
An Assessment of Regional Council Water Quality Data (1996–2002) in Support of National State of Environment Reporting (ENZ07)

Report to Ministry for the Environment

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PREPARED BY

National Institute of Water & Atmospheric Research Ltd

Gate 10, Silverdale Road, Hamilton

P O Box 11115, Hamilton, New Zealand

Phone +64-7-856 7026, Fax +64-7-856 0151

www.niwa.co.nz

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1. Introduction

The Ministry for the Environment's comprehensive State of the Environment report for New Zealand (ENZ07) required supporting information on water quality state and trends in a representative set of New Zealand rivers. Building on earlier work using the National River Water Quality Network (NRWQN: Scarsbrook 2006), the National Institute of Water & Atmospheric Research (NIWA) was contracted to provide summaries of regional council water quality monitoring data from river and stream sites. Data compiled by the Ministry and NIWA for a previous study of national scale patterns in water quality state and trends (Larned et al. 2003) was used to provide this assessment.

This brief report summarises the water quality information provided to the Ministry for the ENZ07 report. Readers are referred to Larned et al. (2003) for full details of the data sources and a more detailed treatment of the data within a River Environment Classification (Snelder & Biggs 2002) framework. We provide only limited interpretation of the patterns shown in the data, as this was not part of the project brief.

2. Methods

2.1 The dataset

Larned et al. (2003) compiled a water quality dataset comprising physico-chemical measurements from 15 regional councils and unitary authorities and NIWA's National River Water Quality Network (NRWQN: 77 sites). The full dataset included multiple sampling events from 996 sites across the country, but a number of these sites did not meet pre-defined criteria for state and trend analyses (see Larned et al. 2003). Following data grooming, a final dataset consisting of 622 sites for state and 386 sites for trend analysis was used to assess spatial and temporal patterns in water quality. The River Environment Classification (REC) was used as a spatial framework to partition variability.

In this report, we summarise data from a 545 sites, excluding the 77 sites from the NRWQN that were included in the assessment of Larned et al. (2003). Spatial and temporal patterns in water quality indicators at these NRWQN sites have been reported more fully by Scarsbrook (2006). The locations of the sampling sites used in this report are given in Figure 1.

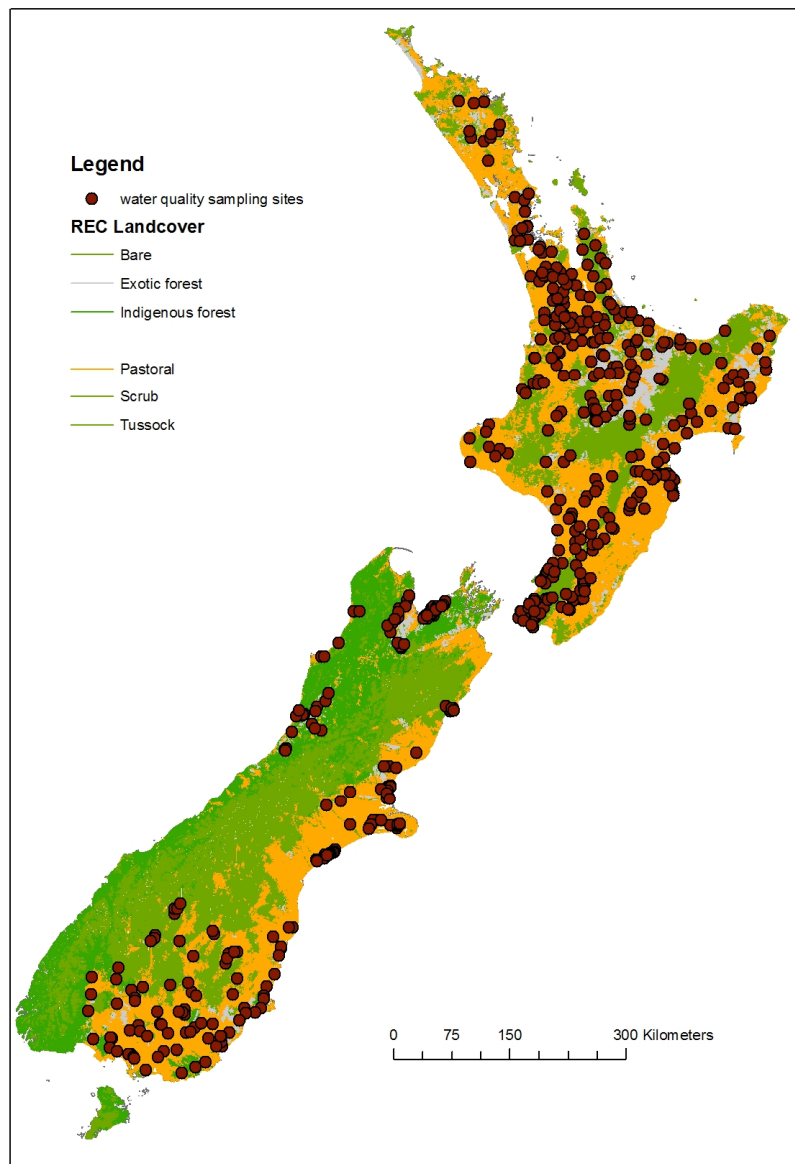


Figure 1: Locations of 545 sampling sites. Map colours relate to REC landcover level following the convention used by Scarsbrook (2006).

2.2 Water quality indicators

Larned et al. (2003) reported on state and trends in five commonly used water quality indicators. The parameters were nitrate+nitrite (NO_x), ammoniacal nitrogen (NH_4), dissolved reactive phosphorus (DRP), and *Escherichia coli* bacterial concentrations, and water clarity measured by the black disk clarity procedure (BDC: Davies-Colley 1988). In the present report, we provide statistical summaries for these same five physico-chemical indicators of water quality, and provide an assessment of percentage

of sites exceeding accepted water quality guideline values (Table 1). Note that ANZECC & ARMCANZ (2000) provide separate guidelines for protection of aquatic ecosystem values in upland and lowland streams, but do not include an ‘average’. We have included an average of the upland and lowland guideline values to allow for a national perspective on water quality across all stream sites.

Table 1: Guideline water quality values for protection of New Zealand river ecosystems (ANZECC & ARMCANZZ 2000: all values except Recreation), and human health (MfE/MoH 2003). MPN = Most Probable Number.

Parameter and unit	Guideline values		
	Upland	Lowland	Average
Ammoniacal nitrogen, NH ₄ -N: g (N)/m ³	0.01	0.02	0.015
Nitrate+nitrite nitrogen, NO _x -N: g (N)/m ³	0.17	0.44	0.31
Dissolved Reactive Phosphorus, DRP: g (P)/m ³	0.009	0.01	0.0095
Black Disk Clarity: m	0.8	0.6	0.7
(Aquatic ecosystem protection)			
Black Disk Clarity: m			>1.6 m
(Recreation)			
<i>E. coli</i> : MPN/100 ml			95 th percentile >550

2.3 Water quality summaries

The summaries provided in this report cover the period 1997–2002. It is recognised that more up-to-date Regional Council data is available, but the timeframe for this study did not allow for collation of new data.

Larned et al. (2003) assigned all monitoring sites to REC classes. In the present report, we use this prior classification to provide summaries across different land uses (ie, Pastoral, Natural and Urban), and for sites in both Upland and Lowland Source of Flow (SOF) categories within the landcover classes (Appendix 1 gives a breakdown of monitoring sites by REC classes). The Pastoral landcover class comprises sites where pastoral agriculture is the dominant land use in the catchment upstream of the monitoring site. The Natural land cover class is an aggregate category, and includes sites in predominantly indigenous forest, tussock grassland, bare mountain and scrub landcover classes. Aggregate summaries are also provided for all Pastoral and Natural sites (ie, regardless of Source of Flow).

The first step in producing data summary tables was to compute annual median values at each site for $\text{NO}_x\text{-N}$, $\text{NH}_4\text{-N}$, clarity DRP, and 95th percentiles for *E. coli*. Summary tables were then compiled as landcover type by Source of Flow by year, with values from each site (ie, either annual median or 95th percentiles) used as the replicate data to calculate 5th, 50th (median) and 95th percentile values for each class. We follow Scarsbrook (2006) and interpret these percentiles as representing the best, average and worst river conditions, respectively. For example the 5th percentile values for $\text{NO}_x\text{-N}$, $\text{NH}_4\text{-N}$, DRP and *E. coli* represent the sites with lowest concentrations, whereas the 95th percentile represents highly enriched, and/or contaminated sites.

The percentage of sites that failed to meet the appropriate guideline values for each variable was also calculated.

3. Summary tables

3.1 Oxidised nitrogen (NO_x-N: g/m³). '>ANZECC' refers to percentage of sites exceeding guideline values (Table 1).

Land use	Source of flow	1997				1998				1999				2000			
		Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC
Pastoral	Upland	0.083	0.008	0.709	21.2	0.048	0.008	0.722	26.5	0.163	0.017	0.768	49.0	0.090	0.007	0.700	33.3
	Lowland	0.560	0.068	3.228	60.2	0.445	0.051	2.845	50.6	0.570	0.037	3.440	58.5	0.476	0.059	4.000	55.0
	Total	0.335	0.020	2.685	52.6	0.310	0.020	2.160	49.6	0.366	0.021	2.843	52.2	0.320	0.025	3.440	51.7
Natural	Upland	0.069	0.010	0.431	11.8	0.070	0.004	0.375	12.1	0.056	0.014	0.404	10.3	0.080	0.010	0.274	14.5
	Lowland	0.174	0.008	0.600	22.2	0.193	0.014	1.250	30.0	0.193	0.013	0.635	20.0	0.118	0.010	0.740	12.5
	Total	0.078	0.009	0.551	14.0	0.080	0.005	0.746	14.0	0.077	0.013	0.597	10.2	0.091	0.010	0.377	7.0
Urban	Total	0.930	0.229	1.813	86.7	0.820	0.263	1.829	87.5	1.000	0.271	1.905	93.8	0.883	0.252	2.890	86.4

Land use	Source of flow	2001				2002				Average (1997–2002)			
		Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC
Pastoral	Upland	0.113	0.008	0.923	35.5	0.094	0.009	1.081	34.3	0.098	0.009	0.817	33.3
	Lowland	0.530	0.068	4.988	57.3	0.708	0.067	5.300	61.4	0.548	0.059	3.967	57.2
	Total	0.355	0.022	4.713	53.2	0.394	0.016	4.715	55.6	0.347	0.021	3.426	52.5
Natural	Upland	0.080	0.010	0.362	16.7	0.052	0.010	0.284	12.3	0.068	0.010	0.355	12.9
	Lowland	0.145	0.023	0.956	11.8	0.155	0.037	0.425	7.7	0.163	0.017	0.768	17.4
	Total	0.091	0.016	0.413	8.5	0.071	0.010	0.300	4.3	0.081	0.011	0.497	9.6
Urban	Total	0.668	0.077	2.260	77.3	0.800	0.097	2.585	88.2	0.850	0.198	2.214	86.6

3.2 Ammoniacal nitrogen (NH₄-N: g/m³). '>ANZECC' refers to percentage of sites exceeding guideline values (Table 1).

Land use	Source of flow	1997				1998				1999				2000			
		Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC
Pastoral	Upland	0.015	0.005	0.059	73.3	0.013	0.005	0.061	63.9	0.020	0.005	0.080	67.1	0.012	0.005	0.066	54.9
	Lowland	0.024	0.005	0.195	53.7	0.023	0.005	0.167	51.5	0.022	0.005	0.151	50.5	0.020	0.005	0.115	40.1
	Total	0.020	0.005	0.183	65.6	0.020	0.005	0.143	60.5	0.020	0.005	0.150	61.6	0.018	0.005	0.114	52.6
Natural	Upland	0.010	0.000	0.050	37.8	0.008	0.000	0.050	33.3	0.010	0.003	0.050	40.0	0.010	0.000	0.050	47.1
	Lowland	0.005	0.000	0.050	22.7	0.005	0.000	0.050	16.0	0.008	0.000	0.050	21.4	0.005	0.000	0.050	19.0
	Total	0.008	0.000	0.050	23.9	0.006	0.000	0.050	19.2	0.009	0.000	0.050	33.7	0.009	0.000	0.050	29.2
Urban	Total	0.050	0.000	1.302	78.9	0.050	0.000	1.233	80.0	0.050	0.000	1.355	70.0	0.050	0.000	0.610	68.2

Land use	Source of flow	2001				2002				Average (1997–2002)			
		Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC
Pastoral	Upland	0.010	0.005	0.128	48.9	0.010	0.000	0.068	32.9	0.013	0.004	0.077	56.8
	Lowland	0.025	0.005	0.114	53.2	0.020	0.005	0.123	49.0	0.022	0.005	0.144	49.7
	Total	0.020	0.005	0.115	59.2	0.020	0.005	0.112	54.9	0.020	0.005	0.136	59.1
Natural	Upland	0.010	0.005	0.050	44.8	0.008	0.003	0.050	25.0	0.009	0.002	0.050	38.0
	Lowland	0.010	0.005	0.054	36.4	0.010	0.005	0.050	27.6	0.007	0.002	0.051	23.9
	Total	0.010	0.005	0.050	32.5	0.010	0.003	0.050	20.8	0.008	0.001	0.050	26.5
Urban	Total	0.050	0.015	0.532	95.5	0.050	0.011	0.495	75.0	0.050	0.004	0.921	77.9

3.3 Dissolved reactive phosphorus (DRP: g/m³). ‘>ANZECC’ refers to percentage of sites exceeding guideline values (Table 1).

Land use	Source of flow	1997				1998				1999				2000			
		Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC
Pastoral	Upland	0.009	0.002	0.071	48.3	0.009	0.002	0.069	47.5	0.010	0.001	0.089	54.4	0.009	0.003	0.081	47.7
	Lowland	0.017	0.004	0.126	65.2	0.017	0.003	0.128	61.7	0.016	0.003	0.146	66.0	0.014	0.004	0.097	64.2
	Total	0.015	0.003	0.103	65.2	0.013	0.002	0.115	62.8	0.014	0.002	0.123	67.4	0.013	0.003	0.090	64.5
Natural	Upland	0.007	0.001	0.028	45.5	0.007	0.002	0.027	48.8	0.006	0.001	0.029	36.0	0.007	0.003	0.023	34.3
	Lowland	0.010	0.002	0.080	40.9	0.010	0.002	0.159	39.1	0.010	0.002	0.089	31.8	0.010	0.004	0.085	35.7
	Total	0.010	0.002	0.034	53.0	0.010	0.002	0.038	53.0	0.008	0.001	0.034	44.4	0.008	0.003	0.032	41.1
Urban	Total	0.020	0.010	0.137	100.0	0.020	0.008	0.175	95.0	0.020	0.007	0.126	90.0	0.015	0.009	0.101	88.5

Land use	Source of flow	2001				2002				Average (1997–2002)			
		Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC	Median	5th	95th	>ANZECC
Pastoral	Upland	0.009	0.003	0.080	44.9	0.010	0.003	0.075	51.1	0.009	0.002	0.077	49.0
	Lowland	0.018	0.005	0.103	70.8	0.015	0.005	0.092	69.5	0.016	0.004	0.115	66.2
	Total	0.016	0.003	0.092	66.9	0.015	0.003	0.086	69.6	0.014	0.002	0.101	66.1
Natural	Upland	0.006	0.002	0.026	35.3	0.006	0.003	0.028	34.7	0.006	0.002	0.027	39.1
	Lowland	0.010	0.002	0.060	43.3	0.009	0.003	0.026	17.4	0.010	0.003	0.083	34.7
	Total	0.007	0.002	0.029	42.9	0.006	0.003	0.027	36.8	0.008	0.002	0.032	45.2
Urban	Total	0.015	0.005	0.104	88.0	0.010	0.005	0.394	80.0	0.017	0.007	0.173	90.2

3.4 Black disk clarity (BDC: m). '<ANZECC' refers to percentage of sites failing to meet guideline values (Table 1).

Land use	Source of flow	1997				1998				1999				2000			
		Median	5th	95th	<ANZECC	Median	5th	95th	<ANZECC	Median	5th	95th	<ANZECC	Median	5th	95th	<ANZECC
Pastoral	Upland	1.2	0.7	3.6	17.8	1.7	0.6	4.6	8.9	1.6	0.3	4.2	11.1	1.6	0.7	4.1	6.2
	Lowland	1.1	0.3	2.9	20.1	1.1	0.3	3.3	20.6	1.2	0.4	3.2	13.7	1.2	0.4	3.6	14.4
	Total	1.2	0.4	3.1	20.7	1.2	0.4	3.6	21.0	1.4	0.4	3.5	16.1	1.3	0.4	3.7	14.7
Natural	Upland	2.3	0.9	4.7	0.0	2.6	1.0	4.8	0.0	2.9	1.3	5.8	0.0	3.1	0.9	6.1	4.2
	Lowland	2.2	0.7	4.9	0.0	1.9	0.7	4.2	0.0	2.1	0.7	5.5	0.0	2.5	0.7	4.5	0.0
	Total	2.3	0.9	4.7	1.7	2.3	0.9	4.3	1.5	2.8	1.0	5.5	1.3	2.9	0.8	5.9	3.8
Urban	Total	0.6	0.2	3.6	50.0	1.0	0.2	4.1	44.4	0.8	0.3	3.5	47.4	1.0	0.3	2.9	47.8

Land use	Source of flow	2001				2002				Average (1997–2002)			
		Median	5th	95th	<ANZECC	Median	5th	95th	<ANZECC	Median	5th	95th	<ANZECC
Pastoral	Upland	1.5	0.4	4.3	8.5	1.4	0.5	3.8	16.0	1.5	0.5	4.1	11.4
	Lowland	1.3	0.4	3.3	12.4	1.2	0.3	3.2	13.2	1.2	0.3	3.2	15.7
	Total	1.4	0.4	3.7	15.3	1.2	0.3	3.5	16.9	1.3	0.4	3.5	17.4
Natural	Upland	3.3	1.0	7.4	0.0	3.1	0.9	8.5	1.4	2.9	1.0	6.2	0.9
	Lowland	2.3	0.8	6.2	2.8	2.1	0.9	5.0	3.2	2.2	0.8	5.0	1.0
	Total	2.8	0.9	7.0	1.0	2.7	0.9	6.8	1.9	2.6	0.9	5.7	1.8
Urban	Total	1.2	0.3	3.8	34.8	1.0	0.2	3.3	26.3	0.9	0.3	3.5	41.8

3.5 Percentage of sites failing to meet recreational guidelines for black disk clarity (ie, BDC < 1.6 m). See Table 1.

Land use	Source of flow	1997	1998	1999	2000	2001	2002	Average (1997–2002)
Pastoral	Upland	73.3	46.7	47.6	47.7	52.1	62.7	55.0
	Lowland	73.1	76.6	68.3	65.3	65.5	67.7	69.4
	Total	73.2	69.4	62.5	60.3	61.7	66.1	65.5
Natural	Upland	21.1	25.6	13.5	16.9	15.9	16.4	18.2
	Lowland	31.8	36.0	28.6	32.4	25.0	25.8	29.9
	Total	25.0	29.4	18.8	21.9	19.0	19.2	22.2
Urban	Total	66.7	77.8	73.7	73.9	65.2	52.6	68.3

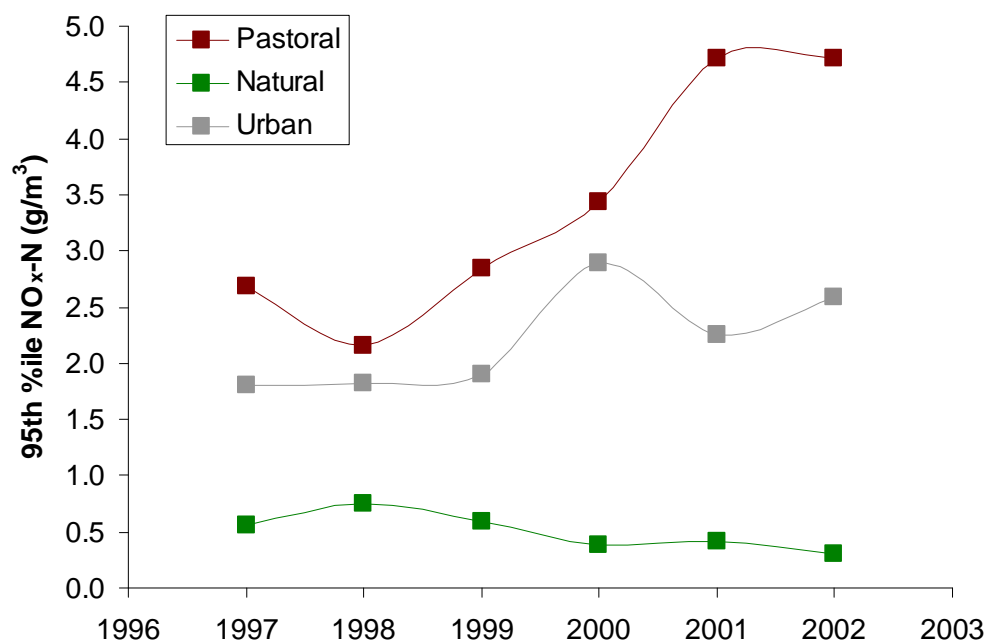
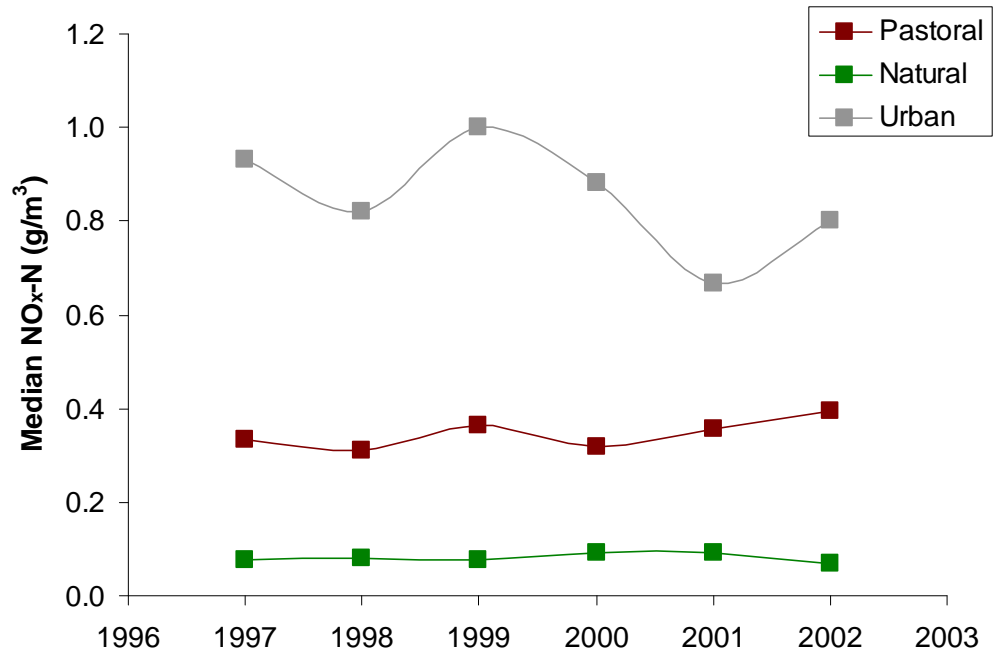
3.6 *E. coli* (MPN/100 ml). ‘>MfE/MoH’ refers to percentage of sites exceeding guideline values (Table 1). MPN = Most Probable Number. Note that data summarised in this table are derived from site data that has been calculated as 95th percentiles (eg, the median for each category in each year is the median of the 95th percentiles).

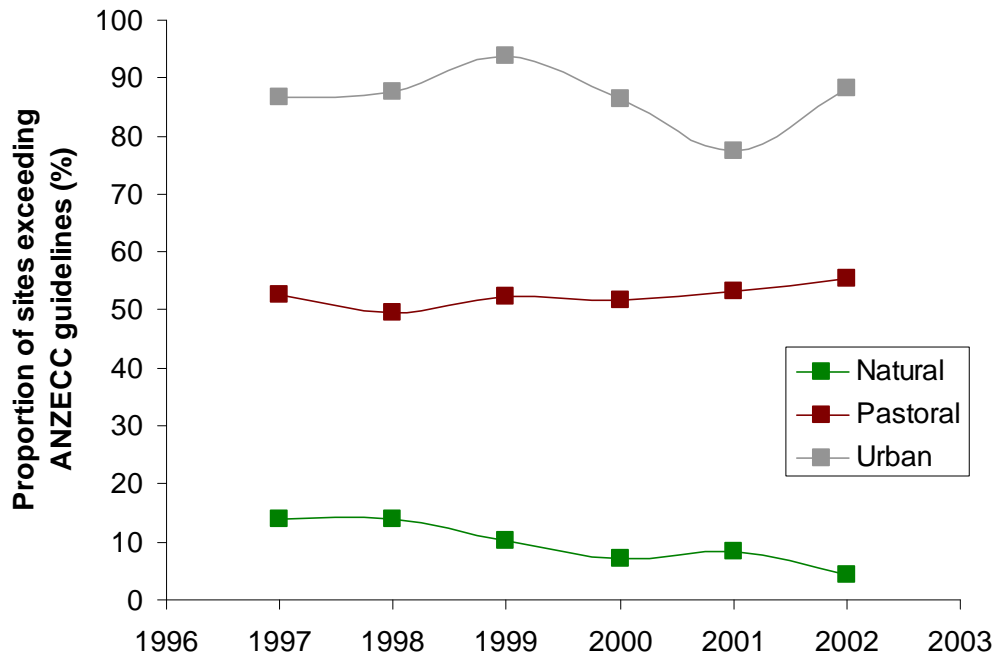
Land use	Source of flow	1998				1999				2000			
		Median	5th	95th	>MfE/MoH	Median	5th	95th	>MfE/MoH	Median	5th	95th	>MfE/MoH
Pastoral	Upland	290	37	6,177	39.3	420	35	7,554	43.6	440	45	8,905	43.9
	Lowland	1,900	130	19,638	72.0	1,300	89	7,870	69.3	1,600	197	20,158	74.8
	Total	970	78	18,193	63.1	993	75	8,000	62.1	1,431	127	15,732	67.1
Natural	Upland	150	2	2,180	19.0	145	4	2,099	33.3	66	5	681	6.5
	Lowland	960	34	28,900	61.5	585	64	15,100	50.0	432	14	2,940	46.2
	Total	220	4	14,960	35.3	320	6	4,200	40.9	97	5	1,972	20.8
Urban	Total	2,800	1,700	9,400	100.0	3,250	1,900	9,700	100.0	4,400	220	9,000	70.0

Land use	Source of flow	2001				2002				Average (1998–2002)			
		Median	5th	95th	>MfE/MoH	Median	5th	95th	>MfE/MoH	Median	5th	95th	>MfE/MoH
Pastoral	Upland	748	64	10,463	55.9	685	51	10,370	56.9	517	46	8,694	47.9
	Lowland	1,600	231	15,060	77.8	1,310	216	18,469	78.9	1,542	172	16,239	74.6
	Total	1,300	126	14,054	71.5	1,200	120	13,999	72.1	1,179	105	13,996	67.2
Natural	Upland	140	14	1,980	25.9	86	5	1,299	15.3	117	6	1,648	20.0
	Lowland	320	33	4,469	33.3	280	15	5,083	26.1	515	32	11,299	43.4
	Total	270	17	2,680	28.4	140	5	3,216	18.3	209	7	5,406	28.7
Urban	Total	1,140	424	2,660	83.3	1,200	356	7,810	72.7	2,558	920	7,714	85.2

4. Changes in water quality state (1997–2002) and land use differences

4.1 Oxidised nitrogen

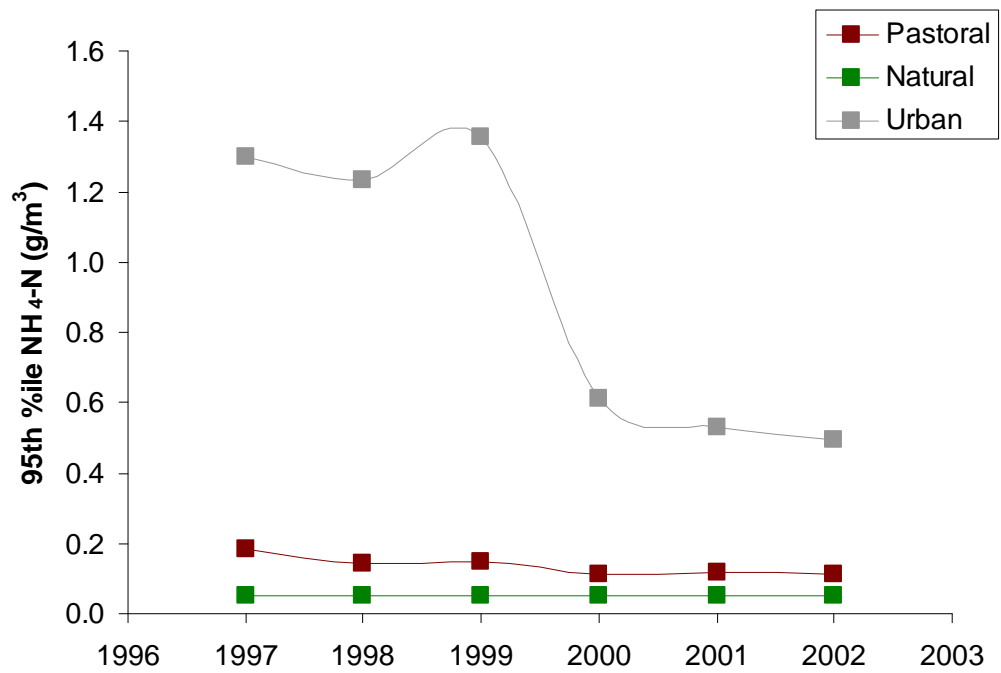
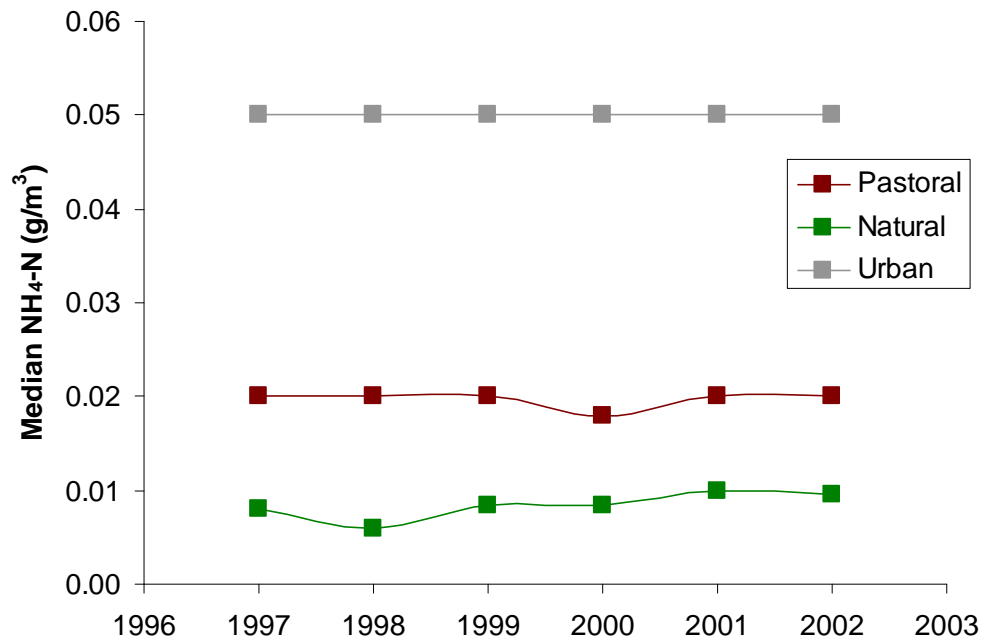


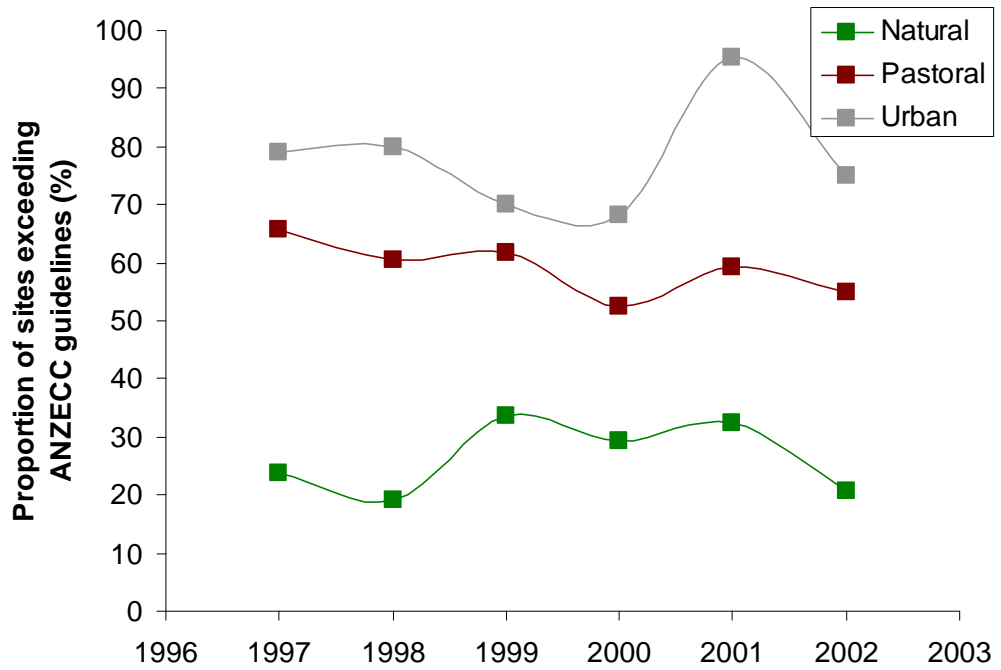


Key findings

- Concentrations of $\text{NO}_x\text{-N}$ increased sharply in the most-enriched pastoral sites (ie, the 95th percentile) between 1997 and 2002. This pattern mirrors that found by Scarsbrook (2006) for the most highly enriched sites in the NRWQN, and provides further evidence that our most enriched streams are deteriorating.
- Urban sites had the greatest percentage exceedance of ANZECC (2000) guidelines. Around 50% of Pastoral sites exceeded the guideline value for NO_x .

4.2 Ammoniacal nitrogen

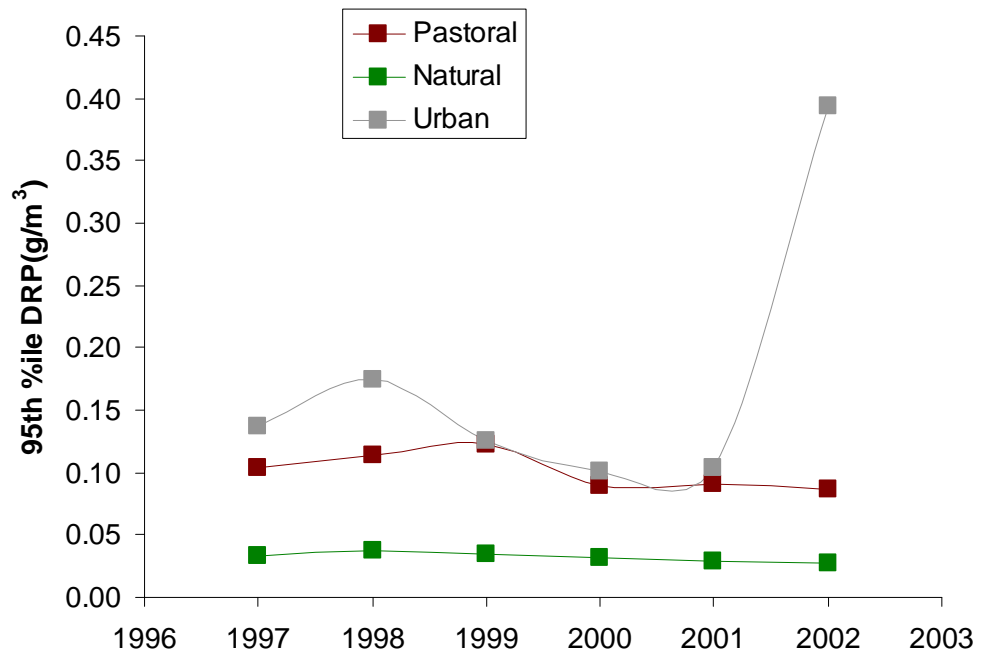
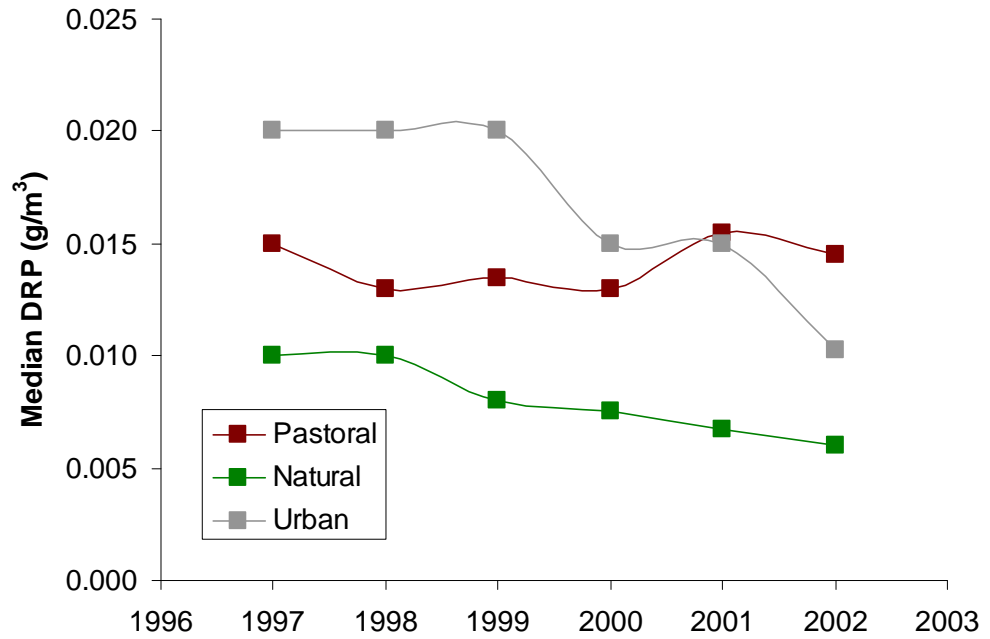


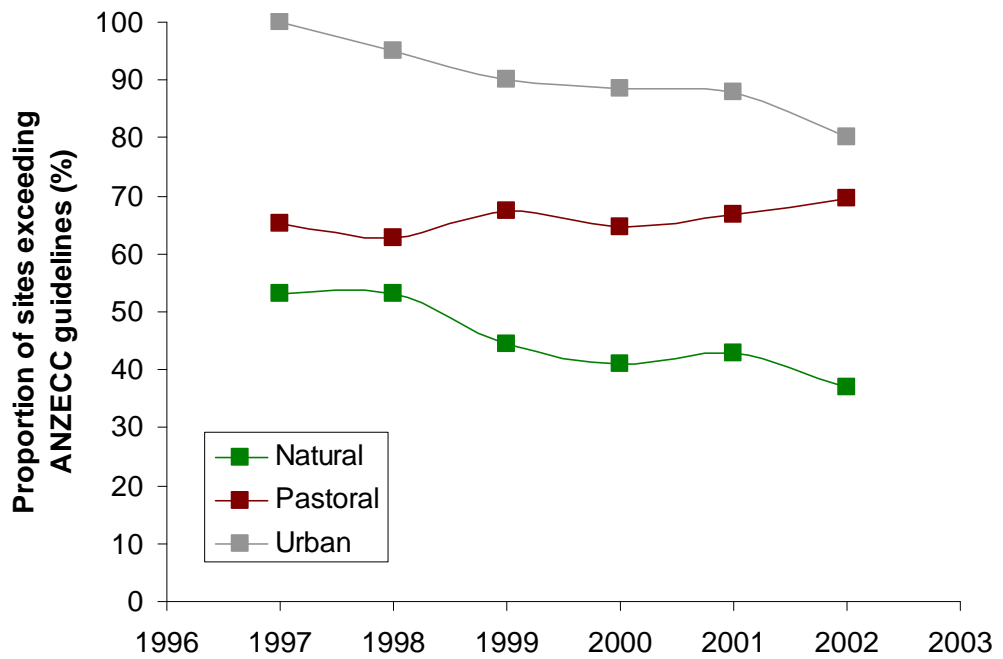


Key findings

- Concentrations of $\text{NH}_4\text{-N}$ in ‘average’ rivers were relatively stable in all three landcover classes over the 1997–2002 period. In contrast, there was a sharp decrease in concentrations in the most enriched urban streams. Again, this is consistent with improvements in point source discharge management, and mirrors similar improving trends in the National River Water Quality Network (Scarsbrook 2006).

4.3 Dissolved reactive phosphorus

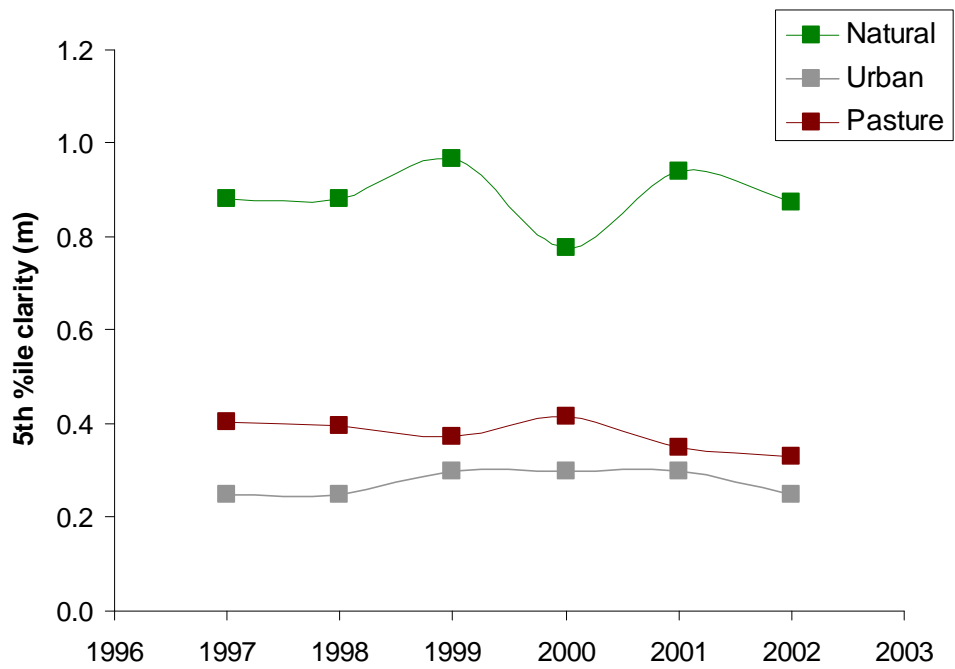
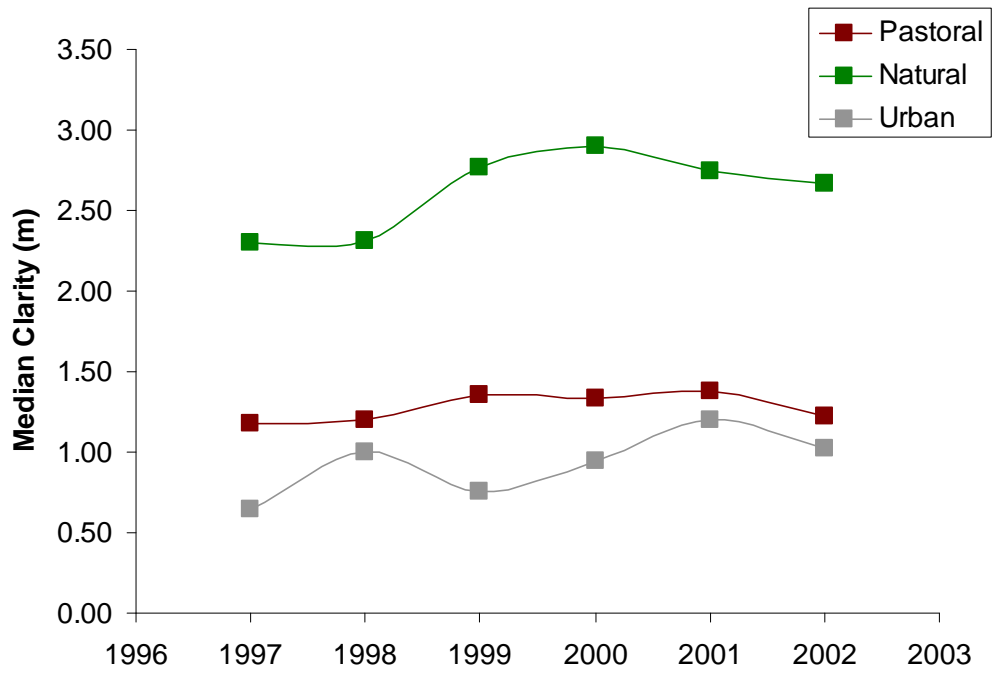


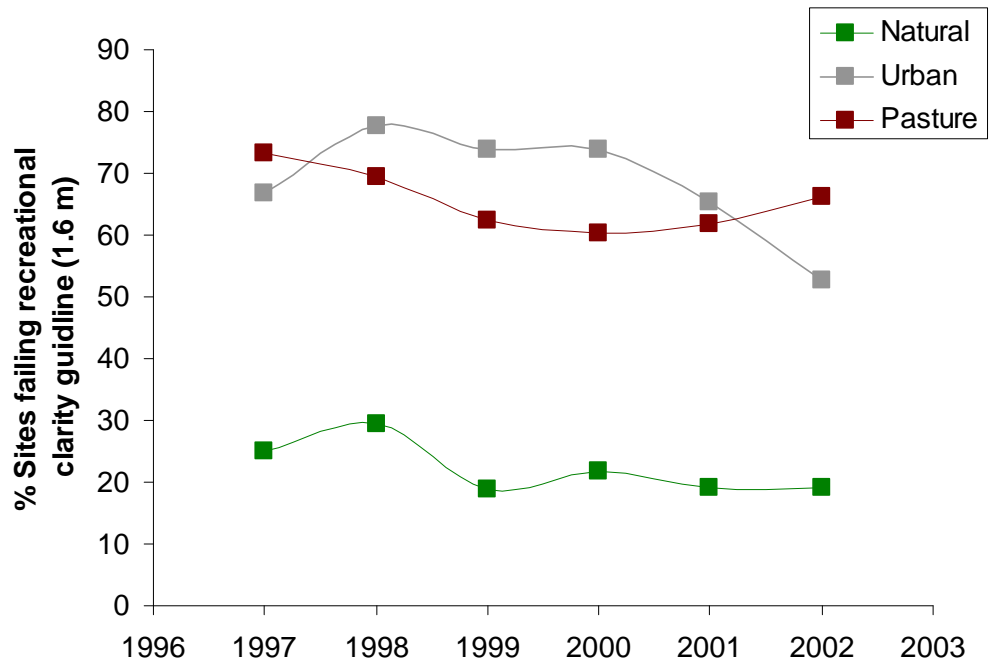


Key findings

- Concentrations of DRP in ‘average’ rivers (ie, 50th percentile) draining Urban and Natural catchments decreased over the 1997–2002 period, whereas DRP increased slightly in Pastoral rivers. Note: The spike in 95th percentile DRP concentrations appear to be due to very high values in Mazengarb Drain, an urban tributary of Waikanae River.
- The percentage of sites exceeding ANZECC & ARMCANZ (2000) guidelines trended downwards at Urban sites during the 1997–2002 period. This may reflect improvements in point source discharge management. Many of the sites sampled, including a relatively high proportion of sites in Natural catchments, exceeded the ANZECC guidelines.

4.4 Black disk clarity

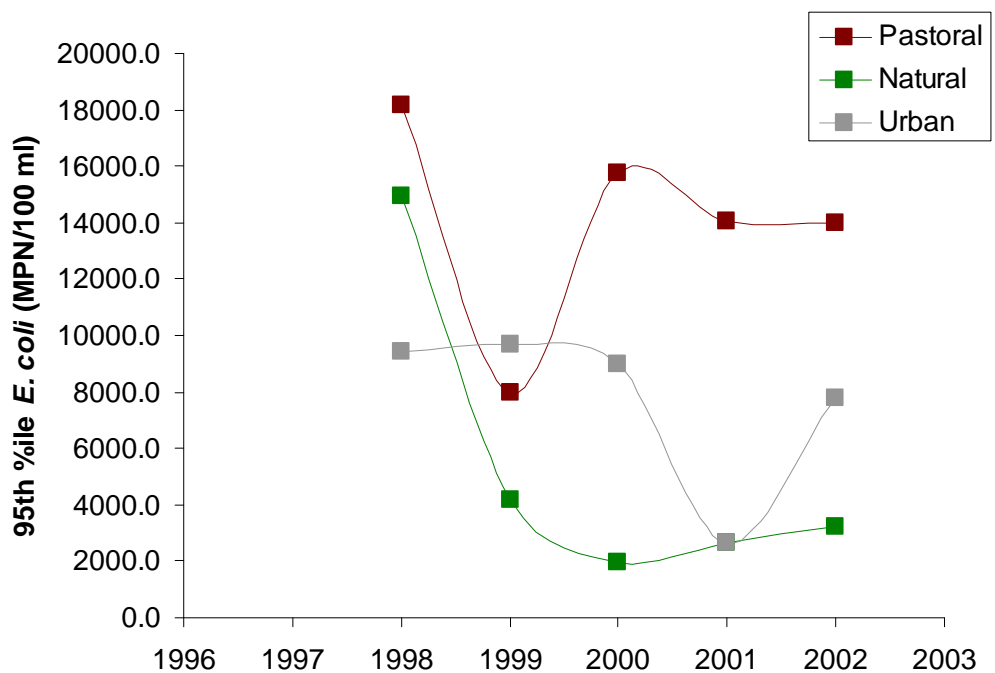
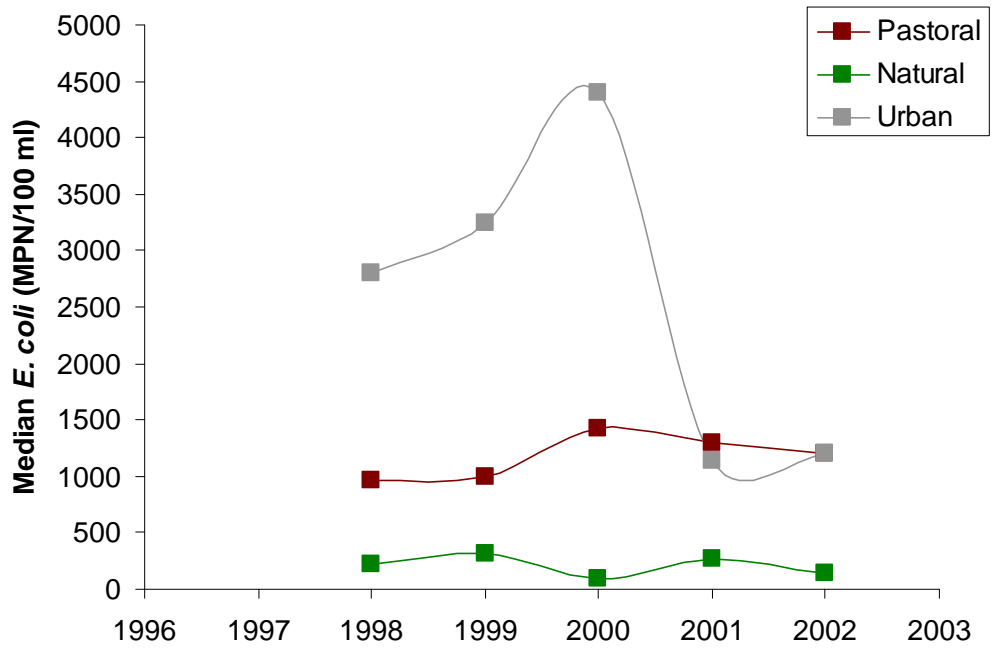




Key findings

- There was little change in the percentage of sites exceeding the ANZECC & ARMCANZ (2000) recreational guidelines with regard to clarity, and little change over time in the values seen in “average” and “dirty” rivers.

4.5 *E. coli*. Note that data presented in the following graphs are derived from site data that has been calculated as 95th percentiles (ie, the medians are medians of the 95th percentiles).



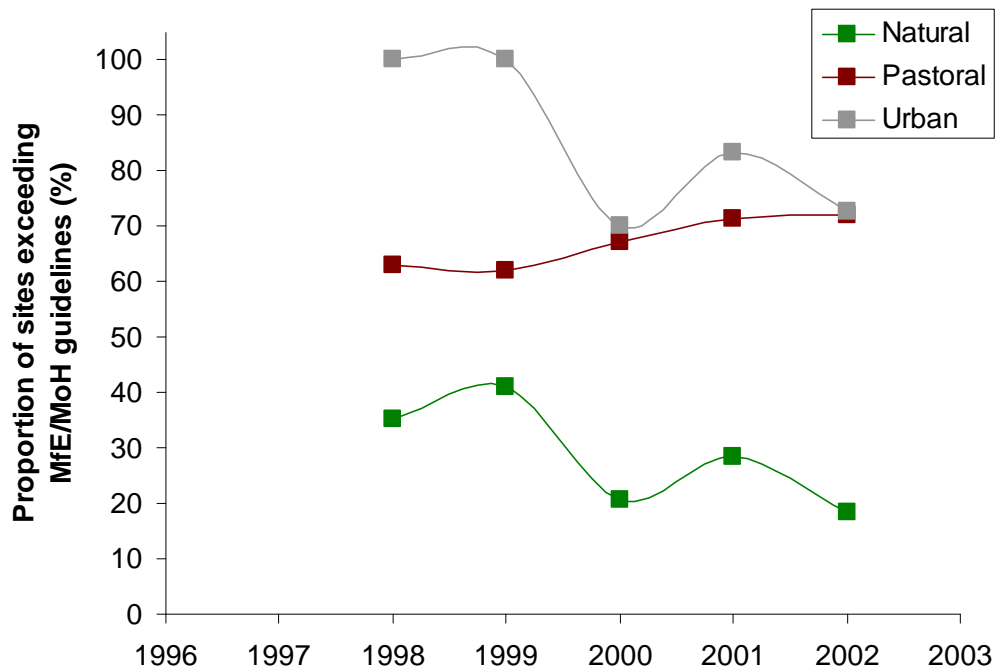


Table 4.1 Summary giving average values across 5 years (1998–2002) for median, 5th and 95th percentile values (see Table 3.6). This provides a long-term average of summary data (5th, 50th and 95th percentiles) for *E. coli* concentrations across all sites. *E. coli* concentrations for individual sites are calculated as the 95th percentile of values for each year.

Summary	Median	5th	95th	% >MfE/MoH
Pastoral	1,178.8	105.2	13,995.6	67
Natural	209.4	7.4	5,405.6	29
Urban	2558	920	7714	85

Key findings:

- On average, 85% of Urban sites, 67% of Pastoral and 29% of Natural sites exceeded the MfE/MoH (2003) freshwater recreation guidelines (ie, a large proportion of sites had 95th percentile concentrations greater than 550 *E. coli* per 100 ml, and hence, would be graded as ‘poor’ or ‘very poor’ for recreational uses). There was some indication of improvements in *E. coli* concentrations at ‘average’ Urban sites, but there was a high level of variability in the data, which makes interpreting patterns over time rather uncertain.

- In another national scale assessment, Scarsbrook & McBride (2004)¹ found that 92% of Urban sites, 85% of Pastoral and 50% of Natural sites exceeded the MfE/MoH (2003) freshwater recreation guidelines. Both the current study and Scarsbrook & McBride used the same compiled dataset. The variation in results of the two studies can be attributed to differences in site selection criteria and the way data was analysed (eg, values from the current study were averages across several years, whereas Scarsbrook & McBride (2004) summarised data across all years). Results from both studies show the same gradient in relative water quality across Urban, Pastoral and Natural sites and also indicate that a majority of sites in Urban and Pastoral fail the freshwater recreation guidelines with respect to *E. coli*.

¹ <http://www.mfe.govt.nz/publications/ser/ecoli-levels-nz-rivers-dec04/ecoli-levels-nz-rivers-dec04.pdf>

5. Summary

An extensive water quality dataset compiled by Larned et al. (2003) from regional councils throughout the country provides a useful tool for national-scale state of the environment reporting. One of the benefits of such a national scale compilation is that it provides an independent dataset with which to compare spatial and temporal patterns provided by the National River Water Quality Network. In this regard, it is worth noting that key findings from the present report (eg, increasing trends in concentrations of $\text{NO}_x\text{-N}$ at the most enriched sites, and patterns in NH_4 concentrations consistent with improvements in point source discharges) mirror national scale trends reported for the NRWQN by Scarsbrook (2006).

6. References

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- Scarsbrook, M. (2006). State and trends in the National River Water Quality Network (1989–2005). Prepared for Ministry for the Environment. NIWA Client report HAM2006-131. 45 p.
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7. Appendix 1: Breakdown of monitoring sites by REC classes

Classification	Categories		Code	Number of sites	
Climate	Warm	Warm extremely wet	WX	4	
		Warm wet	WW	118	
		Warm dry	WD	20	
	Cool	Cool extremely wet	CX	49	
		Cool wet	CW	241	
		Cool dry	CD	113	
	Source of flow	Upland	Glacial Mountain	GM	2
			Mountain	M	11
			Hill	H	182
Lowland		Low elevation	L	315	
Other		Lake	Lk	35	
Land cover	Pastoral	Pasture	P	355	
	Natural	Bare	B	2	
		Indigenous forest	IF	102	
		Tussock	T	15	
		Scrub	S	18	
		Exotic forest	EF	27	
		Wetland	W	0	
	Urban	Urban	U	26	
	<i>Aggregated Categories²</i>	Pastoral Upland			100
Pastoral Lowland			238		
Natural Upland			85		
Natural Lowland			37		

² Excludes sites in Exotic Forest and Lake-fed sites. Natural landcover includes IF, S and T.