

North and Coastal Otago

Summary Report July 08 - June 09



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Water quality monitoring

Between July 2008 and June 2009, the Otago Regional Council (ORC) monitored 19 river and stream sites in the northern and coastal areas of Otago to assess the current state of water quality. Most sites were monitored bimonthly.

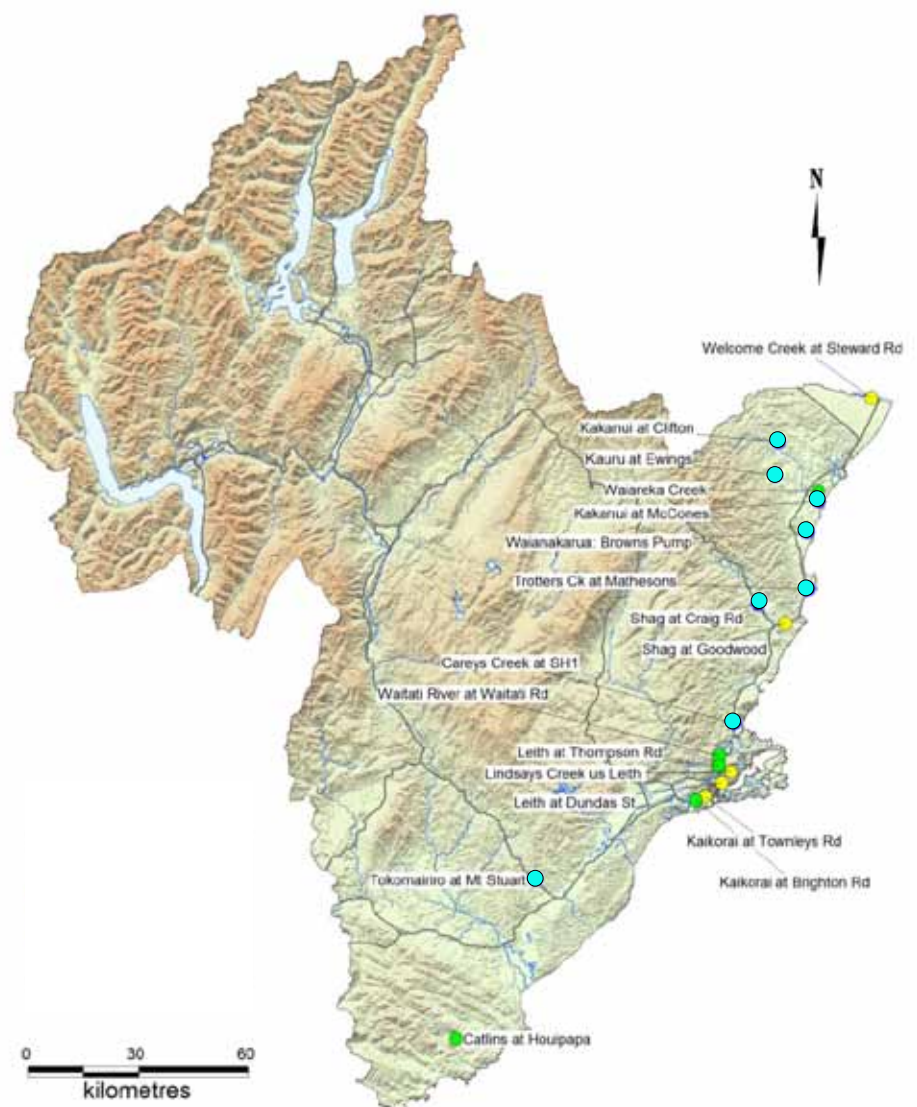
Sites were classified using a water quality index, and the results are shown in the map below.

The water quality index is derived from median values of six 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 MfE/MoH 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

Discharges to streams and rivers in North and Coastal Otago comprise of point sources such as treated sewage and industrial discharges.

However, land use has the greatest effect on water quality and the sites with poorer water quality include urban sites such as Dunedin city streams as well as streams in intensively farmed catchments such as Waiareka Creek.



Key Points

- Two sites were classified as poor in 2008. This was due to low dissolved oxygen levels in Waiareka Creek and Trotters Creek.
- The Kakanui River had much higher levels of *E. coli* bacteria than in 2007.
- Dunedin's urban streams had high concentrations of nutrients and bacteria.
- The Owaka River had the highest concentrations of NNN and TN. It also had concentrations of bacteria and phosphorus above guideline levels.
- Northern Otago coastal rivers showed better water quality than both Dunedin's urban streams and South Otago's rivers.
- There is a reasonable correlation between water quality and biological health.

Guidelines and Standards

- The ANZECC (2000) guidelines outline trigger values for water quality aspects that put stress on river and stream health. The trigger levels specify 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 ANZECC (1992) guidelines for contact recreation waters recommend a season median of less than 126 *E. coli*/100ml.

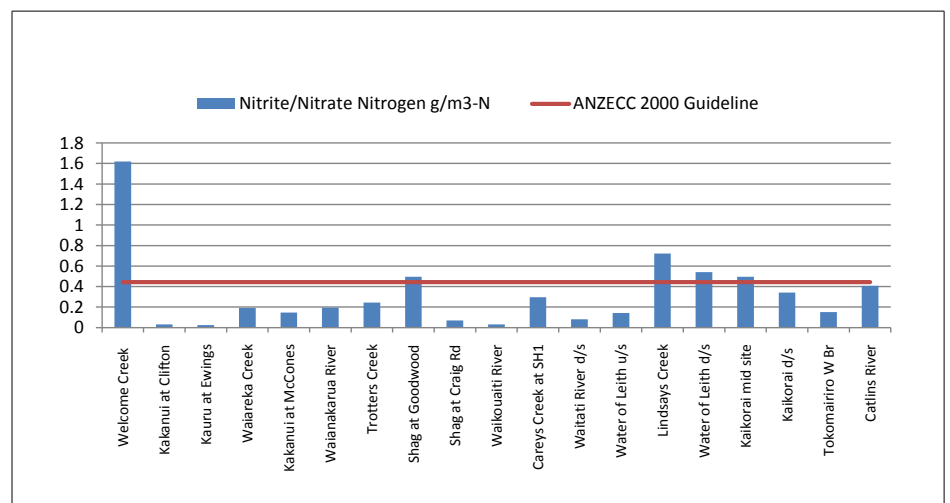
Note: The red lines on these graphs indicate the ANZECC trigger value or the MfEIMoH guideline level.

Water quality results

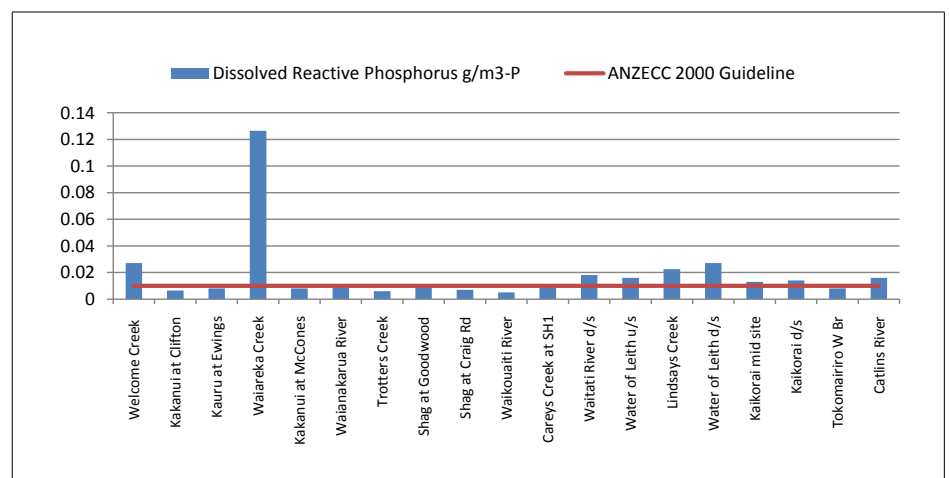
Selected water quality indicators are displayed in the graphs and discussed below. Overall, these graphs show that water quality is generally good or very good, but with poorer quality in Dunedin's urban streams.

Nutrients

Nitrite-nitrate nitrogen (NNN) is a form of nitrogen primarily derived from land drainage. It is an important nutrient for algae and other plant growth, but can be harmful in higher concentrations. Three of the five Dunedin urban stream sites monitored exceeded the ANZECC trigger value, as did the Shag River at the Goodwood water intake and Welcome Creek. Welcome Creek is spring fed and the concentrations of NNN in the groundwater are high. The remainder of sites had median values well below the default trigger.

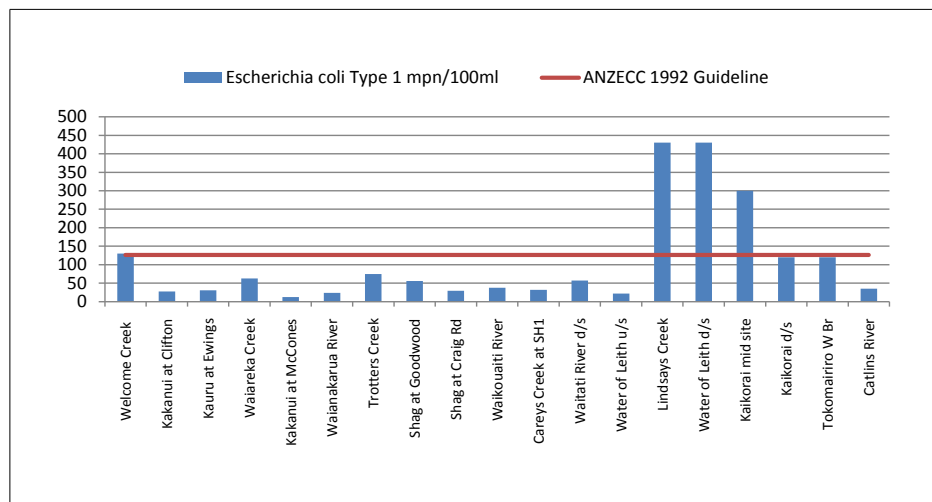


Median dissolved reactive phosphorus (DRP) concentrations were above the ANZECC trigger value at over half of all sites analysed. These high-DRP sites include Welcome Creek, Waiareka Creek, Shag River at Goodwood, the Waitati River, Dunedin's urban streams and the Catlins River at Houipapa. Rivers of the north Otago coast generally showed median DRP concentrations lower than the trigger value, with the exception of Waiareka Creek and Welcome Creek.



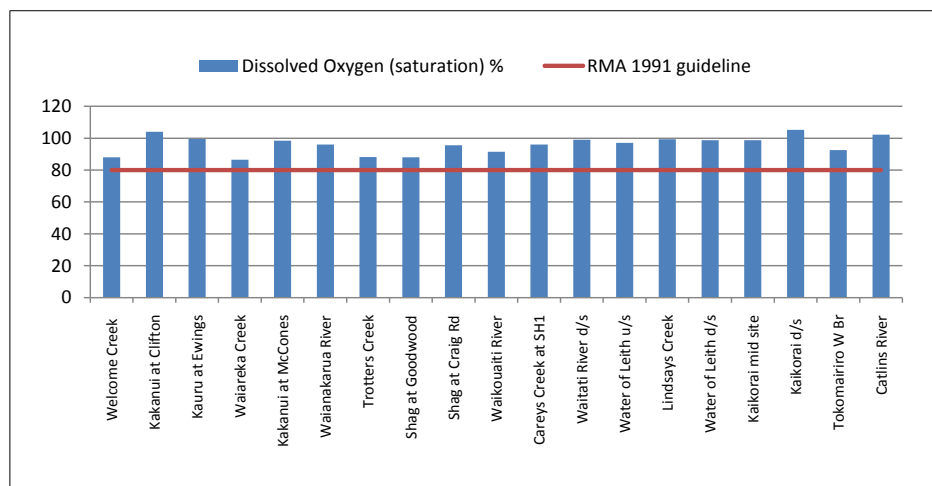
Bacteria

Median levels of *E. coli* bacteria were above the MfE/MoH guideline level (126 cfu/100ml) at four of the 19 sites analysed. Levels were highest in Dunedin's urban streams and the Kakanui River. Welcome Creek just exceeded the guideline level of *E. coli*. The MfE/MoH contact recreation guideline is 260 cfu/100ml for a single sample. The only sites to breach this level at any time were Carey's Creek, Water of Leith (upstream) and the Tokomariri West Branch.



Dissolved oxygen

Dissolved oxygen saturations should be above 80%, as below this level saturation is considered insufficient for biological health. The median saturation was above this level at all sites. This is a vast improvement from last year when Waiareka Creek had a dissolved oxygen saturation of just over 60%, and from 2005 when its saturation was only 21%. The improvement is likely to be due to increased flow from the North Otago Irrigation Scheme.



Other Analytes

- Ammoniacal nitrogen is the combination of ammonium ions and ammonia (NH₃). Levels of ammoniacal nitrogen were well below the ANZECC guideline level of 0.9 mg/l in all samples analysed. NH₃ is the main toxic component of ammoniacal nitrogen, the toxicity of which is dependent on pH and temperature. Taking these factors into account, levels of NH₃ were also well below the guideline value (0.021 mg/l) at all sites.
- Turbidity was below trigger values at all sites. The highest median level (4.1 NTU) was found in the Owaka River.
- Six sites had median concentrations of total nitrogen elevated above the trigger level of 0.614 mg/l: Waiareka Creek (0.84 mg/l), Lindsays Creek (0.66 mg/l), the Water of Leith at Dundas Street (0.995 mg/l), Kaikorai Stream at Brighton Road (0.615 mg/l) and the Tokomariri River east branch (0.695 mg/l). The highest result was recorded in the Owaka River at Purekireka (1.65 mg/l).
- Five sites had median concentrations of total phosphorus above the trigger level (0.033 mg/l). Waiareka Creek showed the most significant elevation at 0.28 mg/l, a similar result to last year (0.29 mg/l). Dunedin's urban streams, the Tokomariri River east branch and the Owaka River also showed elevated concentrations of phosphorus.

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).

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.

Algal samples were collected at 13 sites. Algae were given an abundance score ranging from 1 (rare) to 8 (dominant) based on the protocol of Biggs and Kilroy (2000).

Algal species recorded in 2009

Site	Catlins River @ Houipapa	Kaikorai Stream @ Brighton Road	Kakanui River @ Clifton Falls	Kakanui River @ McCones	Kauru River @ Ewings	Lindsay's Creek @ North Road	Shag River @ Craig Road	Shag River @ Goodwood Pump	Tokomaitiro River West Branch	Trotters Creek @ Mathesons	Waiakarua River	Wakouaiti River	Water of Leith @ Dundas Street
Filamentous Green Algae													
<i>Cladophora</i>							4						
<i>Microspora</i>						4							
<i>Stigeoclonium</i>				6	3		4				4	4	
<i>Ulothrix</i>	7				1					7			
Filamentous Red Algae													
<i>Audouinella</i>		1	3	1				2					
Cyanobacteria													
<i>Oscillatoria</i>	3	1	7	5			8	7					1
<i>Rivularia</i>									5		3		
Diatoms													
<i>Achnanthydium</i>							5						
<i>Cocconeis</i>	1					3			1			2	
<i>Cymbella</i>		3		3	5		3			4		2	1
<i>Didymosphenia</i>			2										
<i>Encyonema</i>												6	
<i>Eunotia</i>					1								
<i>Fragilaria</i>						1	4	7		2			
<i>Frustulia</i>	7	5		4		4				4	4	4	4
<i>Gomphoneis</i>	2	2		2	2	3	3				4		
<i>Gomphonema</i>													3
<i>Hantzschia</i>				1							4		
<i>Melosira</i>	4	3				3	2	2			4	3	3
Navicoid diatom	7	5		4			4			3	4	5	4
<i>Nitzschia</i>			3	5	2			1			3		2
<i>Rhoicosphenia</i>													4
<i>Stauroneis</i>		3								2			
<i>Surirella</i>							3	1				3	
<i>Synedra</i>	1	2	6	4	4					5	3	3	2
<i>Tabellaria</i>				1				3				6	
Phytoplankton													
<i>Cosmarium</i>				1	5						3		
<i>Scenedesmus</i>												1	

Codes based on Biggs and Kilroy (2000) Stream Periphyton Monitoring Manual: 1=rare, 2=rare-occasional, 3=occasional, 4=occasional-common, 5=common, 6=common-abundant 7=abundant, 8=dominant

The invasive species *Didymosphenia geminata* (Didymo) was only present (rare) in the Kakanui River at Clifton Falls. Cyanobacteria (blue green algae) were found at nine sites. *Oscillatoria* was abundant or dominant in the Kakanui River at Clifton Falls and both sites in the Shag River, and *Rivularia* was common in the Waiakarua River.

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.

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 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	10-20	5-15	80-99	4-5
Good	>20-30	>15-20	>100-120	>5-6
Excellent	>30	>20	>120	>6

North and Coastal Otago macroinvertebrate health 2009

	Total species	EPT taxa	MCI	SQMCI
Catlins River at Houipapa	25	15	109	5.1
Kaikorai Stream at Brighton Road	8	1	63	1.4
Kakanui River at Clifton Falls	21	10	94	4.7
Kakanui River at McCones	19	8	82	2.7
Kauru River at Ewings	18	11	109	5.3
Lindsay's Creek at North Road	14	5	91	3.0
Shag River at Craig Road	27	12	99	6.4
Shag River at Goodwood Pump	16	5	81	5.2
Tokomairiro River West Branch	21	13	111	6.3
Trotters Creek at Mathesons	11	4	75	2.4
Waianakarua River at Browns Pump	20	12	123	6.1
Waiareka Creek at Teschemakers	15	4	64	4.0
Waikouaiti River at Orbells Crossing	10	3	84	1.5
Water of Leith at Dundas Street	16	7	89	2.4

Excellent SQMCI scores are found in the Shag, Tokomairiro and Waianakarua Rivers. Poorer macroinvertebrate health is generally found in the lower catchments, where habitat for macroinvertebrates is degraded, typically through sediment build-up. Macroinvertebrate diversity in Trotters and Waiareka Creeks and the Waikouaiti River are all constrained by habitat. However, Dunedin urban streams have variable water quality as well, explaining the poor macroinvertebrate health found in the Kaikorai Stream at Brighton Road as well as the other Dunedin streams.

Biological indices

- EPT species – this index is a sum of the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) species collected.
- 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.



Caddisfly (*Plectrocnemia*). Source: Stephen Moore

Key points

- 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.



Inanga (*Galaxias maculatus*). This species makes up the majority of the whitebait catch.

Source: S.C. Moore, NIWA.

Fish

Electro-fishing was conducted in the summer of 2009 at 16 sites (12 streams) on the north coast and its ocean tributaries. At these sites, 17 species of fish were observed cumulatively.

Observations of fish species in the North and coastal catchments 2008

Site	Callins River at Houipapa	Carey's Creek	Kaikorai Stream at Brighton Rd	Kakanui River at Clifton	Kakanui River at McCones	Lindsay's Creek at NE Valley	Shag River at Craig Road	Trotters Creek at Gorge	Trotters Creek at Horse range	Trotters Creek at Mathesons	Trotters Creek at Rail bridge	Waianakaua River at Browns	Waiaereka Creek	Waitaiti River at Mt Cargill Rd	Water of Leith at Dundas	Welcome Creek at Steward Rd
Black Flounder			1									5		1		
Bully			50		46		14	8	6	1			3	1	1	2
Blue gill bully					694		6			1		230		46		
Common bully		8	1062		199		9	1	2	4	20	184	5	27	3	
Giant bully											8		1	7		
Redfin bully								1	22	4					1	
Upland bully	12			262			106	21								
Eel spp.							1			2	6		2			3
Longfin eel	13	1	28	9	16		157	1	2			1		27	2	
Shortfin eel		9			8		21		1			2				
Canterbury galaxias				16				6				34				
Galaxias sp.								6								
Giant Kokopu										2						
Inanga		68	2		36					8		30	11	29		
Koura	10		1			16								10	2	
Lamprey		3		3								183				
Lamprey sp.				13			3							9		
Shrimp		5			1					1					1	
Torrentfish					4							62				
Brown trout	13	7	10	33	6	133	9	4	3	1	10	4		3	71	13
Number of species	4	7	7	6	9	2	6	8	6	9	4	9	5	10	7	3
% exotic fish	27	6	1	10	1	89	3	8	8	4	23	1	0	2	88	72

Brown trout were found to be present at 94% of the sites and were the only exotic species observed. The most widely distributed native species were the common bully (75% sites) and the longfin eel (69% sites). Torrentfish and giant kokopu were the least common freshwater species in the area.

Fish species diversity among the north and coastal sites averaged 6.37 species per site, which was higher than the Otago average of 4.83 species per site. Six or more species were observed at 11 of the 16 sites and only Lindsay's Creek had less than three species of fish. In addition, the percentage of native species per site was high, with only Lindsay's Creek, the Water of Leith and Welcome Creek showing more than 30% of their catch as exotic.

River flows

The rate of flow is an important determinant of the biological health of a stream 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 2008 to 30 June 2009.

Coastal catchments recorded three high flow events this year: August 2008, March 2009 and May 2009. Flows were around mean annual floods except in the Shag River where the August 2008 event was slightly larger. Low flows occurred in late January/early February, with these being lower than the mean annual low flow MALF at all sites. The lowest 7-day flow in the Shag River at the Grange was around half of MALF.

Table: Comparison of high and low flows during 2008/09 to historical records

Site	7-day low flows			Flood flows	
	2008/09	Historical (MALF)	% change	2008/09	Historical (mean annual flood)
Kakanui River at Clifton Falls Bridge	0.382	0.539	-29	101	127
Kakanui River at Mill Dam	0.291	0.515	-43	384	211
Kauru River at Ewings	0.072	0.122	-41	65.5	59
Shag River at The Grange	0.075	0.171	-56	153	91
Waianakarua River at Browns Pump	0.193	0.214	-10	216	*
Waikouaiti River (south branch) at Lawsons	0.128	0.182	-30	47.2	50
Water of Leith at University Footbridge	0.082	0.150	-45	35.3	37
Tokomairiro River (west branch) at SH 7	0.129	0.166	-22	30.5	28
Catlins River at Houipapa	0.662	0.757	-13	70.4	95

* Insufficient data to calculate Note: all flows are given in m³/s



The Shag River at Goodwood (Otago Regional Council)

Key points

- 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 of the 7-day low flows over the term of record.
- The mean annual flood is the average flow expected each year based on the length of the flow record.

Recent Otago Regional Council reports

- Water quality of the Tokomairiro River (May 2007)
- State of Environment Report, Surface Water Quality in Otago (May 2007)
- Water quality of the Water of Leith and Lindsay's Creek, the Kaikorai Stream and the Waitati River and Carey's Creek (August 2008).



The Shag River at Craig Rd (Otago Regional Council)

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

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