



Mahaanui  
Kurataiao Ltd

# State of the Takiwā 2012

Te Āhuatanga o Te Ihutai

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## Cultural Health Assessment of the Avon-Heathcote Estuary and its Catchment

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*mō tātou, ā, mō kā uri a muri ake nei*

*for us and our children after us*



This follow-up cultural health monitoring programme and report was undertaken and produced by Mahaanui Kurataiao Limited in association with a roopu of whānau from Te Ngāi Tūāhuriri Rūnanga, and a representative from Te Hapu o Ngāti Wheke (Rāpaki) Rūnanga (for the Ōpāwaho catchment)

Mahaanui Kurataiao Ltd and the whānau roopu greatly appreciate the support of Te Rūnanga o Ngāi Tahu to establish this repeat programme and support the technical needs of the monitoring programme and database. Mahaanui Kurataiao Ltd and the whānau roopu also acknowledge the vital support of Environment Canterbury in their funding of this round of State of the Takiwā monitoring.

*He mihi nui ki a koutou katoa*



#### **Cover Photographs:**

**Cover Photo:** The remains of the once prominent Rapanui, (Shag Rock) the proud marker of the entrance to Te Ihutai catchment, now severely damaged by the Canterbury earthquakes.

(Photo: Shane Orchard, MKT).

**Above:** The Rūnanga monitoring team performing field assessments at the Wigram site.

(Photo: Mike Lang, MKT).

**Additional photographs:** Mike Lang, MKT.

## Whakarāpopotanga / Executive Summary

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This report presents the results of a cultural environmental health assessment of Te Ihutai / Avon-Heathcote Estuary and its catchment undertaken by representatives from Te Ngāi Tūāhuriri Rūnanga and Mahaanui Kurataiao Ltd between March and May 2012.

The purpose of the 2012 State of the Takiwā programme was to undertake a cultural assessment of Te Ihutai (Avon-Heathcote Estuary) and its tributaries, the Ōtākaro (Avon) and Ōpāwaho (Heathcote) rivers at 31 sites within the catchment. This mahi is a continuation of the work initiated by Pauling et al. (2007) in their previous State of the Takiwā assessment, and in addition provides an indication of the post-earthquake state of these waterways in relation to Ngāi Tahu values.

The same State of the Takiwā methodology as used in the 2007 programme was used. Two additional fishing survey techniques using hīnaki (set nets) and drag nets were employed to extend the fish survey component to a greater number of sites. In addition a new site was added in Mt Vernon valley to provide an example of a hill-country stream site within the monitoring programme since there are several such streams within the Ōpāwaho/Heathcote catchment.

The results from this assessment indicate that the catchment is in a state of poor cultural health. As was found in the previous State of the Takiwā programme (Pauling et al., 2007) the different assessments conducted indicated that a range of culturally relevant aspects are degraded, including both in-stream and riparian values. When compared with the 2007 study the 2012 results suggest that the catchment is in a similar state of cultural health. However modest improvements noted at some sites whilst further degradation was recorded at others which in some cases was related to earthquake damage.

Although some adverse impacts associated with earthquake damage were expected, the results clearly indicated that many recommendations from the previous State of the Takiwā programme have not been implemented. Consequently, management responses needed to protect and enhance Ngāi Tahu values include all of the recommendations from the 2007 programme. In particular, improvement in water quality and habitat quality including the restoration and conservation of indigenous vegetation in the riparian zone is urgently required. In addition, there is a need to take Ngāi Tahu values into account in the planning and implementation of earthquake repair activities. This includes the need for comprehensive monitoring to establish whether important aspects of waterway recovery are being achieved as the earthquake repair process progresses.





**Above:** The roopu at work at the Waimairi Stream site (top) and Westmorland site (bottom)

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# 1. Te Whakatuwheratanga / Introduction

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Te Ihutai (Avon-Heathcote Estuary) and its tributaries, the Ōtākaro (Avon) and Ōpāwaho (Heathcote) Rivers are highly significant areas for Ngāi Tahu (Beattie, 1994; Evison & Adams, 1993; Tau et al., 1990). The whole of the Ihutai catchment was hugely important as a mahinga kai, and for its network of waterways providing travel routes inland and to neighbouring areas (Boyd, 2011; Tau et al., 1990). The catchment not only provided food and other resources for local Ngāi Tahu people but supported tribal connections through the trading of resources (Tau et al., 1990). However, as a consequence of development of Christchurch city and surrounds, the catchment has undergone dramatic changes from the time that tangata whenua first settled in these areas (Christchurch City Libraries, n.d.; Pauling et al., 2007).

The first Ihutai State of the Takiwā programme was completed in 2007 to provide a comprehensive cultural environmental health assessment from a uniquely tangata whenua perspective. The 2007 assessment was established as a part of a wider water monitoring programme being facilitated by the Avon-Heathcote Estuary Ihutai Trust and supported by the Christchurch City Council, Environment Canterbury and the Ministry for the Environment. Its purpose was to develop a cultural baseline to assist future restoration and management efforts and against which long term environmental change could be measured (Pauling et al. 2007).

More recently, a series of earthquakes have struck the Ōtautahi / Christchurch area resulting in major changes to waterways. Consequently it is now especially timely to re-measure the cultural health of the Ihutai catchment to inform management responses and produce a post-earthquake baseline against which progress can be measured. The 2012 State of the Takiwā programme was established to address this situation and was undertaken by Ngāi Tūāhuriri whanau in conjunction with Mahaanui Kurataiao Ltd and support from Environment Canterbury, Christchurch City Council, and Te Rūnanga o Ngāi Tahu. The purpose of this report is to present findings from the 2012 monitoring programme and discuss management recommendations to address cultural issues.

## 2. Tāhuhu Kōrero / Background

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### 2.1 State of the Takiwā environmental monitoring system

The State of the Takiwā monitoring system was developed by Ngāi Tahu to facilitate tangata whenua to gather, store, analyse and report on information relevant to the cultural health of waterways within their Takiwā (tribal areas). The major objective of State of the Takiwā is to enable tangata whenua to generate robust and defensible information on the health of

the environment for a variety of purposes, including to inform recommendations for management (Pauling, 2004).

The State of the Takiwā approach to environmental monitoring is built on a Ki Uta Ki Tai (mountains to the sea) framework for natural resource management (Pauling, 2003; Te Rūnanga o Ngāi Tahu, 2003). It is suitable for a wider range of water bodies than other cultural health assessment methodologies such as the Cultural Health Index (Tipa & Tierney, 2003) and the Iwi-SHMAK kit (Ogilvie & Penter, 2001), including non-wadeable sites. The approach to data collection is a combination of field assessments measured against cultural criteria, and collection of supporting information on culturally relevant features of monitoring sites, including traditional use. At each monitoring site a variety of assessment methods are used including assessment modules based on the Cultural Health Index and SHMAK methods, and the collection of other data unique to the Takiwā assessment (Pauling, 2003, 2004). The range of assessments performed attempts to capture key cultural values and indicators of environmental health, especially those important to mahinga kai (food gathering) and other cultural activities (Pauling, 2008).

## **2.2 Previous indications of cultural health in the Ihutai catchment**

The establishment of Christchurch City and subsequent industrial and residential development has led to significant impacts on the cultural values of the Ihutai catchment. These are associated with changes such as native vegetation losses, impacts on indigenous species including habitat loss, degradation of water quality, and access issues (Batcheler et al., 2006; Bolton-Richie & Main, 2005; Fisher & Vallance, 2010; Greenwood, 2008; Lobb, 2009; Pauling et al., 2007).

The 2007 State of the Takiwā report provided confirmation that a poor state of cultural health remained at many sites throughout the catchment at that time. Overall the cultural health of the catchment was found to be in a poor to very poor condition. The results showed a number of trends of concern including poor riparian condition and widespread contamination throughout the catchment from both human and agricultural sources (Pauling et al., 2007)

More recently the Canterbury earthquakes have had direct impacts on waterways associated with liquefaction, bank slumping and vertical displacement of stream beds, particularly in the east of the city (James & McMurtrie 2011a, 2011b; McMurtrie, 2011; Measures et al., 2011; Taylor & Blair, 2001; Taylor et al., 2012; Zeldis et al., 2011). Earthquake damage has also led to the direct discharge of untreated sewerage and other contaminants into waterways. Associated effects have included increases in nutrient levels, decreased dissolved oxygen levels, and increased suspended sediment loads leading to potentially detrimental effects on aquatic ecosystems (James & McMurtrie, 2011; Rutherford & Hudson, 2011).



Until now there has been little cultural monitoring or research to assess the post-earthquake state of the catchment from a tangata whenua perspective. The 2012 State of the Takiwā programme addresses this need whilst also providing data for the assessment of change relative to the 2007 results.

### 3. Ngā Whāinga / Study Aims and Objectives

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The major objectives of this monitoring programme were:

1. Provide a current assessment of the cultural health of the Avon/Heathcote/Ihutai catchment;
2. Identify and evaluate the cultural health changes indicated by the results of the 2007 and 2012 State of the Takiwā programmes; and
3. In association with whānau, consider future needs for State of the Takiwā monitoring in the Ihutai catchment.

### 4. Ngā Kauneke / Methods

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#### 4.1 Tāngata Arotake / Monitoring Team

The monitoring team consisted of representatives from Te Ngāi Tūāhuriri Rūnanga, supported by staff from Mahaanui Kurataiao Ltd. Laboratory work conducted by Hills Laboratories for analysis of water samples. Antibiotic resistance testing was conducted by John Aitken.

The Rūnanga roopu with support from Mahaanui Kurataiao Ltd staff involved were:

- Makarini Rupene (Ngāi Tūāhuriri)
- Cherie Williams (Ngāi Tūāhuriri)
- Tui Falwasser (Ngāi Tūāhuriri)
- Nukuroa Tirikatene-Nash (Ngāi Tūāhuriri)
- Shane Orchard (Project Manager, Mahaanui Kurataiao Ltd)
- Michael Lang (Programme Coordinator, Mahaanui Kurataiao Ltd)

Additional assistance was provided by Craig Pauling (Te Rūnanga o Ngāi Tahu) and Rewi Couch (Te Hapū o Ngāti Wheke).

#### 4.2 Wāhi Arotake / Monitoring Sites

A total of 31 monitoring sites were selected for the 2012 programme including all 30 sites from the 2007 programme (Table 1). A further new site was incorporated into the

programme based on feedback from a Te Hapū o Ngāti Wheke (Rāpaki) representative who noted that hill country streams were under-represented in the distribution of sites in the catchment. The new site selected was located in Mt Vernon valley near Rāpaki Track in the mid-reaches of this catchment. The final location was determined by the Rūnanga roopu in the field on the basis of accessibility, safety for the monitoring team from rockfall hazards in the area, and likelihood of traditional associations. The site included a pool within an otherwise ephemeral watercourse which was considered likely to have been a feature known and frequented by tangata whenua in the past. In addition the presence of terraces featuring regenerating indigenous vegetation and sources of aruhe (fern-root) confirmed the mahinga kai value of the site, which was notable in comparison to the predominantly steep hillsides nearby.

The selection of these sites provided reasonable geographic coverage over the entire catchment (Figure 1), in keeping with Ngāi Tahu's 'Ki Uta Ki Tai' or source to sea resource management philosophy. The sites selected included sites of both traditional and contemporary significance to Ngāi Tahu and included locations exposed to a range of land use issues (Pauling et al., 2007).

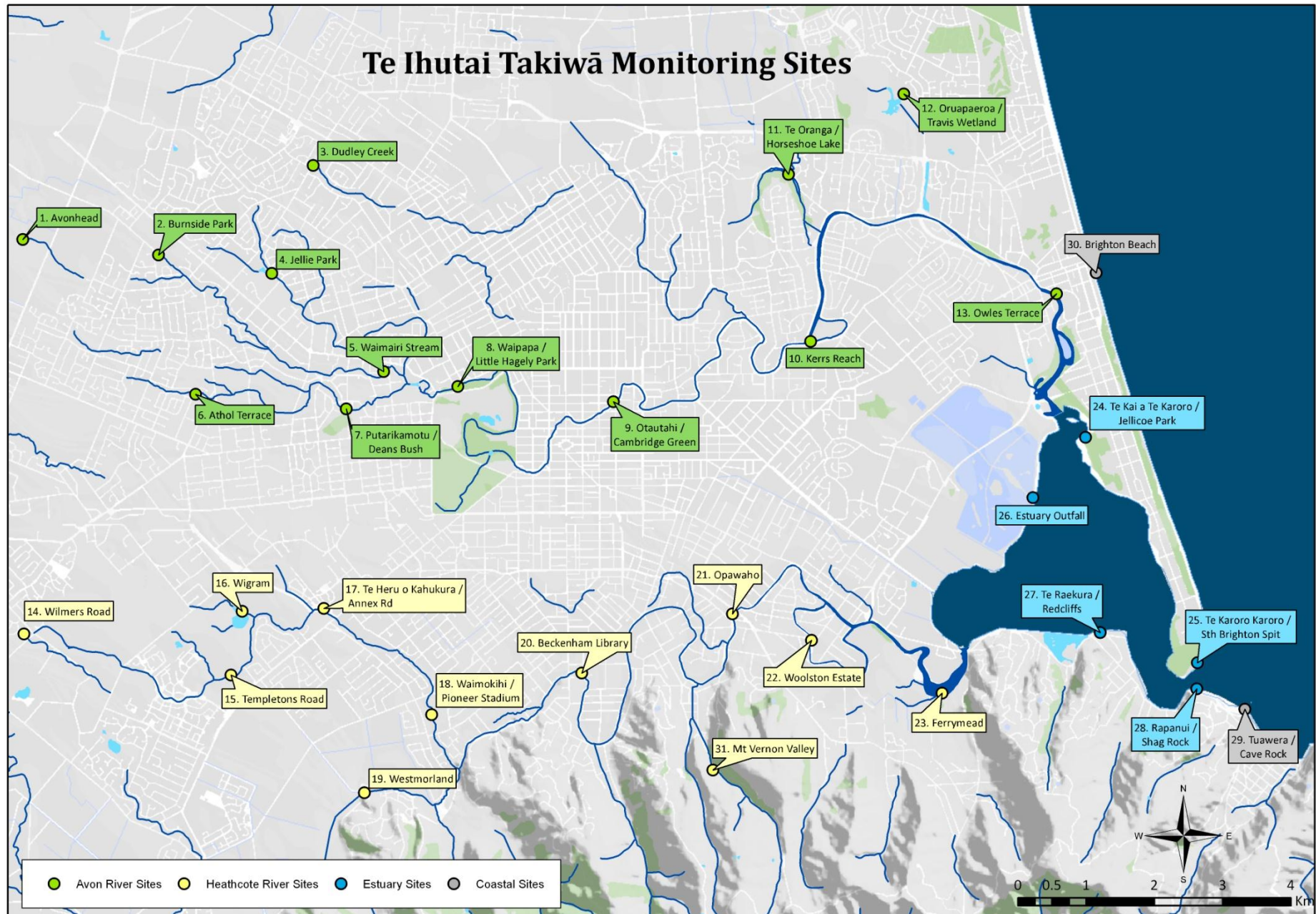
*Table 1: Description of monitoring sites used for the 2012 State of the Takiwā programme*

#	Site Name	Significance	Land use
<b>Ōtākaro / Avon River</b>			
1.	Avonhead @ Russley Rd	Western most source of the Avon River and Waimairi Tributary	Rural
2.	Burnside Park / West Burn	Source of West Burn Tributary flowing into Waimairi and significant recreational area – rugby, soccer and cricket	Urban/Park
3	Dudley Creek	Source of Dudley Creek, northern most tributary of AvonRiver	Urban
4	Wairārapa Stream @ JelliePark	Near source of Hewlings Stream and Wairarapa Stream, including spring fed lake and significant recreational area within urban park – public pool, skatepark	Urban/Park
5	Waimairi Stream @ Royds Reserve	Mid-catchment reference (ease of access)	Urban
6	Ilam Stream @ Athol Terrace	Source of Ilam Stream tributary	Urban
7	Pūtārikamotu / Ilam Stream @ Deans Bush	Traditional settlement and food gathering site, remaining native forest remnant, protected reserve	Urban / Reserve
8	Waipapa / Little Hagley Park	Traditional settlement and food gathering site, upper most main channel site	Urban / Park
9	Ōtautahi / Kilmore St	Traditional settlement and food gathering site	Urban
10	Kerrs Reach	Contemporary recreational site – rowing /waka ama /hockey and complimentary sample site.	Urban / Park
11	Te Oranga / Horseshoe Lake	Traditional settlement and food gathering site, significant urban drainage sink and native/natural wetland/spring remnant	Urban / Park / Reserve
12	Ōruapaeroa / Travis Wetland	Traditional settlement and food gathering site, significant urban/rural drainage sink and native/natural wetland remnant	Urban and Rural / Reserve
13	Owles Terrace	Contemporary recreational area – waka ama, former public works site and lower most Avon river site	Urban / Industrial
<b>Ōpāwaho / HeathcoteRiver</b>			
14	Wilmers Rd / Warren Park	Source of main Heathcote River, upper most catchment site, between Warren Park (recreational area) and Wigram Air base	Urban / Park / Industrial
15	Templetons Rd	Significant source spring of upper Heathcote River between rural land, urban development and significant recreational reserve, and complimentary sample site.	Urban / Rural / Reserve
16	Wigram Basin	Significant drainage sink and historic sources of upper Heathcote river – contemporary recreational area – rugby league, horse riding, agricultural show grounds, area also owned by Ngāi Tahu Property	Urban / Park / Reserve
17	Te Heru o Kahukura / Annex Rd	Situated between Ngāi Tahu Property subdivision development, Linden Grove (former Sunnyside Hospital)	Urban / School /

		and Spreydon Primary School, and complimentary sample site.	Hospital
18	Waimokihi / Pioneer Stadium	Significant recreational area – public pool, soccer and cricket as well as site of Kura Kaupapa Māori, and complimentary sample site.	Urban / Park / School
19	Westmorland	Near source of Cashmere Stream tributary	Urban / Rural
20	Beckenham Library	Mid-catchment reference	Urban
21	Ōpāwaho / Garlands Rd Bridge	Traditional settlement and food gathering site	Urban
22	Woolston Industrial Estate	Lower catchment	Industrial
23	Settlers Reserve / Ferrymead	Inter-tidal, lower most Heathcote river site, adjacent to new Māori tourism development	Rural / Industrial
<b>Te Ihutai / Estuary</b>			
24	Te Kai a Te Karoro / Jellicoe Park	Traditional settlement & food gathering site and contemporary recreational site, and complimentary sample site.	Urban / Park
25	Te Karoro Karoro / South Brighton Spit	Traditional settlement and food gathering site on northern mouth of Estuary	Reserve/ Urban
26	Estuary Outfall	Outfall of Bromley Oxidation Ponds and near Pleasant Point Yacht Club and opposite Te Kai o Te Karoro	Reserve / Oxidation Ponds
27	Te Raekura / Redcliffs	Traditional settlement and food gathering site, beach access and complimentary sample site.	Urban / Park
28	Rapanui / Shag Rock	Traditionally significant site, contemporary recreational swimming area, and complimentary sample site.	Urban / Beach
<b>Te Tai o Maha-a-nui / Pegasus Bay</b>			
29	Tuawera /Cave Rock /Sumner Beach	Traditionally significant site, contemporary recreational swimming/surfing area, and complimentary sample site.	Urban / Coastal Reserve
30	Ōruapaeroa / New Brighton Beach	Traditionally significant site, contemporary recreational swimming/surfing area	Urban / Commerce / Coastal
<b>New Sampling Location - Ōpāwaho / Heathcote River catchment</b>			
31	Mt Vernon Valley / Rāpaki Track	Traditionally significant site, contemporary recreational site, native restoration and livestock grazing land	Reserve/Park/ Recreation



Figure 1: Location of monitoring sites used for the 2012 State of the Takiwā programme



## 4.3 Kauneke Arotake / Data Collection & Assessment

### 4.3.1 Overview

Data collection was conducted over eight days between 21 March and 4 April 2012. Each site was assessed using the same approach as was used in the 2007 Ihutai State of the Takiwā programme. Additional fishing surveys were conducted at sites throughout the catchment to gain further information on culturally important fish species and mahinga kai values.

The following types of assessments were utilised:

- Takiwā general site assessment (all sites)
- Cultural Health Index (CHI) Waterway Assessment (river and stream sites only)
- Stream Health Monitoring (SHMAK) Assessments (river and stream sites only)
- Fishing surveys (selected sites)
- *Escherichia coli* (*E. coli*) water testing (all sites with water)
- Antibiotic resistance testing of *E. coli* samples

Prior to the commencement of work at a site, the team gathered for a hui to identify access and safety issues and kōrero on other features of the site supported by appropriate karakia and whakamoemiti/prayer. Roopu members individually completed the Takiwā general site assessments and CHI Cultural Stream Health Assessments at all applicable sites. Other assessments were completed by the roopu as a group.

All data from field monitoring exercises were entered into the Takiwā 2.0 database developed by Ngāi Tahu (Pauling et al., 2007). Takiwā 2.0 is Microsoft Access 2002 runtime application linked to a physically separate database. It includes a site assessment module which provides a range of index calculations to assist tangata whenua analyse assessment data on particular sites, and to facilitate comparisons between sites or monitoring visits.

Index calculations provided by Takiwā 2.0 include an overall site health assessment index, a species abundance index, and indexes for stream health based on both the Cultural Health Index assessment method (Tipa & Tierney, 2003, 2006) and the Stream Health Monitoring and Assessment Kit (Biggs et al., 2000).

### 4.3.2 Takiwā General Site Assessment

The Takiwā general site assessment consists of three forms (Appendix 1). The Site Definition form records the site name, locality, traditional significance and traditional condition of the site amongst other details. As this State of the Takiwā programme was a follow-up to the work done by Pauling et al. (2007) the assessment of traditional significance and traditional condition of the site been previously completed for the 30 sites used in the 2007 programme. Traditional significance and condition aspects of the Mt Vernon valley / Rāpaki

Track site was determined on the basis of feedback from Rūnanga representatives supported by the field observations of the roopu on aspects such as landforms, waterway morphology, soil type and vegetation type in the area.

The Site Visit form records information on aspects of the monitoring visit. These include the date, time, weather conditions, heritage/archaeological details, land use, and other relevant information. Following completion of the Site Visit form the General Site Assessment form was completed individually by each member of the monitoring roopu. The same set of assessment questions as developed by Pauling et al. (2007) was used in the 2012 programme. These questions address the health of the site in relation to the following categories:

- The amount of pressure from external factors;
- Levels of modification/change at the site;
- Suitability for harvesting mahinga kai;
- Access issues;
- Willingness to return to the site;
- Overall state/health of the site; and
- Presence and abundance of culturally relevant species.

The information gathered was entered into the Takiwā 2.0 database and the index score for overall site health calculated. This index reflects the average score from nine individual assessments, all of which are a score on a one to five scale. These assessments include the following six scores taken directly from the Takiwā General Site Assessment form; site pressure, modification, harvest access, willingness to harvest, willingness to return for cultural use, and overall health of the site. The remaining three scores considered are derived from the % cover in indigenous plant cover, an expression of current versus traditional number of species found at the site, and a score based on the Takiwā Abundance Index result (see section 5.6).

#### **4.3.3 CHI Cultural Health Waterway Assessment**

The Cultural Health Index (CHI) involves three aspects of the monitored waterway; whether the site is of traditional or contemporary significance to Māori, a mahinga kai assessment, and a cultural stream health assessment (Tipa & Tierney, 2003, 2006). Traditional or contemporary significance is established by the roopu based on feedback from whānau and kaumātua in particular. The remaining two assessments consist of a series of questions to which scores of between 1 and 5 are assigned and averaged to reflect the current condition of the site for these cultural aspects (Appendix 2).

The CHI mahinga kai assessment considers the abundance of mahinga kai species present at the site in relation to the traditional abundance, along with score for access and a score reflecting whether or not Maori would return to use the site in the future. The CHI cultural

stream health score is based on a series of questions which score aspects of stream health including water clarity, flow, catchment land use, margin vegetation, riverbed sediments, water quality, variety of habitats, and impression of overall health.

#### **4.3.4 Stream Health Monitoring Assessment (SHMAK)**

The Stream Health Monitoring and Assessment Kit (SHMAK) was developed by the National Institute of Water and Atmospheric Research (NIWA) in partnership with Federated Farmers of New Zealand and the Ministry for the Environment (MfE) (Biggs et al., 2000). There are several variations of the SHMAK method in use for waterways assessment including an Iwi-SHMAK kit has also been developed (Ogilvie & Penter, 2001).

The methodology used for the State of the Takiwā programme involved assessment of stream habitat quality parameters, and invertebrate and periphyton communities (Appendix 3). The stream habitat quality parameters measured were water velocity, pH, temperature, conductivity, clarity, streambed composition, bank vegetation and the nature of loose deposited material on the streambed (Appendix 3). The invertebrate assessment was based on five randomly selected stones in the stream bed which were scored for presence or absence of 17 invertebrate taxa as per the standard SHMAK method. The same five stones were also assessed for periphyton presence/absence using the standard SHMAK method (Biggs et al., 2001). Scores from all SHMAK assessments conducted contributed to the SHMAK Stream Habitat Health index score calculated in Takiwā 2.0.

#### **4.3.5 Indigenous Vegetation and Bird Surveys**

A survey was conducted to characterise the indigenous vegetation species present within a 100m radius of the monitoring site. Using the methodology established in Pauling et al. (2007), this survey considered only selected species of importance to Ngāi Tahu and was therefore not a comprehensive botanical survey. Plant species were recorded against a schedule of important species recognised within the Takiwā 2.0 database (Appendix 6). In this schedule some related species are referred to by a same Ngāi Tahu name, and where this occurs those species are therefore lumped and appear as a record of a single taxonomic group. The percentage cover in indigenous plant species for the total site area was estimated to the nearest 5%.

Bird species observed during the monitoring visit within the same 100m radius were also recorded with particular emphasis on identifying any native bird species present.

#### **4.3.6 Fish Surveys**

Fish surveys were conducted at a total of 16 sites using three different fishing techniques. Electric fishing was undertaken at a total of 9 sites which were all of the sites at which electric fishing could be safely and effectively conducted. This was the same approach as used in the 2007 State of the Takiwā programme.



In addition hīnaki (fyke net) and drag-net fishing surveys were completed at other sites to provide further information on fish communities in the catchment (Table 2). Together they provided for the collection of information on fish communities from a further seven sites including those not suitable for electric fishing such as those which are not wadeable, or are saltwater localities (Figure 3).

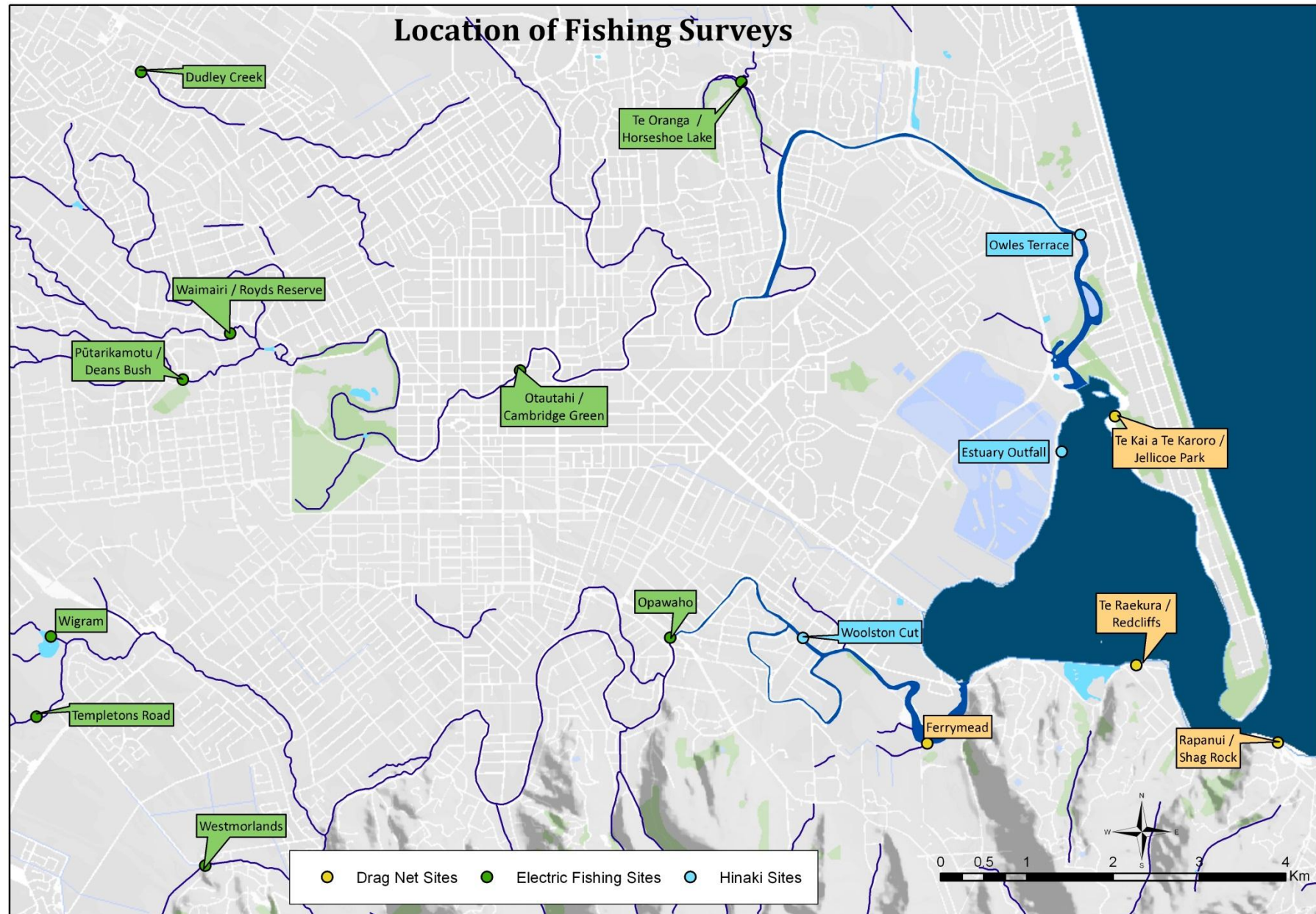
*Table 2: Sites by method used for fish surveys*

Electric fishing	Hīnaki	Drag netting
<ul style="list-style-type: none"> <li>• Dudley Creek</li> <li>• Pūtārikamotu /Deans Bush</li> <li>• Waimairi</li> <li>• Templeton Road</li> <li>• Westmorlands</li> <li>• Wigram</li> <li>• Ōpāwaho</li> <li>• Horseshoe Lake</li> <li>• Ōtautahi</li> </ul>	<ul style="list-style-type: none"> <li>• Owles Terrace</li> <li>• Estuary Outfall</li> <li>• Lower Heathcote/ Woolston Cut</li> </ul>	<ul style="list-style-type: none"> <li>• Rāpanui/ Shag Rock</li> <li>• Ferrymead</li> <li>• Te Kai a Te Karoro/ Jellicoe Park</li> <li>• Te Raekura / Redcliffs</li> </ul>

*Figure 2: Drag netting at Tuawera / Cave Rock / Sumner Beach*



Figure 3: Location of fishing surveys



### ***Electric Fishing***

Electric fishing involves using an electric current delivered into the water which temporarily stuns fish so they can be gathered for inspection, identification and measurements. This method of surveying is suitable in freshwater locations which are wadeable (NIWA, 2012).

This study utilised the Kainga EFM 300 packset in-conjunction with a hand held scoop net and larger mesh net. The EFM300 consists of a battery-powered backpack generator unit, a fibreglass wand with cathode, and an earthing wire. Both machine and net operators wear full length neoprene waders and rubber safety gloves, with cotton inners during surveying (NIWA, 2012).

Surveying was conducted over varying distances, but typically between 10 and 30 metres with a single pass over each bank. The total time taken to complete electric fishing surveys was typically 10 to 20 minutes.

### ***Hīnaki***

Hīnaki were traditionally constructed with natural resources of aka/vine, kareao pirita/supple jack pataka/hoops and harakeke/flax korari/flower stalk (Beattie, 1994). Muka/fibre was extracted and prepared for the netting around the frame work and braided for the taura/securing rope. As this method was reliant on the natural resource of the area, where this cultural activity was carried out, Ngāi Tahu whānui would also utilise any other natural resources including aka/ vines and tororaro (a vine which grows on the flats). With the introduction of man-made resources including fencing wire, the traditional structures of hīnaki became modified. Today, these methods of catching tuna are now executed with modern apparatus that are made from synthetic nylon and aluminium and galvanised steel frames.

A single hīnaki baited with fish frames and scraps was set at each of three locations on 13 April. These sites were selected on the basis of being suitable hīnaki sites, not amenable to electric fishing, and where ease of access and safety of team members and equipment was acceptable. In each case the hīnaki remained set overnight and was collected on the morning of 14 April and their contents assessed.

### ***Drag Netting***

Traditionally, hi ika/fishing was carried out with big nets known as kupenga which were constructed with harakeke. After they had been used they were dried and rolled up to be stored till the next use in caves on beaches. Salt water did not seem to rot the flax and often these kupenga nets would break from through the struggles of the fish (Beattie, 1994). This activity enabled many to take part, especially if the resulting catch was to be prepared for preservation and stored for trade or kai hau kai/barter system.

Drag netting was utilised at four monitoring sites. In each case the technique used consisted of a single pass over all of the suitable terrain present at the location using a 40m fine mesh net (1cm mesh size). The distance fished was recorded in addition to the fishing results.

#### 4.3.7 *E. coli* testing

*E. coli* is a subset of the group of faecal coliform group which commonly live inside the intestinal tract of healthy warm blooded animals and will survive but not duplicate in aquatic environments. *E. coli* itself does not typically cause illness on its own, but its presence in water is used as an indicator of faecal contamination. Therefore the occurrence of *E. coli* suggests a greater risk of other pathogens such as campylobacter that cause health problems (Ministry of Health, 2009).

Table 3: Standards for *E. coli* levels (Source: Ministry for the Environment & Ministry of Health 2003; Ministry of Health, 2008)

Standard	Drinking water	Recreational - Alert	Recreational - Action
<i>E. coli</i> / 100ml	<1	260	550

Water samples were collected from all freshwater and estuarine sites at which water was present using plastic screw top vials. These samples were labelled and stored during the day in ice and subsequently hand delivered to Hills Laboratory at the end of each day for analysis of *E. coli* levels. These were assessed and recorded as the MPN (most probable number) count of *E. coli* per 100ml using standard procedures.

#### 4.3.8 *E. coli* antibiotic resistance

In addition to *E. coli* levels in water samples it is also necessary to determine the likely sources of the contamination due to the impact of human faecal contamination on cultural values (Te Rūnanga o Ngāi Tahu, 1999). Specific antibiotics (e.g. Apramycin) are uniquely associated with the agricultural use of antibiotics and therefore the detection of *E. coli* which may be resistant to these antibiotics suggests contamination of agricultural origin. Similarly, resistance to antibiotics used on humans (e.g. Ampicillin) are indicators of human faecal contamination (Pauling et al., 2005). To obtain this information samples were isolated and tested against a panel of antibiotics to identify resistances of the samples, and from here patterns of resistance can help identify the source of contamination. Where possible, 10 isolates being different *E. coli* colonies, were obtained from each water sample tested. Each isolate was tested against a panel of 14 antibiotics.

### 4.4 Taputapu Arotake / Monitoring Equipment

- Takiwā forms, Cultural Health Index forms, SHMAK Kit, manual and forms
- Electric Fishing Machine, probe and nets
- Waders and protective gear
- Hīnaki set nets, bait (fish frames and scraps), and drag net equipment.
- *E. coli* kit (vials, ice packs, chilly bin, forms)
- First Aid kits
- Private vehicles
- GPS unit, digital camera
- Species identification resources
- Maps
- Laptops and Takiwā software



## 5. Ngā hua / Results

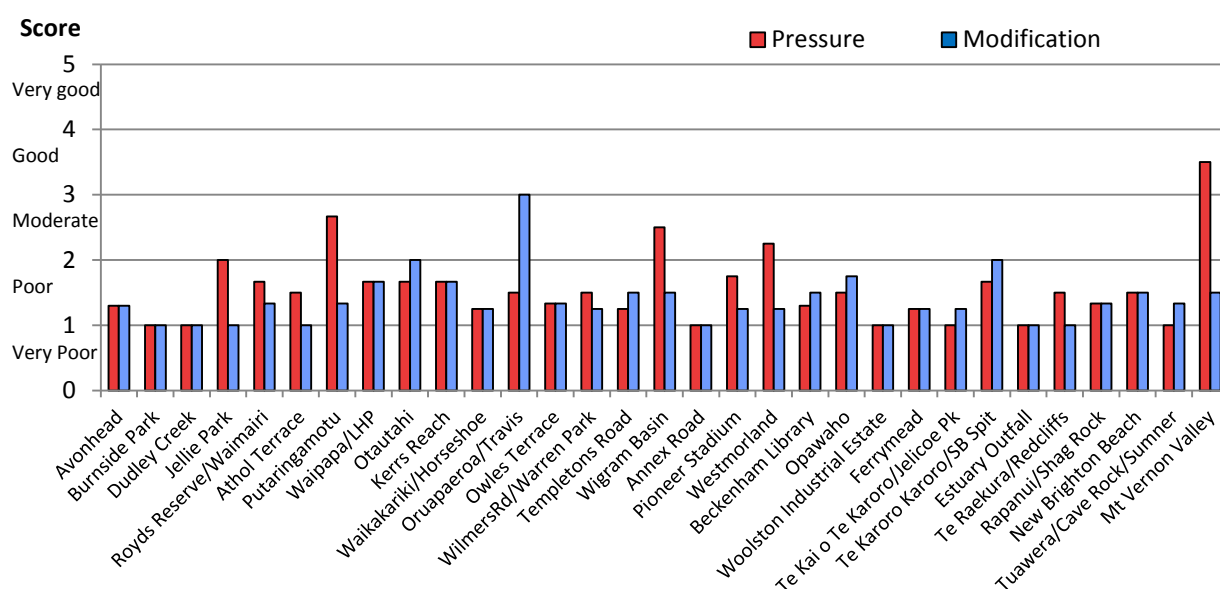
This section reports results from the 2012 field assessments. A comparative analysis of these against the results of the 2007 State of the Takiwā programme is presented in Section 6.

### 5.1 Takiwā General Site Assessments

#### 5.1.1 Modification and Pressure

A strong trend in the results was evident in the level of modification of sites (relative to traditional condition) and level of pressure on cultural values (Figure 4). Nearly all sites were considered to be highly modified and currently experiencing a high level of pressure indicating that current conditions in the catchment are not supportive of cultural values.

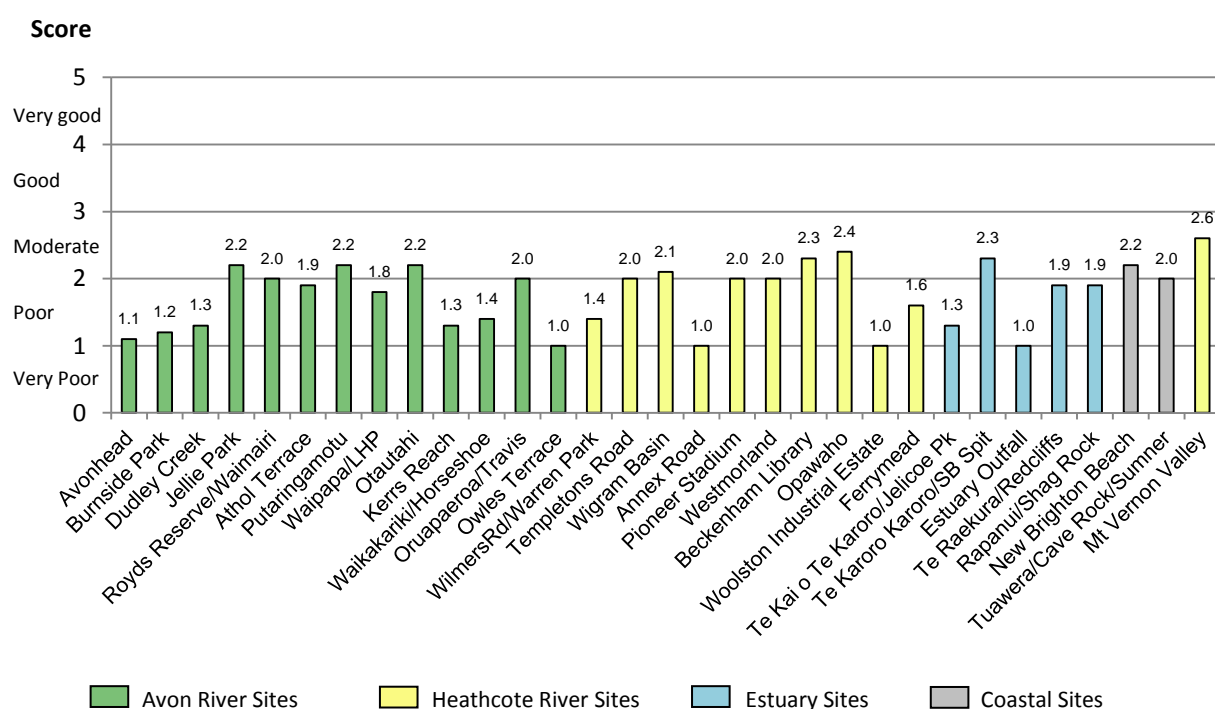
Figure 4: Scores for levels of modification and pressure on monitoring sites



#### 5.1.2 Takiwa 2.0 Overall Health Index

Results for the Takiwā 2.0 Overall Health Index scores for each site demonstrated that the condition of the Ihutai catchment is generally poor. 13% of sites were rated as very poor, with 39% rated as poor, and a further 48% scoring as moderate in terms of overall cultural health (Figure 5).

Figure 5: Takiwā 2.0 Overall Health Index scores



The site at Mt Vernon Valley / Rāpaki Track scored the highest (2.6/5), with Ōpāwaho scoring 2.4/5, Beckenham Library and Te Karoro Karoro / South Brighton Spit at 2.3/5, and Wairārapa / Jellie Park, Pūtārikamotu / Deans Bush, Ōtautahi and New Brighton Beach all scoring 2.2/5. In contrast, many sites across the catchment were rated very poorly with four sites equalling the lowest possible score of 1.0/5. These were Owles Terrace, Te Heru o Kahukura / Annex Rd, Woolston Industrial Estate and the Estuary Outfall.

Across the Avon and Heathcote River catchments the range of results was similar, although the Heathcote / Ōpāwaho results showed greater variability between sites. Estuary sites were typically in poor or very poor condition, particularly Jellicoe Park and the Estuary Outfall sites, while coastal sites were slightly higher and consistent but still overall of poor cultural health.

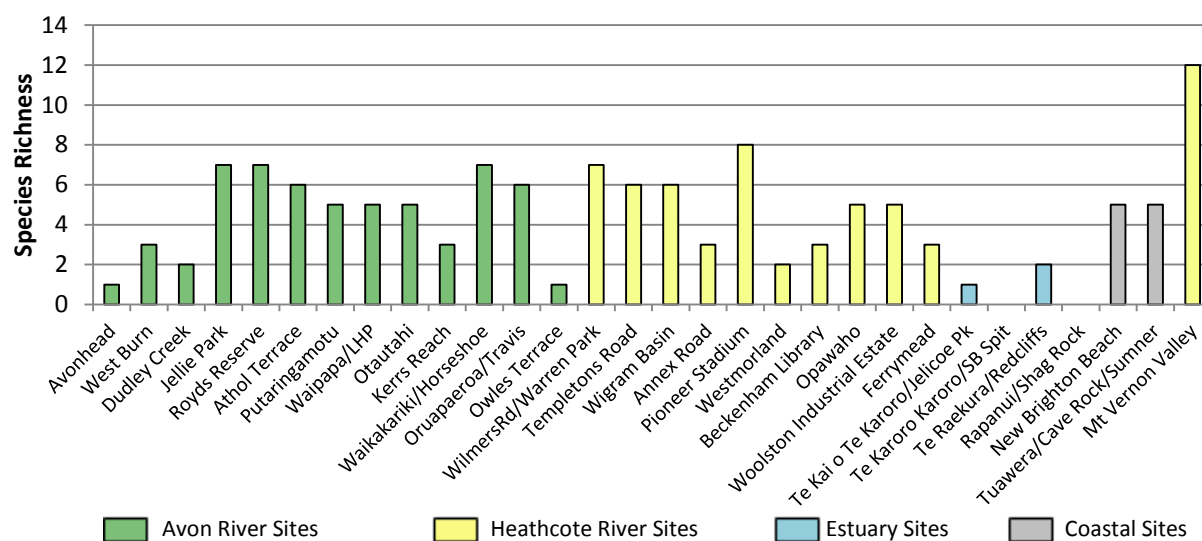
Responses on management recommendations suggested that actions needed to improve many sites include restoration of water quality and improvement of habitat for native species.

## 5.2 Indigenous Vegetation

Indigenous vegetation richness for species of interest varied across the catchment with the highest score recorded being at the Mt Vernon Valley / Rāpaki Track site (Figure 6). The most frequently recorded species were ti kouka (cabbage tree), identified at 21 of the 31 sites, and harakeke (flax) found at 17 sites.

Figure 6: Vegetation richness\* of indigenous vegetation recorded at monitoring sites

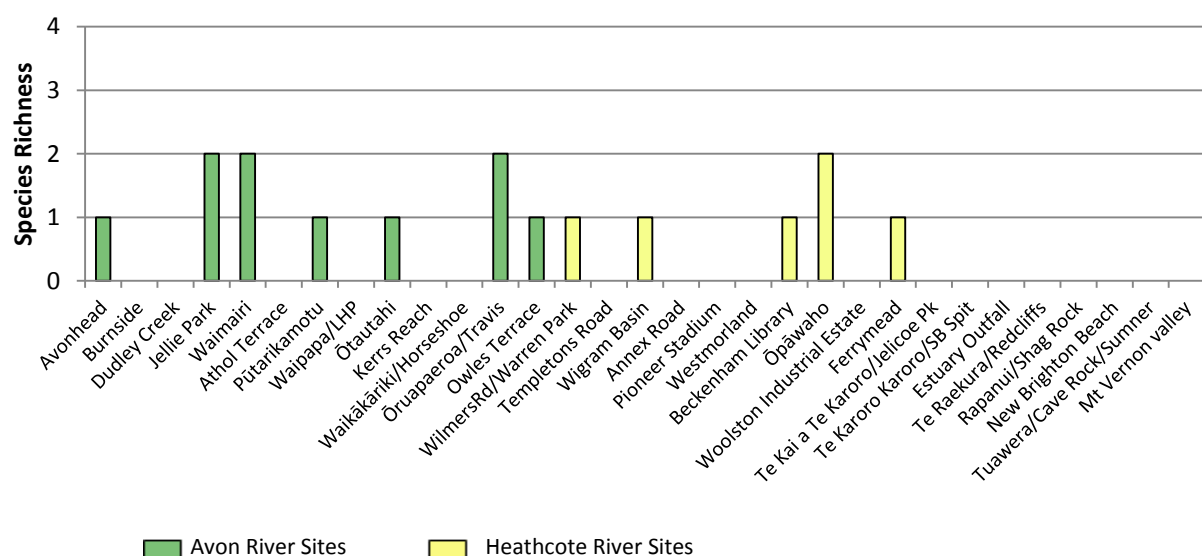
\* refers to selected taxonomic groups of interest to Ngāi Tahu as recorded in the Takiwā 2.0 database



### 5.3 Indigenous Bird Species

The overall abundance of indigenous bird species was low. At just 12 sites native birds were positively identified, with a maximum of two species being recorded at any one site (Figure 7). Putakitaki (paradise duck) was the most widespread of native birds identified at seven sites, with karoro (black billed gull) and pukeko identified at 2 sites. Other native bird species recorded were tui, piwakawaka (fantail), kereru (NZ pigeon) and korimako / kopara (bellbird).

Figure 7: Species richness of indigenous birds recorded at monitoring sites

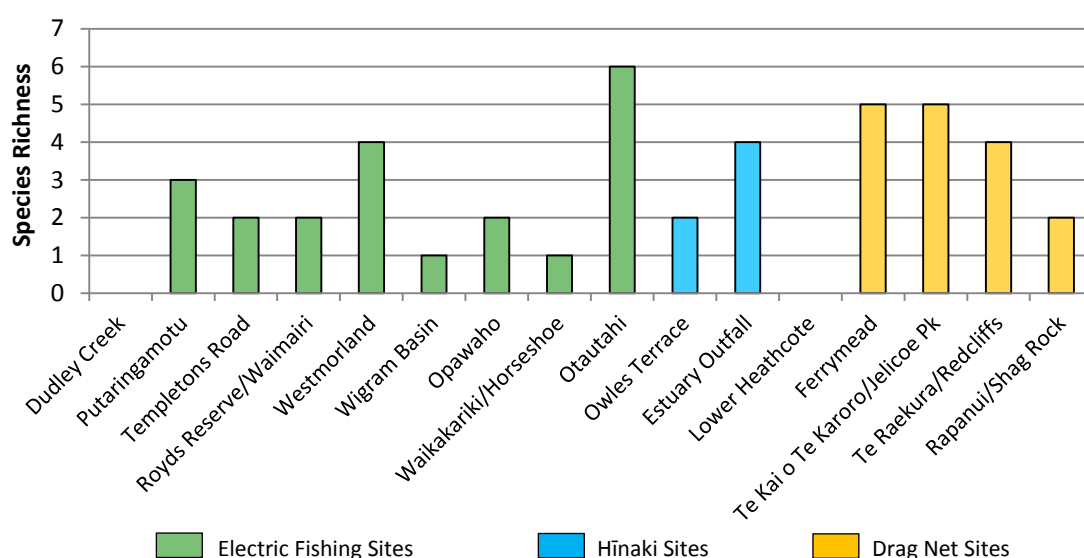


## 5.4 Indigenous Fish Species

The combined use of the three different fish survey techniques provided information on fish species from a selection of sites across the catchment. Ten fish species were recorded in these surveys, being tuna paku (shortfin eel), tuna roa (longfin eel), common bully, brown trout, giant bully, yellow-eyed mullet, herring, smelt, inaka (whitebait) and patiki (flounder). Although providing only a snapshot the hīnaki and drag netting results may be related to mahinga kai values since they are an example of the catches obtained through use of traditional fishing technique on a single occasion at each site.

The results of surveys indicated the presence of a relatively diverse fish population at coastal and estuarine sites (Figure 8). Typically lower numbers of fish were recorded at freshwater sites, and in some cases low diversity. The most commonly recorded species at freshwater sites were short fin eel and common bully, consistent with previous reports (James & McMurtrie, 2011b).

Figure 8: Species richness of indigenous fish species recorded at monitoring sites



### Electric fishing results

Electric fishing was conducted at nine freshwater sites and native freshwater fish were identified at eight of these sites. Short-fin eel were the most abundant species recorded and were found at all eight of these sites. Long-fin eel were identified at just two sites (Pūtārikamotu / Deans Bush and Ōtautahi). Giant Bully were found at two sites (Westmorland and Ōpāwaho), and common bully found at four of the nine sites. Dudley Creek was the only site where electric fishing was conducted that did not contain any fish.

The most diverse site amongst electric fishing sites was Ōtautahi, with long and short-fin eel, giant bully, common bully, trout and yellow eyed mullet being recorded.

### ***Hīnaki results***

Hīnaki nets produced mixed results at the three locations where they were used. At Owles Terrace five short fin eel (ranging from 33 to 61cm in length) were identified. The Ocean Outfall site had the highest diversity, although low abundance, with a single giant gully, shrimp, a common bully and herring recorded. In contrast, a hīnaki set at the Woolston Cut did not yield any fish.

*Figure 9: Tuna paku (Shortfin eel) from hīnaki at Owles Terrace*



### ***Drag netting results***

Drag netting was conducted at four coastal and estuary sites. The results indicated that some fish species are relatively abundant at these sites. Most notable was the Jellicoe Park site where a significant catch of a variety of species were identified including the presence of between 50-100 inaka (adult whitebait) from a single 50m pass with the drag net as well as 5 small patiki (flounder), 300-400 herring and approximately 150 smelt. Similarly, surveying at Redcliffs and Sumner identified approximately 400 small herring and 300 yellow eyed mullet respectively (all <10cm). Ferrymead was found to have less abundance of fish, however diversity was relatively good. 25 smelt, 20 common bullies and 6 small flounder (<10cm) along with a single shrimp and plentiful snails were recorded.

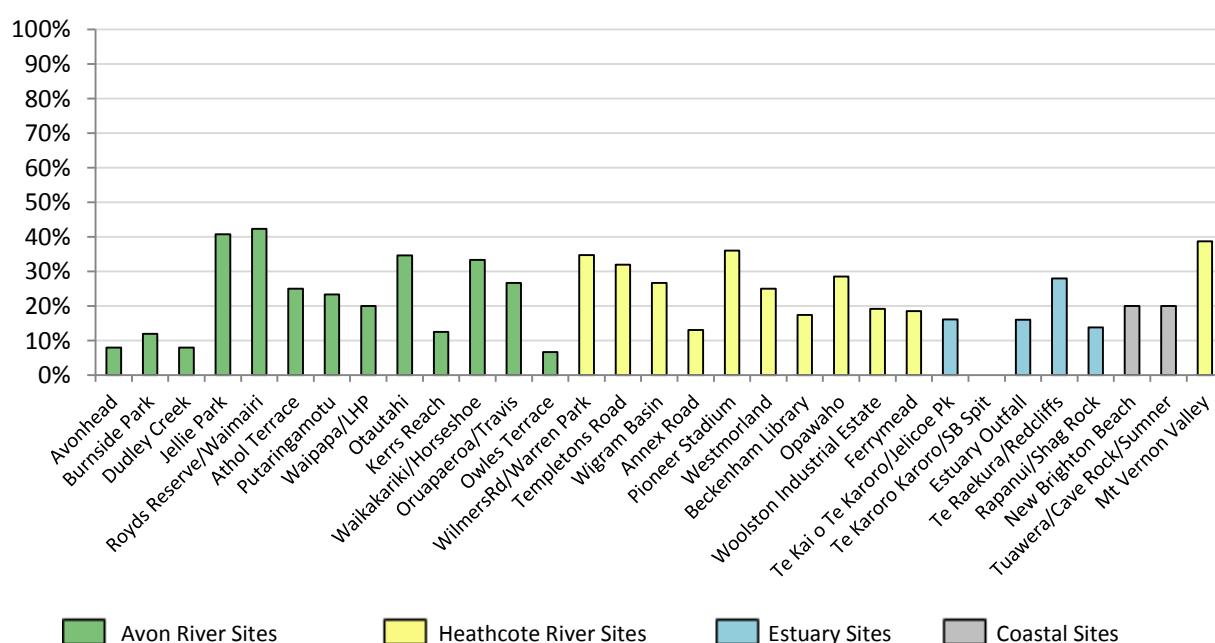
Figure 10: Electric fishing at Waimairi Stream / Royds Reserve (left) and setting a hīnaki at the Estuary Outfall site (right)



## 5.5 Current versus traditional presence of indigenous species

A comparison of the number of taxonomic groups of indigenous species recorded during the monitoring visit versus the number regarded as being traditionally present provides an indication of the ability of the site to sustain traditional Ngāi Tahu values. Although not all species traditionally present would be expected to be present and recorded during a single monitoring visit, surveys were completed for plant, bird and fish species. For these taxonomic groups the results show that at most sites across the catchment between ten and 40% of species traditionally present were recorded during monitoring. The sites at which higher percentages were recorded were typically those with remnant or restored indigenous vegetation in the riparian zone (Figure 11).

Figure 11: Number of species recorded during monitoring as a percentage of those traditionally present at each site for selected taxonomic groups

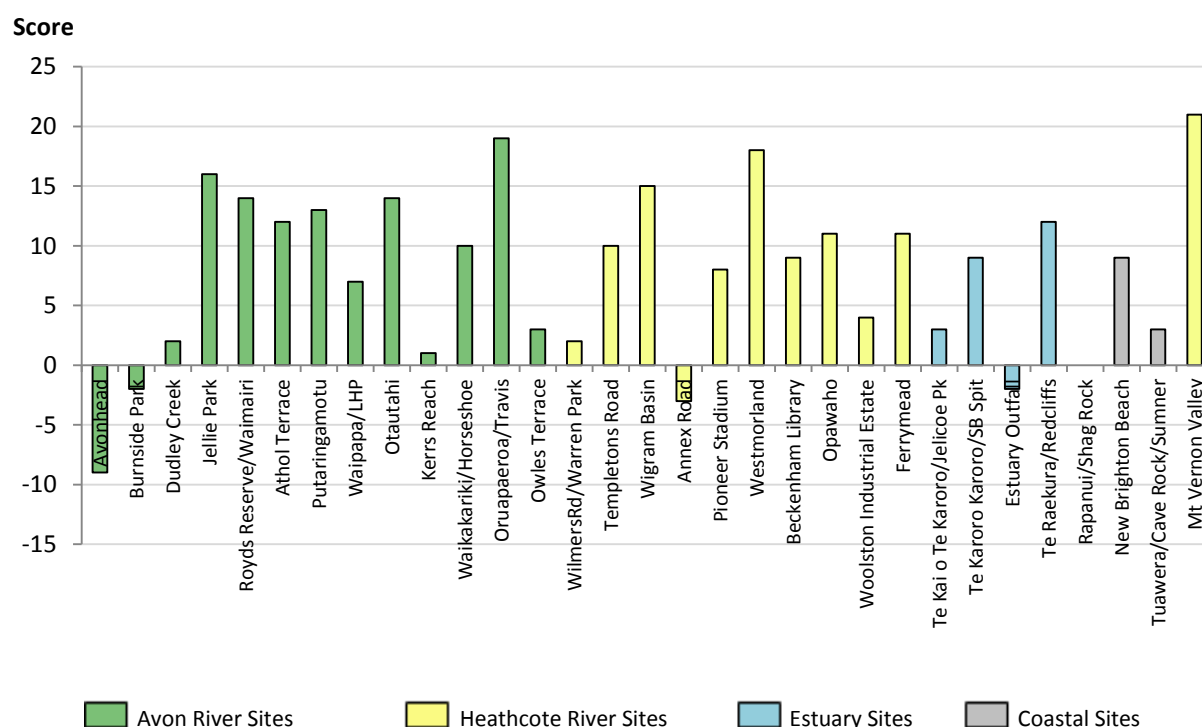




## 5.6 Takiwā 2.0 Abundance Index scores

Takiwā 2.0 calculates an Abundance index which considers the abundance of native species as a positive value and the abundance of exotic species as a negative value. Negative values therefore relate to higher proportion of exotics, and positive to higher proportion of indigenous species (Figure 12). Vegetation, bird and fish species are considered.

Figure 12: Abundance Index scores as calculated in Takiwā 2.0



This index provides an indication dominance of native species in comparison to exotic species recorded. Although there is no maximum score to the index, higher scores indicate greater dominance of native species versus exotics. Most sites across the catchment returned low positive scores indicating the presence of indigenous species. It is worth noting that the presence of pasture grasses and exotic weeds were recorded as a single taxonomic group since the focus of the vegetation assessment methodology was on the shrub and tree species present. This aspect influences the Takiwā 2.0 Abundance Index result which could be interpreted as showing that indigenous species are dominant at many sites, whereas in reality pasture grasses and exotic weed species were often the dominant species present in terms of percentage cover for vegetation.

However the results do support observations that indigenous shrub and tree species are more dominant than exotic shrubs and trees at many monitoring sites. These results are similar to those recorded in the 2007 study and are also consistent with the current versus traditional presence of indigenous species comparison which showed that at most sites at least a percentage of the indigenous species traditionally present were found. On the other hand the results also indicate that there is much room for improvement, suggesting that

restoration efforts focussed on restoring habitat for indigenous species would be an effective approach to improve Ngāi Tahu values.

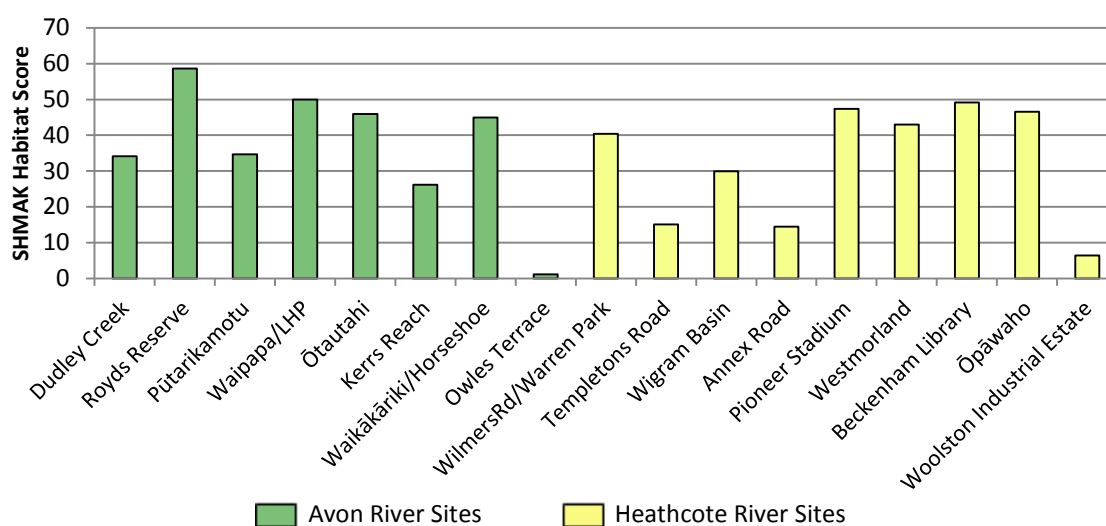
## 5.7 SHMAK Stream Habitat and Stream Bed Life Assessment

### 5.7.1 Stream Habitat

Stream habitat was assessed at 17 sites being those with suitable substrate. The assessment was not applicable at other sites due to the absence of rock substrate or where the stream bed was dry.

Stream habitat scores are calculated based on a range of physical factors, relating to flow velocity, water temperature, pH, and clarity, in addition to stream bed composition, deposits, and riparian vegetation. The site which rated the best was Waimairi Stream / Royds Reserve, while Owles Terrace and Woolston Industrial Estate rated very poorly (Figure 13).

Figure 13: SHMAK Stream Habitat scores

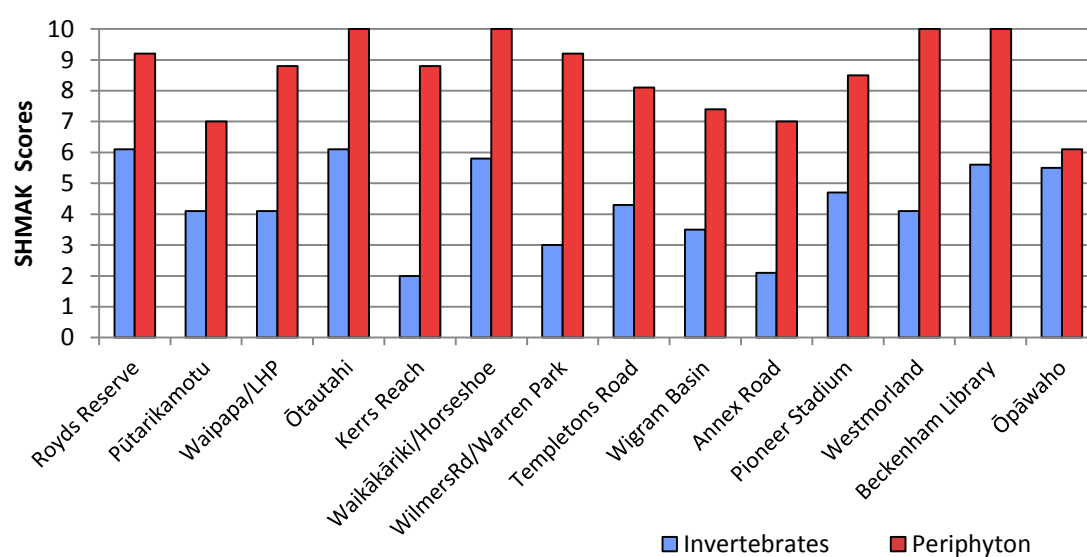


### 5.7.2 Stream Bed Life

The scores obtained using the SHMAK method are based on the presence of various invertebrates and periphyton located on rock samples, which are scored based on NIWA's invertebrate and periphyton assessment kit. Both the invertebrate and periphyton scores are based on a scale from 1 – 10, with 10 being the highest score possible.

Invertebrate scores ranged between 2 and 6 indicating the in-stream habitat was generally below average in the catchment. The lowest scores were recorded at Kerrs Reach and Annex Road, and the highest at Royds Reserve, Ōtautahi and Horseshoe Lake. Scores from the periphyton assessment ranged between 6 and 10, indicating relatively healthy in-stream conditions for periphyton (Figure 14).

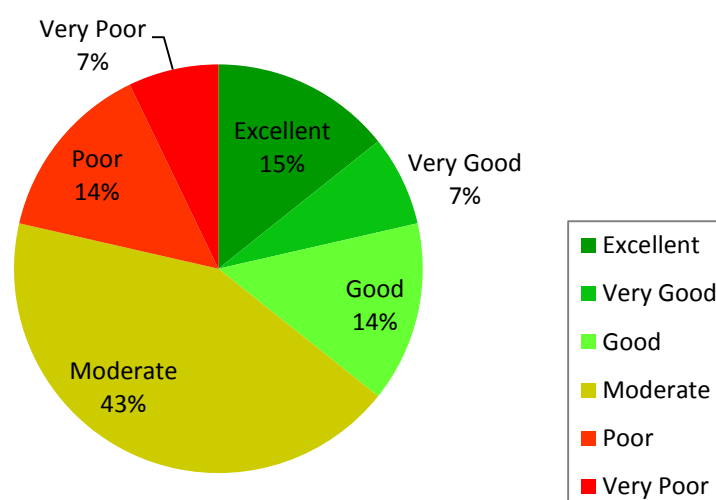
Figure 14: SHMAK Invertebrate and Periphyton scores



### 5.7.3 Overall assessment of stream health using the SHMAK method

The SHMAK method also provides for an assessment of overall stream health based on the combined scores of invertebrate and periphyton assessments. The majority of monitoring sites were assessed as being in moderate condition (Figure 15). This reflected the presence of at least some attributes which are associated with good stream health. However, it should be noted that the range of attributes informing this assessment are not culturally specific assessment. Generally the periphyton scores indicated better stream health than invertebrate scores and this is reflected in the range of overall stream health scores obtained.

Figure 15: SHMAK assessment of overall stream health across the 17 sites assessed using the SHMAK method

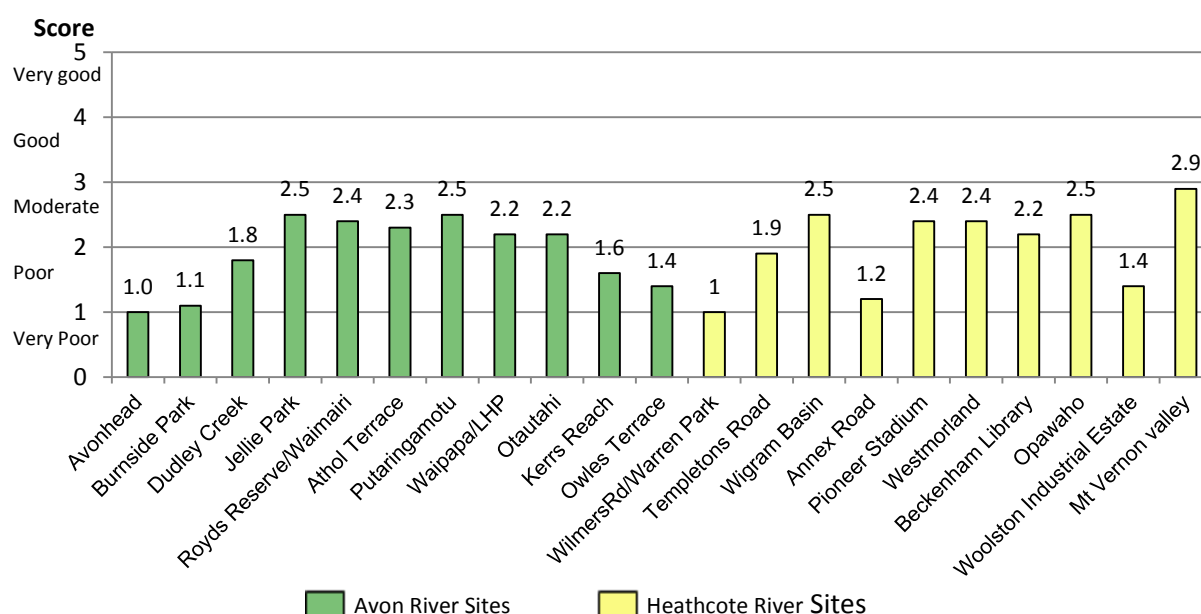


## 5.8 CHI Stream Health Assessment

Results from CHI Stream Health Assessments indicate stream health is below average, and are in-line with results indicated in the Takiwā General Site Assessments.

Of the 21 stream sites evaluated 43% received scores below two with the remaining 57% scoring between two and three out of a possible score of five (Figure 16). Scores were similar for each catchment with the Heathcote / Ōpāwaho averaged slightly higher at 2.0, with the Avon / Ōtākaro scoring 1.9 on average. Scores for the overall health of the river at these sites indicate stream health is below average. Of the 21 stream sites evaluated in this assessment 43% were rated for overall health as being either poor or very poor. The remaining 57% were rating as being of moderate health. Scores were similar for each catchment with the Heathcote / Ōpāwaho averaged slightly higher at 2.0, with the Avon / Ōtākaro scoring 1.9 on average.

Figure 16: CHI Cultural Stream Health Assessment scores



These results consistently indicated lower levels of stream health across the catchment than obtained using the SHMAK method, and no sites in the catchment were assessed as being in good or very good condition using the CHI method for stream health. This likely reflects the lower weighting applied to periphyton assessments. In other respects the CHI method takes more attributes of a site into account, and importantly the range of assessment topics used are culturally-specific.

When the CHI Stream Health Assessment results were compared with Takiwā Overall Site Health scores there was much similarity in the results (Figure 17). Although the components of each assessment involve different parameters and assessment questions, the focus of both assessments is on culturally relevant indicators of environmental health.

Figure 17: Comparison between CHI Stream Health scores and Takiwā 2.0 Overall Site Health scores

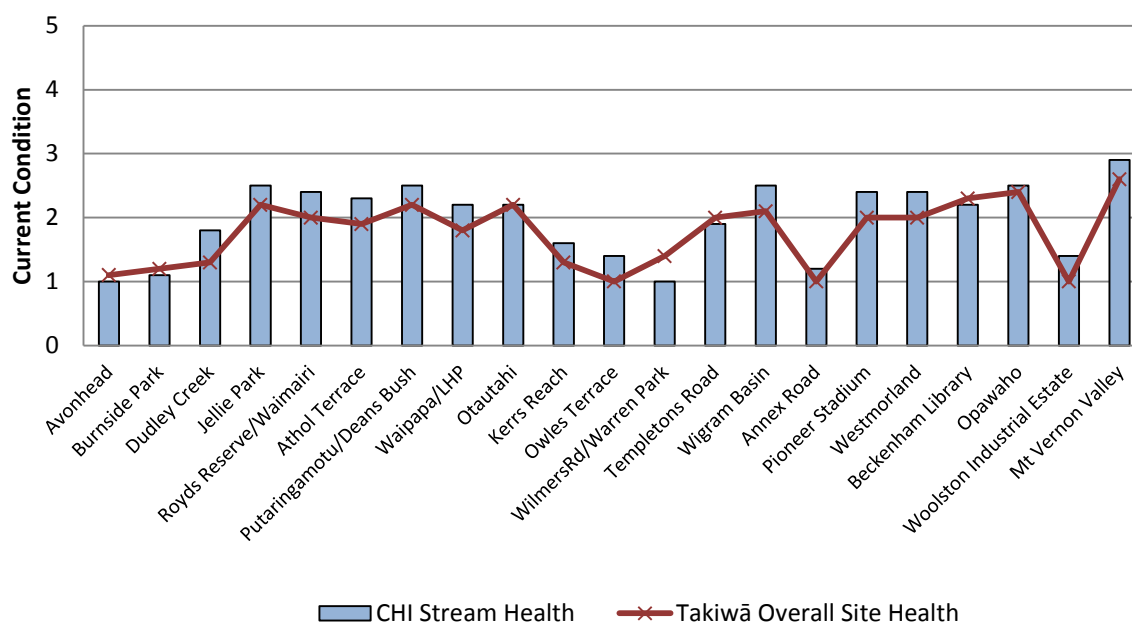


Figure 18: View from the eastern shoreline of Te Ihutai / Avon-Heathcote Estuary at high tide

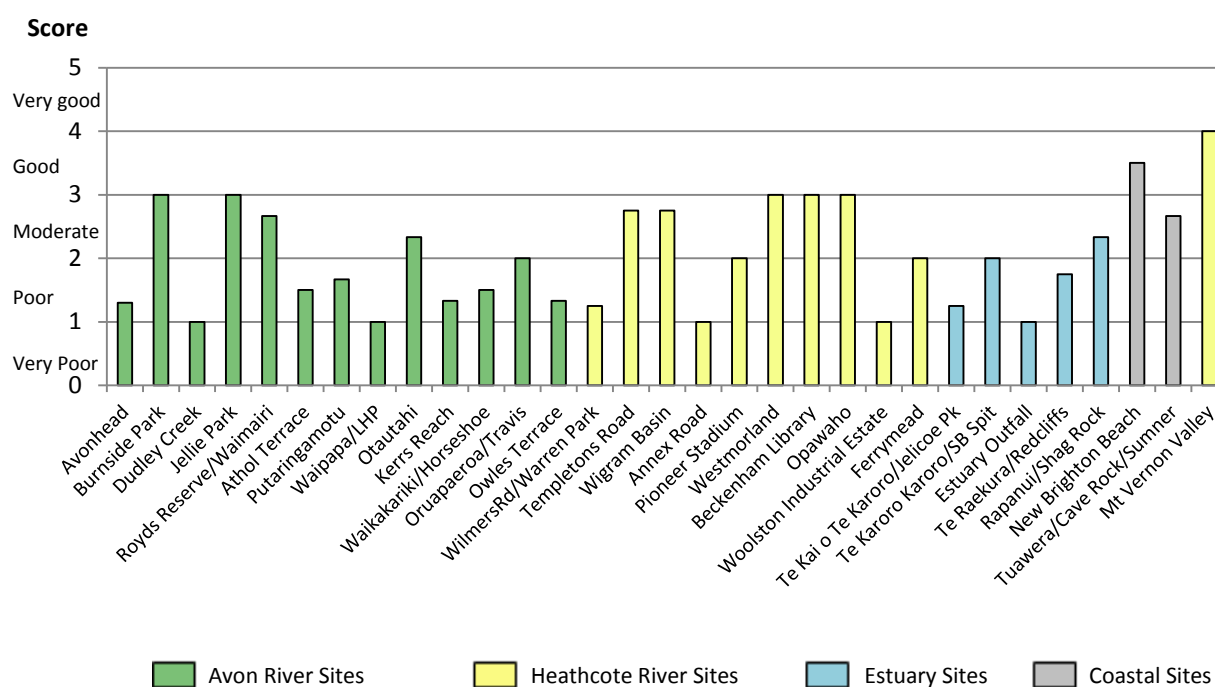


## 5.9 Mahinga Kai Assessments

### 5.9.1 Suitability for harvesting mahinga kai

At most sites scores for the suitability of monitoring sites for harvesting mahinga kai were between one and three, indicating poor to moderate culture health. Only two sites were assessed as being “good” or better for harvesting mahinga kai, these being Mt Vernon Valley and New Brighton Beach. Five sites were scored 1/5 which is the lowest score possible, indicating that these sites were highly degraded in terms of suitability for harvesting mahinga kai (Figure 19).

Figure 19: Suitability for harvesting mahinga kai



### 5.9.2 Willingness to return to the site for cultural use

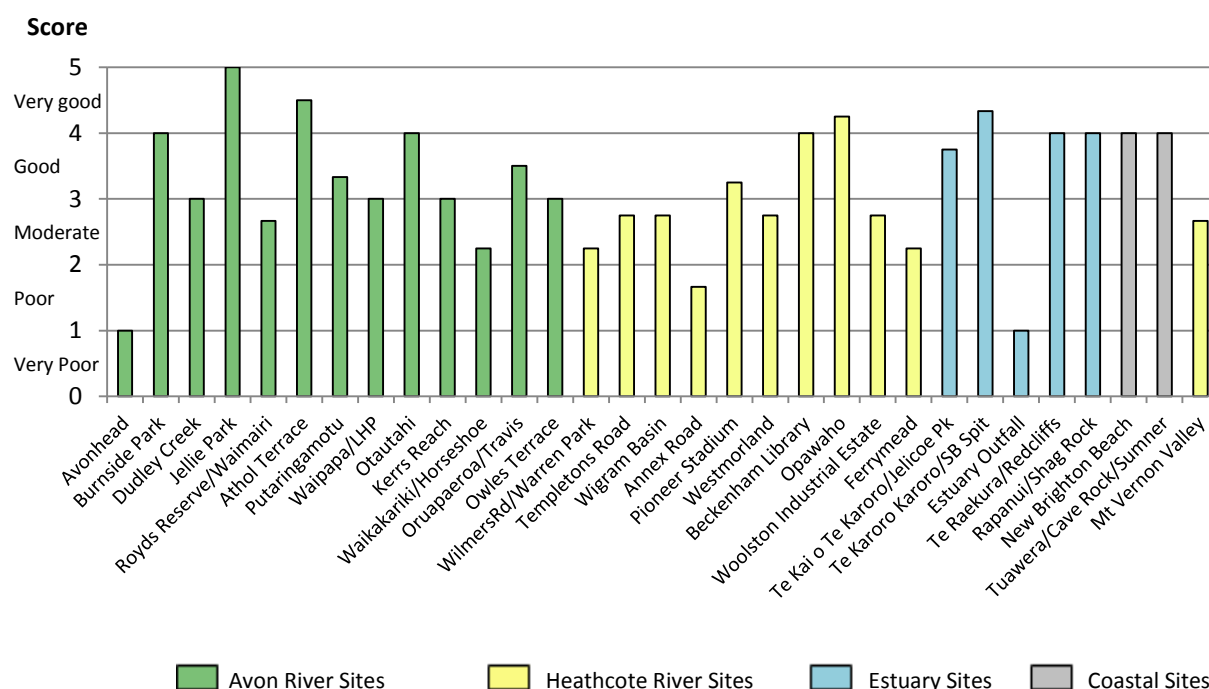
Thirteen sites (41%) were evaluated as not suitable to return to by all roopu members, and 11 sites (35%) of which were deemed to be suitable to return to by all members on the day. The remaining sites received varied responses from the monitoring team regarding the suitability to return to the site for cultural use.

### 5.9.3 Accessibility for mahinga kai

Access was typically assessed as being moderate to good with most sites being located in urban areas or near to roading infrastructure. Avonhead, Annex Road, and the Estuary Outfall sites were rated as having poor access related to traffic or private land issues (Figure 20).



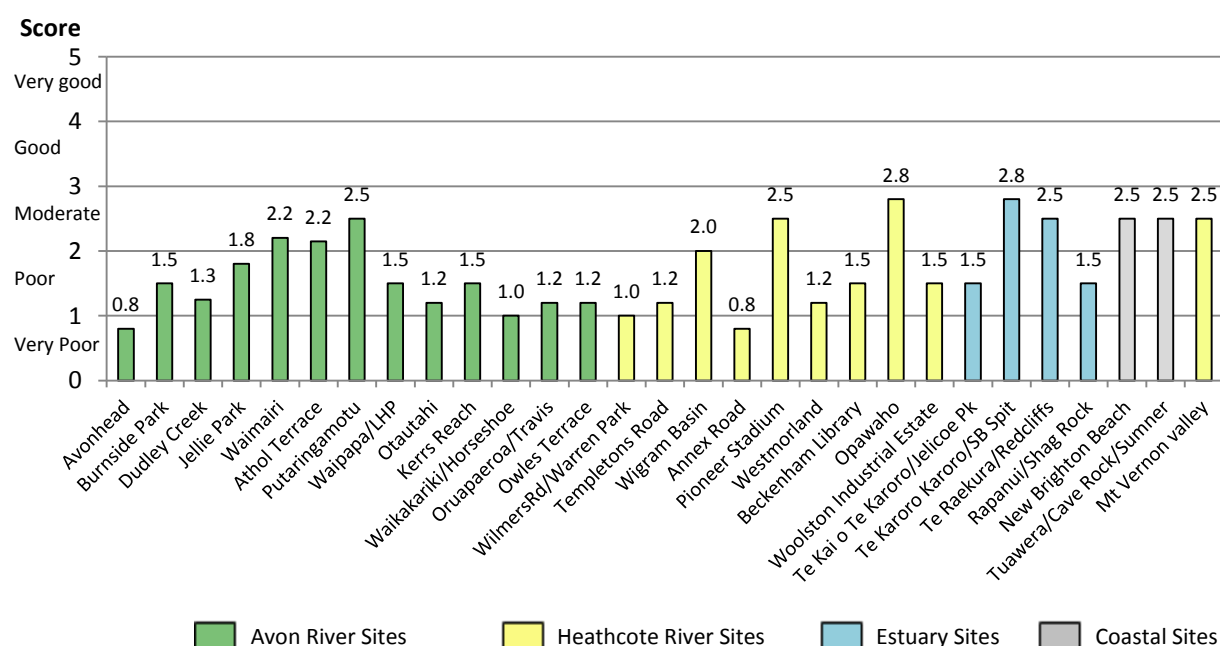
Figure 20: Accessibility for harvesting mahinga kai



### 5.9.4 CHI Mahinga Kai Index

Assessments of mahinga kai values showed that most sites in the catchment were in below average condition. 14% of sites were rated as very poor, 52% as poor and 34% as moderate in terms of mahinga kai values with no sites with a good rating (Figure 21). Avon / Ōtākaro sites were slightly higher on average at 1.5, with Heathcote / Ōpāwaho sites averaging 1.6, and coastal sites at 2.4.

Figure 21: CHI Mahinga Kai Index scores

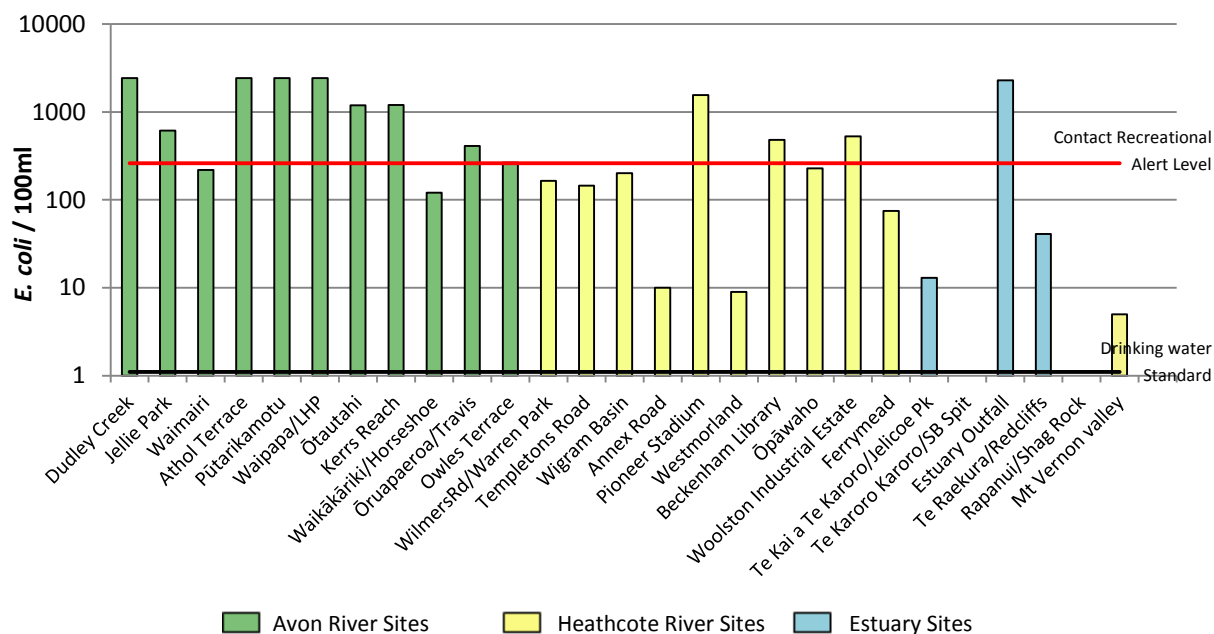


## 5.10 *E. coli* and Antibiotic Resistance

### 5.10.1 *E. coli* levels

Sampling and testing of *E. coli* indicated that levels of faecal pollution were high across the catchment at the time of sampling (Figure 22).

Figure 22: Results of *E. coli* testing



45% of sites exceeded the Recreational Alert level of 260 *E. coli* /100ml at the time of sampling (see Appendix 5). In the Avon / Ōtākaro catchment all but two sites exceeded the contact recreational standard. In the Heathcote / Ōpāwaho catchment 40% of sites exceeded this standard at the time of sampling. *E. coli* levels were significantly higher in the Avon River overall. However, it is important to consider that values are highly variable on a daily basis and are influenced by a number of factors.

A value of 2420 *E. coli* /100ml is the upper limit of measurement in the direct method and was recorded at four sites. Actual *E. coli* levels at these sites were therefore equal or greater than 2420 *E. coli* /100ml. However, these four sites were sampled directly following rainfall events, which is known to influence *E. coli* values (Moriarty & Gilpin, 2009), and especially so in the post-earthquake context.

Figure 23: Health warning sign at Te Raekura / Redcliffs



### 5.10.2 Antibiotic resistance results

Results of *E. coli* antibiotic resistance patterns (antibiograms) demonstrated that the faecal contamination present was widespread and from a variety of sources. Some sites are indicative of human faecal contamination, which is likely to be associated with continuing sewerage problems following the earthquakes.

Sampling of the Avon River / Ōtākaro identified contamination from human sources at Dudley Creek, Athol Terrace, Waipapa / Hagley relating to ampicillin resistance. The Ōtautahi site additionally showed resistance to apramycin which is exclusively used on cattle and poultry. Agricultural contamination is potentially linked to the Waimairi Stream site since the results showed the isolate resistance to tetracycline, sulphonamide and intermediate to apramycin.

Horseshoe Lake / Te Oranga also indicated possible agricultural contamination with resistance to cefoxitin and apramycin. At the Travis Wetlands / Oruapaeroa site *Plesiomonas* species were identified, indicating an agricultural or wildfowl source and some intermediate streptomycin resistance which likely represents avian-agricultural contamination.

The *Plesiomonas* species, resistant to apramycin, is indicative of an agricultural source which appears widespread in Canterbury rivers, and may also be carried by waterfowl. Ampicillin resistance and low level streptomycin resistance was also identified at several sites which may represent a combination of agricultural and sewerage sources. A similar range of results were obtained from the Heathcote River / Ōpāwaho with Annex and Wigram sites containing possible agricultural contamination associated with *Plesiomonas* species.

Samples taken from Woolston Industrial Estate and Owles Terrace are of particular concern and identified definite example of a medically important pathogen, resistant to gentamicin, and in addition, resistance to multiple antibiotics in the Owles Terrace sample. These *E. coli* resistance traits are associated with serious urinary tract infections throughout New Zealand. Additional antibiotic resistances likely to be of medical origin were also identified in

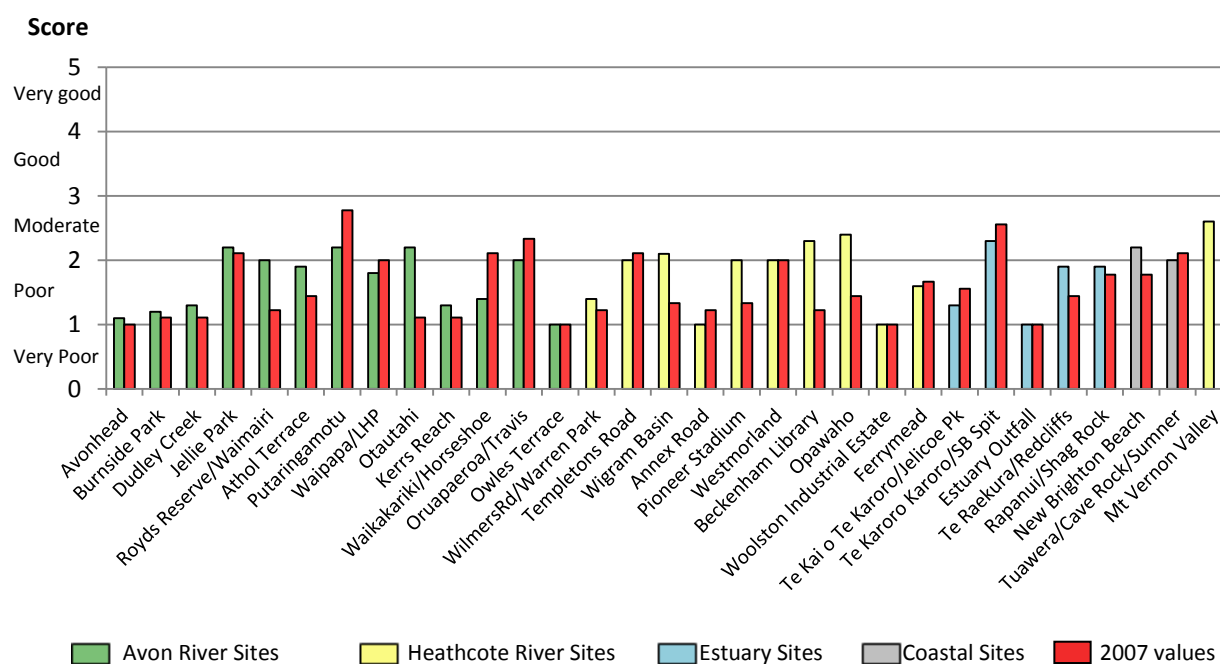
the Woolston Industrial Estate with sensitivity to gentamicin and norfloxacin present, and some with sulphonamide and ampicillin resistance. Jellicoe Park results were inconclusive, but some resistances to trimethoprim, ampicillin, and sulphonamide resistance there also suggest human contamination.

## 6. Comparisons between 2007 and 2012 data

### 6.1 Takiwā 2.0 Overall Site Health scores

Results from this monitoring programme indicate that the current condition of the Ihutai catchment remains poor, and is comparable to the findings reported in the previous monitoring programme (Pauling et al., 2007). The following graph depicts a comparison between Takiwā Overall Site health scores from 2007, and from the 2012 monitoring programme (Figure 24).

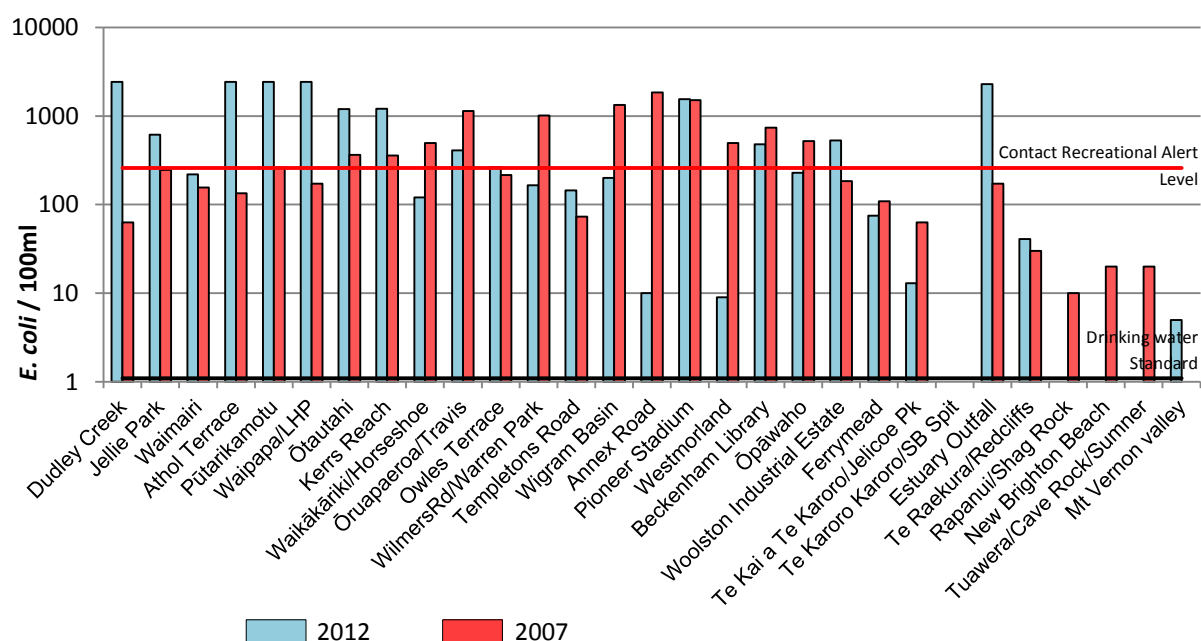
Figure 24: Comparison between Takiwā 2.0 Overall Site Health scores from 2007 and 2012 monitoring programmes



### 6.2 *E. coli* levels

Results from the two State of the Takiwā programmes indicate that *E. coli* levels in the catchment are high relative to the Contact Recreation Alert Level, with many sites exceeding that level. Comparison of *E. coli* data between the two years shows the variable nature of one-off sampling, but nevertheless provides useful information. In the 2012 study, lower *E. coli* levels were recorded at Annex Road and Westmorland observed. Large increases were recorded at other sites including Estuary Outfall, Dudley Creek, Athol Terrace, Pūtarīkamotu and Waipapa (Figure 25).

Figure 25: Comparison between *E. coli* sampling results from the 2007 and 2012 State of the Takiwā monitoring programmes



Due to the post-earthquake context some faecal contamination from damaged wastewater infrastructure was expected, and the antibiotic resistance results provide strong evidence that this was the case at several sites. However the reduced *E. coli* levels recorded at Annex Road and Westmorland does indicates that the previous contamination issues at those sites has been improved. Both of these sites are in areas that have been less affected by earthquake damage compared to many sites further east.

## 7. Kōrero / Discussion

### Overview of the catchment

When taking all results and assessments into consideration the cultural health of the Ihutai catchment is considered to be poor. The majority of sites contained high levels of pollution and were deemed unsafe to gather mahinga kai and in some cases, unsafe to swim. Other indicators of degradation and modification were also widespread. Low scores for indigenous vegetation diversity and cover were commonplace, and coastal and estuarine sites typically contained limited native vegetation in the riparian zone, which was often dominated by exotic species.

These results also indicate that the cultural health of the catchment is similar to that recorded in the 2007 State of the Takiwā programme. Despite this modest improvements in the cultural health of some sites are apparent. A greater number of sites were found to have improved cultural health versus reduced cultural health across the 30 sites originally surveyed in 2007. A comparison of Takiwā 2.0 Overall Site Health scores shows that 16 sites



have improved and 10 sites have deteriorated with four sites returning the same score. Improvements were most notable at sites where riparian restoration actions have occurred such as at the Beckenham Library and Ōpāwaho sites.

The site which was considered to have the poorest cultural health was located at the Woolston Industrial Estate (Figure 26). This is an area of heavy industry and no improvement in cultural health was recorded when compared to the 2007 results. At this site water quality and in-stream values remain very poor despite there being some indigenous species in the riparian zone.

*Figure 26: Example of a site in poor cultural health at Woolston Industrial Estate*



However, some sites have undergone extensive restoration and/or conservation initiatives. Examples including Pūtarikamotu (Deans Bush), Ōruapaeroa (Travis Wetland), Waikākāriki (Horseshoe Lake) and Wigram Basin sites scored well across a variety of cultural health indicators (Figure 27).

*Figure 27: Example of a restored site at Ōruapaeroa / Travis Wetland. Culturally important vegetation present includes Ti Kouka, Harakeke, Raupo and sedges*



Riparian planting was observed at a number of sites although in many cases this is spatially limited due to constraints from urbanisation. An example is at the Pioneer Stadium site where native riparian restoration has been undertaken but is limited primarily to one side of the bank and confined by residential properties (Figure 28).

*Figure 28: Indigenous riparian species well established on one side of the waterway at the Pioneer Stadium site*



In the upper reaches of both the Avon and Heathcote rivers catchments of particular note was a loss of visible springs and water flow. The head of the Avon / Ōtākaro river is now just a remnant dry overgrown channel at the Avonhead site, while the upper Heathcote / Ōpāwaho at Warren Park contained only stagnant water from storm water inputs (Figure 29).



*Figure 29: The Wilmers Road / Warren Park site*



### ***Cumulative effects on waterways***

As identified in Pauling et al. (2007) the impacts of past and present modification and intensification of land use has had dramatic impacts on the cultural health of waterways in the Ihutai catchment, particularly in relation to drainage, stormwater and wastewater discharges. Waterway health issues have been further compounded by the series of earthquakes to strike Canterbury. Earthquakes effects have been particularly noticeable in the eastern part of the city, and have included damage to infrastructure and utilities in and around the waterways, increased pollution from a variety of sources, and direct damage to culturally important sites such as Rapanui (Shag Rock) (Figure 30).

*Figure 30: Examples of earthquake damage at Kerrs Reach (left) and Rapanui (right)*



### ***Future management considerations***

In considering the results of this study, a similar set of negative influences as reported by Pauling et al. (2007) was observed. This may indicate a lack of progress in addressing these management concerns. In particular, poor cultural health associated with the presence of contaminants associated with stormwater and wastewater discharges, sedimentation at the site, and unnatural flow patterns (including the absence of water) were concerns reported in 2007 and remain widespread concerns in the catchment today. There are also examples of where positive influences have improved the cultural health of monitoring sites (Table 4). Greater attention to implementing these positive influences on cultural health is needed in the management of all waterways in the catchment.

*Table 4: Examples of positive and negative influences on the cultural health of waterways in the Ihutai catchment*

<b>Positive influences - factors associated with good cultural health scores</b>
<ul style="list-style-type: none"> <li>• Native restoration and/or remnant vegetation</li> <li>• The presence and abundance of indigenous species and mahinga kai species in particular</li> <li>• High water quality including clarity</li> <li>• Natural water flow patterns</li> <li>• Natural stream bed morphology and stream bed composition eg. absence of silt</li> <li>• Presence of natural springs or other taonga in good condition</li> </ul>
<b>Negative influences - factors associated with poor cultural health scores</b>
<ul style="list-style-type: none"> <li>• The absence of flowing water (e.g. Avonhead, Burnside, Wilmers Road)</li> <li>• Degraded and/or heavily urbanised areas</li> <li>• Limited vegetation and/or the presence of exotic vegetation</li> <li>• Poor water clarity and/or high sedimentation</li> <li>• Highly modified river channels</li> <li>• Lack of indigenous species</li> <li>• Lack of mahinga kai species</li> </ul>

Relative to 2007 there have also been notable improvements at some monitoring sites including the Wigram Basin, Beckenham Library, and Ōpāwaho sites. At these sites key factors responsible for improving overall scores were good water clarity, and the presence of indigenous species including culturally appropriate vegetation in the riparian zone. Another notable site was at Waimairi / Royds Reserve where water clarity was exceptional, and the identification of a previously unknown natural spring was of particular significance, as well as an abundance of tuna.

## 8. Te Whakamutunga / Conclusions

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The 2012 State of the Takiwā programme has provided a cultural health assessment of Te Ihutai / Avon-Heathcote Estuary and its catchment following the devastating earthquakes suffered in the region. A total of 31 monitoring sites were assessed using the Takiwā monitoring system developed by Ngāi Tahu including all 30 sites assessed in the 2007 State of the Takiwā programme.

Results from the monitoring programme indicate the catchment remains in poor cultural health. For the majority of sites, cultural health was assessed as being similar to that in 2007. As was found in the 2007 study, the different assessments conducted indicated that a range of culturally relevant aspects were typically degraded, including both in-stream and riparian values.

*E. coli* and antibiotic resistance results indicate that faecal contamination from a variety of sources is widespread throughout the catchment. These include human sources which poses a major cultural concern. Although this situation was expected following earthquake damage, it does indicate the need for comprehensive attention including monitoring of these waterways in conjunction with earthquake repair activities to establish whether recovery is occurring. Despite that much repair work to wastewater infrastructure had already been completed at the time of these assessments, these results indicate that faecal contamination remains widespread in the catchment.

Implications for mahinga kai activities are particularly difficult to address and will rely heavily on ongoing monitoring to confirm if, and when, recovery occurs. Monitoring of *E. coli* levels by source is strongly suggested as a useful and practically relevant indicator of cultural concerns, in addition to other human health concerns. As an interim measure, culturally relevant signage to support practices such as rāhui may also be useful to manawhenua as kaitiaki, in association with regular information exchange between the parties involved in waterways management.

At the majority of monitoring sites mahinga kai values were assessed as being low, and in many cases mahinga kai activities would not be conducted at these sites due to the presence of safety concerns. A wide range of factors influencing mahinga kai values were apparent across the catchment indicating that a suite of management issues needs to be addressed. Negative influences that are important to address in this respect include water quality concerns, degraded riparian areas, and other habitat degradation factors such as erosion and the presence of weed and pest species.

However the fish surveys conducted found that fish species abundance and diversity was acceptable at many sites. At freshwater sites, similar results to the 2007 assessment were recorded in terms of species present and abundance. The results from sites surveyed using hīnaki and drag netting also indicated the presence of fish species that were expected to be



found, and at some sites good numbers were recorded. Shortfin eel was by far the most prevalent of all fish species recorded and was found at the majority of sites surveyed.

The condition of habitats for indigenous species was variable across the catchment although typically degraded. Further attention to the restoration of riparian and in-stream habitat values is a priority issue for Ngāi Tahu. Related aspects include ensuring that urban development does not further encroach on waterways, and that all developments are consistent with or enable riparian restoration activities.

Management responses needed to protect and enhance Ngāi Tahu values include all of the recommendations from the 2007 programme. In particular, improvement in water quality and habitat quality including the restoration and conservation of indigenous vegetation in the riparian zone is required at many sites in the catchment. There is also a need to take Ngāi Tahu values into account in the planning and implementation of earthquake repair activities, especially with regard to critical issues such as water quality. This includes the need for comprehensive monitoring to establish whether important aspects of waterways recovery are being achieved as the earthquake recovery process progresses.

*Figure 31: A view from near the entrance of Te Ihutai / Avon-Heathcote estuary with Rapanui (Shag Rock) in the foreground and Te Raekura (Redcliffs) beyond*



## 9. Recommendations

- The progressive elimination of contaminant inputs throughout the catchment, including from the wastewater network and from stormwater runoff and rural land uses.
- Restoring of water quality to a level at which mahinga kai can be safely gathered.
- Further studies to investigate the source of human, agricultural, and medical contaminants located throughout the catchment, and a move towards *E. coli* monitoring by source as a standard approach to environmental monitoring.
- Specific enquiry into all heavily degraded sites (for example Woolston Industrial Estate) and identification and implementation of remedial actions to improve the health of those sites.
- In consultation with tangata whenua, consideration of recovery and management responses for degraded and damaged sites of high cultural significance, for example Rapanui (Shag Rock).
- The protection and enhancement of all known springs in the catchment.
- A concerted effort is required to restore and protect indigenous riparian vegetation throughout the catchment, particularly on council/public land.
- Incentives to encourage the restoration of riparian areas on private land, especially within 20m of any waterway.
- Implementation of methods to ensuring that urban development does not further encroach on waterways, and that all developments are consistent with or enable riparian restoration activities.
- Implementation and reporting on all of the recommendations from the 2007 State of the Takiwā programme (see Appendix 5). All of those recommendations remain important and require further work although the restoration work that has been conducted at some sites (for example around Wigram) has been noted and is appreciated.
- Cultural monitoring and reporting on a regular basis throughout the catchment, including to address catchment wide issues and specific management concerns and programmes of work, such as those associated with earthquake repair activities.

## 10. Tohutoro / References

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