



# Clutha River/Mata-Au

Annual Monitoring Summary

2007-2008

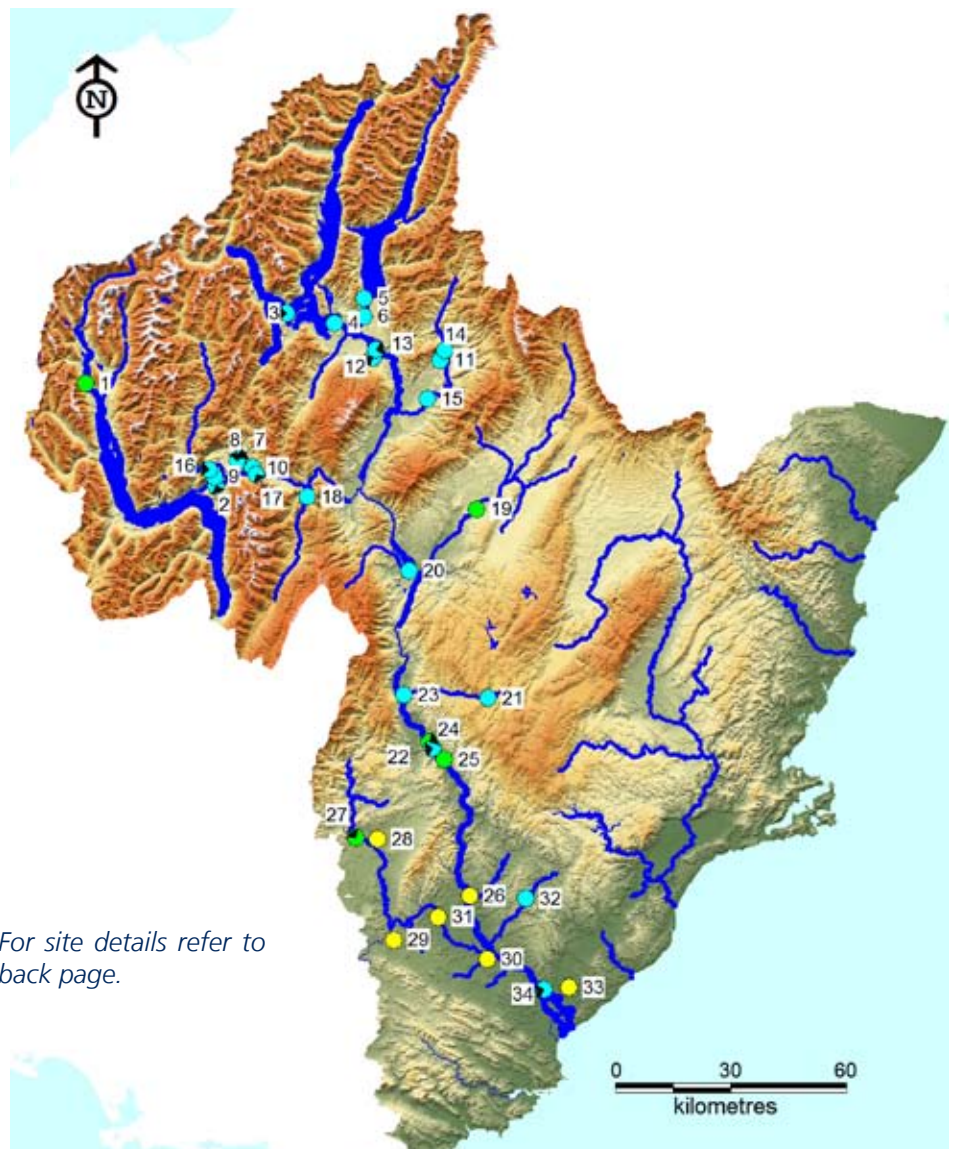
## Key points

- South West Otago's surface water is typically high in nutrients, exceeding the ANZECC water quality guidelines for nitrogen and phosphorus.
- The median level of *E. coli* was generally below the Department of Health (DoH) guideline level at all sites other than in the Pomahaka Catchment in South West Otago.
- There is a reasonable correlation between water quality and biological health.

## Water quality monitoring

Between June 2007 and the end of May 2008 the Otago Regional Council monitored 29 river and stream sites in the Clutha Catchment to assess the current state of water quality. Of these sites, seven are monitored only once every three years. NIWA monitored a further five sites (Clutha River/Mata-Au at Luggate, Millers Flat, Balclutha, the Kawarau River and the Shotover River). All the sites are shown in the map below. For historical results see previous report cards and trend analysis is available in the 2007 SOE report.

There are few significant point source discharges to freshwater in the Clutha Catchment and land use has the greatest effect on water quality. The sites with poorer water quality are generally intensively farmed, such as in South West Otago, whereas the sites with good water quality are in the upper catchment including the large lakes and upper tributaries.



*For site details refer to back page.*



## Guidelines & 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. Note: the ANZECC trigger values used here are for lowland rivers (< 150m).
- Otago's water quality standards are outlined in the Regional Plan: Water (Water Plan), which sets targets to maintain and improve water quality within the region.
- The Department of Health (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.



Heriot Burn at Parkhill-Kelso Road

## Water quality results

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

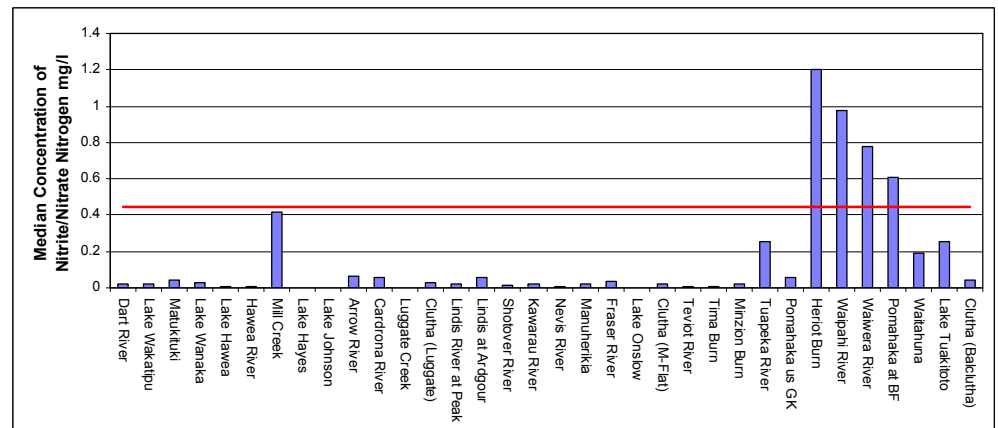
Median values of these variables were compared with ANZECC and DoH guideline levels, enabling classification of water quality into one of the following groups:

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

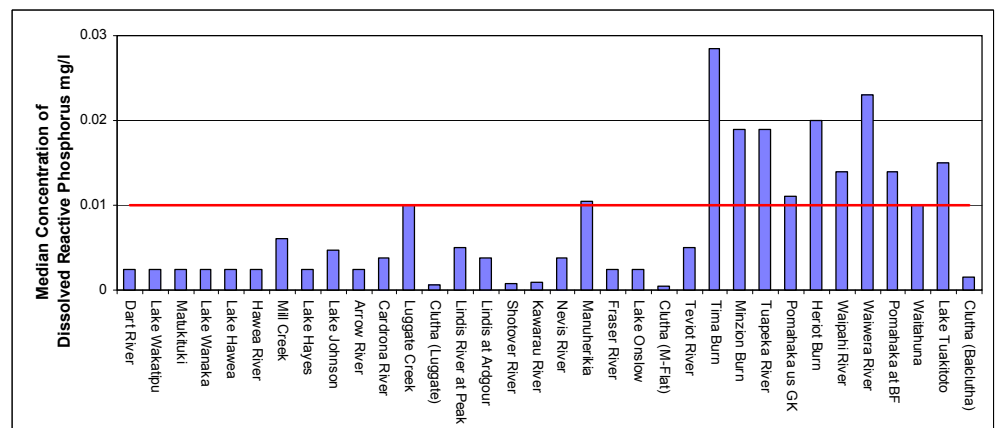
Selected water quality indicators are displayed in the graphs and discussed below. Overall these graphs show that water quality in the lakes and mainstem of the Clutha River/Mata-Au is generally very good, but poorer water quality is evident in the Pomahaka Catchment.

### Nutrients

Nitrite-nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It's an important nutrient for algae and other plant growth, but can be harmful in higher concentrations. The median concentration of NNN was above the ANZECC trigger value at four sites, all of which are in the Pomahaka River Catchment.

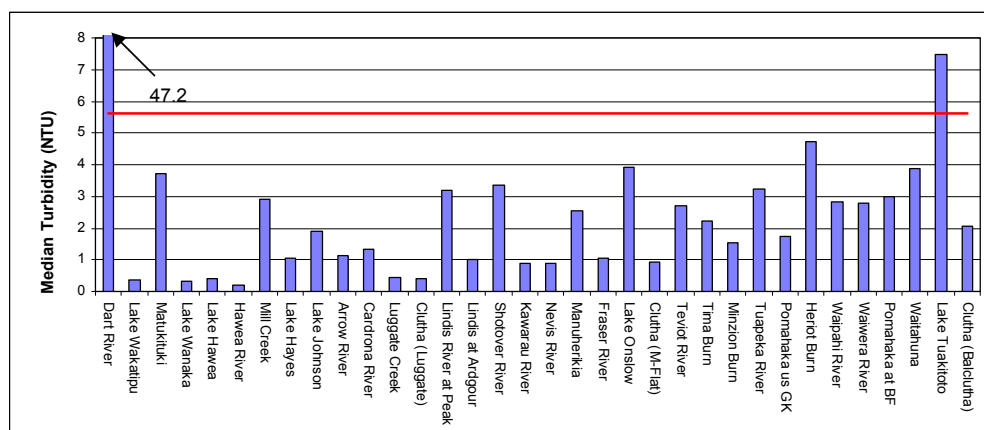


Median dissolved reactive phosphorus (DRP) concentrations were above the ANZECC trigger value at 10 of the sites monitored. These high DRP sites included the lower Manuherikia, the Tima Burn and Minzion Burn, the Tuapeka River, all sites in the Pomahaka Catchment and Lake Tuakitoto.



## Turbidity

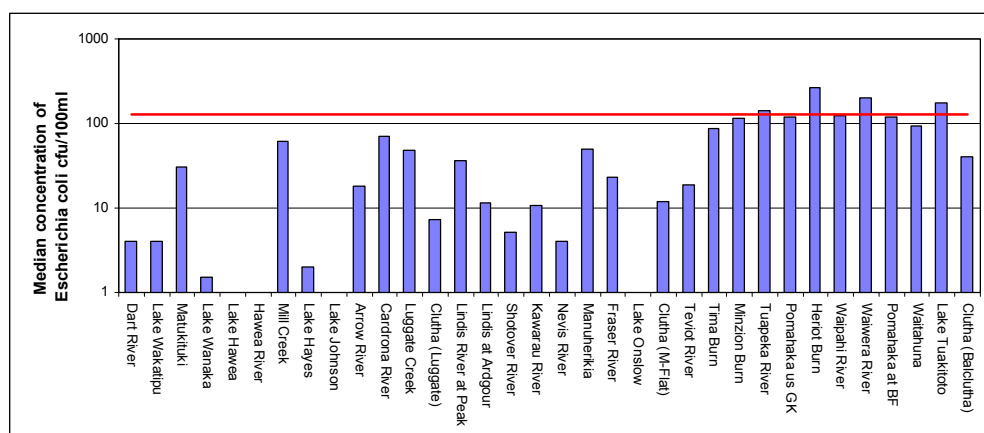
Turbidity was elevated above the ANZECC trigger value at only two sites - the shallow Lake Tuakitoto and the Dart River.



## Bacteria

Median levels of *E. coli* were above the DoH guideline (126 cfu/100ml) at only four sites: the Tuapeka River, the Heriot Burn and Waiwera River in the Pomahaka Catchment and Lake Tuakitoto.

All other sites showed bacteria levels below the trigger value indicating minimal overall health risk. However, bathers should be aware that bacteria levels are likely to be high immediately following rainfall events.



## Other analytes

- NH<sub>3</sub> is the main toxic component of ammoniacal nitrogen, the toxicity of which is dependent on pH and temperature. Taking these factors into account, none of the sites other than Lake Hayes (December sample) and Lake Johnson (February sample) had NH<sub>3</sub> concentrations likely to be toxic to fish (>0.021 mg/l).
- Water at all sites was neutral with respect to pH, falling within ANZECC guideline levels.
- Dissolved oxygen saturations should be **above** 80%, which was the case at all sites
- Total nitrogen was elevated above the trigger level at most sites in the Pomahaka Catchment, as well as the Tuapeka River. Lake Johnson and Lake Tuakitoto also had elevated levels of TN.
- Total phosphorus was elevated above the ANZECC trigger value in the Dart River, Lake Johnson and Lake Tuakitoto, the Tima Burn and Minzion Burn, the Tuapeka River and Waitahuna River as well as most sites in the Pomahaka Catchment.



Lindis River at Ardgour Road

## Biological indices

- MCI – The Macroinvertebrate Community Index is 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.

## Ecosystem health results

Ecosystem health takes into account a wide range of inter-linked factors, such as water quality, habitat and instream biota. It's 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. They're therefore inherently coarse tools that give a broad view of general patterns. However, they're useful as the presence or absence, abundance and distribution of species can inform us greatly about the quality and condition of the site at which they live.

### Macroinvertebrate health

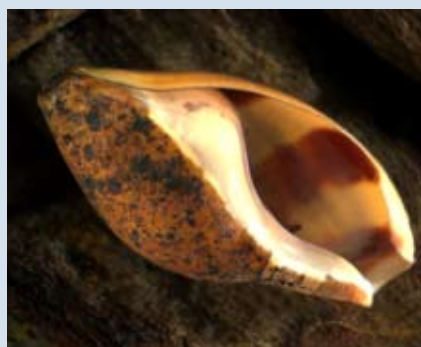
A key component of the MCI index is the availability of suitable habitat. As the MCI index is specifically designed for stony riffle substrates in flowing water, MCI values can vary due to the availability of suitable habitat and not necessarily due to water quality. As substrate type can vary greatly between riffles, it's often more appropriate to compare changes in MCI values at the same site over a period of time, rather than between sites throughout a catchment. However, taking this limitation into account, the MCI index is still useful for noting improvement or deterioration in water quality at an individual site over time.

### Criteria for macroinvertebrate health

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

### Clutha River/Mata-Au macroinvertebrate health 2007 - 2008

Sample location	Total species	EPT taxa	MCI	SQMCI
Cardrona River @ Mt Barker	16	8	101	5.7
Fraser River @ Marshall Rd	18	10	106	3.7
Heriot Burn @ Parkhill/Kelso Rd	17	10	100	4.9
Kaihiku @ Clifton Rd	15	4	79	4.1
Kaihiku @ Hillfoot Rd	19	10	106	5.7
Lindis River @ Ardgour Rd	19	10	104	2.4
Luggate Creek @ Luggate Creek Br	19	9	94	3.0
Manuherikia River @ Blackstone	20	13	111	6.1
Mill Creek @ Fish Trap	9	4	89	5.9
Waipahi River @ Cairns Peak	14	6	90	3.7
Waipahi River @ Waipahi	19	6	78	3.6
Wairuna Stream @ Clydedale-Waipahi	14	3	77	4.0
Waitahuna River @ Tweeds Bridge	13	8	105	5.3
Waiwera River 1km upstream Clutha	22	9	85	3.6



Mollusc (*Melanopsis*). Source, Stephen Moore

Six sites recorded poor SQMCI scores (Fraser River, Lindis River, Luggate Creek, Waipahi River at two sites and the Waiwera River). At all these sites the substrate for macroinvertebrates is good. The SQMCI at Fraser River and the Lindis River at Ardgour



Road changed from a rating of excellent in 2007, to one of poor in 2008, although the MCI at these sites remained excellent. The Waipahi River also changed from an MCI and SQMCI of average in 2007 to one of poor in 2008. Mill Creek above Lake Hayes, the Kaihiku Stream and the Wairuna Stream scored poorly for EPT species, which was likely to be due to fine sediments or marginal habitat suitability.

## Periphyton

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	Cladophora (Green Algae)	Microspora (Green Algae)	Rhizoclonium (Cyanobacteria)	Oscillatoria (Cyanobacteria)	Didymosphenia (Diatom)
Cardrona River @ Mt Barker				7	
Kaihiku Stream @ Clifton Rd	6				
Lindis River @ Ardgour Rd					8
Manuherikia River @ Blackstone					6
Mill Creek @ Fish Trap				6	
Waipahi River @ Cairns Peak	6				
Wairuna Stream @ Clydevale-Waipahi Rd			7		
Waitahuna River @ Tweeds Bridge				8	
Waiwera River 1km upstream Clutha		6			

The invasive species *Didymosphenia geminata* was present in four samples (Cardrona River at Mt Barker, Fraser River at Marshall Road, Lindis River at Ardgour Road and the Manuherikia River at Blackstone). Cyanobacteria (blue green algae) were found at four sites (Waiwera River, Waitahuna River, Mill Creek and the Cardrona River).



Diatom (*Didymosphenia*). Source, Environment Southland.

## 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).



Manuherikia River at Blackstone

## 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 16 streams across the Clutha Catchment, with nine species of fish being observed in the catchment as a whole. The most widely distributed species in the catchment is the exotic brown trout (observed in 75% of the Clutha sites), while both Perch (exotic) and the Clutha flathead galaxiid were the least frequently observed, being caught in only 6% of surveyed sites.

### Observations of fish species in the Clutha catchment 2008.

2008 electro-fishing sites	Native						Exotic			Number of species	% Native species
	Upland bully	Common bully	Koaro	Clutha flathead galaxiid	Longfin eel	Lamprey	Brown trout	Rainbow trout	Perch		
Fraser River at Marshall Rd							X	X		2	0
Minzion Burn at Millers Flat Rd					X	X	X			3	67
Teviot at Roxburgh East				X	X	X	X			4	75
Tuapeka at Mouth		X			X		X			3	67
Tima Burn at MF Roxburgh Rd					X			X		2	50
Nevis at Wentworth							X	X		2	0
Arrow at Morven Ferry Rd								X		1	0
Cardrona at Mt. Barker	X		X				X	X		4	50
Hayes Creek at SH6		X							X	2	50
Lindis at Ardgour Road	X						X			2	50
Luggate Ck at SH6 Br							X			1	0
Mill Creek at Fish Trap		X					X			2	50
Heriot Burn at Parkhill Rd	X		X				X			3	67
Waipahi River at Waipahi	X				X	X	X			4	75
Waitahuna at Tweeds Bridge	X						X			2	50
Waiwera River 1km u/s Clutha	X									1	100
% of sites species was observed	37	19	12	6	31	19	75	31	6		

Fish species diversity among Clutha sites averaged 2.4 species per site, which is slightly lower than the Otago average of 3.4 species per site. Diversity was generally highest at sites closer to the coast, though no more than four species of fish were recorded at any single site in the Clutha Catchment. At least one exotic species was present in 15 of the 16 sites surveyed, with brown trout found throughout the catchment. Eels were found in 63% of sites located below the existing dams on the main stem Clutha River/Mata-Au, but neither eels nor lamprey were observed at any of the sites located above these dams.

## River flows

Flow statistics have been calculated for five monitoring sites across the Clutha Catchment between July 2007 and June 2008. Low flows have been examined as well as the highest flows of the 2007/08 period. The 7-day low flow in the Lindis River at Lindis Peak was 0.9 m<sup>3</sup>/s (40% below the MALF for this site). This occurred during an extended period of low flow throughout March and April 2008. Low flows in the Manuherikia River at Ophir were close to normal this year (-12.8%) with a 7-day low flow of 1.9 m<sup>3</sup>/s.

The lower Clutha experienced one of the driest summers on record, with the Waipahi River at Waipahi recording its lowest 7-day flow for 10 years (1.37 m<sup>3</sup>/s) which was 74% below MALF. Flows in the Pomahaka River at Burkes Ford were half of MALF, with a 7-day low flow of 2.7 m<sup>3</sup>/s.

No significant flooding occurred in the Clutha Catchment this year, with all sites recording maximum flows well below historical flood events.

### 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
Cardrona at Mt Barker	0.955	0.415	-56.5	145.3	48.9
Lindis at Lindis Peak	1.522	0.911	-40.1	322.2	53.1
Manuheridia ds Ophir	2.171	1.893	-12.8	602.4	19.5
Pomahaka ds Burkes Ford	5.358	2.662	-50.3	1157.3	478.5
Waipahi @ Waipahi	1.217	0.314	-74.2	379.9	182.0

\*Note: all flows are given in m<sup>3</sup>/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.



*Hydrological monitoring station on the Clutha River/Mata-Au*

## Recent ORC reports

- Monitoring the effects of irrigation runoff on water quality (Thompsons Creek, Ida Burn, Chatto Creek), May 2006.
- Water Quality of the Lindis and Cardrona Rivers, May 2006.
- State of Environment Report, Surface Water Quality in Otago (May 2007).

## Key to water monitoring sites.

Name of site	No.
Dart River @ G-Routeburn Rd	1
Lake Wakatipu	2
Matukituki @ W Wanaka	3
Lake Wanaka	4
Lake Hawea	5
Hawea @ Camphill Br	6
Mill Creek	7
Lake Hayes	8
Lake Johnson	9
Arrow @ Morven F Rd	10
Cardrona @ Mt Barker	11
Luggate Ck @ SH6	12
Clutha @ Luggate NIWA	13
Lindis @ Lindis Peak	14
Lindis @ Ardgour Br	15
Shotover NIWA	16
Kawarau NIWA	17
Nevis River	18
Manuherikia ds Ophir	19
Fraser River @ Marshall Rd	20
Lake Onslow	21
Clutha @ Millers Flat NIWA	22
Teviot	23
Tima Burn @ Roxburgh	24
Minzion Burn	25
Tuapeka River	26
Pomahaka us Glenken	27
Heriot Burn PH-Kelso Rd	28
Waipahi @ Waipahi	29
Waiwera River 1km us Clutha	30
Pomahaka ds Burkes Ford	31
Waitahuna @ Tweeds Br	32
Lake Tuakitoto	33
Clutha @ Balclutha NIWA	34

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