Otago Coastal

5 Year Monitoring Summary

December 2008

Key points

- Dunedin's urban streams have high concentrations of the bacteria *E. coli*.
- The Owaka River has high levels of nutrients and bacteria.
- Welcome Creek has naturally high concentrations of nitrate.
- Northen Otago coastal rivers generally showed better water quality than both Dunedin's urban streams and South Otago's rivers.
- The Catlins and Waianakarua Rivers generally have excellent macroinvertebrate health.
- Dunedin urban streams, Trotters Creek and Waiareka Creek generally have poor macroinvertebrate health.
- The toxic algae *Phormidium* has been identified in the Shag, Kakanui and Waianakarua Rivers.
- The Shag and Waikouaiti Rivers recorded the highest number of fish species.

State of Environment Monitoring (SOE)

The Otago Regional Council (ORC) carries out routine SOE monitoring throughout Otago to fulfil its responsibilities under the:

- Resource Management Act (1991)
- the Regional Policy statement for Otago
- the Regional Plan: Water for Otago (2004).

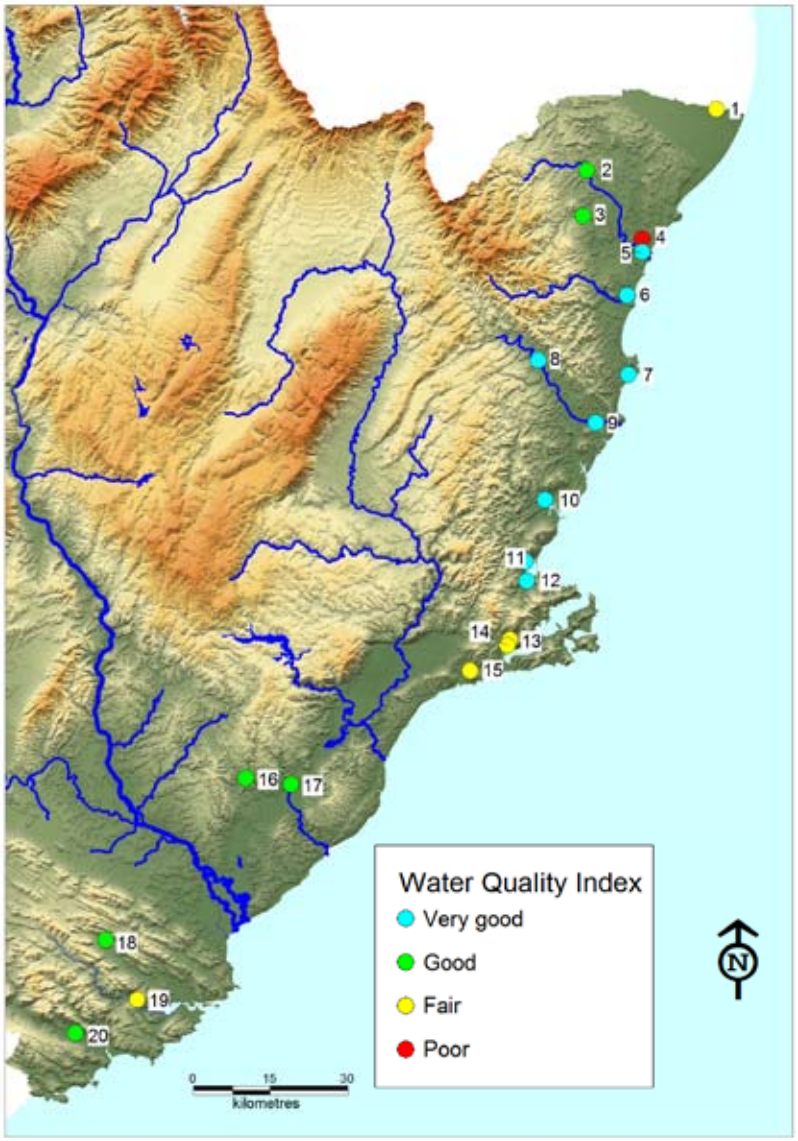
Water quality of coastal Otago catchments

Five Year Monitoring Summary 2003 to 2008

This report summarises results from a range of water monitoring programmes undertaken by Otago Regional Council between 2003 and 2008 in north and coastal river catchments. These include:

- Water quality
- Macroinvertebrate monitoring
- Periphyton monitoring
- Fish monitoring

The catchments monitored include those from the south of the Waitaki River to the Tahakopa, excluding the Clutha and Taieri catchments. The principal sites monitored in the north and coastal Otago catchments are shown in the map below.



photos courtesy of Stephen Moore

River Environment Classification System (REC)

REC characterises river environments at six hierarchical levels, according to:

- Climate
- Source of flow
- Geology
- Land cover
- Network position
- Valley landform

It is the effect of land cover that has the greatest bearing on water quality.

Water Quality Index (WQI)

The WQI allows inter-site comparisons about the state of water quality in Otago's rivers and streams.

REC and WQI for each water quality site.

	River	REC geology and land cover	Water quality index
1	Welcome Creek Lower Site	Alluvium/pastoral	Fair
2	Kakanui @ Clifton Falls	Soft sedimentary/pastoral	Good
3	Kauru @ Ewings	Hard sedimentary/pastoral	Good
4	Waiareka Ck @ Teschmakers	Soft sedimentary/pastoral	Poor
5	Kakanui @ McCones	Alluvium/pastoral	Very good
6	Waianakarua @ Br. Pump	Hard sedimentary/pastoral	Very good
7	Trotters Creek @ Mathesons	Soft sedimentary/pastoral	Very good
8	Shag @ Grange	Hard sedimentary/pastoral	Very good
9	Shag @ Goodwood Intake	Alluvium/pastoral	Very good
10	Waikouaiti @ Orbells	Hard sedimentary/pastoral	Very good
11	Careys Creek @ SH1	Hard sedimentary/pastoral	Very good
12	Waitati @ Mt Cargill Rd	Volcanic basic/pastoral	Very good
13	Lindsays Creek at N Rd Br	Volcanic basic/urban	Fair
14	Water of Leith @ Dundas St	Volcanic basic/urban	Fair
15	Kaikorai @ Brighton Rd	Soft sedimentary/urban	Fair
16	Tokomairiro West Br	Hard sedimentary/pastoral	Good
17	Tokomairiro East Br	Hard sedimentary/pastoral	Good
18	Owaka @ Purekireka	Soft sedimentary/pastoral	Good
19	Catlins @ Houipapa	Soft sedimentary/pastoral	Fair
20	Tahakopa @ Tahakopa	Soft sedimentary/pastoral	Good

Water Quality Index

Sites were also classified using a water quality index, derived from median values of seven indicator variables: turbidity, dissolved oxygen (% saturation), nitrite-nitrate nitrogen, ammoniacal 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:

Very Good	All six values comply with guideline values
Good	Four or five median values comply (to include dissolved oxygen)
Fair	Two or three median values comply (to include dissolved oxygen)
Poor	Two or fewer median values comply with guideline values

Right: Waiareka Creek catchment

Water quality guidelines

Most of the guidelines used in this report are the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand's (ARMCANZ) default trigger values for aquatic ecosystems (referenced as ANZECC 2000).

Summary of guideline values

Analyte		Guideline Value	Reference
Ammoniacal nitrogen	NH4	<0.9	ANZECC & ARMCANZ (2000)
Nitrite/nitrate nitrogen	NNN	<0.444	ANZECC & ARMCANZ (2000)
Total nitrogen	TN	<0.614	ANZECC & ARMCANZ (2000)
Dissolved reactive phosphorus	DRP	<0.01	ANZECC & ARMCANZ (2000)
Total phosphorus	TP	<0.033	ANZECC & ARMCANZ (2000)
Water temperature	Deg C	<20	-
Dissolved oxygen	DO	>80	RMA 1991 Third Schedule
Escherichia coli	*E. coli*	<126	Department of Health 1992
pH	pH	6.5-9.0	ANZECC (1992)
Turbidity	Turbidity	<5.6	ANZECC & ARMCANZ (2000)

These trigger values are intended to be compared with the *median* values over a period of time. They are not statutory standards and exceedences do not necessarily mean an adverse environmental effect would result, but act as an early warning mechanism of potential problems or a change in water quality that may warrant investigation.

The best reference conditions or guideline values are set by locally appropriate data. The ANZECC (2000) guidelines therefore recommend deriving site-specific trigger values for different catchments where possible, using a minimum of two years of water quality results from continuous monthly sampling (24 samples) of appropriate reference sites.

Shag River at Craig Road

- 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 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*/100ml.

Nitrogen

- Low levels of nitrogen may occur naturally, but nitrogen is more often associated with contamination by organic matter – typically effluents and fertilisers. Oxidised nitrogen (nitrate) is the principal form of combined nitrogen found in natural waters. Ammoniacal nitrogen is found in reducing conditions (i.e. where no oxygen is present), and may be a key indicator of contamination (e.g. effluent or landfills).
- Ammoniacal nitrogen is the combination of ammonium ions and ammonia (NH_3). Levels of ammoniacal nitrogen were well below the ANZECC guideline level of 0.9 mg/l in all samples analysed.
- NH_3 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 NH_3 were also well below the guideline value (0.021 mg/l) at all sites.

Water quality results

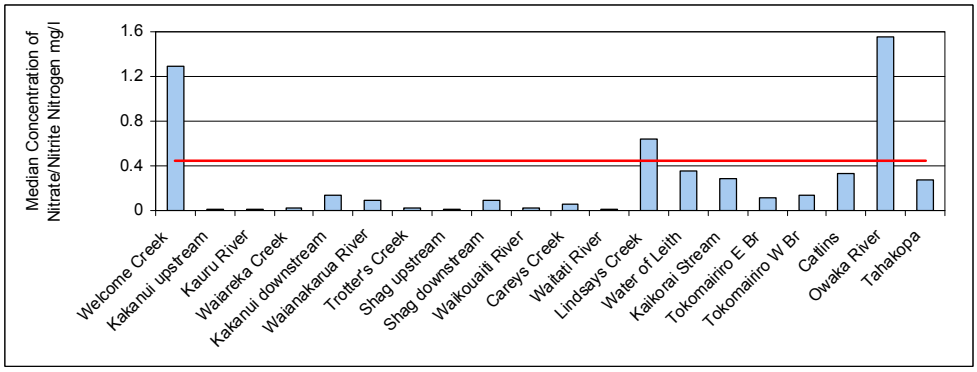
Selected water quality indicators are displayed in the graphs and discussed below.

Nutrients

The major aquatic nutrients include nitrogen and phosphorus. Each of these is essential for aquatic life. However, excessive nutrients can result in undesirable water quality conditions. For example, excessive growth of algae and plants can lead to a loss of oxygen when these biota die and oxygen is consumed as part of the decay process. Some activities, such as the discharge of sewage effluents will raise nutrient levels.

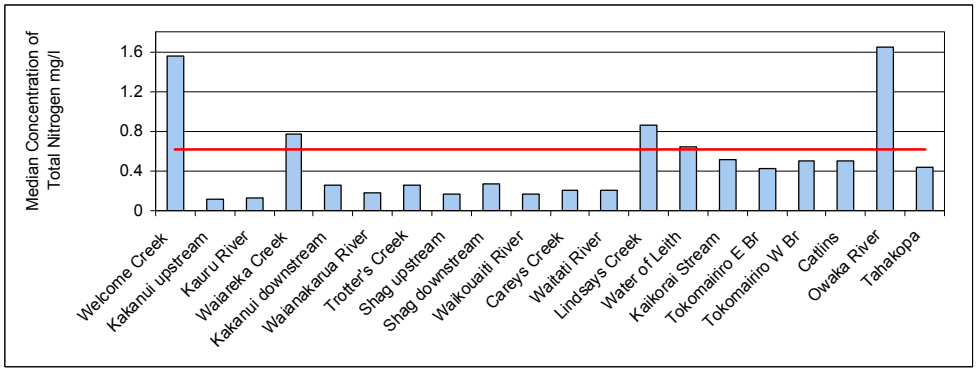
Nitrogen

The median concentration of NNN was above the ANZECC trigger value of 0.444 mg/l at three sites: Welcome Creek, Lindsay's Creek and the Owaka River. The other Dunedin urban streams approached the trigger value, as did the Catlins and Tahakopa while the remainder of sites had median values well below the default trigger.

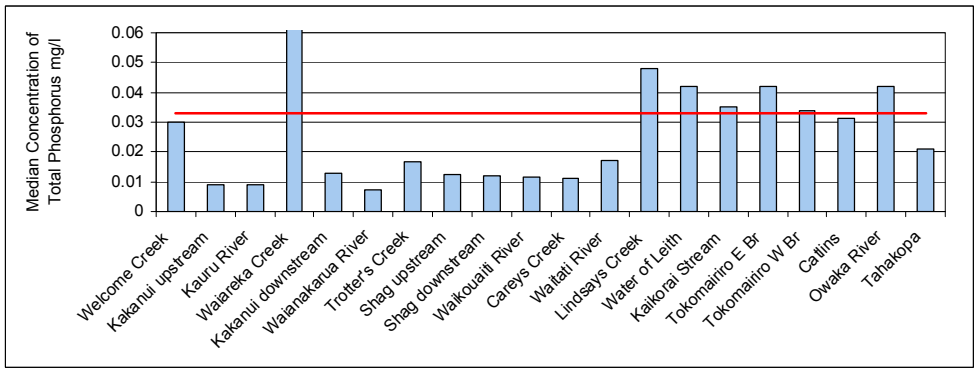


The median concentration of TN followed the same pattern, but was also elevated in the Waiareka Creek and the Water of Leith.

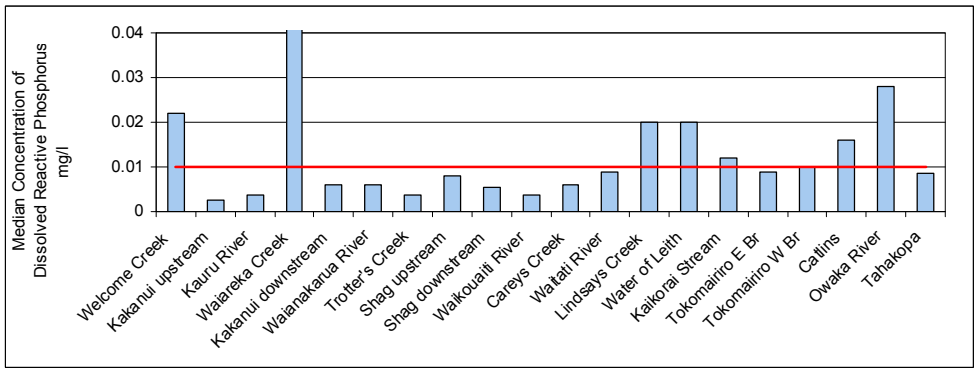
The highest recorded value of NH_4 over the entire monitoring period was in the Kaikorai Stream at Townleys Rd (0.39 mg/l on 2/8/04), median values were highest in Waiareka Creek at 0.03 mg/l.



Phosphorus



The median level of TP was elevated above the ANZECC trigger guideline (0.033 mg/l) at eight of the twenty sites. These included all the Dunedin urban streams, both branches of the Tokomairiro and the Owaka, however the most extreme median result was Waiareka Creek with a median value of 0.229 mg/l (nearly seven times the guideline value), not only are levels high, but TP values also show an increasing trend in this creek (ORC 2007).



The DRP component of TP shows similar results, with seven of the sites exceeding the ANZECC guideline value of 0.01 mg/l. Welcome Creek is on this list, as are the Dunedin urban streams, the Catlins River and the Owaka River. Once again the most elevated result was Waiareka Creek (0.177 mg/l).

Kaikorai Stream at Townleys Road

Phosphorus

- Phosphorus is found in a number of forms in water. It is an essential plant nutrient, often found at reduced concentrations in surface waters due to uptake by plants, and is considered the "limiting nutrient" because its presence or absence in the water controls the growth of aquatic vegetation.
- Natural sources of total phosphorus (TP) are soil and rock, while contamination may result from effluents, detergents or fertilisers. However, as much of the TP associated with particulates is not biologically available, it is not always a good indicator of phosphorus pollution.
- Dissolved reactive phosphorus (DRP) is a better indicator of the biologically available fraction of TP. While phosphorus is not normally toxic, it can result in undesirable conditions such as eutrophication.

Dissolved oxygen

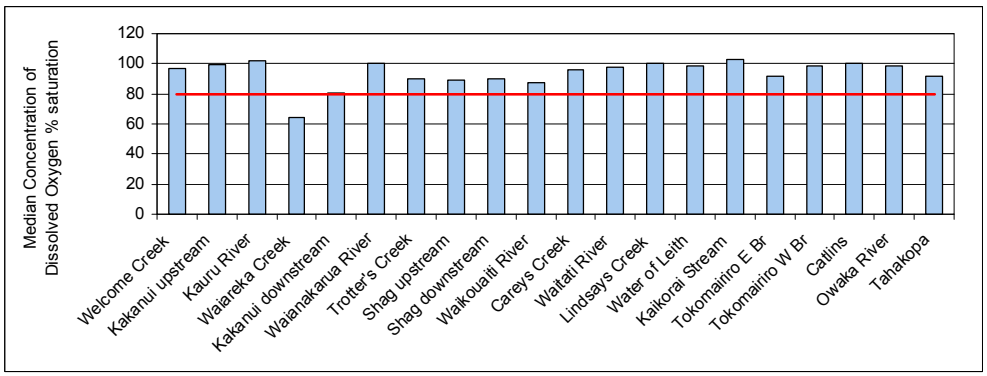
- Adequate amounts of oxygen are required to support fish and other organisms in aquatic systems.
- The solubility of oxygen depends on the partial pressure of oxygen in the air, water temperature, turbulence, mineral content of the water, and the ability of the water to exchange freely with the atmosphere.
- Bacteria that decompose dead organic matter consume oxygen and reduce the DO in water.

Turbidity

- Turbidity is the measurement of the adsorption and scattering of light in water by suspended particles (clays and silts), organic matter and other suspended matter.
- The unit of measurement is Nephelometric Turbidity Units (NTUs).
- Turbidity is an indicator of suspended sediments in water and can be correlated with measurements of total suspended sediments and it will generally increase with flow rates.

Dissolved Oxygen

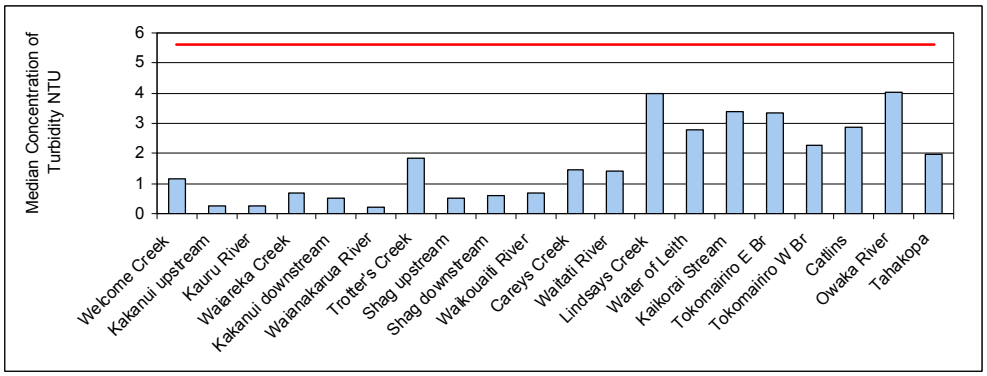
Dissolved oxygen levels are shown below. Dissolved oxygen saturations should be above 80%, as below this level saturation is considered insufficient for biological health. The median saturation was below the trigger value of 80% only at Waiareka Creek.



In 2005 Waiareka Creek had extremely low O_2 saturation (20.9%), this situation has improved, probably due to increased flow from the North Otago Irrigation Scheme, however it is still a slow flowing stream with prolific plant growth, which are both causes of low oxygen levels.

Turbidity

None of the sites had a median turbidity above the ANZECC 2000 guideline level of 5.6NTU. The Dunedin urban streams, the Tokomairiro, the Catlins and the Owaka River recorded some of the higher medians.

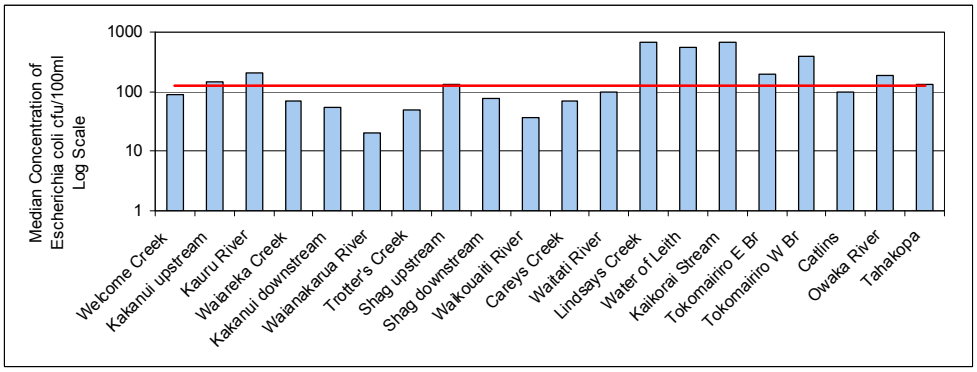


Kakanui River at Clifton Falls

Bacteria

The presence of faecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the faecal material of humans or other warm-blooded animals. It is important to note that faecal coliform is an indicator species for more harmful pathogens or disease producing bacteria or viruses which can also exist in faecal matter. Some waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis and hepatitis A. The presence of faecal coliform is an indicator that a potential health risk exists for individuals exposed to this water.

Median levels of *E. coli* bacteria were above the Department of Health guideline level (126 cfu/100ml) at ten of the 20 sites. Levels were highest in Dunedin's urban streams and the Tokomairiro River, the Kakanui, Kauru, Shag, Owaka and Tahakopa Rivers also had elevated levels of *E. coli*.



Diminishing returns

Bacteria

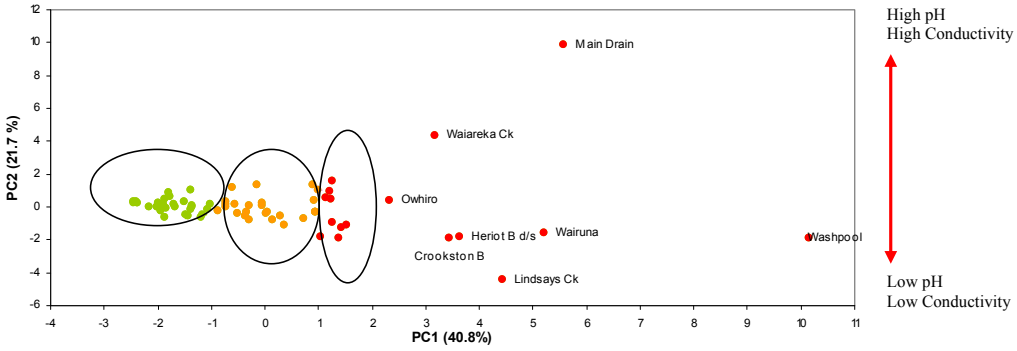
- Total coliform bacteria are a collection of relatively harmless micro-organisms that live in large numbers in the intestines of humans and animals.
- A specific subgroup of this collection is the faecal coliform bacteria, the most common member being *Escherichia coli* (*E.coli*).
- These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the faecal material of warm-blooded animals.

Water quality summary

- Discharges to water in the north and coastal Otago river catchments are mainly to the coastal environments and comprise largely of treated sewage and industrial discharges.
- Land use has the greatest effect on water quality and the sites with poorer water quality include the urban sites such as the Dunedin city streams as well as streams in intensively farmed catchments such as Waiareka Creek.

Summary of Water Quality Results

It is useful to get a broad view of where coastal water quality fits in with water quality at other sites in Otago. In the State of Environment Report (ORC 2007) a principal components analysis was undertaken in order to identify sites with similar characteristics. It is useful to reproduce one of the graphs here, this shows all the water quality results in Otago, with three broad categories.



The green sites have the highest water quality and include the majority of the coastal sites in this report.

The orange sites have water quality somewhere between the poorer 'red sites' and the better 'green sites'. The orange sites include the Tokomairiro, which is intensively farmed, Welcome Creek which is groundwater fed and the Catlins River.

The sites with poorer water quality (higher concentrations of nutrients and faecal indicator bacteria) are shown in red. These sites typically exceed water quality guidelines. Most of the sites are intensively drained for urban or agricultural use. This group includes all the urban streams – the Water of Leith, Lindsay's Creek and the Kaikorai Stream.

The water quality index confirms this pattern. Only one site was classified as having a poor WQI. This was due to low dissolved oxygen levels in Waiareka Creek. Generally the higher WQI's are found north of Dunedin, while the sites with lower WQI's are either urban, intensively farmed or affected by groundwater with high nitrate levels (Welcome Creek).

Overall it is clear that Dunedin's urban streams have high concentrations of nutrients and bacteria, while the streams north of Dunedin generally have excellent water quality. The exception being Waiareka Creek.

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).

Macroinvertebrate monitoring 2003 to 2008

Macroinvertebrates provide the most useful information relating to water and habitat requirements because at present there is a greater understanding of the habitat requirements of invertebrate taxa than for periphyton groups.

Four biological indices have been used to simplify and evaluate the invertebrate data, the MCI, taxonomic richness, EPT richness and SQMCI.

These biological indices put a large amount of information into a compact form. 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. Each of these invertebrate indices tend to produce a higher result as habitat quality increases.

Of fundamental importance is whether a habitat is a fast flowing riffle or a slower flowing run, or a near stagnant pool. Scores 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.

The following four tables compare MCI, SQMCI, species diversity and EPT taxa at the same sites over a five year period.

MCI results

MCI SCORE	Habitat	2003	2004	2006	2007	2008
Kakanui River @ Clifton Falls	Riffle	93	99		110	106
Kauru River @ Ewings	Riffle				106	99
Waiareka Creek @ Teschmakers	Pool		81		60	
Kakanui River @ Pringles	Riffle	91	85		90	100
Waianakarua River @ Browns Pump	Run	126	127		109	113
Trotters Creek @ Mathesons	Riffle				81	81
Shag River @ Grange	Run	97	101		98	106
Shag River @ Goodwood Pump	Riffle	95	84		103	90
Waikouaiti River @ Orbells	Run	93	82		88	81
Lindsay Creek @ North Road	Riffle			89	95	83
Water of Leith @ Dundas Street	Riffle/Run	79	89	112	99	98
Kaikorai @ Brighton Rd	Riffle	54	54	62	73	73
Tokomairiro River @ Mt Stuart	Riffle/Run	112	106	114		
Tokomairiro @ Coal Gully	Pool	87	86	87		119
Catlins @ Houipapa	Riffle	108	118	108	114	123
Owaka River @ Purekerika	Riffle					94
Poor	<80					
Average	>80 to <100					
Good	100 to <120					
Excellent	>120					

Biological indices

- The Macroinvertebrate Community Index (MCI) which 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.
- Taxonomic richness, or the number of invertebrate taxa at each site.
- EPT richness, or the sum of the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) species collected.
- The Semi-quantitive Macroinvertebrate Community Index (SQMCI) which is a variation of the MCI that accounts for the abundance of pollution sensitive and tolerant species.

Results for MCI

- The Waianakarua River is the only site to have achieved an MCI of more than 120 – which it did in 2003 and 2004.
- In 2007 and 2008 the MCI had dropped back to good.
- The opposite is the case in the Kakanui, where the MCI has improved from average to good, as it has in the Tokomairiro.
- Other sites have been consistent, the Kaikorai at Brighton Road has a consistently poor MCI, the Waikouaiti River at Orbells has an average MCI and the Catlins at Houipapa has an MCI of good.

Results for SQMCI

- Poorer macroinvertebrate health is generally found in the lower catchments, where habitat for macroinvertebrates is compromised, generally through sediment build up.
- Dunedin's urban streams have poorer habitat as well as poorer water quality which impacts on macroinvertebrate health.
- Excellent SQMCI scores have been found in the Catlins, Kakanui, Kauru, Shag and Waianakarua Rivers and Water of Leith.
- Some of the sites have had very variable results, for example the Kauru changed from a rating of excellent in 2007 to one of poor in 2008.
- The Kakanui River at Clifton was average in 2008, but excellent in 2007.
- The Water of Leith is poor most of the time, but was excellent in 2006.

SQMCI results

SQMCI Score	Habitat	2003	2004	2006	2007	2008
Kakanui River @ Clifton Falls	Riffle	5.4	4.3		6.5	5.0
Kauru River @ Ewings	Riffle				6.7	3.2
Waiareka Creek @ Teschmakers	Pool		4.0		4.4	
Kakanui River @ Pringles	Riffle	4.2	4.3		4.2	4.7
Waianakarua River @ Browns Pump	Run	5.8	5.2		6.7	4.9
Trotters Creek @ Mathesons	Pool				3.7	3.7
Shag River @ Grange	Run	4.5	3.6		6.4	7.0
Shag River @ Goodwood Pump	Riffle	5.6	2.6		4.2	4.8
Waikouaiti River @ Orbells	Run	4.6	4.0		4.5	2.9
Lindsay Creek @ North Road	Riffle			3.2	2.9	3.0
Water of Leith @ Dundas Street	Riffle/Run	1.9	2.9	6.7	5.1	2.7
Kaikorai @ Brighton Rd	Riffle	1.5	1.5	2.6	1.7	1.7
Tokomairiro River @ Mt Stuart	Riffle	5.8	5.1	5.1		4.2
Tokomairiro @ Coal Gully	Riffle/Run	3.7	3.6	4.7		
Catlins @ Houipapa	Riffle	4.7	5.1	6.1	5.3	5.1
Owaka River @ Purekerika	Riffle					5.0
Poor	<4					
Average	>4 to 5					
Good	> 5 to 6					
Excellent	>6					

Deleatidium mayfly (Stephen Moore)

Total Richness and EPT Richness results

Total Richness	Habitat	2003	2004	2006	2007	2008
Kakanui River @ Clifton Falls	Riffle	20	22		16	19
Kauru River @ Ewings	Riffle				17	15
Waiareka Creek @ Teschmakers	Pool		16		9	
Kakanui River @ Pringles	Riffle	17	21		16	15
Waianakarua River @ Browns Pump	Run	16	14		17	18
Trotters Creek @ Mathesons	Pool				14	14
Shag River @ Grange	Run	24	25		9	14
Shag River @ Goodwood Pump	Riffle	19	18		7	18
Waikouaiti River @ Orbells	Run	19	9		18	14
Lindsay Creek @ North Road	Riffle			14	15	16
Water of Leith @ Dundas Street	Riffle/Run	14	17	19	18	18
Kaikorai @ Brighton Rd	Riffle	7	7	9	8	9
Tokomairiro River @ Mt Stuart	Riffle	24	25	22		15
Tokomairiro @ Coal Gully	Riffle/Run	15	20	19		
Catlins @ Houipapa	Riffle	20	19	24	17	22
Owaka River @ Purekerika	Riffle					18
Poor	<10					
Average	>10 to <20					
Good	20 to <30					
Excellent	>30					

EPT Richness	Habitat	2003	2004	2006	2007	2008
Kakanui River @ Clifton Falls	Riffle	9	11		8	10
Kauru River @ Ewings	Riffle				8	8
Waiareka Creek @ Teschmakers	Pool		1		0	
Kakanui River @ Pringles	Riffle	7	8		9	9
Waianakarua River @ Browns Pump	Run	10	8		9	9
Trotters Creek @ Mathesons	Pool				4	1
Shag River @ Grange	Run	10	11		5	9
Shag River @ Goodwood Pump	Riffle	10	6		4	8
Waikouaiti River @ Orbells	Run	7	3		8	4
Lindsay Creek @ North Road	Riffle			6	7	6
Water of Leith @ Dundas Street	Riffle/Run	4	8	11	9	8
Kaikorai @ Brighton Rd	Riffle	0	0	2	0	1
Tokomairiro River @ Mt Stuart	Riffle	12	12	14		11
Tokomairiro @ Coal Gully	Riffle/Run	8	8	7		
Catlins @ Houipapa	Riffle	12	12	13	11	16
Owaka River @ Purekerika	Riffle					8
Poor	<5					
Average	>5 to <15					
Good	15 to <20					
Excellent	>20					

Results for number of species

- The number of species found at sites tends to follow the same pattern.
- There are no sites with excellent scores, and in 2007 and 2008 only the Catlins River received a rating of 'good'.
- As expected the Kaikorai Stream at Brighton Road received a rating of poor, and surprisingly in 2007, both sites on the Shag River had very few taxa.

Results for EPT Richness

- EPT richness at every site over the entire sampling period was never greater than average.
- Again the Kaikorai Stream received consistently poor scores, as did Waiareka Creek and Trotters Creek.

***Polyplectropus* caddis larvae**
(Stephen Moore)

Periphyton

- Algal samples were collected at 22 sites.
- Algae were given an abundance score based on the protocol of Biggs and Kilroy (2000).

Abundance Scores
1 = rare
2 = rare-occasional
3 = occasional
4 = occasional-common
5 = common
6 = common-abundant
7 = abundant
8 = dominant

- The green algae are often the first aquatic life observed in the shallows of streams, rivers and lakes. They are also the subjects of most algae related complaints. They are commonly grass green in colour.

Didymo

- *Didymosphenia geminata* (Didymo) was found in the Kakanui River at McCones during the 2008 survey, it was rare scoring only one on the abundance scale.

Didymo

Periphyton monitoring 2003 to 2008

Results in the table below are shown for those algae which were identified as being abundant (code seven) or dominant (code eight) at any site at any time over the entire sampling period. The table is also colour coded for easy differentiation between the different algae groups.

Site		Bulbochaete	Cladophora	Mougoetia	Spirogyra	Stigeoclonium	Zygnema	Audouinella	Audouinella sp.	Epithemia spp.	Gomphoneis spp	Melosira varians	Nitzschia spp.	Synedra spp.	Oscillatoria/Phormidium
2004	Kakanui @ Clifton	8		7							6		2	5	
2008	Kakanui @ Clifton	8								1	3			7	
2008	Kauru @ Ewings				3						3			7	5
2008	Kakanui @ McCones			2		4					5			4	7
2004	Kakanui @ Pringles		4			8						3	8	4	
2007	Kakanui @ Pringles												1		8
2007	Kakanui @ McCones												2		8
2004	Waianakarua								8		6		3	5	
2004	Shag @ Grange		8						5	7	7		4	4	
2004	Shag @ Intake			7							8		3	5	
2003	Waikouaiti @ McG			6	8						2		2	5	
2004	Waikouaiti @ McG						8			6			3	3	
2008	Waikouaiti @ Orbells				7							3		5	
2006	Kaikorai @ Townleys										7	4			
2008	Kaikorai @ Townleys											8	4		
2003	Tokomairiro @ SH8							8			6	4	3	4	7
2004	Tokomairiro @ SH8													1	8
2003	Tokomairiro @ CGR							5				8		7	3
2004	Tokomairiro @ CGR								8			7	3	4	
2004	Akatore Creek												3		8
2003	Catlins @ Houipapa					8		2			7	6	2		6
2007	Catlins @ Houipapa										1	7			
Green filamentous															
Red/Brown Algae															
Red filamentous															
Diatoms															
Cyanobacteria															

Green Algae

The Kakanui River was dominated by *Bulbochaete sp* at Clifton in both 2004 and 2008, while below Maheno at Pringles the dominant algae in 2004 was *Stigeoclonium spp*. The Catlins was also dominated by *Stigeoclonium spp*. in 2003. The Waikouaiti River at Orbells was dominated by *Spirogyra spp*. in 2008, but at McGrath Rd in 2004 the dominant species was *Zygnema*. The Shag River was dominated by *Cladophera* and *Mougeotia spp*. in 2004.

Red/Brown Algae

There are few 'red' algae species that occur in fresh water, however *Audouinella* is found in both marine and fresh waters, and grows as small tufts of red, brown or black hair like filaments on any solid surface. It was found particularly in the Tokomairiro River in 2003 to 2004, but was also abundant in the Waianakarua River in 2004.

Diatoms

The diatoms are a major group of algae and one of the most common types of phytoplankton. Most diatoms are unicellular, although they may exist as colonies. A characteristic feature of diatom cells is that they are encased within a unique cell wall made of silica (hydrated silicon dioxide) called a frustule. The most common diatom found in the coastal catchments was *Gomphoneis spp*. these form dense masses of cells usually attached to solid surfaces in fast-flowing streams by long stalks made of mucilage. The dense mats they sometimes form may be confused with the exotic algae Didymo.

Blue Green Algae

The cyanobacteria or blue green algae are very different to other algae as their cells lack internal structures. Blue green colours are common, but these algae can also be green, brown, orange or almost colourless. The only species found in abundance in the coastal rivers were *Oscillatoria* and *Phormidium*. *Phormidium* is a very common, yet potentially toxic riverbed genus. It forms dark brown, purple or blue green mats on stony and muddy surfaces. In 2007/2008 *Phormidium* was found in abundance in the Kakanui River, and although not reported in the annual survey, was also found in abundance in the Shag and Waianakauru Rivers later in the year.

Phormidium in the Shag River. (ORC 2008)

Didymo

Fish monitoring 2007 to 2008.

Surveys to investigate fish species diversity were performed on selected sites during 2007 and 2008. The four sites located south of Dunedin were sampled only in 2008.

Fish surveys were carried out by electric fishing and by spotlighting. Electric fishing has limitations and it is most effective in water less than 0.75 m deep. Therefore fish species in deeper areas and in pools may be missed. The technique can also be difficult to apply in very fast turbulent water as the stunned fish cannot be seen and are rapidly swept away. Notwithstanding these limitations, electric fishing is one of the most commonly used techniques for fisheries surveys in New Zealand. Spotlighting is a common method for surveying kokopu species and is the survey method recommended by the large galaxiid recovery group (Department of Conservation 2005).

Diversity among coastal sites was relatively high during both years, with an average of 4.6 species per site in 2008 (n=14), and 4.9 species per site in the 2007 sites (n=10). By comparison the average for Otago in 2008, excluding coastal sites, was somewhat less with 2.3 species per site (n=20). When comparing equivalent sites the average diversity per site is slightly higher in 2008 with 5.1 species per site. Diversity tended to be greater in sites located to the north and/ or closer to the coast.

The most widely distributed families of fish were *Gobidae* (bullies) *Anguillidae* (eels) and *Salmonidae* (salmon and trout), each of which were present in 86% of surveyed sites. *Geotriidae* (lamprey) were present in 64% of surveyed streams, while the family *Galaxiidae* (galaxias and whitebait) were found in slightly more than half of the sampled sites. *Pinguipedidae* (torrentfish) were only observed in 14 % of sites.

- 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.

Lamprey

Longfin Eel

Adult male lamprey

Longfin eels were the most widely distributed species of fish being found in 83% of sites surveyed, followed by the common bully (71%). Brown trout were the only exotic species observed and were identified in close to 63% of sites. The least distributed species were the longjaw galaxias, of which only one individual was observed in 2007 in the Kauru River (the only stream it is known to exist within), and smelt, with a single example identified in the Waikouaiti River in 2007.

The twelve native fish found in the coastal catchments are all diadromous species, that is they require access to and from the sea to complete their lifecycles (McDowall 1990). The native fish included six galaxias species (all whitebait), two eels, lamprey, three bullies, and torrentfish. Brown trout was the only exotic fish found.

The number of species per family observed during electro-fishing surveys in selected coastal Otago streams in 2007 and 2008 combined.

	Native Bully Species				Native Galaxiid Species				Exotic
Site	Upland	Bluegill	Redfin	Common	Koaro	Long Jaw	Inanga	Canterbury	Brown Trout
Kakanui River at Clifton Falls	X			X					X
Kakanui River at McCones		X	X	X			X		X
Kauru at Ewings	X			X	X	X		X	X
Shag at Goodwood Pump	X	X	X	X			X	X	X
Trotters Ck at Mathesons			X	X			X		
Waianakarua at Browns		X		X			X	X	
Waikouaiti at Orbells Cr.			X	X	X		X		
Kaikorai Stm at Brighton Rd	X			X			X		
Lindsay's Ck at North Rd Br							X		X
Water of Leith at Dundas St			X	X					X
Owaka River at Purekerika									X
Tokomairro at Lisnatunny			X						X
Tokomairro at West Branch				X					X
Tahokopa at Tahokopa			X	X					X
% of sites species present	28%	21%	50%	79%	14%	7%	49%	21%	70%
	Other Native species								
	Smelt	Torrentfish	Longfin eel	Shortfin eel	Lamprey	Black flounder		Total Species	% Native
Kakanui River at Clifton Falls					X			4	75%
Kakanui River at McCones		X	X	X				8	87%
Kauru at Ewings			X					7	85%
Shag at Goodwood Pump			X	X	X	X		11	91%
Trotters Ck at Mathesons			X	X				5	100%
Waianakarua at Browns		X	X	X	X			8	100%
Waikouaiti at Orbells	X		X	X	X	X		9	100%
Kaikorai Stm at Brighton Rd			X	X	X	X		7	100%
Lindsay's Ck at North Rd Br			X					3	67%
Water of Leith at Dundas St			X					4	75%
Owaka River at Purekerika			X					2	50%
Tokomairro at Lisnatunny			X		X			4	75%
Tokomairro at West Branch					X			3	67%
Tahokopa at Tahokopa			X		X			5	80%
% of sites species present	7%	14%	84%	42%	56%	21%			

Summary of Biological Results

Kakanui River

The mid reaches of the Kakanui River show good quality invertebrate communities, which only decrease slightly with distance downstream. There is often dense algal growth throughout the river, including green filamentous and cyanobacteria, again due to a combination of landuse activity and low flows. Fish diversity at the upper site was limited, due primarily to its distance from the sea, however the lower site at McCones had three species of bully as well as brown trout, torrentfish, galaxiids, eels and lampreys.

Kauru River

The Kauru River is a tributary of the Kakanui River and often has prolonged low flows. This river generally shows moderate invertebrate assemblages with sometimes heavy diatom algal infestations, however SQMCI scores can be excellent (2007). It has good fish diversity, the seven species including bullies, galaxiids, eels and brown trout.

Waianakarua River

The Waianakarua River, with its pastoral catchment has probably the best invertebrate community of any coastal catchment monitored. MCI (2003, 2004) and SQMCI scores (2007) can be excellent, and dominant algal growths are infrequent. The site has good fish diversity with eight species found including bullies, torrent fish, galaxiids, eels and lampreys.

Trotters Creek

Trotters Creek shows a limited invertebrate community largely due to its pool like condition. This is reflected in its low SQMCI score compared to an average total species. The site has not been dominated by any specific algal community since monitoring began. It recorded a moderate fish diversity, the five species include bullies, galaxiids and eels, however it is known that up to 15 species live in Trotters Creek.

Shag River

The mid-reaches of the Shag River support good quality invertebrate communities for an agricultural catchment. There are occurances of conspicuous algal growths. The lower reaches show moderate quality invertebrate communities and often have prolific algal growth, due to a combination of low flows and farmland influences. The lower reaches also have a great fish diversity with 11 species including brown trout, flounder, smelt, galaxiid, eel, lamprey and bully.

Waikouaiti River

The lower Waikouaiti River supports a moderate invertebrate community which is usual for a larger, slow flowing river in an agricultural setting. The site is often dominated by green filamentous algae. There is a great fish diversity at this site, with 10 species found comprising both migratory and non migratory species, probably due to its proximity and easy access to the sea.

Kakanui River at Pringles

Kauru River at Ewings

Waianakarua River at Browns Pump

Trotters Creek at Matheson's

Shag River at Goodwood

Waikouaiti River at Orbells

Lindsay's Creek at North Rd Bridge

Water of Leith at Dundas St

Kaikorai Stream at Brighton Rd

Tokomairiro River at SH8

Catlins River at Houipapa

Owaka River at Purekireka

All images from ORC.

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Lindsay's Creek

Lindsay's Creek has an average MCI score, but a poor SQMCI score reflecting the scarcity of pollution sensitive invertebrates. This site flows through an urban area and probably receives stormwater pollution on occasions. Excessive algal growths that dominate the community do not seem to occur at this site. Only galaxiids and eels have been found at this site.

Water of Leith

The Water of Leith at Dundas Street is located at the bottom of an urban catchment. It generally has poorer invertebrate assemblages than Lindsay's Creek, particularly the pollution sensitive species. Again, this site has not recorded excessive algal growth in recent years. Only two species of fish were found at this site, bullies and eels.

Kaikorai Stream

The lower reaches of the Kaikorai Stream support poor invertebrate communites, probably due to a combination of physical habitat alteration and contaminated stormwater and wastewater discharges. The lower Kaikorai also gets smothered by filamentous diatom growths. The stream does support a large number of fish species, including black flounder, lamprey, eel, brown trout, galaxiid and bully.

Tokomairiro River

The mid-reaches of the Tokomairiro River support a moderate to good quality invertebrate communitiy for a site located in a rural catchment. When the site has a dominant algal community it is generally either red/brown algae or diatoms. The fish community is limited to three species; bullies, lampreys and brown trout.

Catlins River

The Catlins River has a largely forested catchment that supports very high quality invertebrate communities, for example in 2007 the SQMCI score was excellent. There are no prolific filamentous algae growths likely to cause problems.

Owaka River at Purekireka

The lower Owaka River shows limited invertebrate communities largely due to the naturally pool like conditions. These conditions dominate over water quality factors in shaping the invertebrate and algal community assemblages. It also supported only two species of fish; eels and brown trout.