & Corry, Hall-Jones 1990). A hoe or traditional canoe paddle was found near Belmont, a little south of Monowai, giving good evidence to the use of the area by ngā tūpuna. In 1862, James McKerrow was the first European to visit Lake Monowai, giving names to various features including, Borland Burn, which reminded him of a similar place in Ayrshire, Scotland. The Power Station was built in the early 1920's to supply Invercargill with electricity. This was done by damming and raising the lake by eight feet, and building the channel, penstocks and finally the power station. It was linked to the national grid in 1938 and continues to produce 6 megawatts of power (Esler 2004). The site remains in an otherwise unmodified state surrounded by the extensive Mountain Beech forest.

FRESHWATER FISH DATABASE FORM										15967					
Date	28/01/2003		River/Lake system Waiau R					Catchment number		797					
Time	1730		Sampling locality Waiau River												
Observer	Jab		Access					Altitude (m)		160					
Organisation	niwa		NZMS 260		d44		Coord.		20917 54788		Distance inland (km)		74		
Fishing method	efp		Area fished (m ²)		10		Number of electric fishing passes		1		Tidal water		n		
HABITAT DATA															
Water		Colour		Average depth (m)		0.3		Clarity		Temp.		pH			
Habitat type (%)		Still		Back water		Pool		20		Run		Riffle		80	
Substrate type (%)		Mud		Sand		Fine gravel		Coarse gravel		Cobble		Boulder		Bed-rock	
Fish cover (%)		Substrate		Wet algae		Instream debris		Bank veg.		Undercut bank		Overhead shade		Other	
Catchment vegetation (%)		Native forest		Exotic forest		Farm		Urban zone		Scrub		Swamp land		Other	
Riparian vegetation (%)		Native forest		Exotic forest		Grass tussock		Exposed bed		Scrub willow		Raupo bed		Other	
Type of river/stream/lake: fdmsln															
Water level		n		Downstream barrier		n		Pollution		n		Permanent water		y	
FISH DATA															
Species		Abundance		Length		Habitat/Comments									
Oncorhynchus mykiss		Rainbow trout		1		50		gen							
Anguilla dieffenbachii		Longfin eel		2		120		gen							
Gobiomorphus cotidianus		Common bully		2		30-40		gen							
Perca fluviatilis		Perch		1		112		gen							
Comments															

Complimentary Data

Freshwater Fish data taken for Monowai, January 2003.

Source: Boubee et al (2003).

Manokiwai – Monoao



Monowai Power Station in 2005: Powerstation and Monowai River outlet (left),
Waiau River upstream (centre) and downstream (right)

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	3	Loses mark because the river is controlled
Degree of modification:	2	Power station/hydro generation has altered river, plus boat ramp
Access for harvesting:	3	Comfortable gravel road to site - but quite far inland. Access to both rivers
Willingness to harvest:	4	Although may be issues with power station outflow, but clean water
Would you return?	Yes	Both rivers at this site have very little housing & less pollution, nice country

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Bird	Bellbird	> >	Pest	Broom	>
Bird	Grey Warbler	> >	Pest	Silver Birch	>
Plant	Beech	> > >	Pest	Willow	> >
Plant	Fern	> >			
Plant	Toetoe	> >			
Plant	Tutu	> >			
Fish	Not applicable	>			

% of site covered by taonga plants: 75%

Taonga Species Comparison: 7 Current vs 16 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	3
River Margins:	3
River Channel:	2
River Flow:	3
Water Quality:	4
Overall River Health:	3

E.coli notes: E.coli = 100-135* (*estimated)
No. Tubes Positive = 4/10

Health Assessment Index: 3.18

Abundance Index: 17

Cultural Health Index Score: A-1 / 3.0 / 3.0

Site Summary: The Monowai site ranked in the mid range of the sites monitored and was viewed favourably by the monitoring team. All said they would return to the site and most were willing to harvest mahinga kai from the area. One member noted 'Both rivers at this site have very little housing, therefore there is little pollution'. The reason for the site getting only an average score was due largely to the modification caused by the power station and power generation. The power station is a striking feature of the site and therefore detracts from the natural character of the place. In saying this, the extensive native beech forest on the opposite bank and up and down the river meant the site held potential for future harvest. The E.coli testing also showed only medium levels of contamination.

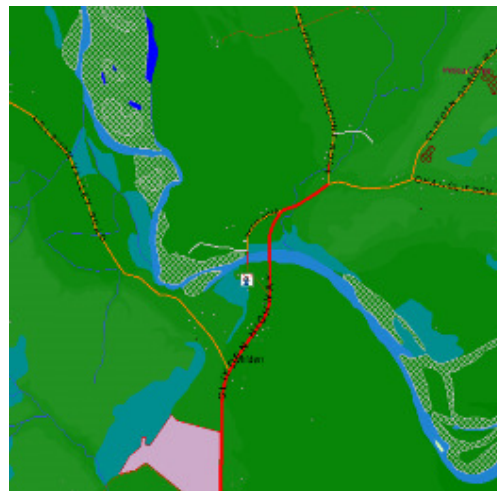
Overall this site was of medium cultural value and health, but with good potential due to the extensive native beech forest present on the north-eastern bank.

Issues and Actions: It will be important to keep an eye on this site in relation to the ongoing effects on the power station, and even the small settlement nearby. Upgrades to the power station have been investigate in the past and further investigations maybe pursued when the power station is due for its next resource consent. This would need to take the natural and cultural values of the site into consideration and therefore, ongoing Takiwā monitoring would be worthwhile.

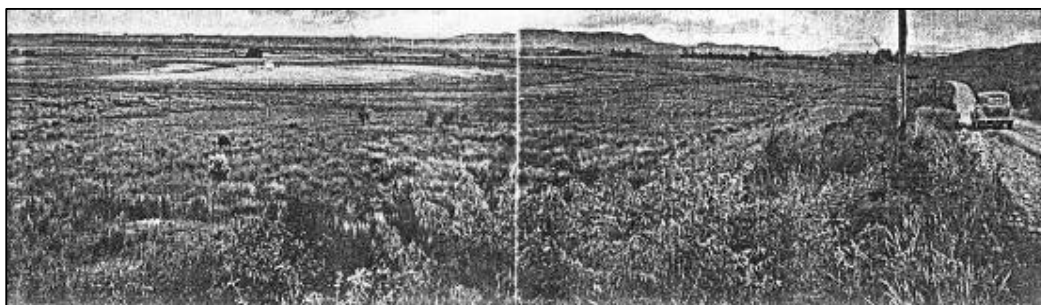
Clifden Caves/Bridge

Location: The Clifden monitoring site focussed on two areas, one on each bank of the Waiau River, around the old Clifden Bridge. The first area was the site of the traditional gathering caves on the south-western bank and the second area was almost directly opposite at the rest area next to the Bridge. Clifden Bridge is approximately 20kms from the coast and 10kms from Tuatapere, on a stretch of the river that veers to the west before heading north again near where the Lill Burn joins the main river channel.

Description: The Clifden Cave site is on a private farm and as such is covered by exotic grass and tree species, including Chestnut, Oak and Walnut. However, the labyrinth of majestic limestone caves and outcrops still dominate the area. The outcrop features a unique 'atea' or open area running up its middle, with different shaped caves running along the eastern side. The western side features access ways down to the river below that become dominated by native riparian shrubs and vegetation towards the bank. The old Clifden Bridge site is a restored native tree fenced rest area next to the start of the bridge and on top of a steep bank that drops approximately 5 metres to the river below. Willows were dominant to the east and west and there was a view to the Caves site on an even higher terrace directly opposite.



Historical: The Clifden area is of immense traditional significance to the people of Murihiku. The Caves opposite the bridge were well known and used by ngā tūpuna. Te Ana Whakairo are the caves where Tamatea and his crew stored information about their canoe and voyage in the form of rock drawings. While Te Rua o te Kaiaimio is a rock shelter that was designated as a meeting place for the local Māori, similar to a Marae (S. Cormack in Puenteener & Corry p14). In 1856, one of the early runs was established at Clifden where sheep and occasionally cattle were farmed. The area was later subdivided for further settlement in the 1890's, while the now historic bridge was built in 1915. In 1899, the Bellmount Dredge was launched near Clifden searching for gold (Day 1993 & Miller 1954). Today it remains as a major agricultural area within the valley.



The Clifden Flat as it was in the 1950s. Source: Dobie (1953)

Complementary Data

Bird sightings in the Clifden Area 1993-1996. Source: McClelland (1996).

Species	Clifden/Wairaki Reach Breeding Season		Clifden/Wairaki Reach Post-Breeding Season		Pukeko	Pied Oystercatcher	Variable	Oystercatcher	Pied Stilt	Banded Dotterel	Black-fronted Dotterel	Spur-winged Plover	Bar-tailed Godwit	Black-backed Gull	Red-billed Gull	Black-billed Gull	Black-fronted Tern	Caspian Tern	White-fronted Tern
	24.11.93	11.12.95	09.03.94	21.3.96															
Black Shag	1	7	21	5	-	21	22	-	-	-	-	21	76	24	12	-	-	-	-
Pied Shag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Little Shag	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Shag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White-faced Heron	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Black Swan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canada Goose	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feral Goose	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paradise Shelduck	97	170 (+44 juv)	41	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mallard/Grey Duck	41	10	14	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grey Duck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grey Teal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shoveler	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scaup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Te Ana Whakairo-Te Rua o Kaiamio



The Waiau at Clifden in 2005: Upstream towards the Lill Burn (left) and downstream, showing old Clifden bridge

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	3	Regenerating natives along with many established exotic weed/tree species
Degree of modification:	2	Farming in catchment. Drop in flow due to hydro. Bridge used for recreation
Access for harvesting:	2	Easy Access to bridge but steep cliffs to river. Private access on Cave side.
Willingness to harvest:	3	There is a commercial fishery for tuna.
Would you return?	Yes	If something was done about access/restoration of caves site

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Bird	Bellbird	>	Other	Caves	> >
Bird	Fantail	>	Other	Limestone	> > >
Bird	Grey Warbler	>	Pest	Chestnut	>
Plant	Coprosma sp	> >	Pest	Eucalyptus	>
Plant	Matai	> >	Pest	Macrocarpa	> >
Plant	Ribbonwood	> >	Pest	Oak	>
Plant	Totara	> >	Pest	Walnut	> >
Fish	Not applicable	>	Pest	Willow	> >

% of site covered by taonga plants: 15%

Taonga Species Comparison: 8 Current vs 17 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	2
River Margins:	2
River Channel:	3
River Flow:	4
Water Quality:	3
Overall River Health:	3

E.coli notes: E.coli count = 80-200* (*estimated)
No. Tubes Positive = 8/10

Health Assessment Index: 2.91

Abundance Index: 37.5

Cultural Health Index Score: A-1 / 2.8 / 2.8

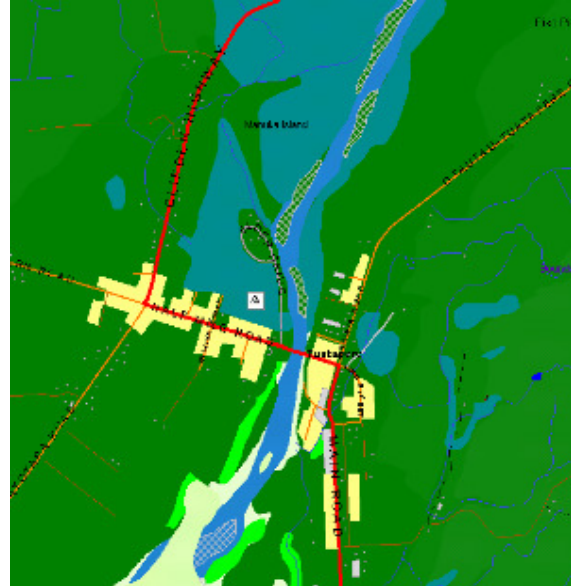
Site Summary: The Clifden site scored in the mid to bottom range of all the sites monitored, although the entire monitoring team noted that they would definitely return to the site and were mostly willing to harvest mahinga kai from the area. The scores therefore represented the level of modification noted at the site, with the surrounding domination of farmland and the drops in river flow through hydro generation. The dominance of exotic plant species was also apparent in the low assessments of this site. The positive feature of this site was definitely the caves, which although being hugely modified, held a spiritual importance for the local tangata whenua. One member noted 'the caves are a part of our heritage and a place where we can always come to feel safe'. The Clifden site recorded high levels of E.coli, demonstrating potential contamination from the surrounding farmland. Overall this site was of medium to low cultural health, but of extreme cultural value – due mainly to the Caves, which represents an important taonga of the tangata whenua.

Issues and Actions: Further water testing may be important to discover whether the E.coli is a major and/or persistent concern, as well as further investigation to identify its source. Restoration and protection of the caves is perhaps of the most priority and concern. It would be a great place to take rangatahi to educate them about their cultural heritage and the world of their tūpuna.

Tuatapere Domain

Location: Tuatapere Domain is located on the western bank of the Waiau River, just passed the main township of Tuatapere, which is located on the eastern bank of the river approximately 10kms from the mouth at Te Waewae Bay. The monitoring site centred on the boat ramp at the south-east end of the domain.

Description: The Tuatapere Domain site is interesting, being almost a 50:50 mix of outstanding native beech forest reserve and the developed domain area, with its exotic grasses and buildings/facilities. Willows are also a predominant feature of the site, dominating the lower banks of the river on both sides. Further back from each bank and between the houses and roads of the Tuatapere settlement, beech trees again begin to take precedence. Tuatapere Domain is also part of a DoC reserve, a campground and the site of the town's water supply, with tanks and discharge pipe being present, just near the boat ramp.



Historical: Tuatapere Domain does not appear to be an exact site of traditional use, but rather the whole area is important, particularly to the nearby kaika at Te Waewae. However, a number of traditional sites are located nearby. Ka Karehu o Tamatea is an area of black rocks near the Tuatapere ferry site, referring to the charcoal of Tamatea's fire left by the crew of the Takitimu. Kirirua is a swamp just below Tuatapere that takes its name from a type of eel that was traditionally harvested and found there (Puentener & Corry p14, 59-61). Tuatapere is of course an important area of European settlement, being famous for the forestry exploits of its inhabitants. At one stage, peaking around 1905, at least 8 sawmills were in operation in the area processing the formally dominant Podocarp species (Day 1993, Hanger 1981 & Miller 1954). Forestry is still an important part of the town today. Tuatapere was also the site of an early ferry service, initiated in 1899 and then a bridge, built in 1904, which substantially opened up access to, and development in the valley (Day p9).



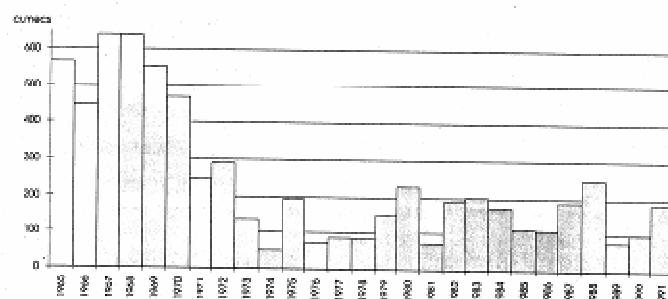
Tuatapere Ferry and Bridge in 1915.

Source: Hanger (1981).

Complementary Data

Waiau River flows at Tuatapere 1965-1991.

Source: Ridell 1993.



Ka Karehu o Tamatea



Tuatapere Domain in 2005: The resident beech forest on DoC reserve (left), the boat ramp looking downstream (centre) and the view of the domain area and water supply tanks (right).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	3	Decreased river flow due to hydro. Algae present but nice native beech forest
Degree of modification:	1	Willows on both banks. Water supply, boat ramp & boulders/river works.
Access for harvesting:	3	Straight off main road and good access to river with boat launching ramp
Willingness to harvest:	1	Seasonal site for inanga, kanakana, tuna - except it's a DoC reserve!!
Would you return?	Yes	Nice area but much modified & close to habitation, water testing is needed!

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Bird	Bellbird	> >	Other	Clay	> >
Bird	Grey Heron	>	Other	Riverstone	> > >
Bird	Grey Warbler	>	Pest	Broom	>
Bird	Wood Pigeon	>	Pest	Willow	> > >
Plant	Beech	> > >			
Plant	Cabbage Tree	> >			
Plant	Kohuhu	> > >			
Plant	Lemonwood	> > >			
Plant	Tawhiri	> >			
Fish	Not applicable	>			

% of site covered by taonga plants: 80%

Taonga Species Comparison: 10 Current vs 24 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	2
River Margins:	2
River Channel:	3
River Flow:	2
Water Quality:	2
Overall River Health:	3

Health Assessment Index: 2

Abundance Index: 34

E.coli notes: Coliform count = >201
E.coli count = 130
Tubes Positive = 4/10

1 anti-biotic resistant E.coli = Ampicillin

Cultural Health Index Score: B-0 / 2.2 / 2.2

Site Summary: The Tuatapere site was one of the lowest scoring sites out of all the sites monitored, due to a number of factors identified by the monitoring team. Firstly, the natural river flow at the site has been dramatically modified due to hydro generation. Secondly, the site is further modified by the presence of the domain and its facilities as well as it being the site of the town water supply. Thirdly, the monitoring team felt that the site was too close to habitation to be of great value as a mahinga kai, even though it had good access and the presence of native forest and birds. Being a DoC reserve was also mentioned in the negative, in that harvesting may be difficult due to legislative issues. Further, many thought the water actually needed testing – which proved to be an acute observation with the result of the E.coli test. The Tuatapere site recorded high levels of both faecal coliforms and E.coli and was the only site to return an anti-biotic resistant sample. In this case, for Ampicillin - an anti-biotic used by both humans and for animals within agriculture. Overall this site was of low to poor cultural value and health, with the main redeeming feature being the beautiful native beech forest and the birds that make their home there.

Issues and Actions: Further testing of the water at Tuatapere may be important to discover whether the E.coli is a major and/or persistent concern, as well as further investigation to identify its source. Work to ensure that the use of the domain does not adversely affect the river and surrounding forest/reserve may also be worth investigating, along with some further study of the native bird populations – which over time may provide a potential source of kai?

Waiau Mouth East

Location: Matatarawae is located on the far eastern side of the Waiau River mouth, approximately 2kms from the main river channel, where the river forms a large thin lagoon running parallel to the sea. The monitoring site is situated part way along the lagoon, on the inland bank, at the end of Fishing Camp Road, just below the start of the main cliff of the bay.

Description: Matatarawae is a semi-sheltered site, nestled under the beginning of a flax covered upper terrace that forms the main cliff running the length of Te Waewae Bay to the east. To the west and north is an open river flat stretching back towards the main channel. The area is dominated by the lagoon itself, which runs from the main channel down the bay for a distance of approximately 3kms where it is separated from the sea by a thin spit. A few small baches are present at the site.



Historical: Matatarawae is mentioned as the traditional name for the lagoon at the mouth of the Waiau and Te Waewae Bay. It was an important mahinga kai for the nearby kaik of Te Waewae. Being sheltered behind the spit, it abounded with eels, flounder and yellow-eyed mullet, available in all types of weather. There were also the eggs and chicks of the various seabirds nesting on the spit as well as driftwood, mussels, paua, kelp and seals available on the beach and along the coast (Mitchell & Davis p7). Joseph Banks, who on the 11 of March 1770 sat off the coast of Te Waewae Bay aboard Cook's Endeavour, said this of the area "We stood in with the shore which provd very high and had a most romantick appearance from the immense steepness of the hills, many of which were conical and covered with snow, on their sides and bottoms was however a good deal of wood, so much we could see and no more". More than 50 years later, John Boulton noted a similar scene "An extensive prospect presents itself from this place, of hills ranging along tier above tier, till they are succeeded by distant high mountains; vales of flax between these hills and the seaside setting off the whole to advantage" (Begg & Begg, p191-192). Another than the constant shifting of the Waiau Mouth in an east-west/west-east pattern and the occasional 'blowing out', the lagoon has changed very little.



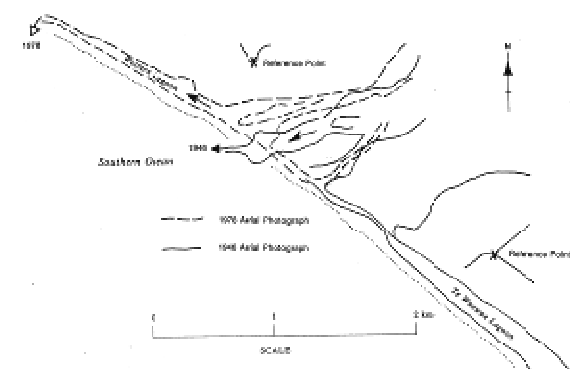
View of the Waiau Mouth, Te Waewae Bay and Lagoon (in far left of mid-ground) in around 1950.

Source: Dobie (1953).

Complimentary Data

Waiau River Mouth Movement 1946 - 1978

Source: Riddell et al (1993).



Te Waewae Lagoon-Matatarawae



Te Waewae Lagoon in 2005: Looking east from terrace (left), views to the west from the site (centre) and signs at the lagoon site looking east (right).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	4	
Degree of modification:	3	A few baches around site and some farming nearby.
Access for harvesting:	5	Good gravel road from main highway- few kms to site
Willingness to harvest:	4	
Would you return?	Yes	

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Bird	Duck	> > >	Other	Driftwood	> > >
Bird	Oystercatcher	>	Pest	Grass	> > >
Plant	Cabbage Tree	>	Pest	Lupin	> > >
Plant	Flax	> > >			
Fish	Not applicable	>			

% of site covered by taonga plants: 40% Taonga Species Comparison: 5 Current vs 21 Traditional

Cultural Stream Health Assessment: Not applicable at this site (being a lagoon site)

Health Assessment Index: 3.82 **Abundance Index:** 7

E.coli notes: Not done at this site **Cultural Health Index Score:** A-1 / 3.2

Site Summary: The Matatarawae site scored well in the CHI and other indexes, being in the mid to high range of all the sites monitored. This seemed due largely to the persistence of a range of mahinga kai species and the opportunities that remain for harvesting. Other factors were the relatively unmodified nature of the site, its sheltered conditions, good access and the impressive cliffs, almost totally dominated in native vegetation, that shadow the site. The area also appears well frequented by campers with baches, a toilet and signage all present. Overall this site has good cultural value and health and a good place to camp and gather kai.

Issues and Actions: The most important issue to follow up at Matatarawae is in relation to the baches at the site and just ensuring that the use of the site does not have adverse effects on the lagoon. Locating the nearby nohoanga site would be important to enhance opportunities for tribal members to use the site. The nohoanga could also be targeted for some restoration of the formally dominant podocarp species, including rimu, matai and kahikatea.

Waiau Mouth West

Location: The Papatotara site is located on the western bank of the Waiau River, at the end of Papatotara Road, on the lower flat near where the river turns and runs parallel to the sea before breaking through to Te Wae Wae Bay.

Description: Papatotara is a low, flat, open riverbank site dominated by exotic grasses that flow from the surrounding farmland on the nearby upper terrace down to the rivers edge. A small but significant wetland / bog is situated on the flat between the riverbank and the upper terrace on the inland side, while signs for camping and a caravan are located on sea side of river. The river itself is wide and slow flowing. Several gravel and sand beds have formed in the middle of the channel, and supply good habitat, being covered with various birds.



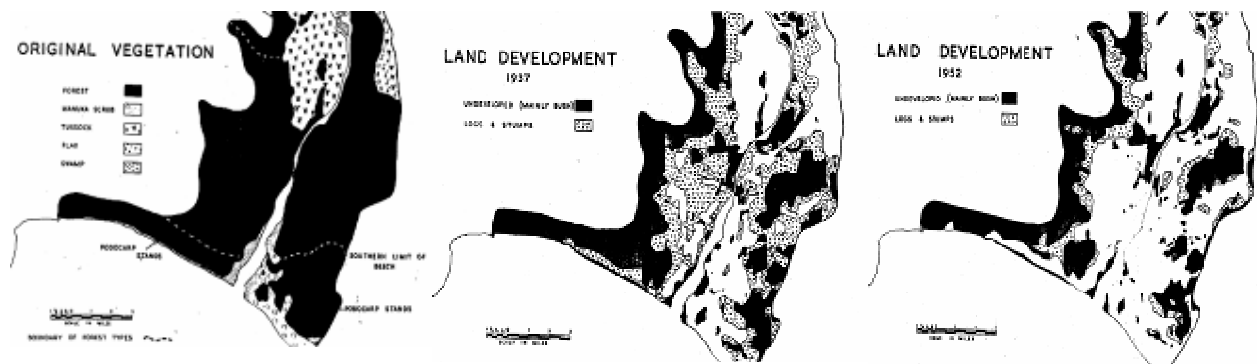
Historical: Papatotara meaning 'Totara Flat' is a well-known traditional site used extensively for the gathering of Totara bark for making poha titi (Hanger, p7). The area is also known to be the site of Te Tua a Hatu - the pa of the Ngāi Tahu chief Te Wae Wae (Puentener & Corry p15). John Boulton, an early European sealer who lived amongst local Māori gives the following account of his journey and stay at the pa for the funeral of Te Waewae in 1827: "When we arrived opposite the settlement, we shouted for a canoe to convey us across the river, the stream being very rapid ... The river is about 500 yards across and at the entrance of its bar. We knelt down resting our elbows on the gunnel, and were obliged to keep very steady to avoid being upset... The River 'Wi iaw' [Waiau] is very spacious in places, a distance up, and abounds in fish, eels and wild ducks of 3 or 4 different kinds." (Begg & Begg, p191). Papatotara later became a focus of early European settlement, where farming and goldmining, followed by flax and timber milling resulted in dramatic land change – 'from bush to pasture' in less than 100 years (Hanger 1981).



Left: Early forestry operations at Papatotara. **Right:** After a fire at the old sawmill. Source: Hanger 1981

Complementary Data

Aerial Maps showing changes in vegetation cover/land-use up to 1952. Source: Dobie (1953)



Papatotara-Te Tua a Hatu



Papatotara in 2005: upstream (left), downstream (centre) and wetland looking to the north (centre).

2005 Site Assessment:

Takiwā Site Assessment	Score	Comment
Overall health:	3	Farming on all boundaries of site
Degree of modification:	2	Hydro has changed the river causing shingle bars in middle of channel
Access for harvesting:	5	Good access via a shingle track (4WD useful) but can access by foot
Willingness to harvest:	5	Possible targets - inanga, patiki and tuna
Would you return?	Yes	

Species Abundance

Type	Species	Abundance	Type	Species	Abundance
Bird	Black Backed Gull	>	Other	Driftwood	> > >
Bird	Oystercatcher	> >	Other	Riverstone	> > >
Bird	Paradise Duck	> >	Other	Wetland	>
Bird	Pied Stilt >	Pest	Gorse	> > >	
Bird	Tern	> > >	Pest	Grass	> > >
Plant	Cabbage Tree	>	Pest	Lupin	> > >
Plant	Flax	> >			
Plant	Sedges	> >			
Plant	Toetoe	>			
Fish	Not applicable	>			

% of site covered by taonga plants: 10%

Taonga Species Comparison: 10 Current vs 20 Traditional

Cultural Stream Health Assessment

Catchment Land Use:	2	E.coli count:	>130* (*estimated using MPN tables)
River Margins:	4	No. of Positive Tubes:	5/10
River Channel:	3		
River Flow:	3	Health Assessment Index:	3.55
Water Quality:	4	Abundance Index:	21.5
Overall River Health:	3		

Cultural Health Index Score: A-1 / 4.0 / 3.2

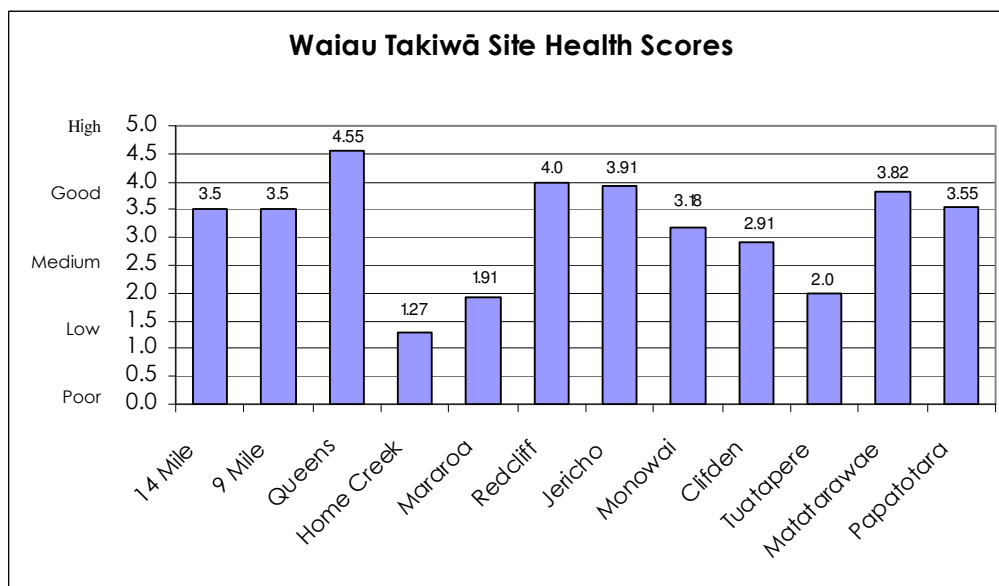
Site Summary: Even though the Papatotara area has undergone significant changes since European settlement and is dominated by exotic vegetation, the site still scored well in both the CHI and other indexes. This is due largely to the persistence of a range of mahinga kai species and the potential opportunities that still exist for harvesting mahinga kai, in particular waterfowl, seabirds and fish. A small wetland present near the site gives further habitat for waterfowl. It appears the area is well frequented by campers and fishers as evidence of campfires was noticed. The E.coli results revealed that there is some residual contamination at this site, which may need further investigation, if the site is to be considered for mahinga kai. Overall this site has good cultural value and health, but could be improved by the restoration of some native riparian/woody vegetation, particularly the formerly dominant Totara.

Issues and Actions: A small wetland is present near the site - it would be important to keep an eye on this for changes overtime. Fluctuations in river flow due to hydro power generation can cause noticeable changes at this site, which is worth keeping an eye on. Would be nice to properly identify the Nohoanga site nearby and instigate some restoration of Totara here. Further E.coli testing would be important to understand the nature and extent of contamination.

4.5 Analysis and Discussion

Overall the pilot study found the Waiau Catchment to be in a state of good cultural health. This assessment is based on an analysis of individual Takiwā site health scores using a simple sliding scale ranking system where sites are given a score from High (5) to Poor (1).

Of the 12 sites assessed, 8 were found to be of good to high health, while only 3 sites were found to be of a low to poor standard. The majority of sites (7) were found to be of good quality and 1 site - Queens Reach – was of high health, scoring 4.55/5. The lowest scoring site – Home Creek – received a poor ranking score of 1.27/5.



Generally, the higher scoring sites were those in the upper catchment – Queens Reach (4.55) and Lake Te Anau – 14 Mile (3.5) and 9 Mile (3.5), in tributaries – Redcliff (4.0) and Jericho (3.91), and at the mouth – Papatotara (3.55) and Matatarawae (3.82). These sites were characterised by either largely unmodified river flows and margins, native vegetation dominance, good access and/or potential for mahinga kai.

The lower scoring sites tended to be mid catchment sites and/or those associated with negative impacts of settlement, agriculture and/or hydro-generation. Home Creek (1.27) and Tuatapere (2.0) displayed signs of faecal contamination from nearby settlements, Clifden (2.91) showed the effects of agricultural runoff and pests & weeds, while Mararoa (1.91) and Tuatapere had obviously reduced river-flows due to hydro-generation.

The exception to both of the above trends was the Monowai site (3.18), which scored well even though it was a mid-catchment site as well as being associated with hydro-generation and human settlement. Its score represented the out of the way location of the site and the largely unmodified nature of the river channel and margins as well as the extensive mountain beech forest surrounding the site.

As mentioned above, the healthiest and highest scoring site was – Queens Reach (4.55). This site had good all round features including a great location, easy access, outstanding natural features, native vegetation dominance and largely unmodified river flows and margins. The fact that there was a Ngāi Tahu Nohoanga present at Queens Reach was also seen as positive.

The two tributary sites were next best and scored well due to for their largely unmodified natures and good mahinga kai potential. These were followed by the two mouth sites, which were noted for their mahinga kai potential – particularly seasonal fishing and game birds/waterfowl, followed by the two Lake Te Anau sites and the Monowai site, scoring well for their native vegetation dominance.

Of the lower scoring sites, Home Creek was the worst; largely due to the fact sewage was being discharged upstream of the monitoring site, but also because of access issues and the general unpleasant nature of the creek mouth area.

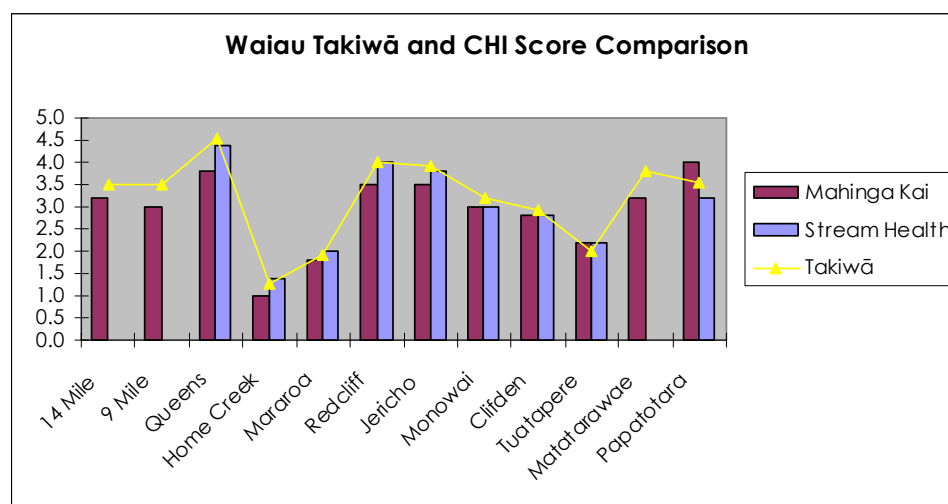
The Mararoa Weir site was the second lowest scoring site. It was noted for its unnatural low river-flows, due to the weir upstream as well as the presence of the Didymo algae. This was followed by the Tuatapere site, which also scored poorly due to its low flows as well as its close proximity to habitation.

Finally the Clifden site, which although held immense cultural value to the tangata whenua, scored poorly due to the presence of many pest and weed species and its obvious degradation due to nearby agricultural activity.

Cultural Health Index Scores and Comparison

The Takiwā health assessment index results correlated very closely to the Cultural Health Index (CHI) scores for the sites. This is shown on the graph below where the mahinga kai and stream health scores from the CHI are compared with the Takiwā score for each site. The only significant difference between the scores is that the Papatotara site had a higher mahinga kai score than any other site.

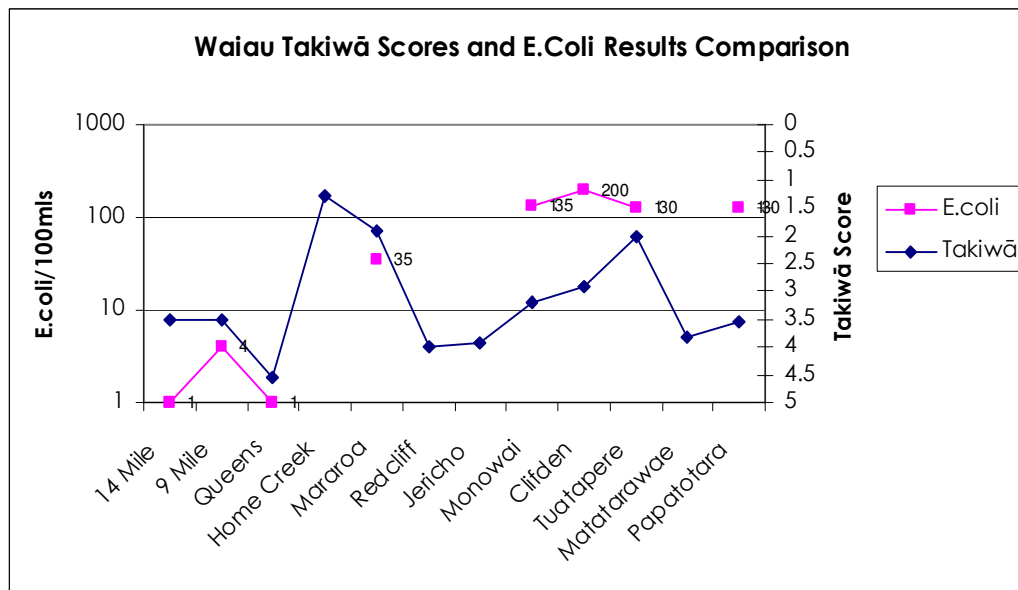
Of the 12 sites, only 3 (Home Creek, Mararoa and Tuatapere) were rated as not being worth returning to through the CHI. This further demonstrated direct correlation, being the three lowest scoring sites using the Takiwā index.



E.coli Results and Comparison

The index scores also correlated well with the E.coli testing carried out at the sites. In general, high E.coli counts were tied in with lower scoring sites and/or those that were either near human habitation or intensive farming, as indicated by the Takiwā and Cultural Health Index results. This was particularly true for the Clifden (200) and Tuatapere (130) sites, and to a lesser extent the Mararoa (35) site.

Exceptions to these trends were the Monowai (135) and Papatotara (130) sites, which although scored well in the Takiwā assessments, had high E.coli results. In fact these two sites returned worse E.coli results than the lower scoring Mararoa site.



Unfortunately, no sample was taken from the lowest scoring site – Home Creek – but instead a sample was taken upstream which returned an all most clean result. It was also unfortunate that no E.coli samples were taken for Matatarawae, Redcliff Creek and the Jericho Stream as the results would have been useful in providing a better overall picture and comparison.

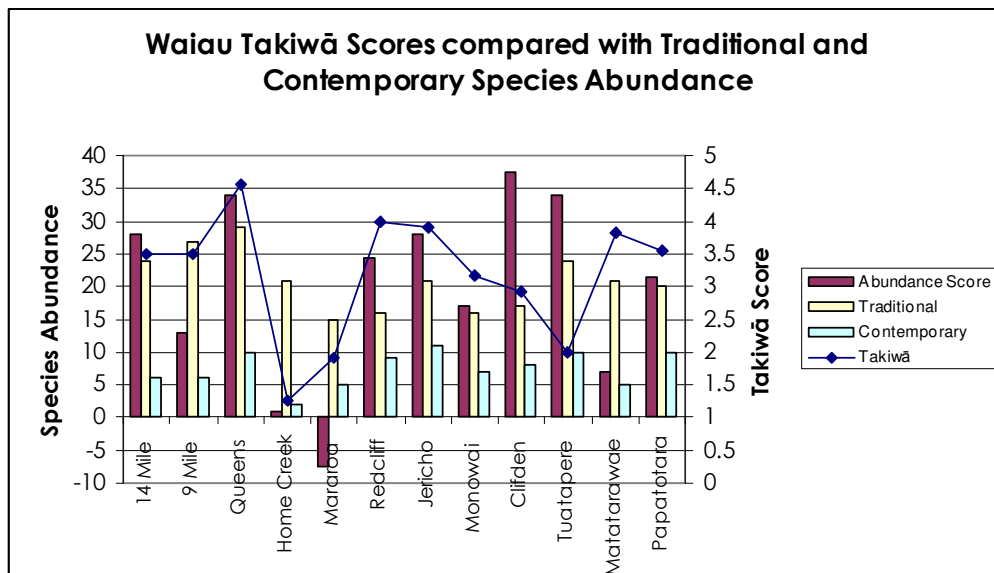
It was alarming however to see E.coli present in Lake Te Anau, albeit minor. These results indicate some pollution associated with boats, sewage discharge and/or tourism. The levels of contamination are of some concern particularly if the water is to be used for drinking, or the harvesting of kai.

Furthermore, one antibiotic resistant E.coli was found at the Tuatapere site. The E.coli was resistant to ampicillin, an anti-biotic used in both humans and animals, giving some indication of the source of this contamination and helpful in eliminating future pollution.

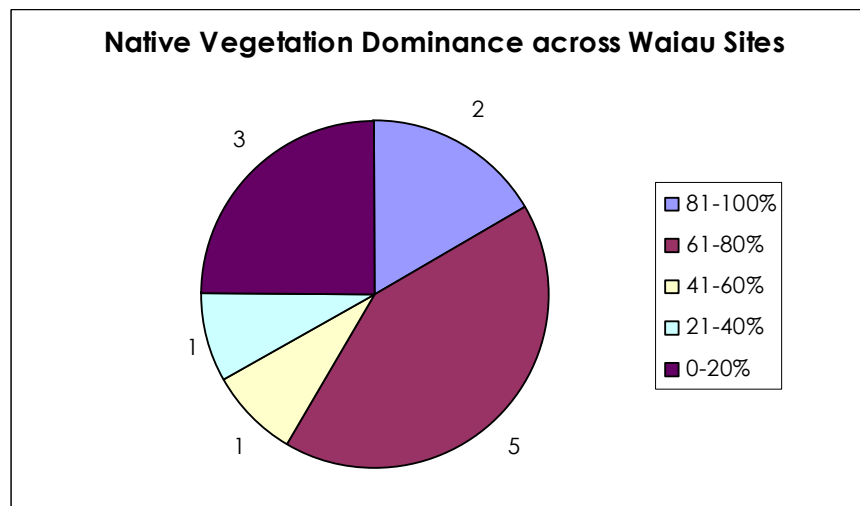
Species Abundance & Native Vegetation Dominance

Species abundance scores for each site, along with the comparative numbers of traditional and contemporary species present at each site also showed close correlation with Takiwā scores and further supported the overall analysis.

In most cases high abundance scores and the presence of taonga species at the sites were associated with high Takiwā scores. The exceptions were at both the Clifden and Tuatapere sites where there were abundant native species but poor water and/or overall quality. Home Creek and Mararoa obtained the lowest abundance scores as well as showing the greatest amount of taonga species loss over time. The Matatarawae site scored poorly in regards to species abundance although having a good Takiwā score. All sites, however, demonstrated significant losses of traditional species. Interestingly, the Jericho sites had high numbers of taonga species.



A further indicator of catchment health that supports the overall assessment is in relation to the number of sites supporting dominant native vegetation cover. Over half the sites (7) were found to have over 61% dominance of native vegetation, while only 3 sites were less than 20%.

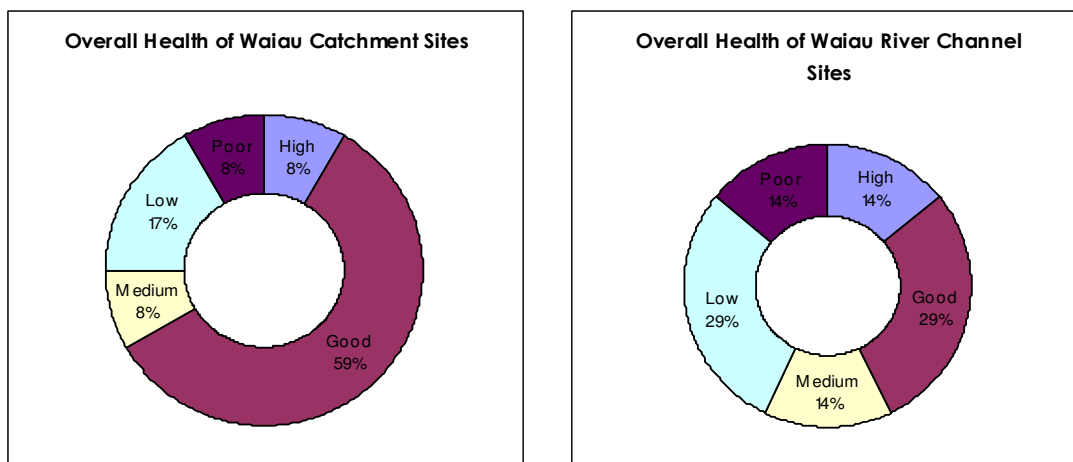


Catchment Health vs River Channel Health

An important result to come from the assessment was the difference in the overall health of the catchment versus that of the main river channel. This result is taken noticed when comparing the scores received for all sites versus those sites that were situated on the main river channel.

While the catchment rated well, with 59% of all sites being ranked as 'good', the same grade was not achieved for the main Waiau River itself. By taking away the non-main channel sites (14 Mile, 9 Mile, Redcliff, Jericho and Matatarawae), only 29% of sites returned a good score – equal to the percentage of sites to return a low score.

This result suggests that the state of the Waiau River itself should be seen as being of medium cultural health.



It is important to recognise, however, that the overall assessment undertaken was limited in the number of sites visited and that this lower rating mostly relates to the obvious effects that hydro power development, forestry, mining, farming, settlement, recreation and tourism have had on the river over the past 150-200 years – particularly in regards to river flow and presence and abundance of native fish, plants and birds.

In summary, what is safe to say is that the while the Waiau is not currently in a state of pristine health, it is and will continue to be of immense cultural value to the tangata whenua. This was particularly evident at the Clifden Caves site and Te Koawa Tūroa o Takitimu. Furthermore, the catchment still holds opportunities and potential for mahinga kai as well as recreation and enjoyment, as demonstrated by the results.

In saying this, ongoing monitoring, such as the assessments carried out in the Takiwā pilot study, will be important and serve to strengthen any opportunities and even assist in the future management of the river and its catchment.

5 Te Whakamutunga / Conclusion

This report represents the first attempt in New Zealand to undertake and report on a large scale, culturally based, environmental health assessment of a single river catchment by and for tāngata whenua.

Building on the concept of State of the Takiwā, Te Rūnanga o Ngāi Tahu, working in conjunction with ngā Papatipu Rūnanga o Murihiku, Environmental Science and Research, Envirolink, Manaaki Whenua and Environment Southland, developed the Takiwā monitoring and reporting tool to complete a pilot study to gather, store, analyse and report on the cultural health of one region within its tribal area.

Guided by local tangata whenua, the pilot study was undertaken in the Waiau River Catchment, Southland using the Takiwā tool, along with the Cultural Health Index and E.coli water testing which found the Waiau to be in a state of good cultural health.

Of the 12 sites assessed, 8 were found to be of good to high health, while only 3 sites were found to be of a low to poor standard. The majority of sites (7) were found to be of good quality and 1 site, Queens Reach, was of high health, scoring 4.55/5. The lowest scoring site, Home Creek, received a poor ranking score of 1.27/5.

Other results, including Cultural Health Index mahinga kai and stream health scores, E.coli testing and native vegetation dominance supported the above conclusion and highlighted the fact that in general, upper catchment, tributary and mouth sites were more healthy than those in the mid-catchment or those associated with settlement, agriculture or hydro-generation.

An interesting result to come from the study was in relation to the comparison of overall scores from all sites with those on the main river channel. Here the overall ranking for the main channel was significantly lower, highlighting the historical degradation of the river via successive waves of settlement, farming, mining, forestry and perhaps most importantly hydro-power generation.

The study further highlighted the need for future monitoring and the importance of continuing to gather environmental health information from a cultural perspective and allowed for the identification of both macro and micro level issues in the catchment.

Individual site assessments therefore provide guidance for future management by outlining issues and actions for the catchment including the restoration of native species, pest and weed management, protection of heritage values and increasing opportunities for cultural use through nohoanga identification and development.

Most importantly, the study resulted in the gathering of defensible and quantifiable information on the cultural health of the catchment which will only serve to be of greater value into the future, and as more data is gathered in subsequent years.

Such information may prove vital in managing future issues such as the recent invasion of the Didymo algae, and any regimes required to control it.

Tohutoro / References

References referred to in the main text:

1. Te Rūnanga o Ngāi Tahu. (2001). Ngāi Tahu Vision 2025. Christchurch, NZ: TRoNT. www.ngaitahu.iwi.nz
2. Ministry for the Environment. (1997). The State of New Zealand's Environment 1997. Wellington, NZ: MfE. <http://www.mfe.govt.nz/publications/ser/ser1997/index.html>
3. ibid 1, Glossary.
4. Ministry for the Environment. (1999). Māori Input into the Environmental Performance Indicators Programme. Wellington, NZ: MfE - page 7.
5. Puentener, R. & Corry, S.A. (1993). Tikanga Māori Cultural, Spiritual and Historical Values of the Waiau River: A Report for the Iwi Task Group of the Waiau River Working Party – page 15.
6. Ogilvie, S & Penter, B. (2001). Stream Health Monitoring Assessment Kit for Māori. Chch, NZ: NIWA http://www.smf.govt.nz/results/1027_finalreport.pdf
7. Tipa, G. & Tierney, L. (2003). Cultural Health Index. Wellington, NZ: MfE. www.mfe.govt.nz/publications/water/cultural-health-index-jun03/html/
8. Harmsworth, G. (2002). Coordinated Monitoring of New Zealand Wetlands, Phase 2, Goal 2: Māori Environmental Performance Indicators for Wetland Condition and Health. Palmerston North, NZ: Landcare Research. www.landcareresearch.co.nz/research/social/maoriindicators.asp
9. Otaraua Hapū. (2003). Kaimoana Monitoring Guidelines for Iwi and Hapū. Wellington, NZ: MfE. www.mfe.govt.nz/publications/ser/kaimoana-oct03.html
10. Te Rūnanga o Ngāi Tahu. (2003). State of the Takiwā: A Scoping Document. Christchurch, NZ: TRoNT. <http://www.ngaitahu.iwi.nz/Development/Natural%20Environment/Environmental%20Research/State%20of%20the%20Takiwa>
11. Water Information New Zealand Database – <http://www.drinkingwater.org.nz>
12. PA Handford & Associates Ltd. (2003). Forest Monitoring Assessment Kit. Wellington, NZ: MfE. www.formak.co.nz/default.aspx
13. see www.niwa.co.nz
14. ibid 7, page 26.
15. Ministry of Health. (2000). New Zealand Drinking Water Standards. Wellington, NZ: MoH – page 18. <http://www.moh.govt.nz/moh.nsf/0/70727db605b9f56a4c25696400802887?OpenDocument>
16. Ministry for the Environment. (2003). Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Wellington, NZ: MfE. <http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/index.html>
17. Cruickshank, R., Duguid, J.P., Marmion, B.P. & Swain, R.H.A. (1975). Medical Microbiology: The Practice of Medical Microbiology. Presumptive Coliform Count. Churchill Livingstone: Edinburgh.
18. Biosecurity New Zealand. (2004). Background Information Pamphlet on Didymo Algae. www.biosecurity.govt.nz/didymo
19. Southland Regional Council. (1993). Waiau Catchment Water Quality Review. Invercargill, NZ: SRC.
20. Ridell, D.C., Freestone, H. & Nutting, S. (1993). Waiau River Hydrology – pages 3-69 & 3-70.

21. Day, D. (1993). Historical Review of the Waiau River and Coastal Area – page 8.
22. ibid 19 – page 29.
23. Mitchell, C. & Davis-Te Maire, K. (1994). Mahinga Kai Resources of the Waiau Catchment.
24. Cormack, S. in Day 1993 – page 2.
25. Te Rūnanga o Ngāi Tahu. (1997). Te Karaka Special Edition: Crown Settlement Offer – page 33.
26. ibid 21.
27. Ngāi Tahu Claims Settlement Act 1998 - Schedule 69.
28. ibid 23 – page 121.
29. Lucas Associates/Te Waiau Mahika Kai Trust. (2001). Jericho Restoration Plan: A plan to restore the mahika kai values of the Jericho Block of the Takitimu Mountains and Waiau Valley of Murihiku.
30. Cormack, S., & Orwin, J. (1997) Four generations from Maoridom: the memoirs of a South Island kaumatua and fisherman - Syd Cormack as told to Joanna Orwin. Dunedin, N.Z: University of Otago Press
31. Anderson, A. (1983). When all the moa ovens grew cold: 9 centuries of changing fortune for the Southern Maori. Otago Heritage Books: Dunedin, NZ.
32. Hawkesworth. (1773). Voyages in the Southern Hemisphere Volumes II-III. <http://southseas.nla.gov.au/journals/hv23/422.html>
33. Begg, A.C. & Begg, N.C. (1979). The World of John Boulton.
34. Beattie, H. (1947). The Pioneers of Otago. Otago Daily Times and Witness Co. Ltd: Dunedin, NZ.
35. Hall-Jones, F.G. (1976). Fiordland Explored.
36. Shortland, E. (1851). The Southern Districts of New Zealand: A Journal. London: Capper Press, Christchurch 1974 reprint.
37. Hall-Jones, F.G. (1945). Historical Southland.
38. Beattie, H. (1996). Five Books on Fiordland. Cadsonbury Publications: Christchurch, NZ.
39. ibid 21 – page 5.
40. McNab, R. (1909) Murihiku: a history of the South Island of New Zealand and the islands adjacent and lying to the south, from 1642 to 1835. Wellington, N.Z. : Whitcombe & Tombs.
41. ibid 37.
42. Miller, F.W.G. (1954). West to the Fiords: The History of Western Southland. Christchurch, NZ:
43. Hanger, M. (1981). Papatotara: From Bush to Pasture. Invercargill, NZ:
44. Elser, L. (2004). Monowai History and Natural History.
45. Dore, Y. (1992). Dore to Manapouri – The Development of Tourism in Early Fiordland. Craig Printing Co. Ltd, Invercargill, NZ.
46. Hall-Jones, J. (1983). Pioneers of Te Anau. Craig Printing Co. Ltd, Invercargill, NZ.
47. see www.esouth.govt.nz/
48. ibid 19.
49. see www.fbis.co.nz

References referred to in the Site Assessments:

Te Anau – 14 Mile and 9 Mile Sites

- Beattie, H. (1955).
- Hall-Jones, J. (1983). *Pioneers of Te Anau*. Craig Printing Co. Ltd, Invercargill, NZ.
- Johnson, P. N. (1999). *Lakes Manapouri and Te Anau: report on shore vegetation monitoring*

Queens Reach Site

- Puentener, R. & Corry, S.A. (1993). *Tikanga Māori Cultural, Spiritual and Historical Values of the Waiau River: A Report for the Iwi Task Group of the Waiau River Working Party*
- Day, D. (1993). *Historical Review of the Waiau River and Coastal Area. Report to the Waiau River Working Party.*
- Hall-Jones, J. (1983). *Pioneers of Te Anau*. Craig Printing Co. Ltd, Invercargill, NZ.
- Graynoth, E. (2004). *Review of monitoring and mitigation strategies for longfinned eel management in the Te Anau and Manapouri catchments. NIWA Client Report CHC2004-019 for Meridian Energy. NIWA: Chch, NZ.*

Home Creek Site

- Puentener, R. & Corry, S.A. (1993). *Tikanga Māori Cultural, Spiritual and Historical Values of the Waiau River: A Report for the Iwi Task Group of the Waiau River Working Party*
- Mitchell, C. & Davis-Te Maire, K. (1994). *Mahinga Kai Resources of the Waiau Catchment.*
- Day, D. (1993). *Historical Review of the Waiau River and Coastal Area. Report to the Waiau River Working Party.*
- Hall-Jones, J. (1983). *Pioneers of Te Anau*. Craig Printing Co. Ltd, Invercargill, NZ.
- Boubee, J., Williams, E. & Richardson, J. (2003). *Fish Survey of the Waiau River Catchment – January 2003. NIWA Client Report HAM2003-050 for Meridian Energy. NIWA: Hamilton, NZ.*

Mararoa Site

- Puentener, R. & Corry, S.A. (1993). *Tikanga Māori Cultural, Spiritual and Historical Values of the Waiau River: A Report for the Iwi Task Group of the Waiau River Working Party*
- Day, D. (1993). *Historical Review of the Waiau River and Coastal Area. Report to the Waiau River Working Party.*
- McDonald, D.C. (1972). *The Margins of Fiordland: an historical geography of the Upper Waiau basin, Southland. A thesis submitted f..*
- Kilroy, C., Lambert, P., Robinson, K. & Blair, N. (2005). *Periphyton and invertebrate monitoring programme, lower Waiau River. Results of the 2005 Survey and a commentary on the ecological effects of Didymosphenia geminata. NIWA Client Report CHC2005-032 for Meridian Energy. NIWA: Chch, NZ.*
- Mitchell, C. & Davis-Te Maire, K. (1994). *Mahinga Kai Resources of the Waiau Catchment.*

Redcliff and Jericho Sites

- McDonald, D.C. (1972). *The Margins of Fiordland: an historical geography of the Upper Waiau basin, Southland. A thesis submitted f..*
- Kilroy, C., Lambert, P., Robinson, K. & Blair, N. (2005). *Periphyton and invertebrate monitoring programme, lower Waiau River. Results of the 2005 Survey and a commentary on the ecological effects of Didymosphenia geminata. NIWA Client Report CHC2005-032 for Meridian Energy. NIWA: Chch, NZ.*

- Boubee, J., Williams, E. & Richardson, J. (2003). Fish Survey of the Waiau River Catchment – January 2003. NIWA Client Report HAM2003-050 for Meridian Energy. NIWA: Hamilton, NZ.
- McClelland, T.J. (1996). Waiau River Aquatic Birds: December 1995 and March 1996. Report for the Waiau River Working Party.
- Lucas Associates/Te Waiau Mahika Kai Trust. (2001). Jericho Restoration Plan: A plan to restore the mahika kai values of the Jericho Block of the Takitimu Mountains and Waiau Valley of Murihiku.

Monowai Site

- Puentener, R. & Corry, S.A. (1993). Tikanga Māori Cultural, Spiritual and Historical Values of the Waiau River: A Report for the Iwi Task Group of the Waiau River Working Party
- Elser, L. (2004). Monowai: History and natural history. Borland Lodge Adventure and Education Trust
- Boubee, J., Williams, E. & Richardson, J. (2003). Fish Survey of the Waiau River Catchment – January 2003. NIWA Client Report HAM2003-050 for Meridian Energy. NIWA: Hamilton, NZ.

Clifden Site

- Puentener, R. & Corry, S.A. (1993). Tikanga Māori Cultural, Spiritual and Historical Values of the Waiau River: A Report for the Iwi Task Group of the Waiau River Working Party
- Day, D. (1993). Historical Review of the Waiau River and Coastal Area. Report to the Waiau River Working Party.
- Miller, F.W.G. (1954). West to the Fiords: The History of Western Southland. Christchurch, NZ:
- McClelland, T.J. (1996). Waiau River Aquatic Birds: December 1995 and March 1996. Report for the Waiau River Working Party.
- Boubee, J., Williams, E. & Richardson, J. (2003). Fish Survey of the Waiau River Catchment – January 2003. NIWA Client Report HAM2003-050 for Meridian Energy. NIWA: Hamilton, NZ.

Tuatapere

- Puentener, R. & Corry, S.A. (1993). Tikanga Māori Cultural, Spiritual and Historical Values of the Waiau River: A Report for the Iwi Task Group of the Waiau River Working Party
- Day, D. (1993). Historical Review of the Waiau River and Coastal Area. Report to the Waiau River Working Party.
- Miller, F.W.G. (1954). West to the Fiords: The History of Western Southland. Christchurch, NZ:
- Hanger, M. (1981). Papatotara: From Bush to Pasture. Invercargill, NZ:
- Ridell, D.C., Freestone, H. & Nutting, S. (1993). Waiau River Hydrology
- Boubee, J., Williams, E. & Richardson, J. (2003). Fish Survey of the Waiau River Catchment – January 2003. NIWA Client Report HAM2003-050 for Meridian Energy. NIWA: Hamilton, NZ.

Papatotara and Matatarawae – Te Waewae Bay

- Hawkesworth. (1773). Voyages in the Southern Hemisphere Volumes II-III.
- Mitchell, C. & Davis-Te Maire, K. (1994). Mahinga Kai Resources of the Waiau Catchment.
- Begg, A.C. & Begg, N.C. (1979). The World of John Boulton.
- Dobie, K.G. (1953). Pioneer Fringes in Southern New Zealand. Dunedin: University of Otago.
- Hanger, M. (1981). Papatotara: From Bush to Pasture. Invercargill, NZ:
- Ridell, D.C., Freestone, H. & Nutting, S. (1993). Waiau River Hydrology

Āpitihanga / Appendices

Appendix A - State of the Takiwā Project Milestones

Appendix B - Takiwā Monitoring Forms

Appendix C - Waiau Field Work Site Assessment Data

Appendix D - Waiau Field Work Monitoring Plan

Appendix E - New Zealand Water Standards for E.Coli and MPN Coliform
Tables

Appendix F - A selection of Research Reports to the Waiau River Working
Party (Meridian Energy/Southland Regional Council)

Appendix G -Environment Southland Monitoring Sites in the Waiau Catchment

Appendix A – State of the Takiwā Project Milestones

Appendix B – Takiwā Monitoring Forms

Appendix C – Waiau Field Work Site Assessment Data

Appendix D – Waiau Field Work Monitoring Plan

Appendix E – New Zealand Water Guidelines for E.coli and MPN Coliform Tables

Appendix F – A Selection of Research Reports to the Waiau River Working Party (Meridian Energy/Southland Regional Council)

Appendix G – Environment Southland Monitoring Sites in the Waiau Catchment

