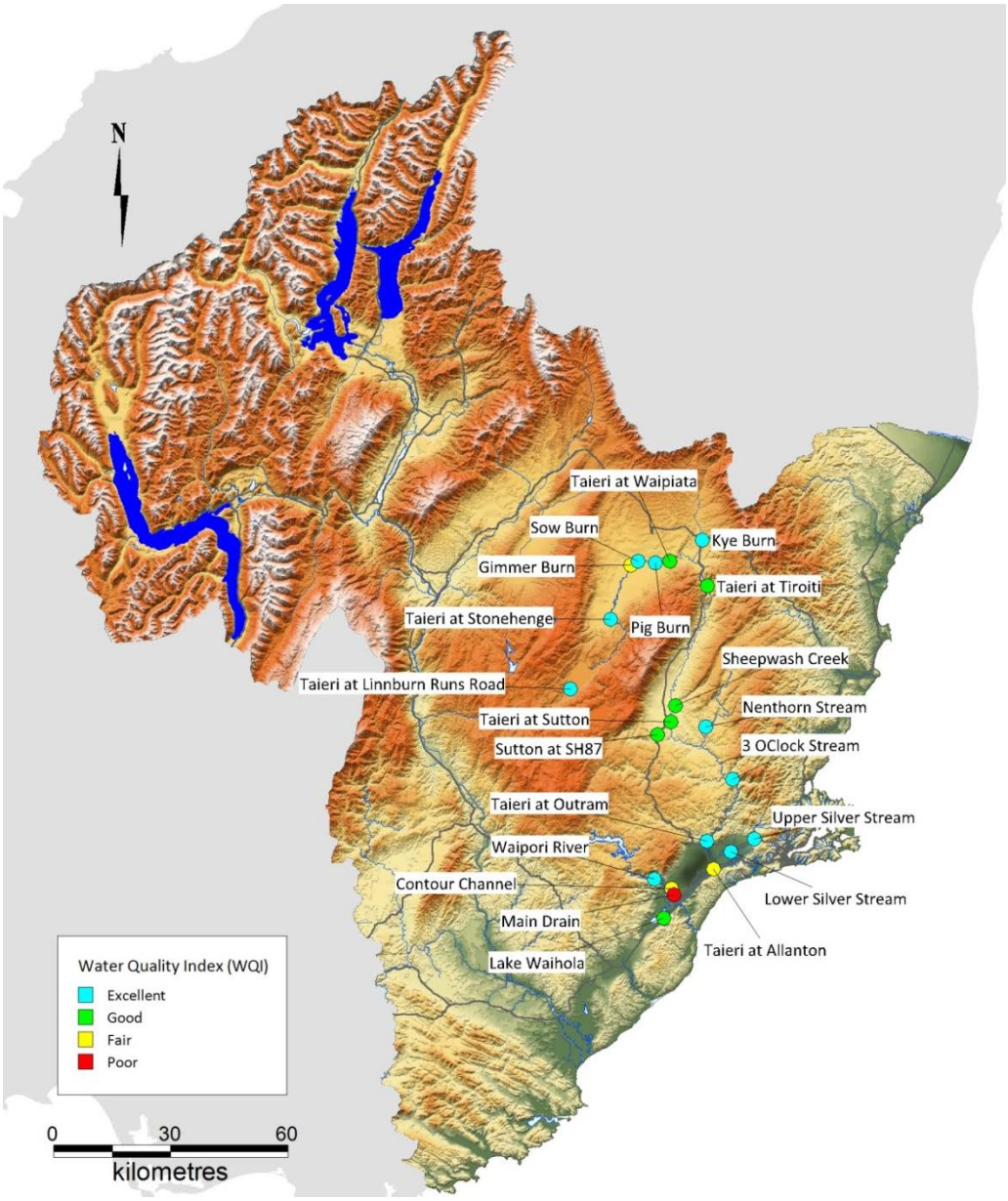
Taieri River catchment

Water quality and ecosystem health
July 2011 to June 2012

Water quality

To assess the current state of water quality, the Otago Regional Council (ORC) monitored 21 river and stream sites in the Taieri catchment between July 2011 and June 2012. Most sites were monitored every two months, but three sites (Taieri at Tirioiti, Sutton at SH87, and Taieri at Outram) were monitored monthly by NIWA as part of the National River Water Quality Network (NRWQN). Sites were classified using a water quality index.



Summary

Water quality was generally excellent or good. The Main Drain was the only site with poor water quality. This was followed by the Gimmer Burn, Taieri at Allanton and the Contour Channel with fair water quality.

Macroinvertebrate communities were good or excellent. The Kye Burn had an abundance of endangered Central Otago Roundhead galaxiids.

The Silver Stream had the most diverse fish population, which is attributable to its proximity to the coast.

Water quality index

ORC uses a water quality index (WQI) derived from median values of six indicator variables: turbidity: dissolved oxygen (percent saturation), ammoniacal nitrogen (NH_4), nitrite-nitrate nitrogen (NNN), dissolved reactive phosphorus (DRP) and *Escherichia coli* (*E. coli*).

Median values of the six values are compared with ANZECC (2000) and MfE/MoH (2003) guidelines, enabling classification of water quality into one of the four groups.

Excellent	All six values comply with guideline values
Good	Five median values comply
Fair	Three or four median values comply
Poor	Two or fewer median values comply with guideline values

Guidelines for nutrients

The ANZECC (2000) guidelines outline trigger values for lowland water courses (less than 150 m above sea level). The trigger values specify a level below which the risks of adverse biological effects are considered low.

The horizontal lines in red (in the graphs on the right) depict the relevant ANZECC guideline value.

Taieri at Linnburn Runs Road

Taieri scroll plains

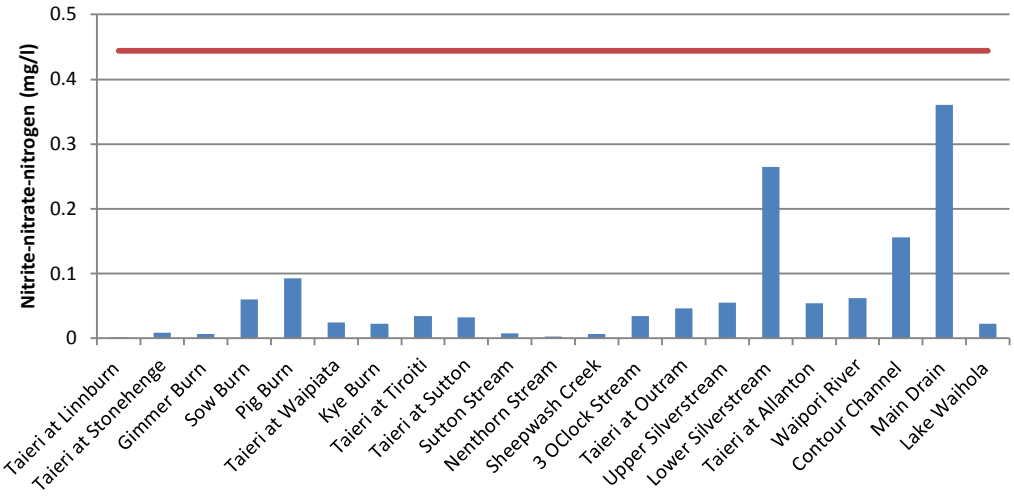
Taieri at Tiroiti

Water quality

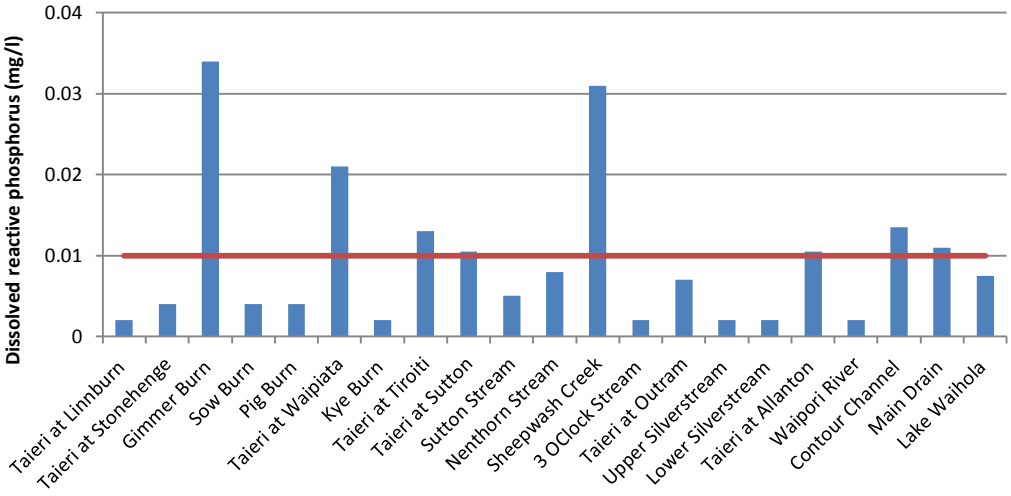
Selected water quality indicators are displayed in the graphs and discussed below. Overall, these graphs show that water quality is generally good or very good, but with poorer quality in Mosgiel's urban streams.

Nutrients

Nitrite-nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It is an important nutrient for algae and plant growth. All sites throughout the catchment were below the guideline value. The highest concentration of NNN was recorded in the Main Drain (0.36 mg/l) followed by the Silver Stream (0.27 mg/l).

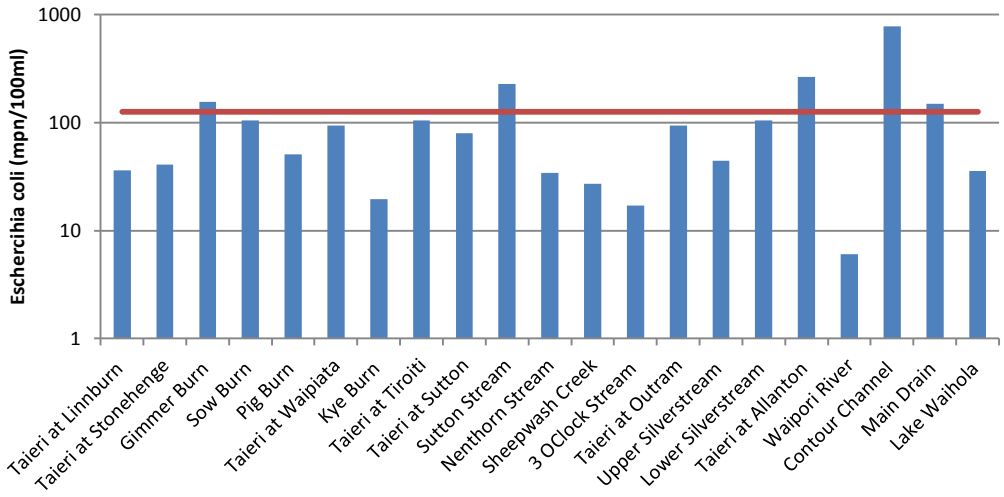


Dissolved reactive phosphorus (DRP) is a growth-limiting nutrient. Sources of DRP can be traced back to point source discharges of wastewater effluent, animal effluent, and fertiliser. The highest concentrations of DRP were in the Gimmer Burn (0.034 mg/l) and Sheepwash Creek (0.031 mg/l). Irrigated land in both these catchments is dominated by border dyke (Gimmer Burn) and wild flood (Sheepwash). These methods of irrigation are notorious for containing high concentrations of DRP.



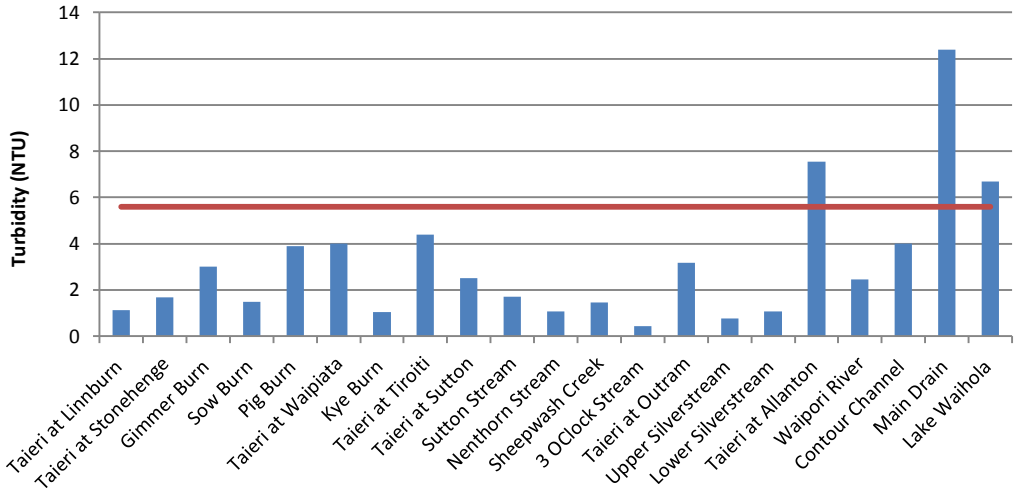
Bacteria

Median bacteria counts were relatively low and only exceeded the guideline at four sites. The Contour Channel had the highest *E. coli* count (780 cfu/100ml). There was a notable increase in *E. coli* counts between the Taieri mainstem sites between Sutton and Allanton.



Turbidity

Turbidity was low at most sites. Turbidity levels only became elevated in the lower Taieri. The Main Drain had the highest turbidity value (12.4 NTU) followed by the Taieri at Allanton (7.5 NTU).



Water quality references

Australian and New Zealand Environment and Conservation Council (ANZECC). 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Ministry for the Environment, Ministry of Health, 2003. Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Ministry for the Environment, Wellington.

Guidelines for bacteria

The ANZECC (1992) guidelines recommend a season median of less than 126 cfu (colony forming units)/100 ml.

The Ministry of Health and Ministry for the Environment (2003) guideline recommends that a single sample does not exceed 260 cfu/100 ml.

Kye Burn at SH85

Sow Burn at Patearoa

Guidelines for turbidity

Turbidity is a measure of how much light is able to penetrate the water column to the river bed. Streams with high turbidity often have high suspended sediment loads. Having high turbidity can reduce light penetration, impacting on macrophyte and algae's ability to photosynthesise, and reducing basal food supplies. High sediment loading also tends to smother bed habitat, creating poor fish spawning conditions.

The ANZECC guideline value for turbidity is less than 5.6 NTU (Nephelometric turbidity units).

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: streambed macroinvertebrates (e.g. insects, crustaceans, snails and worms) and periphyton (e.g. algae). Biotic indices are used to summarise a large amount of information into a compact and simple form. They are therefore, inherently coarse tools that give a broad view of general patterns. However, they are useful as the presence, abundance, or distribution of species can inform us greatly about the quality and condition of the river in which they live.

Limited algal growth in a stream

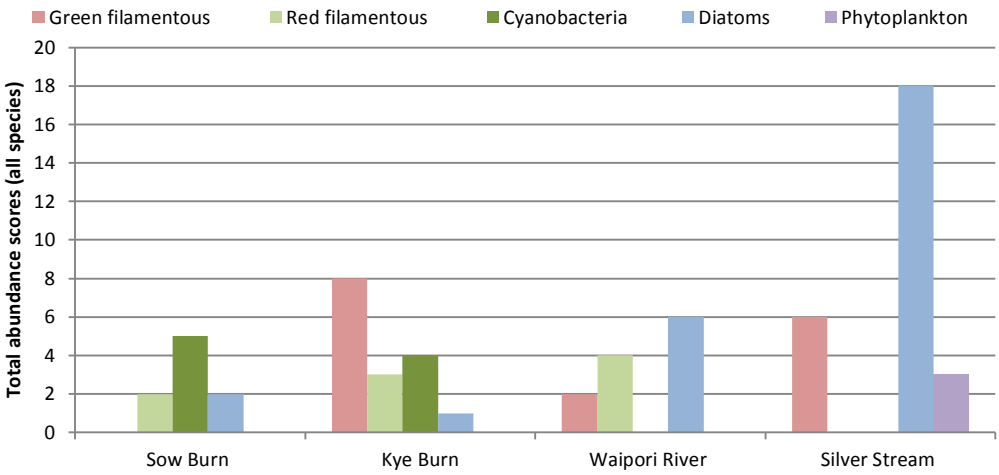
Silver Stream at Riccarton Road

Algae (periphyton)

Excessive amounts of periphyton, in particular, filamentous algae, can reduce the amenity value of waterways by decreasing their aesthetic appearance, reducing visibility, and being a physical nuisance to swimmers. While algae is a useful tool for monitoring the nutrient conditions in rivers and streams, it 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 composition, river flows, the amount of light reaching the river bed, and water temperature.

Algal samples were collected from four sites. Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocols developed by Biggs and Kilroy (2000). All abundance scores were added up for each algae type (graph below) to give an appreciation of relative abundance.

The Sow Burn had low total abundance scores and was dominated by cyanobacteria. The Silver Stream had the greatest abundance of periphyton and was dominated by diatoms. *Didymosphenia geminata* wasn't present at any of the sites, while *Phormidium* (toxic cyanobacteria) was present in the Silver Stream.



Macroinvertebrates (stream bed insects)

Macroinvertebrates are an important component of streams and rivers, as they aid ecosystem processes and provide food for fish. Macroinvertebrates are also good for assessing pollution, as different macroinvertebrates have differing pollution tolerances. They have a relatively long life span, and as such, are good indicators of environmental conditions over a prolonged period. The main measure of macroinvertebrate communities, 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 types can vary greatly between riffles, it is often appropriate to compare changes in MCI values at the same site over a period rather than between sites throughout the catchment. However, the MCI can still be a useful tool for picking up changes in ecosystem health, notwithstanding its limitations.

The Sow Burn had the healthiest macroinvertebrate community. Total taxa was 23, half of which were EPT taxa. This corresponded to the highest MCI and SQMCI scores for all the sites in the Taieri catchment. The least healthy site was the Silver Stream, out of the 11 taxa present, only one was in the EPT category (*Psilochorema*).

Category	No. of Taxa	EPT richness	MCI	SQMCI
Excellent	n/a	n/a	>120	>6
Good	n/a	n/a	>100 to 120	>5 to 6
Average	n/a	n/a	80 to 100	4 to 5
Poor	n/a	n/a	<80	<4
Site	**No. of Taxa**	**EPT richness**	**MCI**	**SQMCI**
Kye Burn	11	7	113	7.0
Silver Stream	11	1	87	5.0
Sow Burn	23	13	117	7.1
Waipori River	13	5	91	5.1

Collecting a kicknet sample in the Silver Stream

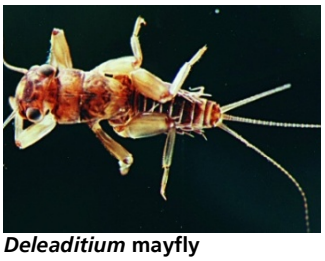
Indices to measure macroinvertebrate community health

Macroinvertebrate community index (MCI)
The MCI is calculated by adding the pollution tolerance scores of all species found at a site. Species that are very sensitive to pollution score highly. The invertebrates suited to muddy/weedy-bedded, pool-like habitats are generally the more tolerant, low-scoring taxa that tend to reduce MCI values.

Semi-quantitative macroinvertebrate community index (SQMCI).
The SQMCI is also based on the ratios of sensitive to tolerant taxa, but SQMCI results are primarily determined by the most abundant taxa (unlike the MCI where all taxa are given equal weight in the calculation.

EPT species
EPT richness is a sum of the total number of :
Ephemeroptera (mayflies);
Plecoptera (stoneflies) and;
Trichoptera (caddisflies) species collected.

EPT taxa are generally sensitive to a range of pollutants including fine sediment and nutrient enrichment.



***Deleaditium* mayfly**

Substrate composition

The size distribution of the stream substrate influences the habitat quality for algae, invertebrates and fish, and determines the quantity and quality of refuge from floods and predators *(Harding et al 2009).*

Kye Burn substrate

Riparian zone

Riparian zones are defined as areas where direct interaction between land and water occur. They have a large influence on stream habitat and water quality relative to their proportion of catchment area. Good riparian management usually involves fencing to exclude livestock and planting with native trees and shrubs in a riparian buffer.

Fenced off riparian zone

Reference

Harding, J. et al. 2009. Stream Habitat Assessment Protocols for Wadeable Rivers and Streams of New Zealand. University of Canterbury, New Zealand.

Habitat

Substrate composition

Physical habitat surveys are conducted every two years using the physical habitat assessment protocols (Harding et al. 2009). Specifically, protocols P2B3 and P2B4, P2C and P2D are used.

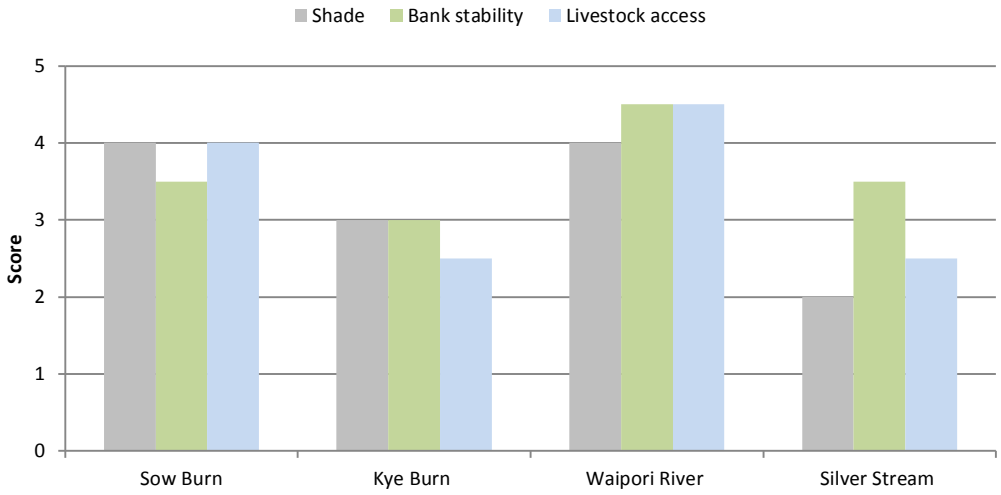
The Kye Burn had similar proportions of cobble and gravel substrate. The Waipori River and Silver Stream were dominated by cobble substrate.

	Boulder (256– 000mm)	**Cobble (64 - 255 mm)**	**Gravel (2 – 63 mm)**
Sow Burn			
Kye Burn	5	45	50
Waipori River	10	60	30
Silver Stream	0	80	20

Riparian zone

The Sow Burn, Kye Burn, and Waipori site were relatively stable and shaded. The Silver Stream had the least shade and relatively high livestock access.

	Score 1	Score 2	Score 3	Score 4	Score 5
Shading	Little	10 - 25%	25-50%	50-80%	>80%
Bank Stability	>40% recently eroded	>15-40% recently eroded	>5 to 15% recently eroded	1-5% recently eroded	<1% recently eroded
Livestock access	High	Moderate (access)	Limited	Very limited	None



Fish facts

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 part of their lifecycle in both fresh and salt water.

Exotic species such as trout are known to limit the range of native species through predation and competition. Often streams with large numbers of exotic species show lower densities and diversity among native fish species.

Central Otago Roundhead Galaxiid

Electrofishing is a common scientific survey method used to sample fish populations to determine abundance, density, and species composition.

Fish values

The most diverse site was Silver Stream due to its proximity to the ocean and its ability to support migratory species such as Inanga and lamprey. The Central Otago roundhead galaxiid (endangered species) was prevalent in the Kye Burn while the Sow Burn had a large brown trout population.

Site	Brown Trout	Long fin eel	Central Otago Roundhead	Inanga	Lamprey	Common Bully	Species present	% exotic
Sow Burn	478	1					2	50
Kye Burn	61	1	21				3	33
Silver Stream	58	3		24	10	9	5	20

Juvenile Lamprey

Adult Lamprey

Electrofishing in the Silver Stream

Waipori River at Falls Reserve

Kye Burn at SH85

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Further information on this and other Otago catchments is available on the ORC website:

www.orc.govt.nz

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