

What Consent Monitoring Information is Available?

New River Estuary Landfill

Discharge permit 9445v does not specify the required monitoring but states that the Post Closure Management Plan (PCMP) should specify this. The current version of the PCMP requires monitoring of groundwater, landfill gas, lagoon water, and surface water.

Groundwater Monitoring

What is measured?

- Water Level
- pH
- Conductivity
- CBOD
- Total Nitrogen
- Ammoniacal Nitrogen
- Nitrate Nitrogen
- Total Phosphorus
- Dissolved Calcium
- Dissolved Magnesium
- Dissolved Sodium
- Chloride
- Sulphate
- Total Zinc
- Total Iron
- Total Lead
- Faecal Coliform
- Organochlorine Pesticides (trace)

Where is it measured?

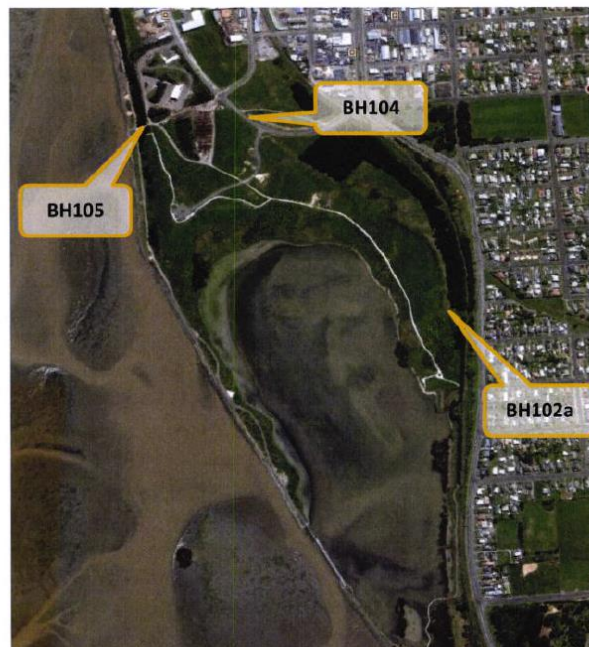


Figure 3.1 Bore Locations

Table 3-1 Bore Location Descriptions

BH102a	Inside East boundary of site near Scandrett Street. Established 2010, Destroyed October 2016
BH104	Outside north east Boundary of Landfill Site beside Bond Street. Established 2002
BH105	Inside west Boundary of Landfill toward northern end of site. Established 1997

How often is it measured?

Twice per year, starting in the late 90's.

Summary results:

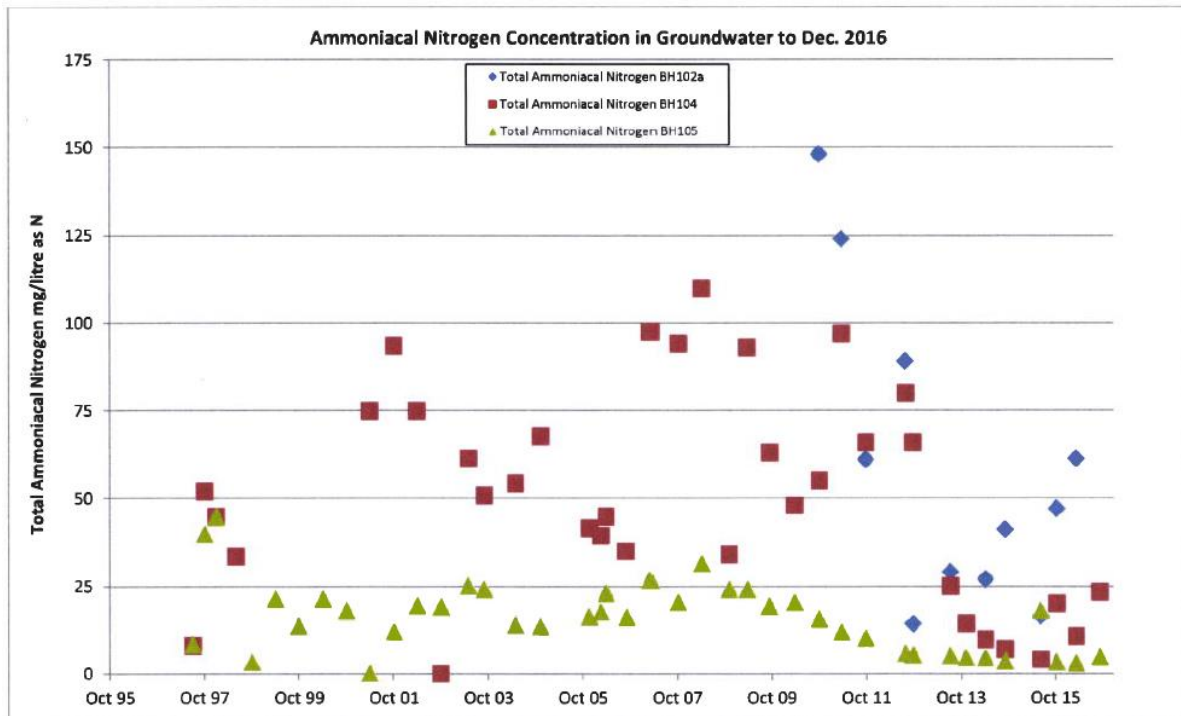


Figure 3-2 Total Ammoniacal Nitrogen Concentration in Groundwater

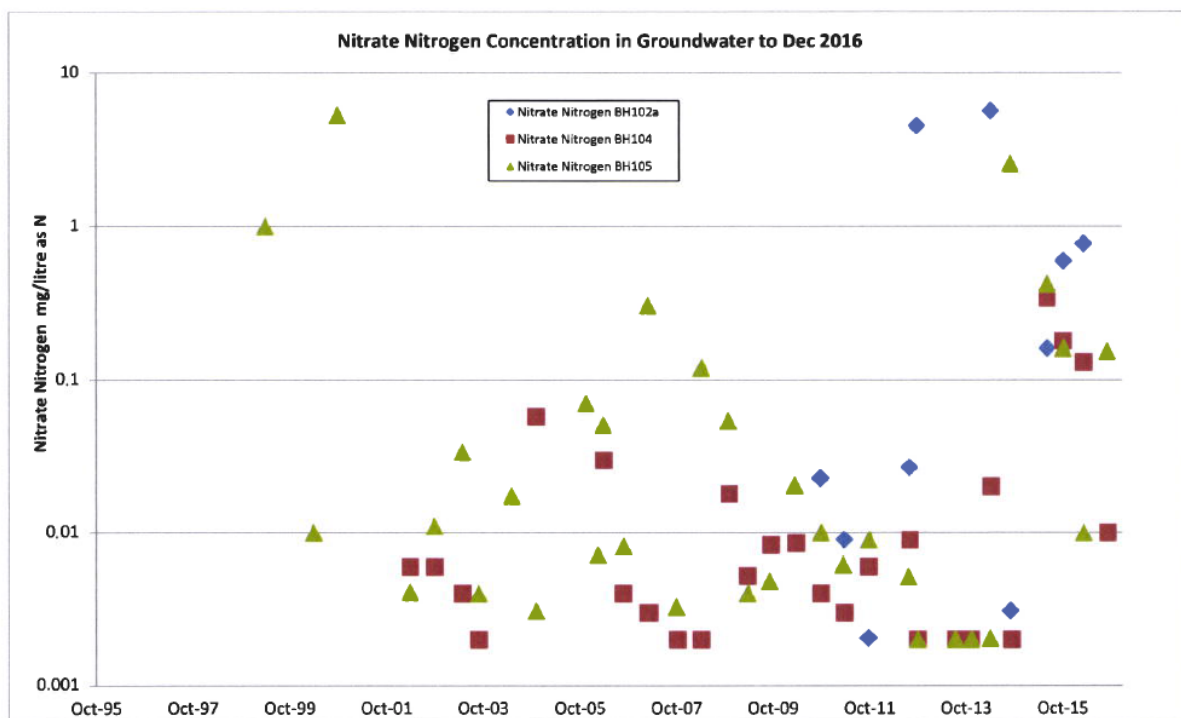


Figure 3-3 Total Nitrate Nitrogen Concentration in Groundwater

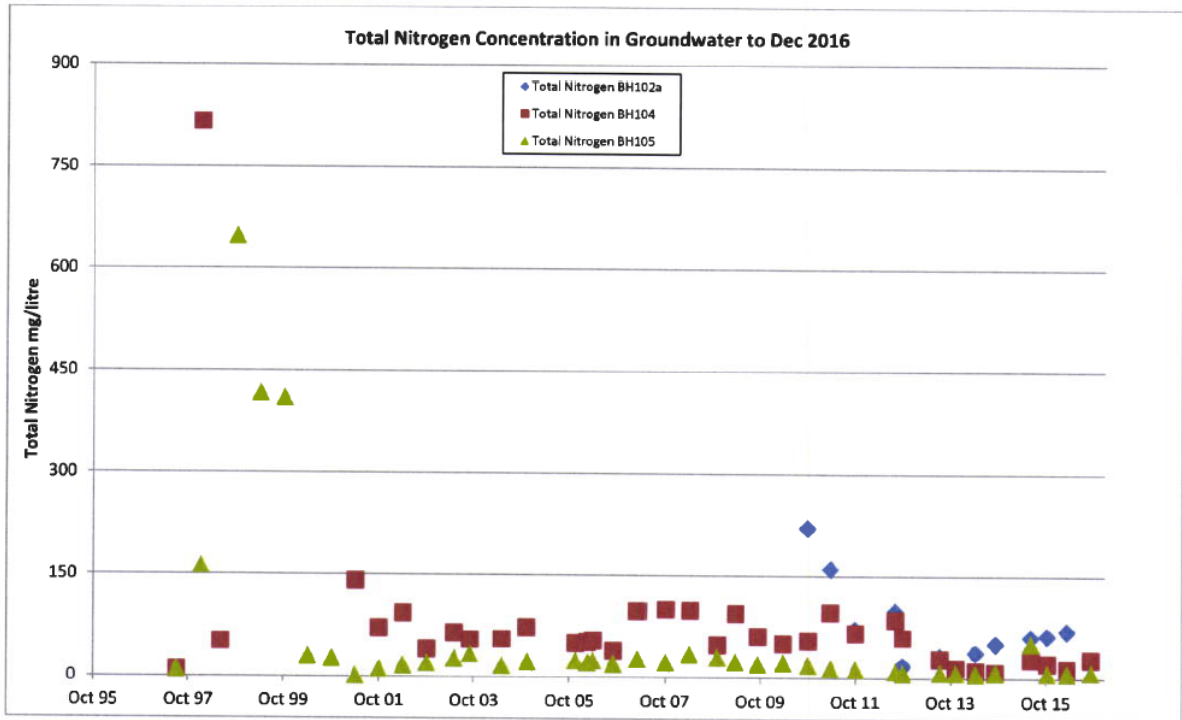


Figure 3-4 Total Nitrogen Concentration in Groundwater

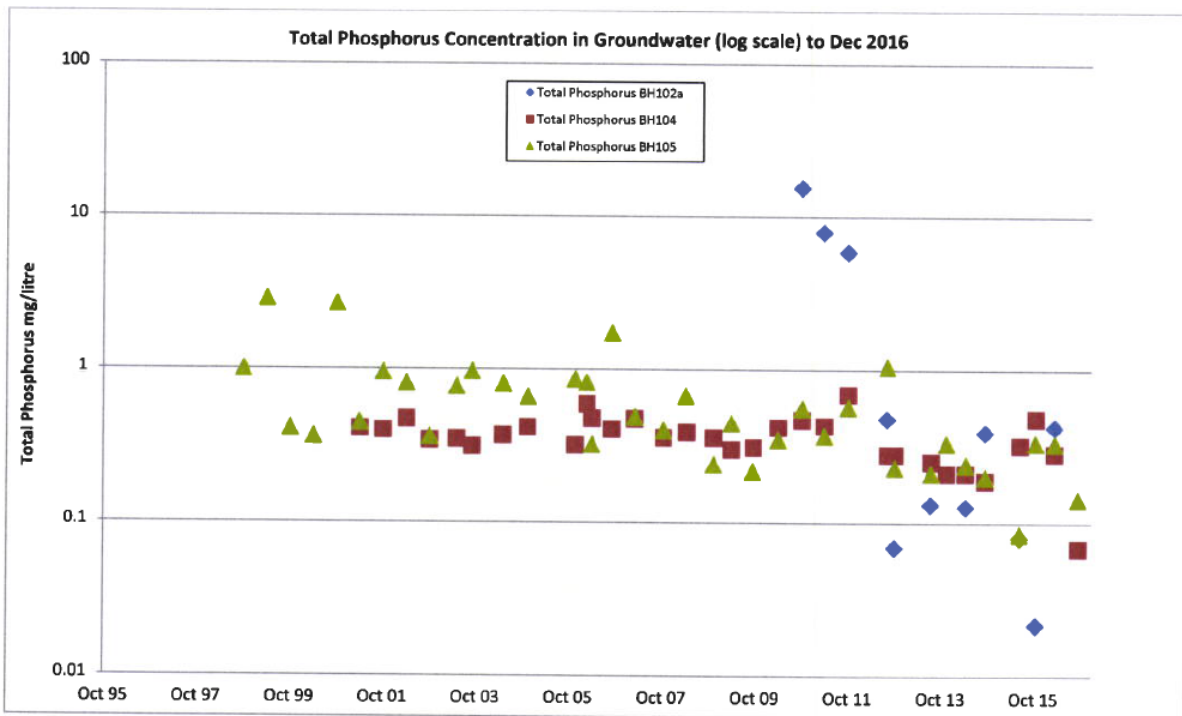


Figure 3-5 Total Phosphorus Concentration in Groundwater

Surface Water Monitoring (Overland flow)

Surface water monitoring is designed to detect overland flow of contaminated surface water from the active landfill sites.

What is measured?

- Conductivity
- Suspended Solids
- pH
- Chloride
- Sulphate
- Calcium
- Magnesium
- Sodium
- Boron
- Total Iron
- Total Lead
- Total Zinc
- Total Manganese
- Total Phosphorus
- Nitrate Nitrogen
- Ammoniacal Nitrogen
- CBOD5
- Faecal Coliform

Where is it measured?

Opportunistic sampling from a number of trench/pipe locations around the landfill. Locations shall include the culvert that runs through the site as well as the operating face. Consideration is to be given to samples from around the sewage sludge piles. Upstream samples from the culvert are also advisable.

How often is it measured?

Once every six months during periods of significant stormwater discharge.

Landfill Gas Monitoring

Landfill gas emissions are greatest during landfill operation and up to one year post-closure. The land was closed over nine years ago, capped and established with vegetation. No discernible signs of gas emission were noted during operation.

What is measured?

A GA5000 landfill gas analyser was used to test the manhole and bore sample sites. Sample tubes were lowered into the manhole, flushed for three minutes and then sampled for a further three minutes. The following analytes were measured:

- Depth from Surface
- Pump Time
- CH4 Peak (%)
- CO2 Peak (%)
- O2 min (%)
- CO peak (ppm)
- H2S peak (ppm)

Where is it measured?



Figure 3-10 Landfill Gas Sample Site Locations

How often is it measured?

Once every six months.

Summary results:

Parameter	Units	BH102a	BH104	BH105	Manhole S35009	Manhole S23697	Manhole S23718
		Scandrett	Bond Street	Transfer Station	Lookout	Bond Street	Forest
Date		12 July 2016	12 July 2016	12 July 2016	12 July 2016	12 July 2016	12 July 2016
Depth from Surface ¹		2.0	1.0	1.0	3.5	3.0	3.0
Pump Time ²	minute	3	3	3	3	3	3
CH ₄ peak (%)	mS/cm	0.0	0.0	0.0	0.8	0.0	0.0
CO ₂ peak (%)	mg/l	0.2	0.2	0.2	0.6	0.4	0.2
O ₂ min (%)	mg/l	20.9	20.9	20.9	20.5	20.9	20.9
CO peak (ppm)	NTU	0	0	0	0	0	0
H2S peak (ppm)	CFU/100ml	0	0	0	0	0	0
Technician	ICC	APC	APC	APC	APC	APC	APC

¹ Depth from surface that gas sensor was positioned

² Time that the landfill gas sensor was running after flushing the sample tubes

Lagoon Monitoring

The landfill has an extensive interface with the surface water of the lagoon. The semi-enclosed lagoon is affected to some extent by landfill leachate together with contaminants that may be introduced by tidal influxes. Four sites have been established to monitor the likely influence from

landfill leachate. A further sample site is positioned at the lagoon outlet/inlet to monitor contaminants to and from the estuary.

What is measured?

- Temperature
- pH
- Conductivity
- Dissolved Oxygen
- Suspended Solids
- Turbidity
- Total Coliforms
- Faecal Coliforms
- Enterococci
- Ammoniacal Nitrogen
- Nitrate Nitrogen
- Dissolved Reactive Phosphorus
- Total Phosphorus
- Chlorophyll a
- CBOD5
- Total Iron
- Sulphide

Where is it measured?



Figure 4.1 Lagoon Monitoring Locations

How often is it measured?

Monthly at all sites except the lagoon inlet/outlet, which was sampled an additional 22 times as part of a separate estuarine testing programme (total 34 samples). Flow was towards the estuary (out

of the lagoon) on 28 of those occasions. Estuarine programme samples were generally taken close to high tide or close to low tide.

Summary results:

Parameter	Units	Woodhouse William		Scandrett Selwyn		Old Tip Face		Bathing Beach		Lagoon Outlet		Lagoon Inlet		ANZECC 2000	
		Percentile (5 or 95)	2016 Median	Percentile (5 or 95)	2016 Median	Percentile (5 or 95)	2016 Median	Percentile (5 or 95)	2016 Median	Percentile (5 or 95)	2016 Median	Percentile (5 or 95)	2016 Median	Fresh Water	Marine Water
Temperature	Celcius	6.0-21.3	11.5	5.1-22.0	11.1	6.0-21.5	11.3	6.4-24.8	11.7	5.7-19.5	11.3	6.5-18.8	13.1		
pH		7.12 8.99	7.63	7.29 9.25	7.86	7.33 9.05	7.89	7.43 8.94	7.99	7.26 8.77	7.95	7.18 8.34	7.95	7.2-7.8 ²	
Conductivity	mS/cm	2.95 33.09	19.48	3.06 35.0	19.6	3.83 32.9	19.75	4.63 34.9	22.6	2.76 35.2	19.4	0.98 32.6	23.5		
Dissolved Oxygen	mg/l	7.13 17.3	12.03	7.43 18.11	12.14	6.30 16.92	12.20	7.63 18.01	11.26	7.22 13.46	10.91	8.16 11.04	10.82		
Suspended Solids	mg/l	135	34.1	158	30	161	55	312	66	233	47	153	152		
Turbidity	NTU	56.8	10.8	73	8.5	89	13.8	107	22.1	51	17.1	95	16.1		
Total Coliform	CFU/100ml	4595	667	4430	735	5479	1050	4045	834	7000	587	26000	434		
Faecal Coliform	CFU/100ml	2576	320	1285	285	2867	275	2052	195	2027	200	4800	125		
Enterococci	CFU/100ml	269	14	237	22	173	22	87	13	267	12	600	24		
Ammoniacal Nitrogen	mg/l as N	4.77	0.52	2.78	0.43	4.66	1.07	4.80	1.02	0.72	0.25	0.64	0.19	0.90 ³	0.91 ³
Nitrate Nitrogen	mg/l as N	2.92	0.75	2.86	0.92	3.08	0.71	2.70	0.55	2.57	0.59	3.08	0.51	0.444 ²	
DR Phosphorus	mg/l	0.33	0.037	0.32	0.063	0.48	0.070	0.48	0.080	0.27	0.077	0.144	0.056		
Total Phosphorus	mg/l	0.59	0.110	0.52	0.107	0.58	0.133	0.86	0.171	0.38	0.146	0.251	0.105	0.033 ²	
Chlorophyll α	mg/m ³	14.5	4.72	15.8	5.37	25.7	7.94	28.7	11.36	21.7	5.47	17.8	4.70		
cBOD ₅	mg/l	5	4	4	3	6	3	9	4	4	2	3	NA		
Total Iron	mg/l	7.4	1.10	4.8	0.58	4.2	0.92	9.03	1.63	3.65	1.22	2.21	1.03		
Sulphide ¹	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		

Note Bold red text indicates a result equal or exceeding the historical 5th or 95th percentile
Red shading indicates a result exceeding the relevant ANZECC guideline

¹ Historical 5th Percentile (low), or 95th Percentile (high). For some parameters both the 5th and 95th percentiles are given (2005 to 2016)

² ANZECC physical and chemical stressors for slightly disturbed ecosystem (lowland river)

³ ANZECC trigger values for freshwater, 95% species level of protection (@20 degrees C and pH 8.0)

Invercargill Stormwater Network

The current consents specify a monitoring programme which ICC were to undertake up to June 2013. From that point, ICC were to specify a programme that would be implemented on an annual basis and register this with Environment Southland (ES). This programme has included monitoring of the discharges themselves, the water quality in the water bodies to which the stormwater discharges and the sediment in these water bodies.

Stormwater Discharge

Monitoring of the discharges was conducted for a representative sample (18 in number) of all the discharges from the network as a whole. Sampling of the discharges was often undertaken at a manhole upstream of the actual outfall due to access constraints and because many of the stormwater pipes are underwater.

The sampling was through collection of grab samples. No composite sampling was conducted. The dry weather samples were collected when there had been minimal rainfall for at least 72 hours prior and hence represent the baseflow in the system without inflow from rain related flows. The wet weather samples were taken in a period of wet weather, and were not timed to represent first flush but indicated the general quality of discharge during wet weather.

What is measured?

- Ammonia
- Colour
- Conductivity
- DRP
- E.Coli
- Flow
- FWA
- Nitrate Nitrogen
- pH
- Rainfall (last 2hrs ,24hrs, 72hrs, 10days)
- Suspended Solids
- Temperature
- TKN
- Total Arsenic
- Total Cadmium
- Total Chromium
- Total Coliforms
- Total Copper
- Total Lead
- Total Nickel
- Total Nitrogen
- Total Petroleum Hydrocarbons
- Total Phosphorus
- Total Zinc

Where is it measured?

Eighteen sites across four catchments:

Site	Catchment
Bluff Highway Up Stream South Drain	Kingswell
Brown Street North West Drain	Kingswell
Elles Road North Drain	Kingswell
16 Onslow Street Manhole	Otepuni
34 Onslow Street Manhole	Otepuni
Camden Street Drain	Otepuni
Leven Street Bridge North West Drain	Otepuni
Lindisfarne Street Bridge	Otepuni
Ythan Street Drain	Otepuni
126 Gladstone Terrace	Waihopai
274 Talbot Street	Waihopai

61 Rosewood Drive	Waihopai
Prestonville Discharge	Waihopai
Queens Drive Bridge	Waihopai
Russell Street	Waihopai
Thomsons Bush Backwash Discharge	Waihopai
Thomsons Bush Backwash Inflow	Waihopai
Discharge to Waikiwi Stream	Waikiwi

How often is it measured?

Opportunistic sampling according to the following rules:

- Periods with no rainfall in the catchment for at least three consecutive days: three times per year, with no less than 2 months between each sampling event. Where practicable, the sampling shall occur between 7 a.m. to 9 a.m. or 5 p.m. to 7 p.m.
- During the first two hours of a rainfall event with an intensity of at least 2.5mm in the first hour, that was preceded by at least 72 hours of no measurable rainfall: two times per year, with at least three months between sampling events.

Summary results:

Catchment and number of sites	Presence of sewage	ES Plan WQ Standards	Toxicity (95% protection)			Nutrients	
	E.coli >1,000 in dry weather	Ammonia (<2.2)	Ammonia (<0.9)	Nitrate	Metals ^s	Nitrogen	Phosphorus
Kingswell - 3 sites	Number of sites exceed	Few exceed in dry only	Few exceed in dry only	Most exceed in dry only	Most exceed for Cu and Zn. Few for Cr and Pb	Most exceed	Most exceed
Otepunu - 6 sites	Most exceed	OK	One site in dry only	Four sites in dry only	Most exceed for Cu and Zn. Few for Cr and Pb	Most exceed	Most exceed
Waihopai - 7 sites	Some exceed, half of time	One site few times	One site few times	All sites, most in dry, some in wet	Most exceed for Cu and Zn. Few for Cr and Pb	Most exceed	Most exceed
Waikiwi - 1 site	OK	OK	OK	Exceed few times	Most exceed for Cu and Zn. Half for Cr. Few for Ni and Pb	Most exceed	Most exceed

Receiving Environment

The consents required monitoring of the quality of the water bodies. Sampling was targeted to specific rainfall periods. From 2012 to 2016, between 13 and 19 sampling events (dependent upon location) were collected at each location in dry weather conditions and 5 or 6 in wet weather conditions.

What is measured?

- Ammonia
- Chlorophyll a
- Colour
- Temperature
- TKN
- Total Arsenic

- Conductivity
- Dissolved Oxygen
- DRP
- E.Coli
- Flow
- FWA
- Nitrate Nitrogen
- pH
- Rainfall (last 2hrs ,24hrs, 72hrs, 10days)
- Suspended Solids
- SHMAK (clarity)
- Total Cadmium
- Total Chromium
- Total Coliforms
- Total Copper
- Total Lead
- Total Nickel
- Total Nitrogen
- Total Petroleum Hydrocarbons
- Total Phosphorus
- Total Zinc

Where is it measured?

Site	Catchment
Bain Street East	Clifton
Wicklow Street East	Clifton
Bluff Highway West (Lake Street)	Clifton
Chesney Street (Up Stream)	Kingswell
Bluff Road (Down Stream)	Kingswell
Rockdale Road East (Up Stream)	Otepuni
Lindisfarne Street West (5m Down Stream of South Outfall)	Otepuni
Mersey Street Bridge East	Otepuni
Racecourse Road 50m Upstream	Waihopai
Queens Drive 50m Down Stream	Waihopai
Prestonville 50m Upstream	Waihopai
Prestonville 60m Downstream	Waihopai
North Road Bridge Downstream	Waihopai
Waikiwi Stream 50m Upstream of Stormwater Outfall	Waikiwi
Waikiwi Stream 50m Downstream of Stormwater Outfall (West Plains Rd Bridge)	Waikiwi

How often is it measured?

Opportunistic sampling according to the following rules:

- Periods with no rainfall in the catchment for at least three consecutive days: at least three times per year, with no less than four weeks between each sampling event.
- During the first two hours of a rainfall event with an intensity of at least 2.5mm in the first hour, that was preceded by at least 72 hours of no measurable rainfall: at least two times per year, with at least three months between sampling events.

Summary Results:

Catchment and Number of Sites	ES Plan WQ Standards	NPS-FM (National Bottom Line)			Toxicity (95% protection)			Nutrients	
	Ammonia (<2.2)	Dissolved Oxygen	E.coli <1,000	Nitrate (<9.8)	Ammonia (<0.9)	Nitrate (<2.4)	Metals ⁷	Nitrogen	Phosphorus
Clifton - U/S site - mid site - D/S site	Occasional U/S only exceed	Some in dry weather	Some exceed in wet, U/S only in dry	OK	Some but U/S worse	Some in dry, all sites	All sites, most of time for Cu, Cr, Zn	All sites, most of time	All sites, most of time
Kingswell - U/S site - D/S site	OK	Few in wet and dry	Both sites, most times in wet, few and U/S only in dry	OK	OK	Few in dry both sites	Both sites most of time for Cu, Cr and Zn	Both sites, most of time	Both sites, most of time
Otepunu - U/S site - mid site - D/S site	OK	One site on one occasion in dry	Most exceed in wet, only one site once in dry	OK	OK	Some at all sites in dry only	All sites, most of time for Cu, Zn Cr, Pb and Ni only some in wet	All sites, most of time	All sites, most of time
Waihopai - U/S site - 3 mid sites - D/S site	OK	OK	Most exceed in wet, some in dry	OK	OK	Some at all sites in dry only	All sites, half of time for Cu Some sites half of time for Zn Few sites occasion for Cr	All sites, all of time	All sites, half of time
Waikiwi - U/S site - D/S site	OK	Both sites on one occasion in dry	Both sites, half of time in wet and dry	OK	OK	Both sites, most of time	Both sites, half of time for Cu and Zn Few times D/S only in wet for Cr	All sites, all of time	All sites, half of time

Sediment

The Consent required monitoring of Sediment quality within the various water bodies. Monitoring has been undertaken at the following locations, on an annual basis between 2012 to 2016:

What is measured?

- Dry Matter as received
- Total Organic Carbon
- Total Zinc
- Total Copper
- Total Lead
- Total Arsenic
- Total Nickel
- Total Cadmium
- Total Chromium
- Total Tin
- Total Silver
- Total Selenium
- Total Mercury
- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene (BAP)
- Benzo(b)fluoranthene + Benzo(j)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-c,d)pyrene
- Naphthalene
- Phenanthrene
- Pyrene

Where is it measured?

Thirteen sites across five catchments:

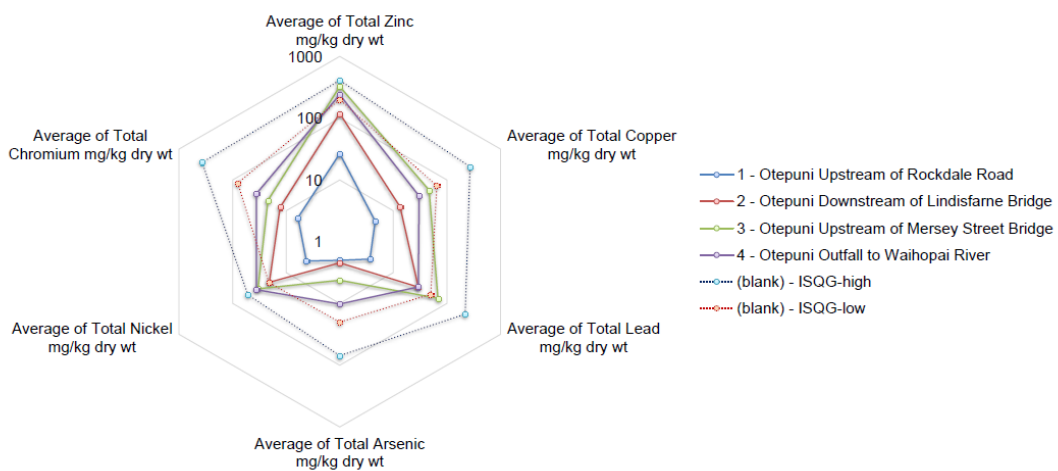
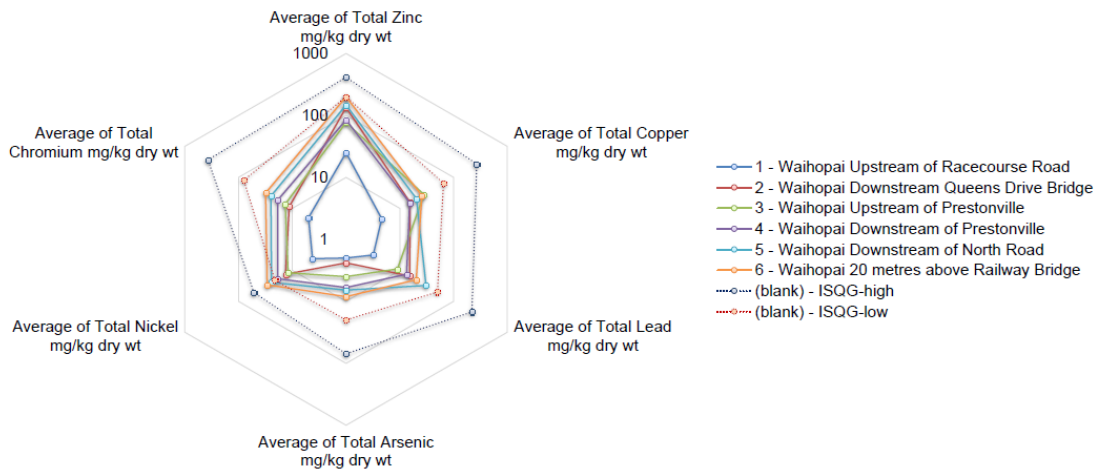
Site	Catchment
Clifton Channel @ Lake Street	Clifton
Kingswell Creek 150m West of Bluff Road @ Walking Track Bridge	Kingswell
Otepunu Upstream of Rockdale Road	Otepunu
Otepunu Downstream of Lindisfarne Bridge	Otepunu

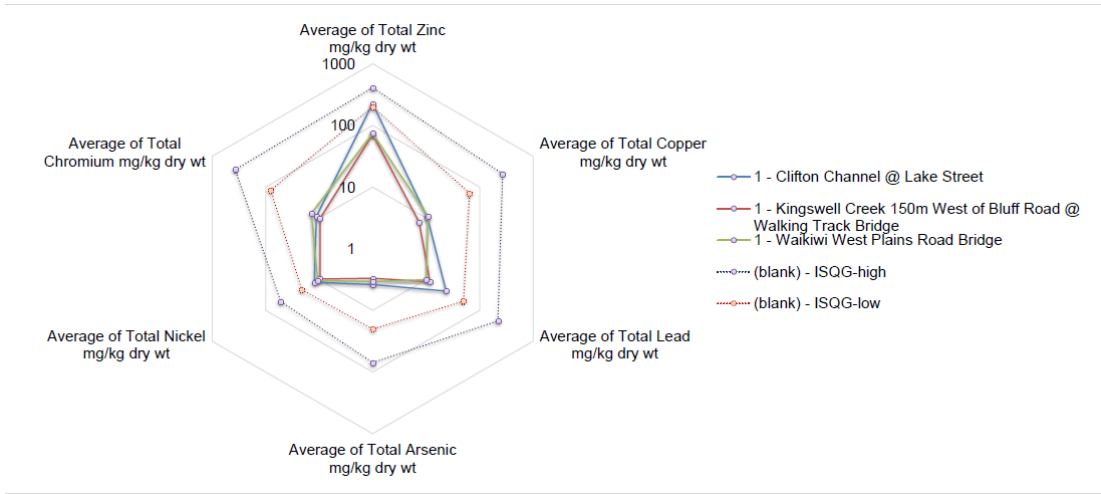
Otepuni Upstream of Mersey Street Bridge	Otepuni
Otepuni Outfall to Waihopai River	Otepuni
Waihopai Upstream of Racecourse Road	Waihopai
Waihopai Downstream of Queens Drive Bridge	Waihopai
Waihopai Upstream of Prestonville	Waihopai
Waihopai Downstream of Prestonville	Waihopai
Waihopai Downstream of North Road	Waihopai
Waihopai 20 metres above Railway Bridge	Waihopai
Waikiwi West Plains Road Bridge	Waikiwi

How often is it measured?

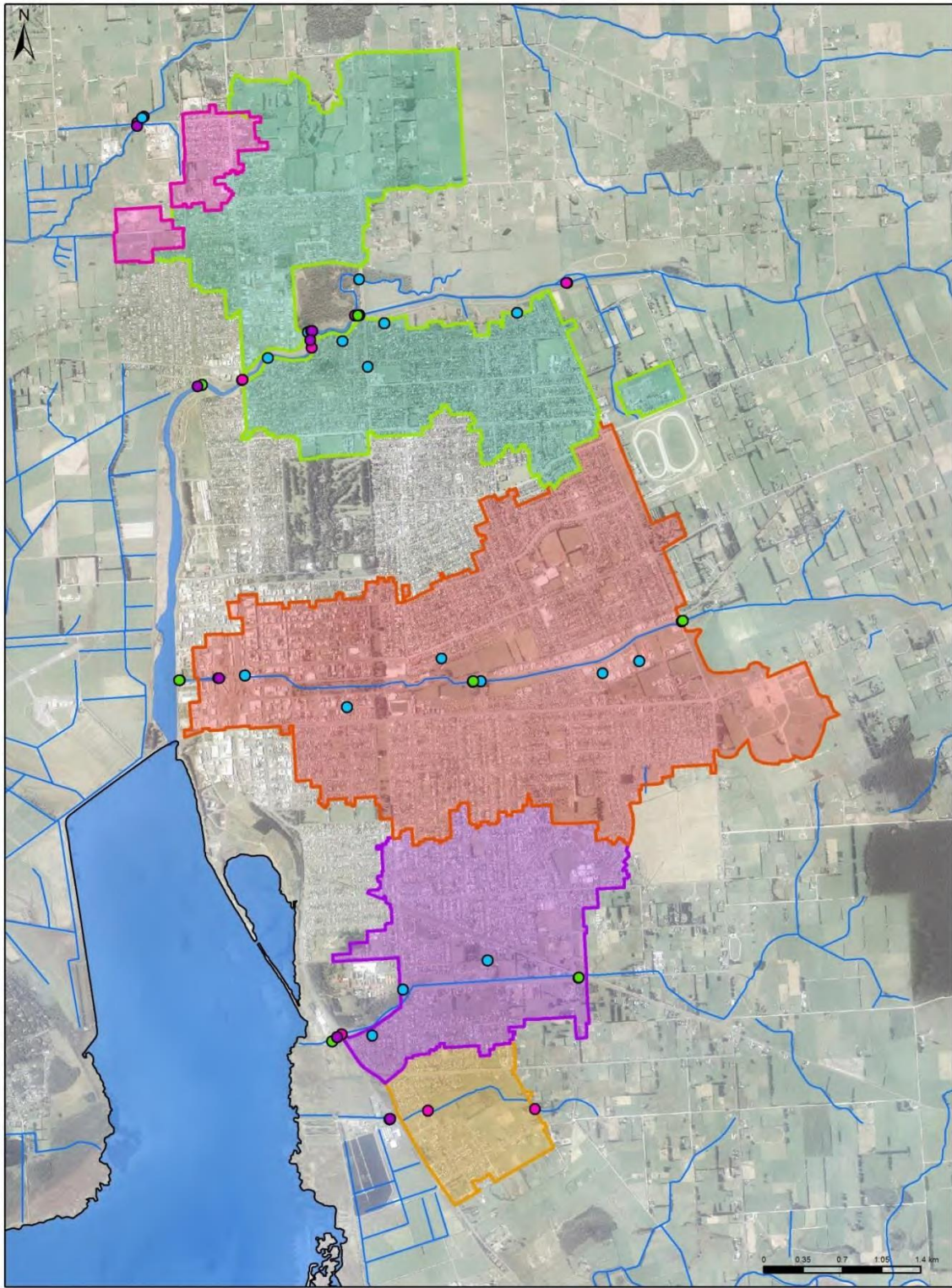
Samples are collected annually in March or April. The first sample was collected in 2012.

Summary results:





Stormwater Network Monitoring Sites



- | | | | |
|--------------------------|---------------------------|-----------------|----------------|
| ICC Stormwater Discharge | ICC Receiving Environment | Clifton Channel | Waihopai River |
| ICC Macro Invertebrates | ICC Sediment | Kingswell Creek | Waikiwi Stream |
| | | Otepuni Stream | |

Invercargill Waste Water Treatment Plant

Treated Waste Water Discharge

What is measured?

24 Hour Flow Proportional Samples (composite over 24hr period):

- Electrical conductivity
- CBOD5
- Suspended solids
- Grease/oil concentration

Weekly Grab Samples:

- pH
- Temperature
- Faecal Coliform
- E. Coli.

Once every three months/flow proportional over 24 hour period:

- Total Nitrogen
- Nitrate Nitrogen
- Total Ammoniacal Nitrogen
- Dissolved Reactive Phosphorus
- Total Copper
- Total Zinc
- Total Chromium
- Total Cadmium
- Total Nickel
- Total Lead

Where is it measured?

The outflow before entry to NRE. The exact coordinates need to be confirmed.

How often is it measured?

See above.

Summary Results:

WWTP Concentrations 1999-2015 (mg/L)										
	TN	NO3	NH4	DRP	Copper	Zinc	Chromium	Nickel	Lead	
Max	74	13	36	7	0.334	0.055	0.011	0.022	0.039	
Min	11	1	10	1	0.006	0.013	0.001	0.001	0.001	
Median	27	3	19	4	0.0155	0.03	0.004	0.006	0.001	
Mean	28	4	19	4	0.0247	0.031	0.0042	0.0074	0.0023	
Kg/Day	712	95	482	98						

Receiving Environment (Sediment Samples)

What is measured?

- RPD
- TOC
- Mud %
- Sand %
- Gravel %
- Total Cadmium
- Total Chromium
- Total Copper
- Total Nickel
- Total Lead
- Total Zinc
- Total Nitrogen
- Epifaunal Species/m²
- Infaunal Species/core

Where is it measured?



How often is it measured?

