



Taieri River

Annual Monitoring Summary

2007-2008

Key points

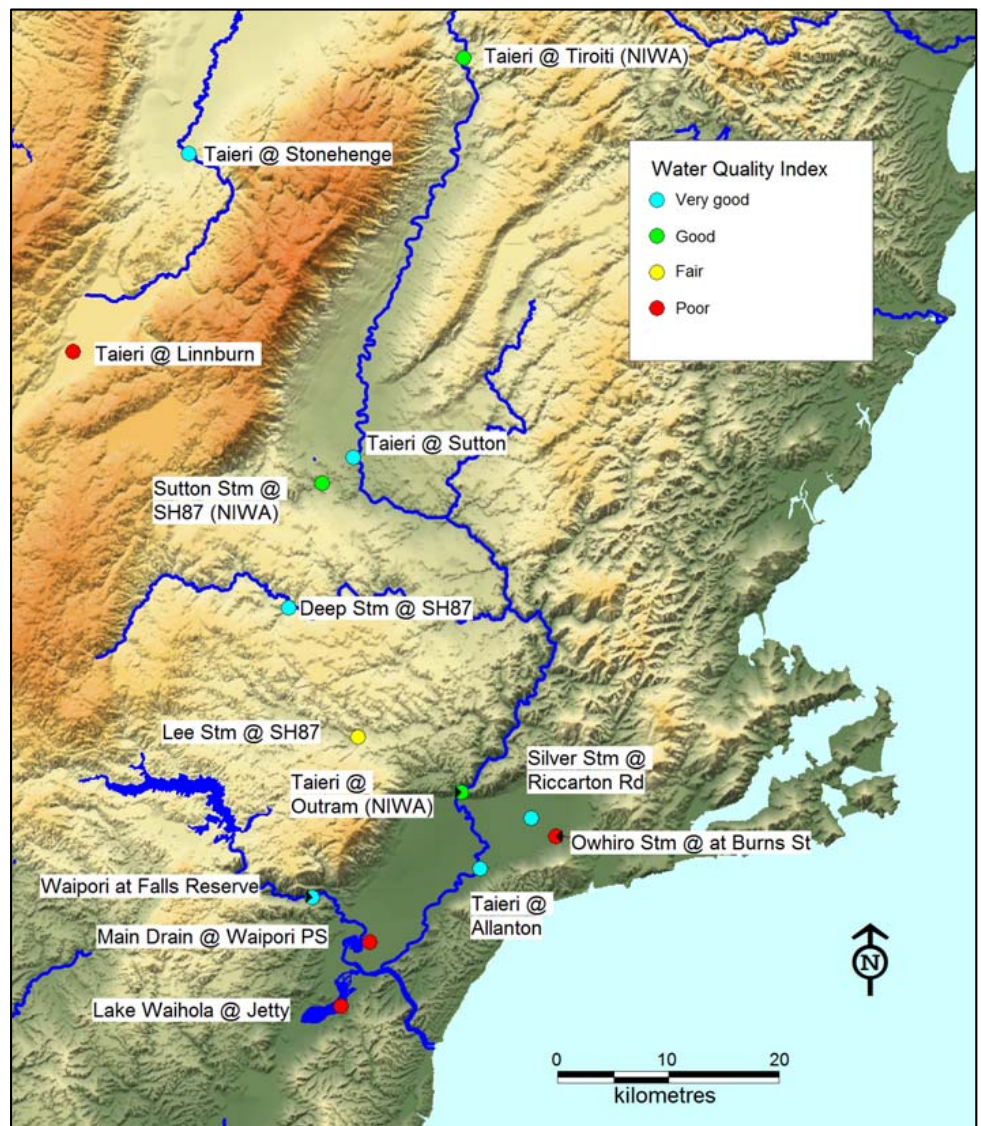
- Water quality in the mid-Taieri River deteriorated then improved further downstream.
- The median concentration of dissolved reactive phosphorus exceeded the guideline at two main stem Taieri River monitoring sites.
- The median level of *E. coli* in the Sutton Stream exceeded the Department of Health (DoH) contact recreation guideline level of 126 *E. coli*/100ml.

Water quality monitoring

Between June 2007 and the end of May 2008 Otago Regional Council (ORC) monitored 11 river and stream sites in the Taieri Catchment as part of the State of Environment (SOE) monitoring programme and NIWA monitored a further three sites (Taieri River at Tiroiti, Taieri River at Outram and the Sutton Stream at SH87). Historical results and longer term trend analysis is available in the 2007 SOE report.

The most important factor influencing water quality is land use. Taieri Catchment sites with poorer water quality are generally found in areas which are more intensively farmed such as the lower Taieri Plain. Sites in the upper catchments generally have better water quality. There are few significant discharges into fresh water in the Taieri Catchment; however, Ranfurly, Naseby, Middlemarch, Waihola, Dunedin Airport and Waipori Falls all have consented sewage discharges.

Taieri Catchment monitoring sites



Guidelines and standards

- The ANZECC (2000) guidelines outline trigger values for water quality aspects that put stress on river and stream health. This specifies a level below which the risk of adverse biological effect is low. The ANZECC trigger values used here are for lowland rivers (< 150m).
- Otago's water quality standards are outlined in the Water Plan, which sets targets to maintain and improve water quality within the region.
- The DoH (1992) guidelines for contact recreation waters recommend a season median of 126 *E. coli*/100 ml.

Note: The red lines on these graphs indicate the ANZECC trigger value or the DoH guideline level.



Silver Stream at Three Mile Hill

Water quality results

Sites were classified using a water quality index, derived from median values of seven indicator variables: turbidity, dissolved oxygen (% saturation), total nitrogen, nitrite/nitrate nitrogen, total phosphorus, dissolved reactive phosphorus, and *Escherichia coli* (*E. coli*) bacteria.

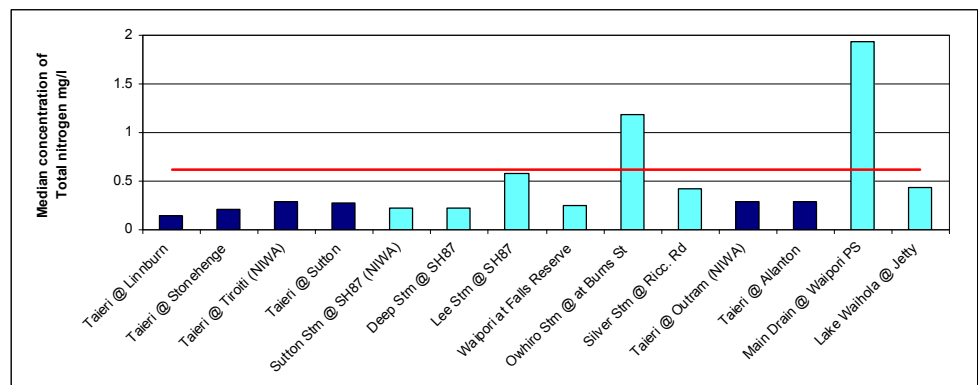
Median values of these variables were compared with ANZECC and DoH guideline levels, enabling classification of water quality into one of the following groups:

Very Good	All seven values comply with guideline values
Good	Five or six median values comply (to include dissolved oxygen)
Fair	Three or four median values comply (to include dissolved oxygen)
Poor	Two or fewer median values comply with guideline values

Selected water quality indicators are displayed in the graphs and discussed below. Overall water quality is generally very good or good for the entire catchment; however, the Main Drain and the Taieri River at Linnburn are classified as poor DO due to low dissolved oxygen levels (low gradient, meandering, slow flowing, pool-like conditions), and two sites are classified as fair (Owhiro Stream and Lake Waipori).

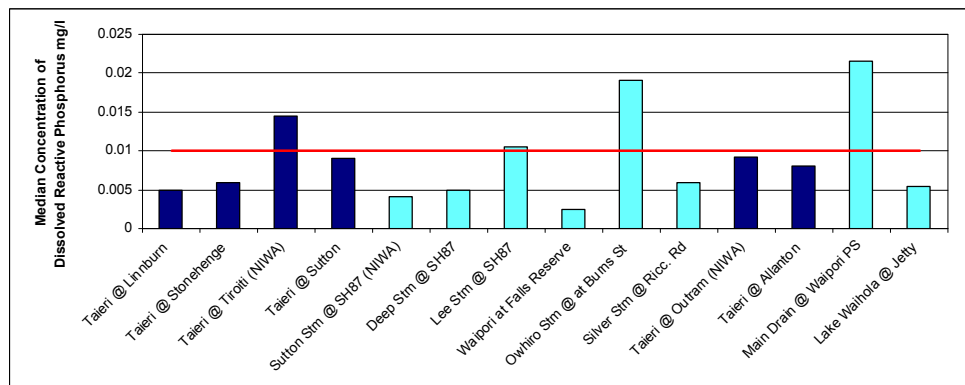
Nutrients

Total nitrogen levels were elevated in the Owhiro Stream and the Main Drain. Ammoniacal nitrogen levels were all well below 0.9 mg/l (ANZECC 95% high reliability trigger value for freshwater), and the ammonia component (after considering temperature and pH) for all sites was less than the ANZECC 2000 guideline of 0.021 mg/l.

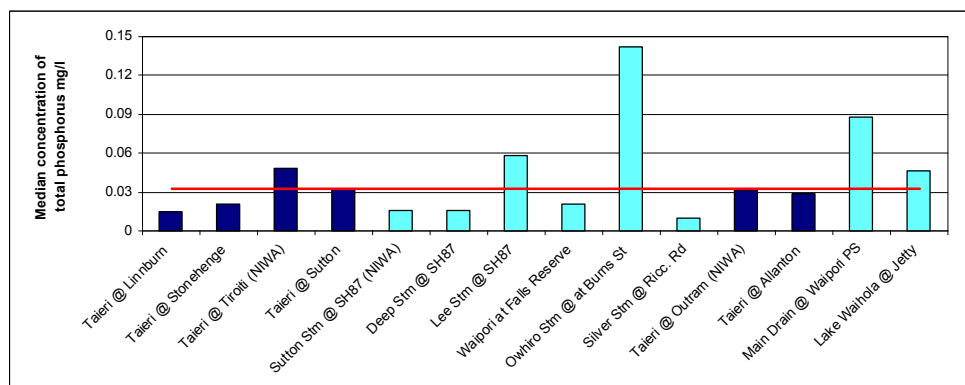


Nitrite/nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It is an important nutrient for algae and other plant growth, but can be harmful in higher concentrations. NN levels in the Taieri River mainstem were all below the ANZECC default trigger value of 0.444 mg/l (lowland rivers), with only the Main Drain exceeding guideline levels.

Median dissolved reactive phosphorus levels in the Taieri River main stem exceeded the ANZECC default trigger value at Tiroiti. Concentrations further downstream then dropped below this trigger value. The Lee Stream, Owhiro Stream and the Main Drain also exceeded the trigger value.

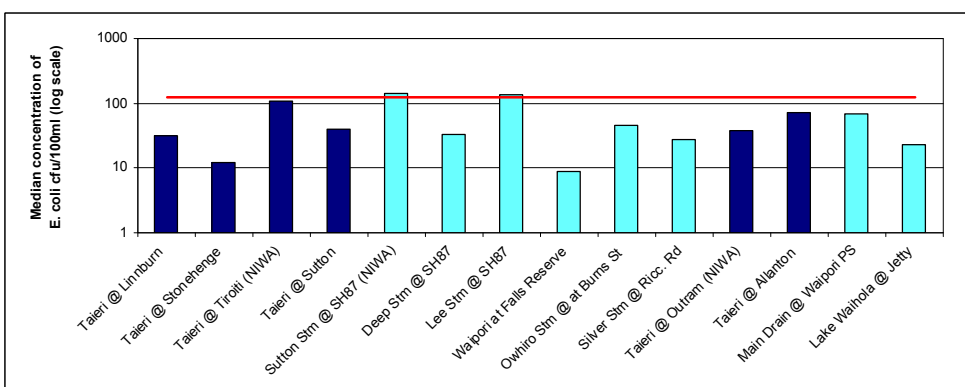


Total phosphorus median values followed the same pattern, with the ANZECC default trigger value being exceeded at Tiroiti; however, both main stem sites downstream of Tiroiti were all close to exceeding the guideline level. The Lee Stream, Owhiro Stream, Main Drain and Lake Waihola also exceeded guideline levels.



Bacteria

The Department of Health (1992) guidelines for contact recreation waters recommend a season median of 126 *E. coli*/100ml. In 2007-08, this was exceeded in Sutton Stream and Lee Stream. Over the monitoring period, only four of the sites exceeded the MfE/MoH guideline of 260 cfu/100ml for a single sample (Owhiro Stream, Taieri River at Tiroiti, Sutton Stream and Taieri River at Outram).



Other analytes

- The upper main stem Taieri River site (Linnburn), the Owhiro Stream and Lake Waihola dropped below 80% dissolved oxygen saturation (less than 80% is considered insufficient for biological health, RMA 1991).
- The Silver Stream at Riccarton Road recorded a maximum pH level of 9.3. This was the only site to have pH levels above the ANZECC 1992 guideline values (pH 6.5 to pH 9.0).
- The highest recorded water temperature was in the Silver Stream at Riccarton Road at 25.3 °C.

Biological indices

- MCI – the Macroinvertebrate Community Index is an index based on adding the pollution tolerance scores of all species found at a site. Species that are very sensitive to pollution score highly whereas more pollution-tolerant species receive a low score.
- SQMCI – the Semi-Quantitative Macroinvertebrate Community Index is a variation of the MCI that accounts for the abundance of pollution sensitive and tolerant species.
- EPT species – this index is a sum of the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) species collected.



Deleatidium (source Stephen Moore)

Ecosystem health

Ecosystem health takes into account a wide range of inter-linked factors, such as water quality, habitat and instream biota. It is generally assessed using two communities that are important to the food chain in rivers and streams: streambed macroinvertebrates (e.g. insects, crustaceans, snails, worms) and periphyton (e.g. algae).

These biological indices put a large amount of information into a compact form. Therefore, they are inherently coarse tools that give a broad view of general patterns. However, they are useful as the presence or absence, abundance, and distribution of species can tell us much about the quality and condition of the site in which they live.

Macroinvertebrate health

A key component of the MCI index is the availability of suitable habitat. The MCI index is designed specifically for stony riffle substrates in flowing water; MCI values can vary due to the availability of suitable habitat and not necessarily due to water quality. As substrate type can vary greatly between riffles, it is often more appropriate to compare changes in MCI values at the same site over a period of time rather than between sites throughout the catchment. However, by understanding the limitation of the MCI index it can still be useful for picking up improvements or deterioration in water quality at individual sites over time.

Criteria for macroinvertebrate health

	Total species	EPT taxa	MCI score	SQMCI
Poor	<10	<5	<80	<4
Average	10 - 20	5 - 15	80 - 99	4 - 5
Good	>20 - 30	>15 - 20	100 - 120	>5 - 6
Excellent	>30	>20	>120	>6

Taieri River macroinvertebrate health 2008

Site	Total species	EPT taxa	MCI score	SQMCI
Kye Burn @ SH85	12	8	135	6.6
Lee Stream @ SH87	22	9	104	3.6
Silver Stream @ Riccarton Rd	14	7	87	4.9
Silver Stream @ Three Mile Hill	26	13	102	4.8
Waipori River @ Waipori Falls	17	11	119	5.5
Owhiro at Burns St	7	0	60	3.4

There is no change to previous years. Owhiro Stream is a very silty slow flowing stream unsuitable for macroinvertebrates. The Silver Stream has good water quality, but marginal habitat due to the modified system (flood banks, straightened channel). The Waipori River is also a modified system; it has good water quality, but macroinvertebrate health can be limited due to the hydroelectric scheme and the rapid rise and fall of water level. Lee Stream has a compromised habitat, due to the extent of bedrock.

Periphyton

While algae are a useful tool for monitoring the nutrient conditions in rivers and streams, this is just one method used to get a complete overview of the river system. Factors other than nutrient levels also influence the composition of benthic algal communities. These include substrate character, the flow regime of the river, the amount of light reaching the river bed and the water temperature.

Algal samples were collected at fifteen sites. Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocol of Biggs and Kilroy (2000).

Sites with abundant or dominant algal species (scores 6 to 8)

Site	Filamentous Green		Cyanobacteria	Diatom	
	Cladophora	Microspora	Oscillatoria	Diatoma	Nitzschia
Lee Stream @ SH87			7		
Silver Stream @ Three Mile Hill					6
Waipori River @ Waipori Falls		6			

The invasive species *Didymosphenia geminata* (Didymo) was not found at any sites in the Taieri Catchment. Cyanobacteria (blue green algae) was found at two sites (Shag River and Lee Stream). The Waipori River had an abundance of Microspora, which was visible as a green mat and the Silver Stream had an abundance of Nitzschia, a genus of riverbed and planktonic diatom.



Silver Stream at Riccarton Road (Otago Regional Council)

Periphyton

- Periphyton samples were analysed according to the “relative abundance using an inverted microscope” method outlined in Biggs and Kilroy (2000).
- Samples were inspected under 200-400x magnification to identify algal species present using the keys of Biggs and Kilroy (2000), Entwisle et al. (1988), Moore (2000) and an unpublished key (National Institute of Water and Atmospheric Research, Christchurch, New Zealand).
- Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocol of Biggs and Kilroy (2000).

Fish

- Fish species diversity is an indicator of stream ecosystem health.
- Diversity varies naturally based on a number of factors including geology, topography, hydrology, groundcover, climate and altitude.
- Streams located near coastal environments often contain relatively high species diversity due to mild climates and the fact that many species spend parts of their lifespan in both fresh and salt water.
- Exotic species such as trout are known to limit the range of native species through predation and competition, and often streams with large numbers of exotic species show lower densities and diversity among native fish species.

Fish

Electro-fishing was conducted in the summer of 2008 on four streams across the Taieri Catchment. Five species of fish were observed in the summer of 2008 at the four electro-fished sites within the Taieri Catchment. Brown trout were the most frequently observed species, being recorded in three out of four sites. In addition, brown trout were the only fish observed in half of the sites sampled in the catchment. The most common native fish was the Longfin eel which was observed in 50% of sites.

Observations of fish species in the Taieri catchment 2008.

2008 electro-fishing sites	Native				Exotic	Number of Species	% Native Species
	Common bully	Longfin eel	Lamprey	Inanga	Brown trout		
Owhiro Stream - Burns St		X				1	100
Silverstream - Riccarton Rd	X	X	X	X	X	5	80
Lee Stream at SH87					X	1	0
Deep Stream at SH87					X	1	0
% of sites species was observed	25	50	25	25	75		

Diversity was low, with observations of only one species at three of the four sites. The exception to this pattern was the Silver Stream at Riccarton Road which had observations of all five species recorded in the catchment.



Longfin eel

River flows

Flow statistics were calculated for five monitoring sites between July 2007 and June 2008. Low flows as well as the highest flows of 2007-08 were also examined

The 7-day low flow in Deep Stream at SH87 was just 0.214 m³/s for 2007-08 (which is close to 60% below MALF); this occurred during an extended period of low flow in January and February. Low flow levels were close to normal at Silver Stream at Riccarton Rd and Tiroiti; both recorded 7-day low flows, 15% below normal, with 0.05 m³/s and 1.67 m³/s, respectively. In the middle reaches of the Taieri River flows were below normal, with Sutton Stream recording a 7-day low flow of 1.85 m³/s, which is 33% below MALF. Further down the catchment at Outram, the 7-day day low flow was 2.8 m³/s, which is 34% below the MALF value of 4.2 m³/s.

The only significant flooding in the Taieri River Catchment this year occurred in the Silver Stream which reached a peak of 158 m³/s on July 30, 2007. The rain band that caused this event was largely restricted to coastal areas and so did not cause any significant flooding further up the catchment.

Comparison of 7-day low flows and MALF as well as maximum flows for 2007/08 to historical maximum flows.

Site	7-day MALF	2007/08 7-day low flow	% Change	Long term max. flow	2007/08 max. flow
Deep Stm @ SH87	0.498	0.214	-57.0	463.027	80.041
Silver Stm @ Ricc. Rd	0.06	0.051	-15.0	199.773	158.73
Taieri @ Outram	4.236	2.804	-33.8	2526.384	1066.804
Taieri @ Sutton	2.751	1.848	-32.8	560.109	123.654
Taieri @ Tiroiti	1.977	1.673	-15.4	520.927	40.217

*Note: all flows are given in m³/s



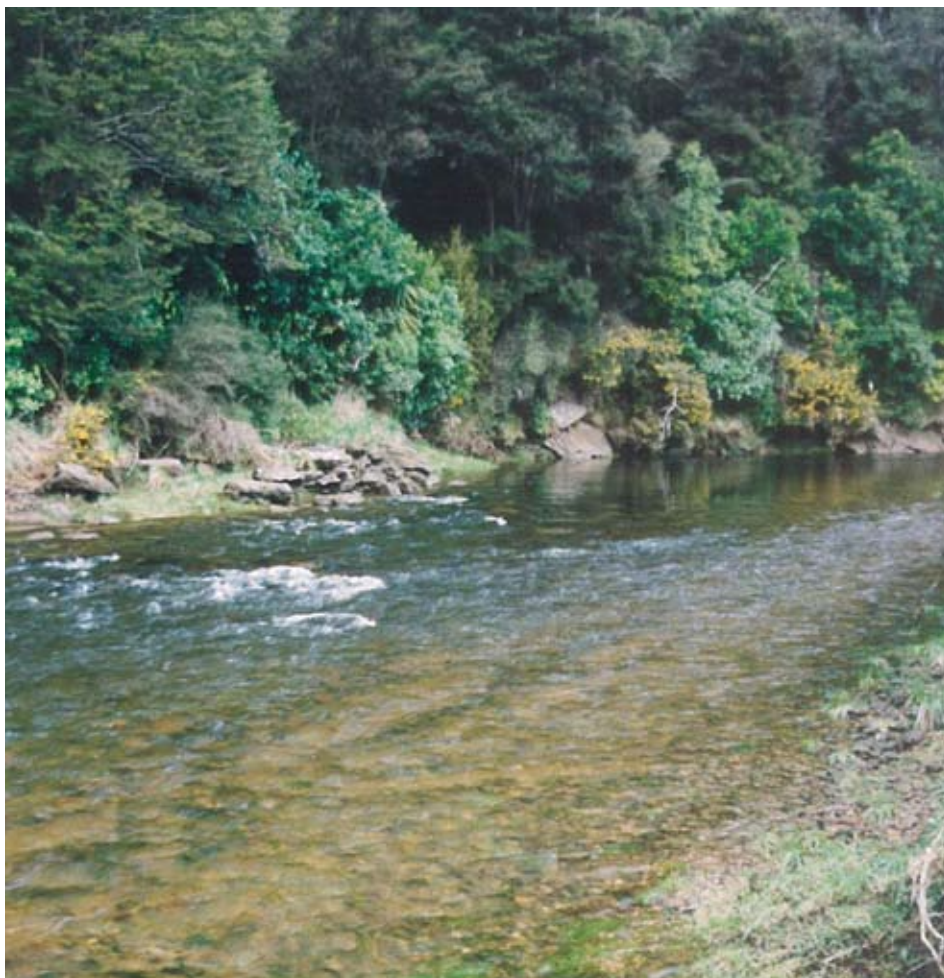
River flows

- The 7-day low flow refers to the lowest 7-day moving average for a given year.
- The 7-day Mean Annual Low Flow (MALF) is the average of all of the 7-day low flows over the term of record.
- The long-term maximum flow is the highest flow recorded at a given site.



Flow monitoring station at Tiroiti

Sutton Stream at Old Dunstan Road (ORC)



Waipori River at Falls Reserve (ORC)

Recent Otago Regional Council reports

- Lake Waihola and Lake Waipori: Trophic Level Status, March 2005.
- Monitoring the effects of irrigation runoff on water quality (Gimmerburn, Sowburn and Pigburn), May 2006.
- State of Environment Report, Surface Water Quality in Otago, May 2007.

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