Clutha catchment

Water quality, macroinvertebrates, algae, fish, instream habitat and river flow

July 2009 to June 2010

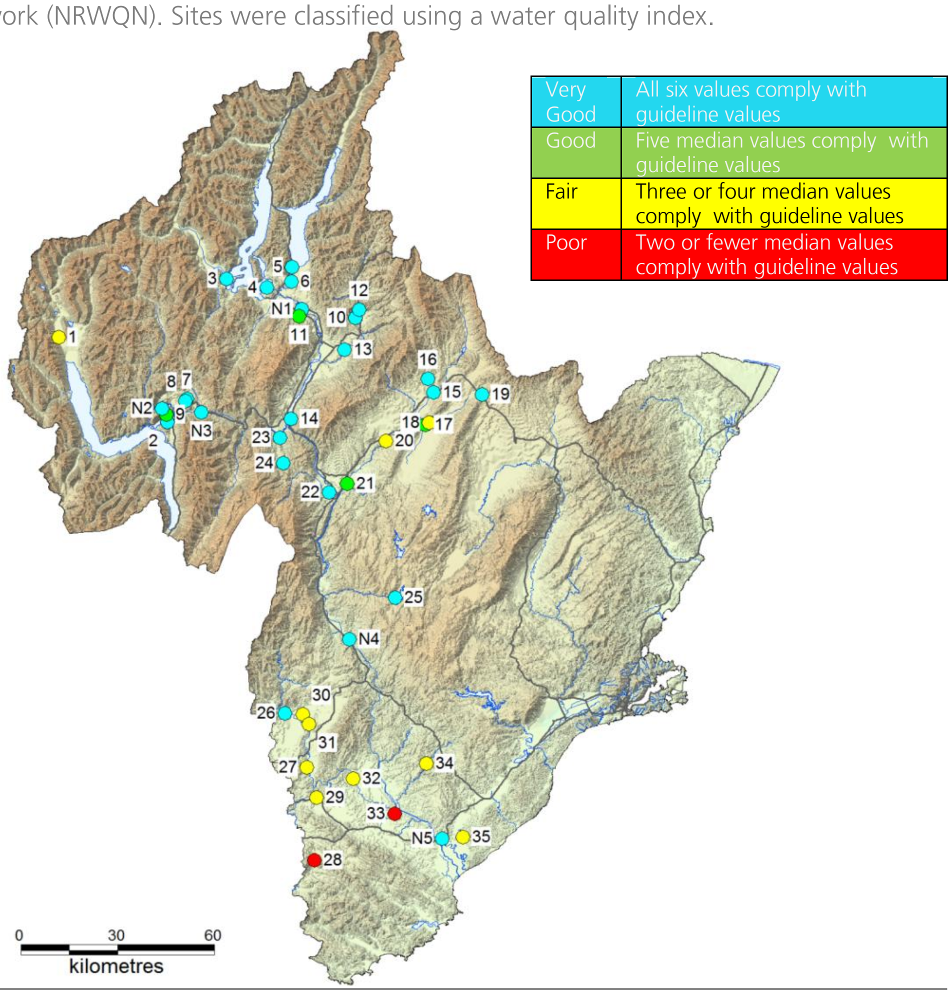
Otago Regional Council

Sites on map

No.	ORC Site
1	Dart River
2	Lake Wakatipu
3	Matukituki River
4	Lake Wanaka
5	Lake Hawea
6	Hawea River
7	Mill Creek
8	Lake Hayes
9	Lake Johnson
10	Cardrona River
11	Luggate Creek
12	Lindis River at Peak
13	Lindis at Ardgour
14	Lake Dunstan
15	Manuherikia Blackstone
16	Dunstan Creek
17	Pool Burn
18	Ida Burn downstream
19	Ida Burn upstream
20	Manuherikia at Ophir
21	Manuherikia Galloway
22	Fraser River
23	Bannock Burn d/stream
24	Bannock Burn upstream
25	Lake Onslow
26	Pomahaka upstream
27	Waikoikoi Stream
28	Waipahi upstream
29	Waipahi downstream
30	Heriot Burn
31	Crookston Burn
32	Pomahaka downstream
33	Waiwera River
34	Waitahuna
35	Lake Tuakitoto
NIWA	NRWQN sites
N1	Clutha at Luggate
N2	Shotover Bowens Peak
N3	Kawarau at Chards
N4	Clutha at Millers Flat
N5	Clutha at Balclutha

Water quality sites

Between July 2009 and the end of June 2010 the Otago Regional Council (ORC) monitored 35 river and stream sites in the Clutha catchment to assess the current state of water quality. Most sites were monitored bi-monthly, but five further sites (Clutha River/Mata-Au at Luggate, Millers Flat and Balclutha, the Kawarau River and the Shotover River) were monitored monthly by NIWA as part of the national river water quality network (NRWQN). Sites were classified using a water quality index.



Water quality index

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

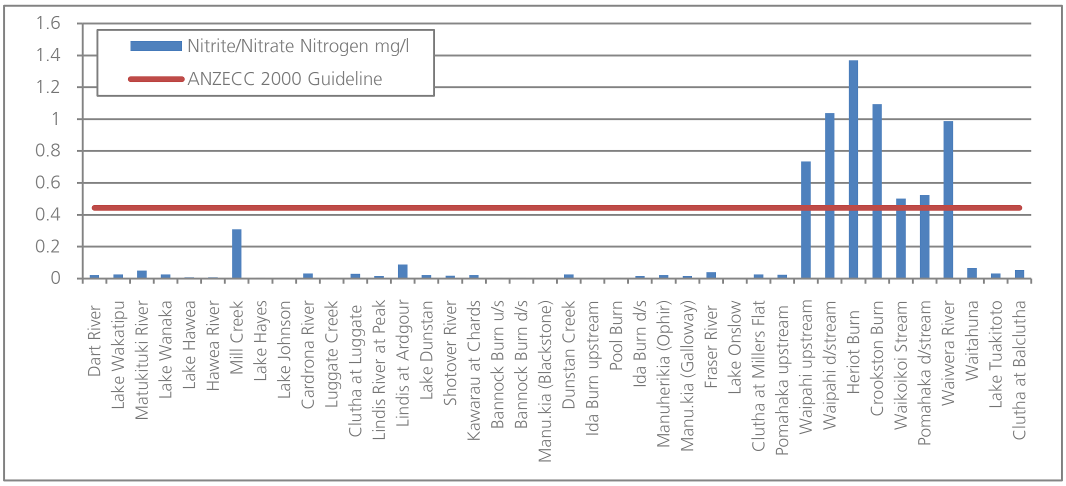
Median values of the six values are compared with ANZECC (2000) and MfE/MoH (2003) guidelines, enabling classification of water quality into one of the four groups.

Water quality

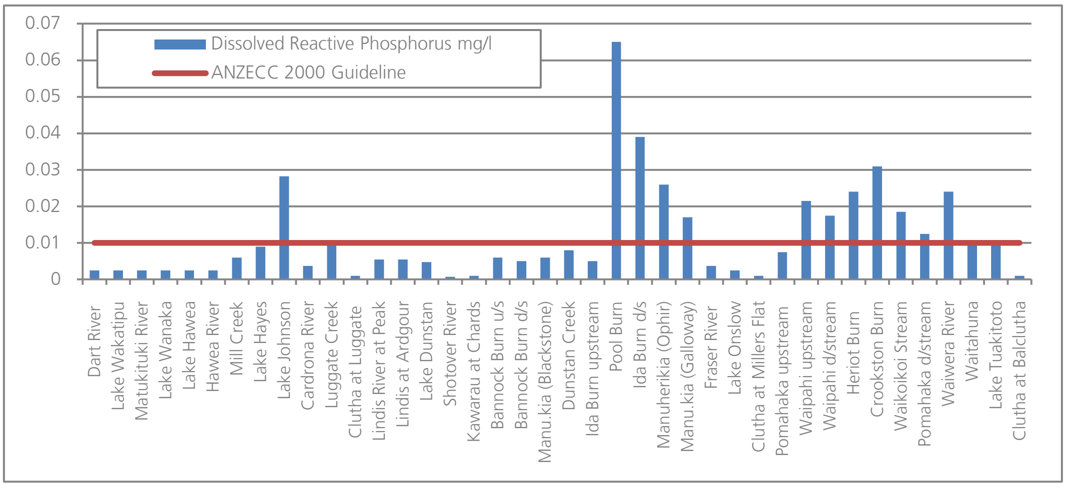
Selected water quality indicators are displayed in the graphs and discussed below. Overall these graphs show that water quality in the lakes and main-stem of the Clutha River/Mata-Au is generally very good, but poorer water quality is evident in the Pomahaka catchment.

Nutrients

Nitrite-nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It is an important nutrient for algae and other plant growth, but can be harmful in higher concentrations. The figure below shows that the median concentration of NNN was above the ANZECC trigger value at seven sites, all of which were in the Pomahaka River catchment. Total nitrogen exceeded the guideline value at nine sites, including Lake Johnson, Pool Burn and the same seven Pomahaka sites.



Dissolved reactive phosphorus (DRP) is a growth-limiting nutrient, concentrations of which are affected by wastewater effluent, fertilisers and animal waste. The graph below shows that the median DRP concentrations were above the ANZECC trigger value at 15 of the sites monitored.



These high DRP sites included Lake Johnson, four sites in the Manuherikia catchment, all sites in the Pomahaka catchment, the Waitahuna River and Lake Tuakitoto. Total phosphorus exceeded the guideline level (0.033 mg/l) at 14 of the sites monitored. These sites were similar to the sites that exceeded the DRP guideline, but included the Dart River, where naturally high levels of suspended solids are associated with total phosphorus.

Water quality

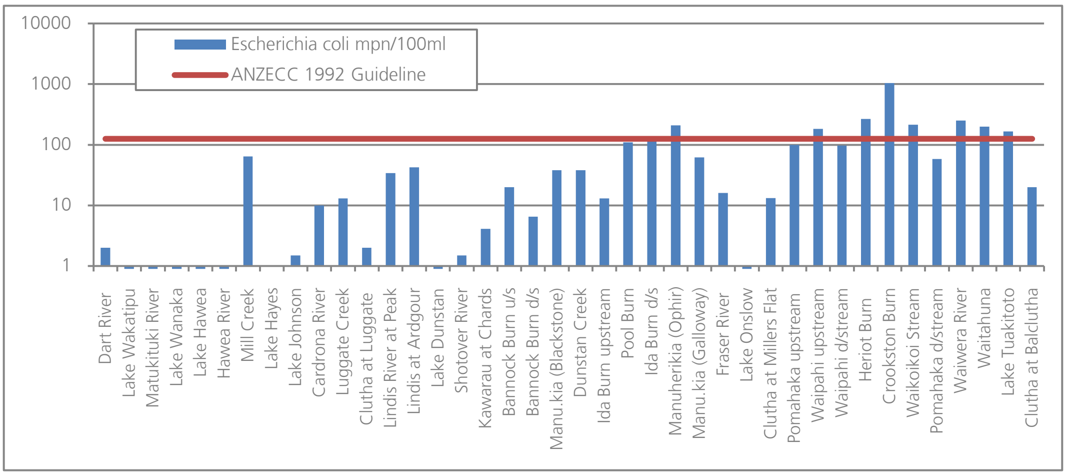
- There are few significant point source discharges to freshwater in the Clutha catchment and land use has the greatest effect on water quality.
- The sites with poorer water quality are generally intensively farmed, such as in South-west Otago, whereas sites with good water quality are in the upper catchment including the large lakes and upper tributaries.
- 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 MfE/MoH guideline level at all sites except in the Pomahaka River catchment in South-west Otago.

Guidelines for nutrients

- 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 ANZECC (2000) guidelines outline trigger values for lowland watercourses (< 150m). The trigger value specifies a level below which the risk of adverse biological effect is low.

Bacteria

Median levels of *E. coli* were above the ANZECC (1992) guideline (126 /100ml) at five sites in the Pomahaka catchment: Waipahi River upstream, Heriot Burn, Crookston Burn, Waikoikoi Stream and Waiwera River, as well as the Manuherikia at Ophir, the Waitahuna River and Lake Tuakitoto. All other sites showed median bacteria levels below the trigger value; however, *E.coli* levels are likely to be high immediately following rainfall events. Of the 35 sites, 19 were safe for swimming on every sampling occasion.



Guidelines for bacteria

• The 1992 ANZECC guidelines recommend a season median of less than 126 *E.coli*/100ml

• The Mfe/MoH (2003) guidelines recommend that a single sample does not exceed 260 *E.coli*/100ml.

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.

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. They are therefore 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 inform us greatly about the quality and condition of the site at which they live.

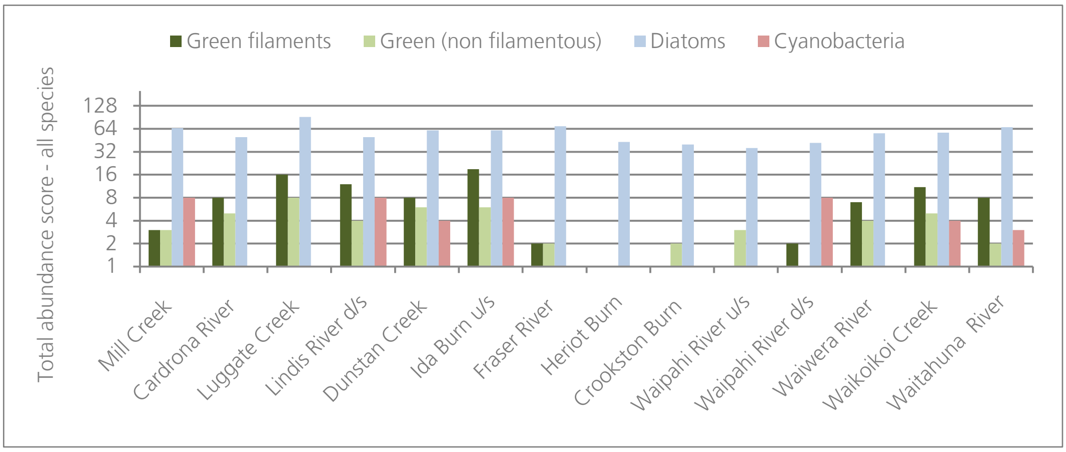
Algae (periphyton)

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 character, river flows, the amount of light reaching the river bed and the water temperature.

Crookston Burn

Waipahi River downstream

Algal samples were collected at 14 sites. Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocol of Biggs and Kilroy (2000 [1]). The abundance scores were added together for four algae types (see figure overleaf). It can be seen that all sites are dominated by diatoms, particularly the Heriot Burn, Crookston Burn and Waipahi River which have very little other algal species. Filamentous algae is most prevalent in Luggate Creek, the Ida Burn, Mill Creek and the Lindis River, while the Ida Burn and Waipahi River downstream have the most cyanobacteria.



Macroinvertebrate health

The diversity of the macroinvertebrate community depends in part on the availability of suitable habitat. The macroinvertebrate community index (MCI) 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 it still can be useful for picking up improvements or deterioration in water quality at individual sites over time.

Criteria for macroinvertebrate health

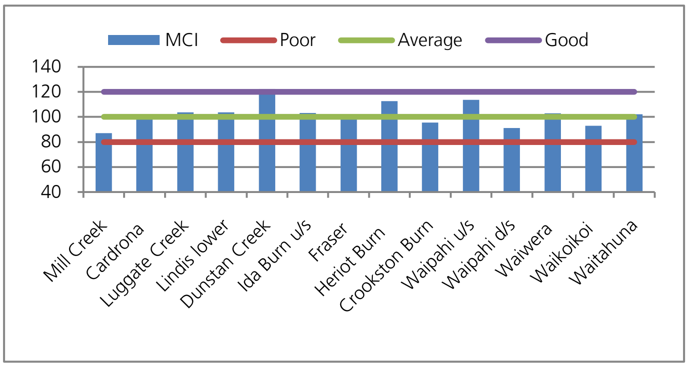
	Total Species	EPT Taxa	MCI	SQMCI
Poor	<10	<5	<80	<4
Average	10 to 20	>5 to 15	>80 to 99	>4 to 5
Good	>20 to 30	>15 to 20	>99 to 120	>5 to 6
Excellent	>30	>20	>120	>6

Poorer macroinvertebrate health is generally found in the lower catchments, where habitat for macroinvertebrates is degraded, typically through sediment buildup.

Of the 14 sites monitored, MCI scores and total species scores at all sites were average or good. This is the same situation as last year. The Waitahuna River, Waipahi River upstream and Dunstan Creek had very good semi-quantitative macro-invertebrate community index (SQMCI) scores. This is a big improvement for the Waipahi River, as it had an SQMCI score of poor in 2007. Habitat availability constrains macro-invertebrate diversity in Mill Creek (above Lake Hayes) and Luggate Creek, which both had a poor SQMCI. Ephemeroptera,Plecoptera and Trichoptera (EPT) richness at all sites was average tending to poor. Poor EPT scores at Waipahi River downstream and Crookston Burn reflect poorer water quality as well as poor habitat availability.

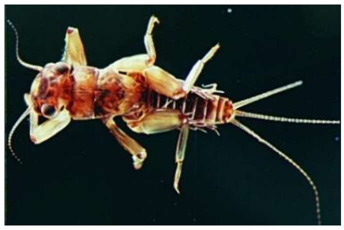
[1] Biggs, B.j.F. & Kilroy, C. 2000. Stream periphyton Monitoring Manual. NIWA, Christchurch, New Zealand. 246 p.

Macroinvertebrate community index (MCI)



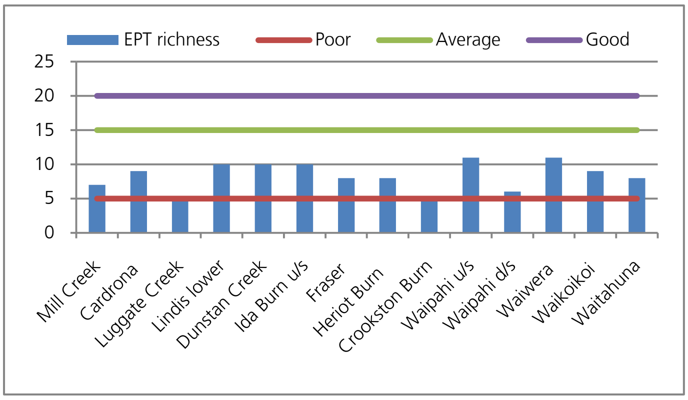
The graph to the left shows the MCI. This index is based on adding the pollution tolerance scores of all species found at a site.

Species that are very sensitive to pollution score highly whereas the invertebrates suited to muddy/weedy-bedded, pool like habitats are generally the more tolerant, low-scoring taxa that tend to reduce MCI values.



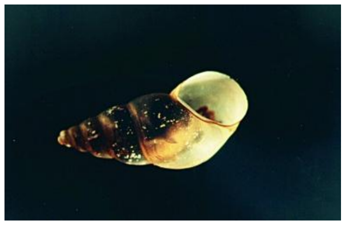
Mayfly *(Austroclima)*. Source: Stephen Moore

EPT species



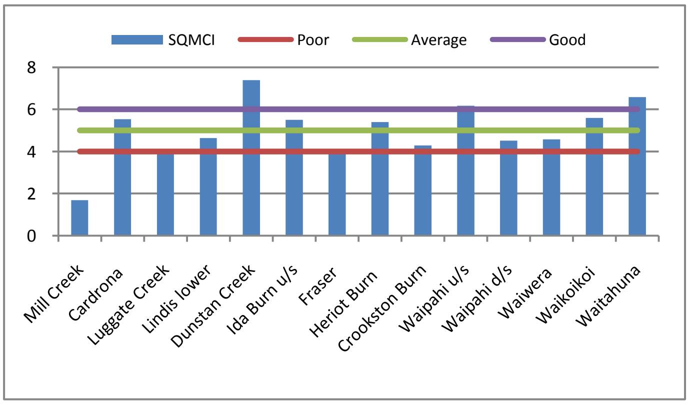
The graph to the left shows EPT richness, this index is a sum of the total number of **E**phemeroptera (mayflies), **P**lecoptera (stoneflies), and **T**richoptera (caddisflies) species collected.

EPT taxa are generally sensitive to a range of pollutants including fine sediment and nutrient enrichment, but they are also sensitive to increases in temperature and decreasing dissolved oxygen levels (both of which can naturally occur with distance downstream.



Mollusc (*Potamapyrgus*). Source: Stephen Moore

Semi-quantitative Macroinvertebrate community index (SQMCI).



The graph to the left shows the SQMCI. This index 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).

Worm (*Oligochaete*). Source: Stephen Moore

.

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.

Fish

Electro-fishing was conducted in the summer of 2010 at nine sites (eight streams) in the Clutha catchment. At these sites nine species of fish were observed cumulatively.

Observations of fish species in the Clutha catchment 2010

Site	Cardrona	Heriot Burn	Lindis lower	Lindis upper	Luggate Ck	Mill Creek	Waipahi lower	Waiwera	Manuherikia upper
Upland Bully	45	8	141	122		208	4	117	94
Longfin eel		2	1				6	19	
Clutha Flathead							1		
Galaxiid sp.		3				2			
Koaro	29								
Koura							P	P	
Perch						5	1		
Brown Trout	9	51	187	20	144	38	11	113	66
Rainbow Trout	11			2					
Number of species	4	4	3	3	1	4	6	5	2
% exotic fish	20	30	57	15	100	17	52	45	41

P = present

Brown trout were present at all sites. In all three species of exotic fish were observed. The most widely distributed native species were the upland bully (eight sites) and the longfin eel (four sites). Clutha flathead and Koaro were the least common freshwater species and found at only one site each. Fish species diversity in the Clutha catchment averaged 3.4 species per site, which was lower than the Otago average (2010) of 5.96 species per site.

Four or more species were observed at five sites and the Waipahi River lower was the most diverse fishery site with six species of fish and Luggate Creek was the least diverse with only brown trout found.

The percentage of native species per site was high, with only the Heriot Burn, Lindis River lower and Luggate Creek having more than 50% of their catch as exotic species.

Trout found in the Pomahaka catchment

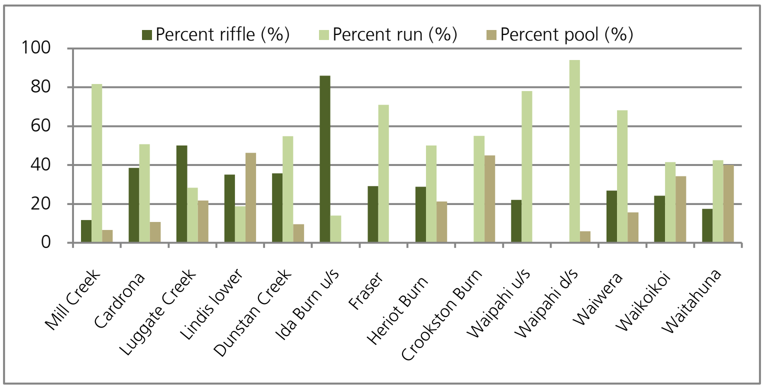
Habitat assessment

In 2010 ORC undertook stream habitat assessment for the first time. The physical character of a stream determines the quality and quantity of habitat available to biological organisms and the stream's aesthetic and amenity values. Physical habitat is the living space for all in stream flora and fauna, it is spatially and temporally dynamic and its condition and characteristics set the background for any assessment of the health of a waterway.

This section will only focus on three of the parameters analysed: flow type, substrate composition and riparian cover.

Flow type

The figure below shows flow type (%) at each ecological monitoring site.



The Crookston Burn and Waipahi River lower have no riffles, while the Ida Burn, Fraser River and Waipahi River upper have no pools. The Ida Burn has the most riffle flow type (86%) while Waipahi River lower and Mill Creek have the most run flow type (>80%).

Flow type

The more diverse the flow types at a site, the more ecological habitat available.

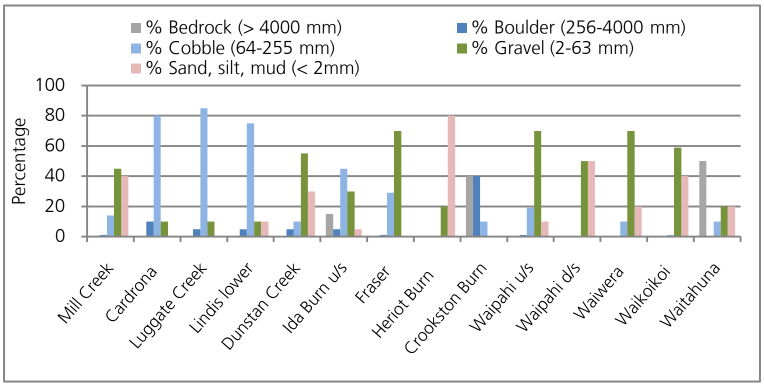
Riffle: shallow depth, moderate to fast water velocity with mixed currents, surface rippled but unbroken.

Run: slow with moderate depth and water velocity, uniform to slightly variable current, surface unbroken, smooth to rippled.

Pool: deep, slow flowing with a smooth water surface, usually where the stream widens and/or deepens.

Substrate composition

The figure below shows the substrate size (%) at each ecological monitoring site.



The figure to the left gives a good indication of the composition of the stream bed and likely habitat availability in runs. It is immediately apparent that the Heriot Burn (with a high percentage of sand silt and mud) will be one of the less ecologically diverse sites.

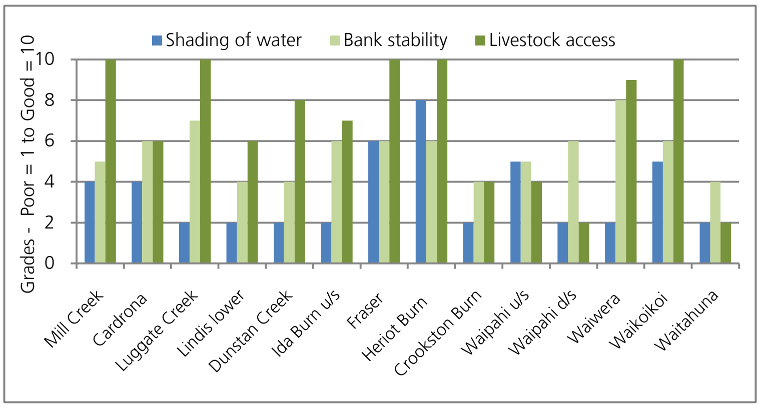
Substrate composition

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[1]).

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

Riparian zone

The figure below shows the state of riparian health at each ecological monitoring site.



Of the 14 sites monitored only five had complete livestock exclusion. The Waitahuna River had the most opportunity for livestock access. The Fraser River and Heriot Burn scored six or more for shading and bank stability was generally good with Luggate Creek and the Waiwera scoring more than six.

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. Riparian management usually involves fencing to exclude livestock and planting with native trees and shrubs in a riparian buffer.

River flow facts

- The 7-day low flow refers to the lowest 7-day average flow for a given year.
- The 7-day mean annual low flow (MALF) is the average of all the 7-day low flows over the term of record.
- The mean annual flood is the average flood flow expected each year based on the length of the record.

River flows

The rate of flow is an important determinant of the biological health of a steam or river, especially the extreme high and low flows. Low and high flow statistics have been calculated for a number of sites throughout the catchment from 1 July 2009 to 30 June 2010.

River flows in the Clutha catchment were extreme this year with the majority of sites experiencing mean annual low flows (MALF) that were considerably lower than the historical average. Dunstan Creek was as much as 72% lower than normal while the Cardrona River at Mount Barker was just over 40% lower than normal. The Matukituki River at West Wanaka had about normal low flows The Hawea River at Camphill Bridge was the exception, with flows a third higher than normal. Flood flows were not as high this year when compared to the historical average. The maximum flood flow in the Clutha River/Mata-Au at Balclutha was more than 400 cumecs less than average and the Lindis River at Lindis Peak had flood flows which were more than a third lower than normal. The Matukituki River at West Wanaka and the Waitahuna River at Tweeds Bridge both had higher flood flows this year than normal.

Site	7- day low flows			Flood flows	
	2009/ 2010	Historical (MALF)	% change	2009/ 2010	Historical (mean annual flood)
Matukituki River at West Wanaka	16.8	16.23	4	871	861
Hawea River at Camphill Bridge	12.5	9.34	34	200	221
Cardrona River at Mt Barker	0.54	0.91	-41	20.2	61.8
Lindis River at Lindis Peak	0.98	1.55	-37	38.7	104
Lindis River at Ardgour Rd	0.21	0.24	-13	25.3	48.9
Dunstan Creek at Beattie Rd	0.11	0.37	-72	22.5	37.4
Manuherikia River at Ophir	1.3	2.12	-38	75.3	173
Waitahuna River at Bridge	0.62	0.74	-16	95.0	49.2
Waipahi River at Waipahi	0.56	0.62	-10	92.2	110
Pomahaka River at Burkes Ford	3.3	4.45	-27	250	391
Clutha River at Balclutha	254	283	-11	855	1286

Low flows in the Lindis River at Ardgour Rd

Otago Regional Council
70 Stafford Street
Private Bag 1954
Dunedin

03 474 0827
0800 474 082

Further information on the Clutha River is available on the ORC website:

www.orc.govt.nz

Otago Regional Council