Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

TECHNICAL REPORT Science Group

Healthy Estuary and Rivers of the City

Water quality and ecosystem health monitoring programme of Ihutai

Water quality of the Estuary of the Heathcote and Avon Rivers/Ihutai

Summary report on data collected in 2016

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Summary

The report presents the results from the 2016 monitoring of water quality within and just outside (in the coastal waters of Pegasus Bay) the Estuary of the Heathcote and Avon Rivers/Ihutai. This monitoring programme is part of the four monitoring programmes described in The Healthy Estuary and Rivers of the City: Water quality and ecosystem health monitoring programme of Ihutai document (Batcheler, *et al.,* 2009).

The water quality was monitored monthly at eight sites within and two sites just outside the Estuary of the Heathcote and Avon Rivers/Ihutai. Eight of the sites were sampled around the time of high tide and three sites (including one also sampled around the time of high tide) were sampled around the time of low tide. The parameters measured monthly were nutrients (total ammoniacal nitrogen, nitrate-nitrite nitrogen and dissolved reactive phosphorus), salinity, total suspended solids, turbidity, chlorophyll-a, dissolved oxygen (% saturation) and faecal indicator bacteria (enterococci/*E. coli*). Dissolved metal concentrations were measured two monthly from July-December, i.e. three times, in 2016.

The results for the parameters measured monthly are presented by site. For each parameter the median and range of values is presented and the measured values are compared to a comparison value. For nutrients, total suspended solids, turbidity, chlorophyll-a and faecal indicator bacteria the exceedance of the comparison value has the potential to influence ecosystem health. For dissolved oxygen % saturation, values below the comparison value have the potential to influence ecosystem health. The results for dissolved metal concentrations for all sites are presented in a table. The dissolved metal concentrations are compared to the ANZECC (2000) trigger values. Values above a trigger value have the potential to influence ecosystem health.

A water quality index was calculated for each site. The parameters used to calculate the index were total ammoniacal nitrogen, nitrite-nitrate nitrogen, dissolved reactive phosphorus, total suspended solids and faecal indicator bacteria concentrations.

Water quality index results:

Site	Water Quality Index
Beachville Road jetty	VERY GOOD
Shag Rock @ high tide	GOOD
Shag Rock @ low tide	FAIR
Pegasus Bay at Caspian Street and Cave Rock	FAIR
South New Brighton Park, Penguin Street, Humphreys Drive, Bridge Street @ low tide, Ferrymead bridge @low tide	POOR
Sandy Point	VERY POOR

The ANZECC (2000) trigger value for dissolved copper was exceeded on occasion at all sites except Bridge Street @low tide and Ferrymead bridge @low tide.

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1 Introduction

Good water quality is required for the plants and animals that live in the water, and on and in the sea bed, to function normally. For the water to be of good quality it should not contain unnaturally high concentrations of nutrients or sediment and must contain sufficient oxygen for living things to survive. High concentrations of nutrients and sediment and low concentrations of oxygen can be detrimental to the plants and animals that live in the water, and on and in the sea bed.

The water within the Estuary of the Heathcote and Avon Rivers/Ihutai (the estuary) is from the Avon River/Ōtākaro and Heathcote River/Ōpāwaho, drains and stormwater that flow directly into the estuary, and coastal water from Pegasus Bay. Therefore the quality of the water within the estuary is influenced by the quality of the water in the rivers, drains, stormwater and coastal water. As well the estuary supports waterfowl and wading birds, with these birds a source of nutrients and micro-organisms to estuary water.

Avon River/Ōtākaro and Heathcote River/Ōpāwaho drain a large part of the city of Christchurch before flowing into the estuary. Both rivers are spring-fed and slow-flowing and have a number of tributaries that include both natural streams and man-made drains. The quality of the water in these rivers is influenced by both the quality of groundwater in the shallow aquifers that feed the springs and the quality of stormwater that runs off the land into the rivers and tributaries when it rains. Stormwater quality is strongly influenced by land use in the river catchment. Other factors that can affect water quality in these urban rivers include catchment geology, point source discharges from industrial sites, sewage overflows, and the presence of large numbers of waterfowl.

This annual summary report presents the water quality data collected in 2016 from within and just outside the estuary.

2 Methods

2.1 Sampling

The sampling sites are shown in Figure 2-1. Water samples were collected monthly over 2016 at these sites by Environment Canterbury staff.

Water samples were collected around the time of high tide at South Brighton@ Caspian Street, Penguin Street, South New Brighton Park, Sandy Point, Humphreys Drive, Beachville Road jetty, Shag Rock (estuary mouth) and Cave Rock. Water samples were collected around the time of low tide at Bridge Street bridge (Avon River/Ōtākaro), Ferrymead bridge (Heathcote River/Ōpāwaho) and Shag Rock.

2.2 Water quality parameters

The water samples were analysed for a range of water quality parameters. The parameters reported here are:

- Salinity (ppt)
- Total ammoniacal nitrogen (mg/L)
- Dissolved reactive phosphorus (mg/L)
- Chlorophyll-a (mg/L)
- Turbidity (NTU)
- Dissolved inorganic nitrogen (mg/L)
- Nitrate-nitrite nitrogen (mg/L)
- Total suspended solids (mg/L)
- Dissolved oxygen (% saturation)
- Dissolved metals (cadmium, chromium, copper, lead, nickel and zinc) (mg/L)

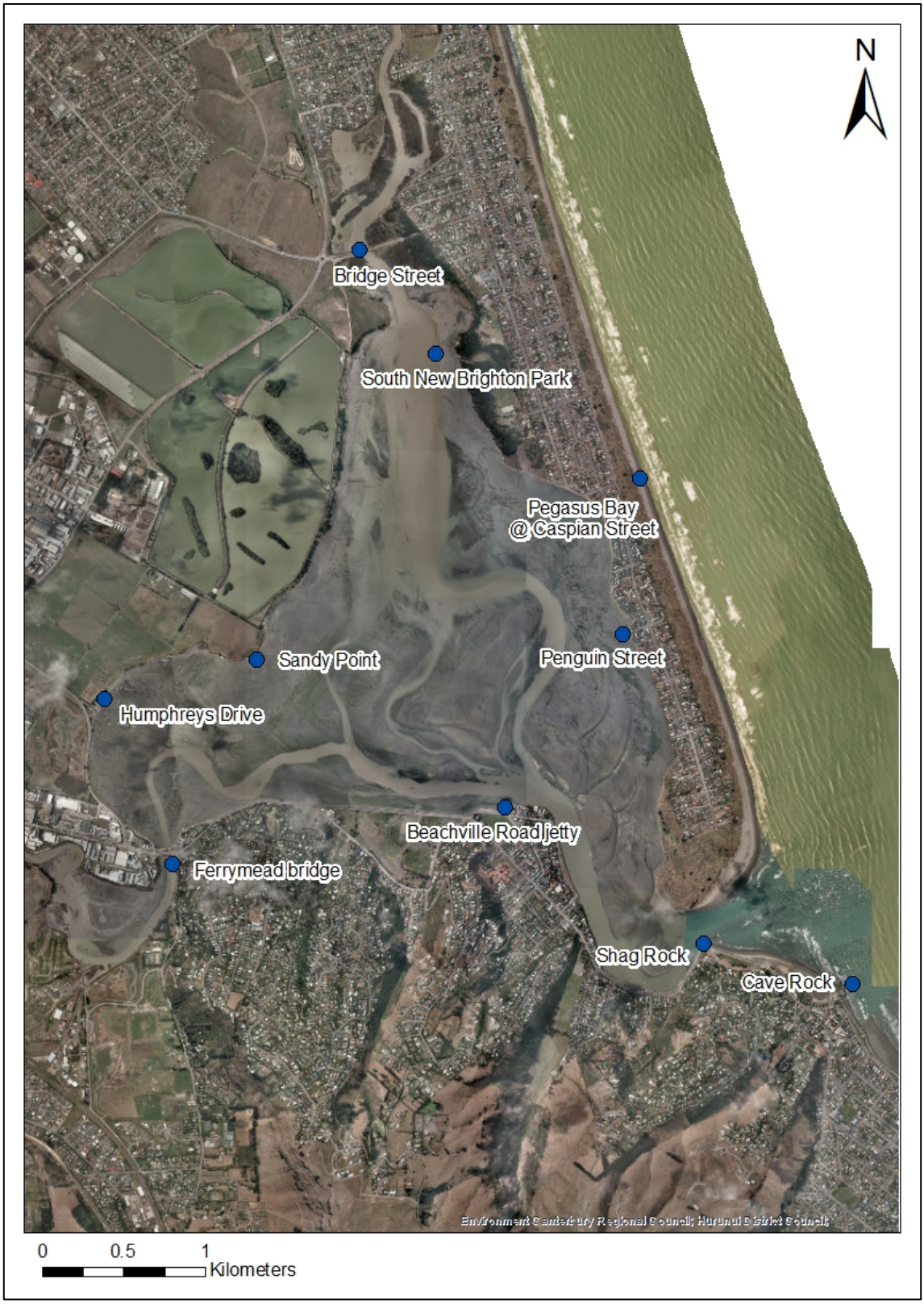

Figure 2-1: Water quality sampling sites

2.2.1 Details about the parameters

Salinity
Salinity is a measure of how salty the water is. The sea water 2.5 to 10 kilometres from shore in Pegasus Bay typically has a salinity of 33 - 34.5 ppt (parts per thousand). Freshwater has a salinity of 0 ppt.

Total ammoniacal nitrogen (NH_4N)
The NH_4N that occurs naturally in water is from the breakdown of once living and non-living nitrogenous matter and from gas exchange with the atmosphere. NH_4N is also formed during the breakdown of human and other animal excreta. NH_4N provides a measure of the quantity of ammonia in the water. Ammonia is a non-persistent and non-cumulative toxin to aquatic life.

Nitrate-nitrite nitrogen (NNN)
Nitrate and nitrite are formed during the breakdown of total ammoniacal nitrogen. They also occur in fertilisers used to enhance plant growth. However, fertilisers can flow into the nearest waterway particularly with rainfall, and fertiliser application can also result in leaching of nitrate into groundwater, which then resurfaces into waterways as springs. NNN also occurs in wastewater which can occasionally be discharged into the rivers if sewerage infrastructure is damaged or pumping stations overflow. Nitrate is the common form of dissolved nitrogen found in natural waters. This is because, when oxygen is present the nitrite quickly forms nitrate. In freshwater nitrate is toxic to aquatic life at elevated concentrations.

Dissolved inorganic nitrogen (DIN)
In estuarine and coastal waters DIN is the nutrient that primarily limits phytoplankton and algal growth.

$$DIN = NNN + NH_4N$$

Dissolved reactive phosphorus (DRP)
The phosphorus that occurs naturally in water is from the surrounding soil and rock. For example, the volcanic rocks/soils of Banks Peninsula contain more phosphorus than the soils of the Canterbury plains. Phosphorus occurs in fertilisers used to enhance plant growth. However, fertilisers can dissolve in rain and flow into the nearest waterway. Phosphorus is a constituent of dishwashing liquid and washing powders and is present in household wastewater.

Chlorophyll-a
Chlorophyll-a concentration is used as a measure of the amount of plant plankton (phytoplankton) in the water, i.e. the higher the chlorophyll-a concentration the more plankton in the water. Chlorophyll-a concentrations of 0.005 mg/L or more can result in discolouration of the water.

Dissolved oxygen % saturation
Dissolved oxygen (DO) is essential for aquatic animals to survive. DO % saturation can exceed 100% when oxygen gas is dissolved in the water. The results obtained are spot measurements. However, DO % saturation at a site does vary during the day and is influenced by water temperature. For DO % saturation the comparison value is a lower limit value. If the recorded DO % saturation is below this lower limit there is the potential for fish and other marine life to be affected because the ease with which they respire is affected.

Total suspended solids (TSS)
Total suspended solids (TSS) concentration is a measure of the amount of particles within the water column. It includes inorganic (non-living) particles such as the sand and mud stirred up from the seabed and soil washed off the land, as well as organic (from living things) particles like detritus (dead plant or animal material) and live organisms. Suspended particles affect the amount of light that penetrates into the water and hence the growth of plant plankton and seaweeds. It also affects feeding and other behaviours of animals.

The recorded TSS concentrations could be from inputs to the estuary from rivers and drains but there is also re-suspension of seabed sediment by the action of wind driven waves.

Turbidity

Turbidity is a relative measurement of light scattering by suspended particles in water. Informally, turbidity is considered synonymous with 'cloudiness' or loss of visual clarity (MfE, 1994). Visible clarity of water is important for aesthetic and safety aspects of recreational water use. Reduction in clarity can affect the behavioural pattern of fish and macro-invertebrates, especially migratory and predatory species.

Metals
Industry, building materials and cars are significant sources of metals, with wastewater and stormwater the pathway of the metals to the aquatic environment. Many of the metals are potentially toxic to aquatic life at low concentration.

3 Evaluation of the state of the water quality at each site

3.1 Comparison values

For each parameter the values recorded at each site are assessed against comparison values.

For some of the parameters in sea water (estuary and coastal sites), there are trigger values in the Resource Management Act (RMA), the ANZECC (2000) Guidelines for Fresh and Marine Water Quality, and the MfE/MoH (2003) Microbiological Water Quality Guidelines. However, for Chlorophyll-a, TSS, turbidity, NNN, DRP and DIN there are no developed NZ trigger values. For turbidity, NNN and DRP I have referred to comparison values used by the Otago Regional Council (Otago Regional Council, 2007). For Chlorophyll-a I have referred to a comparison value used by the Waikato Regional Council[1]. For TSS I have used the freshwater comparison value and for DIN I have referred to a comparison value from the literature (Alber and Sheldon, 2011). It could well be that in the future, the comparison values selected for Chlorophyll-a, TSS, turbidity, NNN, DRP and DIN are replaced by other values that are developed and are more applicable to the estuarine environment. However, for now I have used the values to provide **an indication** of the state of the water quality at the sampling sites within and just outside of the estuary. The comparison values for the estuary and coastal sites are presented in Table 3-1. NOTE: I consider that the terms satisfactory, medium and fair, as used in the column 'Source of comparison value' have a similar meaning in terms of water quality.

[1] The information is from the Waikato Regional Council website, the website address is provided in the References at the end of this report.

Table 3-1: Parameter comparison values for sea water (estuary and coastal sites)

Parameter	Units	Comparison value	Source of comparison value
Dissolved oxygen	% saturation	80	RMA
Enterococci	MPN/100 mL	140	MfE/MoH (2003)
TSS	mg/L	25	Same as freshwater (Stevenson *et al.*, 2010)
Chlorophyll-a	mg/L	0.004	Upper value for satisfactory water quality, Waikato Regional Council
turbidity	NTU	10	Upper value for medium water quality, Otago Regional Council (2007)
Dissolved reactive phosphorus	mg/L	0.02	
Nitrite-nitrate nitrogen		0.05	
Dissolved inorganic nitrogen		0.25	Upper value for fair WQ (Alber and Sheldon, 2011)
Total ammoniacal nitrogen		0.91	ANZECC (2000) 95% level of protection
Cadmium		0.005	
Chromium (CrIII)		0.0274	
Copper		0.0013	
Lead		0.0044	
Nickel		0.07	
Zinc		0.015	

When reporting the water quality results, for nutrients (NH_4N, NNN, DIN, DRP), TSS, turbidity, chlorophyll-a, and enterococci, at each site, I have used symbols to describe the 'status' of each parameter (Table 3-2). When reporting the water quality results for dissolved oxygen % saturation, I have also symbols to describe the 'status' of this parameter (Table 3-3).

Table 3-2: Reporting the status of nutrients, TSS, turbidity, chlorophyll-a, and enterococci at each site

☺	All monthly values are below the comparison value
😐	1 - 3 recorded values are above the comparison value
☹	4 or more recorded values are above the comparison value

Table 3-3: Reporting the status of dissolved oxygen (% saturation) at each site

☺	All monthly values are above the comparison value
😐	1 - 3 recorded values are below the comparison value
☹	4 or more recorded values are below the comparison value

For some of the parameters in freshwater (river sites), there are trigger values in the RMA, the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and the MfE/MoH (2003) Microbiological Water Quality Guidelines. There are values for some parameters in regional plans (Environment Canterbury, 2011, 2015) and the TSS value used by Environment Canterbury to assess TSS concentrations in freshwater is reported in Stevenson *et al.,* (2010).

The comparison values for freshwater sites are presented in Table 3-4. These values have been used to assess the water quality at Bridge Street bridge and Ferrymead bridge at low tide. When reporting the water quality results, for nutrients (NH_4N, NNN, DIN, DRP), TSS, turbidity, chlorophyll-a, dissolved oxygen % saturation and *E. coli*, for each site I have used the symbols described above.

Table 3-4: Parameter comparison values for freshwater (river sites)

Parameter	Units	Comparison value	Source of comparison value
Dissolved oxygen	% saturation	70	Environment Canterbury (2011, 2015)
E.coli	MPN/100 mL	550	MfE/MoH (2003)
TSS	mg/L	25	Stevenson *et al. (*2010)
Chlorophyll-a	mg/L	0.004	Same as for sea water
turbidity	NTU	5.6	ANZECC (2000) NZ Lowland rivers
Dissolved reactive phosphorus	mg/L	0.016	Environment Canterbury (2011, 2015)
Nitrite-nitrate nitrogen		0.444	ANZECC (2000) NZ Lowland rivers
Dissolved inorganic nitrogen		1.5	Environment Canterbury (2011, 2015)
Total ammonical nitrogen (pH adjusted)		1.32 (Ōtākaro) 1.47 (Ōpāwaho)	ANZECC (2000) 90% level of protection
Cadmium (hardness adjusted)		0.00082 (Ōtākaro) 0.00127 (Ōpāwaho)	
Chromium (CrIII)		no value	
Copper (hardness adjusted)		0.00356 (Ōtākaro) 0.00543 (Ōpāwaho)	
Lead (hardness adjusted)		0.01554 (Ōtākaro) 0.02916 (Ōpāwaho)	
Nickel (hardness adjusted)		0.0251 (Ōtākaro) 0.03614 (Ōpāwaho)	
Zinc (hardness adjusted)		0.02970 (Ōtākaro) 0.04526 (Ōpāwaho)	

3.2 Water quality index

A water quality index is a tool for simplifying the reporting of water quality data. The index used here is derived from the Canadian Council of Ministers for the Environment (CCME) water quality index. The index is based on three factors:

Scope - the number of parameters not meeting the water quality comparison value
Frequency - the number of times these comparison values are not met
Amplitude – the amount by which the comparison values are not met

The parameters used to calculate the index:

- Total ammoniacal nitrogen for toxicity
- Nitrite-nitrate nitrogen for effects on phytoplankton and macroalgae growth
- Dissolved reactive phosphorus for effects on phytoplankton and macroalgae growth
- Total suspended solids for effects on clarity and sedimentation
- Enterococci (estuary and coastal sites), *E. coli* (river sites) for effects on suitability for recreation

Dissolved oxygen and salinity were not included because these are spot measurements that show diurnal and state of the tide variability.

The CCME Water Quality Index Calculator 1.2 (http://ceqg-rcqe.ccme.ca/en/index.html#void) was used to calculate the Index value for each site. The index values which range from 0 to 100 are used to categorise the water quality (Table 3-5). The Index categories used have been modified from those described in the CCME Water Quality Index 1.0 User's manual (CCME, 2001), in that the range in values in the Poor – Very Good categories are equal.

Table 3-5: Water quality index categories

Index description	Index value range
Very Good	85 -100
Good	70 - 84.9
Fair	55 - 69.9
Poor	40 - 54.9
Very poor	0 - 39.9

4 Results

The results for nutrients, TSS, turbidity, chlorophyll-a, dissolved oxygen (% saturation), salinity and enterococci/*E. coli* are presented by site (Sections 4.1 – 4.11).

For each site the following are provided:

- A table containing the summary of the data collected including the range and median concentration for each parameter along with the 'status' of each parameter.
- A table containing the summary of the salinity data collected including the range and median values
- The water quality index

The results for dissolved metal concentrations for all sites are presented in one table (Section 4-12).

4.1 Caspian Street

Water quality index – Fair (55.7)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.02	<0.01	0	☺
Nitrite-nitrate nitrogen		0.05	<0.001 - 0.029	0.007	0	☺
Dissolved inorganic nitrogen		0.25	0.0055 - 0.075	0.012	0	☺
Dissolved reactive phosphorus		0.02	<0.004 - 0.016	0.007	0	☺
Total suspended solids		25	12 - 1800	26.5	6	☹
Chlorophyll-a		0.004	0.0008 - 0.0068	0.0043	7	☹
Turbidity	NTU	10	4.1 - 19.5	11.2	6	☹
Enterococci	MPN/100 mL	140	<10 - 40	10	0	☺

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	93.6 - 101.5	98.5	0	☺

	Salinity
	ppt
Range	31.6 - 34.1
Median	33.2

4.2 Penguin Street

Water quality index – Poor (50.9)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.074	<0.01	0	☺
Nitrite-nitrate nitrogen		0.05	<0.001 - 0.125	0.018	4	☹
Dissolved inorganic nitrogen		0.25	0.0055 - 0.158	0.045	0	☺
Dissolved reactive phosphorus		0.02	0.006 - 0.027	0.015	2	😐
Total suspended solids		25	<3 - 210	14.5	5	☹
Chlorophyll-a		0.004	0.0007 - 0.008	0.0019	2	😐
Turbidity	NTU	10	2.2 - 91	6.7	5	☹
Enterococci	MPN/100 mL	140	<10 - 146	10	1	😐
E.coli		550	<10 - 354	31	0	☺

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	85.3 - 115.4	94.3	0	☺

	Salinity
	ppt
Range	25.2 - 33.5
Median	31.2

4.3 South New Brighton Park

Water quality index – Poor (45.9)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.13	0.049	0	☺
Nitrite-nitrate nitrogen		0.05	0.018 - 0.36	0.108	8	☹
Dissolved inorganic nitrogen		0.25	0.023 - 0.436	0.203	3	😐
Dissolved reactive phosphorus		0.02	0.012 - 0.045	0.021	6	☹
Total suspended solids		25	8 - 330	15	5	☹
Chlorophyll-a		0.004	0.0003 - 0.007	0.0008	2	😐
Turbidity	NTU	10	5 - 164	9.2	4	☹
Enterococci	MPN/100 mL	140	<10 - 213	10	1	☺
E.coli		550	<10 - 794	116	1	😐

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	80.1 - 93.8	87.75	0	☺

	Salinity
	ppt
Range	20.6 - 29.5
Median	24.2

4.4 Sandy Point

Water quality index – Very Poor (36.9)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.4	0.1	0	☺
Nitrite-nitrate nitrogen		0.05	0.009 - 0.62	0.104	9	☹
Dissolved inorganic nitrogen		0.25	0.048 - 0.739	0.29	7	☹
Dissolved reactive phosphorus		0.02	0.012 - 0.085	0.028	10	☹
Total suspended solids		25	5 - 390	16	5	☹
Chlorophyll-a		0.004	0.0004 - 0.007	0.0024	3	😐
Turbidity	NTU	10	3.2 - 124	8.5	6	☹
Enterococci	MPN/100 mL	140	<10 - 697	20	1	😐
E.coli		550	<10 - 6490	110	3	😐

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	80.3 - 97.3	91.6	0	☺

	Salinity
	ppt
Range	17 - 32.7
Median	27.2

4.5 Humphreys Drive

Water quality index – Poor (47.5)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.179	0.054	0	☺
Nitrite-nitrate nitrogen		0.05	0.0097 - 0.47	0.099	8	☹
Dissolved inorganic nitrogen		0.25	0.026 - 0.65	0.196	4	☹
Dissolved reactive phosphorus		0.02	0.011 - 0.034	0.020	4	☹
Total suspended solids		25	7 - 122	13.5	2	😐
Chlorophyll-a		0.004	0.0004 - 0.0095	0.001	3	😐
Turbidity	NTU	10	2.7 - 74	8	4	☹
Enterococci	MPN/100 mL	140	<10 - 262	10	1	😐
E.coli		550	<10 - 231	31	0	☺

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	80.4 - 94.4	88.8	0	☺

	Salinity
	ppt
Range	21.4 - 32.4
Median	28.7

4.6 Beachville Road jetty

Water quality index – Very Good (88.4)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.05	0.018	0	☺
Nitrite-nitrate nitrogen		0.05	<0.001 - 0.067	0.008	1	😐
Dissolved inorganic nitrogen		0.25	0.007 - 0.077	0.028	0	☺
Dissolved reactive phosphorus		0.02	<0.004 - 0.018	0.01	0	☺
Total suspended solids		25	5.0 - 12	7	0	☺
Chlorophyll-a		0.004	0.0003 - 0.0048	0.0008	1	😐
Turbidity	NTU	10	1.7 - 4.9	2.7	0	☺
Enterococci	MPN/100 mL	140	<10 - 20	<10	0	☺

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	89.6 - 98.9	94.5	0	☺

	Salinity
	ppt
Range	31.3 - 33.6
Median	33.1

4.7 Shag Rock – @ high tide

Water quality index – Good (76.8)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.034	<0.01	0	☺
Nitrite-nitrate nitrogen		0.05	<0.001 - 0.065	0.009	1	😐
Dissolved inorganic nitrogen		0.25	0.0055 - 0.07	0.021	0	☺
Dissolved reactive phosphorus		0.02	<0.004 - 0.016	0.009	0	☺
Total suspended solids		25	5.0 - 51	9	1	😐
Chlorophyll-a		0.004	0.0007 - 0.003	0.0015	0	☺
Turbidity	NTU	10	1.5 - 24	3.7	1	😐
Enterococci	MPN/100 mL	140	<10 - 52	10	0	☺

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	93.3 - 101.5	96.2	0	☺

	Salinity
	ppt
Range	31.4 - 34
Median	33.1

4.8 Shag Rock – @ low tide

Water quality index – Fair (58.6)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.11	0.058	0	☺
Nitrite-nitrate nitrogen		0.05	0.0087 - 0.159	0.063	9	☹
Dissolved inorganic nitrogen		0.25	0.014 - 0.25	0.138	0	☺
Dissolved reactive phosphorus		0.02	0.011 - 0.029	0.02	5	☹
Total suspended solids		25	9.0 - 87	27	6	☹
Chlorophyll-a		0.004	0.0004 - 0.0019	0.001	0	☺
Turbidity	NTU	10	5.6 - 47	11.3	8	☹
Enterococci	MPN/100 mL	140	<10 - 31	<10	0	☺

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	83 - 98.7	94.1	0	☺

	Salinity
	ppt
Range	28.2 - 30.7
Median	29.5

4.9 Cave Rock

Water quality index – Fair (64.3)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	0.91	<0.01 - 0.03	<0.01	0	☺
Nitrite-nitrate nitrogen		0.05	<0.001 - 0.07	0.003	1	😐
Dissolved inorganic nitrogen		0.25	0.0055 - 0.075	0.008	0	☺
Dissolved reactive phosphorus		0.02	0.004 - 0.021	0.007	1	😐
Total suspended solids		25	5 - 200	12.5	3	😐
Chlorophyll-a		0.004	0.0016 - 0.0053	0.0023	1	😐
Turbidity	NTU	10	2.5 - 21	4.8	2	😐
Enterococci	MPN/100 mL	140	<10 - 63	<10	0	☺

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	80	93.2 - 102.1	98.3	0	☺

	Salinity
	ppt
Range	31.8 - 34.1
Median	33.3

4.10 Bridge Street bridge - @ low tide

Water quality index – Poor (44.8)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	1.32	<0.01 - 0.086	0.034	0	☺
Nitrite-nitrate nitrogen		0.444	0.3 - 0.75	0.49	8	☹
Dissolved inorganic nitrogen		1.5	0.33 - 0.81	0.535	0	☺
Dissolved reactive phosphorus		0.016	0.022 - 0.047	0.032	12	☹
Total suspended solids		25	6.0 - 79	16.5	4	☹
Chlorophyll-a		0.004	0.0006 - 0.0038	0.0017	0	☺
Turbidity	NTU	5.6	6.3 - 46	11.1	12	☹
Enterococci	MPN/100 mL	140	<10 - 98	20	0	☺
E.coli		550	74 - 4610	171.5	2	😐

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	70	83.6 - 105.4	89.2	0	☺

	Salinity
	ppt
Range	1.7 - 6.3
Median	3.4

4.11 Ferrymead bridge - @ low tide

Water quality index – Very poor (37.3t4u)

Parameter	units	Comparison value (CV) upper	Range	Median	Number of samples above CV	STATUS
Total ammoniacal nitrogen	mg/L	1.47	<0.01 - 0.127	0.081	0	☺
Nitrite-nitrate nitrogen		0.444	0.62 - 1.44	0.77	12	☹
Dissolved inorganic nitrogen		1.5	0.64 - 1.57	0.867	1	😐
Dissolved reactive phosphorus		0.016	0.02 - 0.053	0.034	12	☹
Total suspended solids		25	23 - 103	43	11	☹
Chlorophyll-a		0.004	0.0005 - 0.0098	0.0018	4	☹
Turbidity	NTU	5.6	13.8 - 51	24	12	☹
Enterococci	MPN/100 mL	140	<10 - 122	25.5	0	☺
E.coli		550	84 - 934	160.5	2	😐

Parameter	units	Comparison value (CV) lower	Range	Median	Number of samples below CV	STATUS
Dissolved oxygen	% saturation	70	66.1 - 96.7	84.6	1	😐

	Salinity
	ppt
Range	2.3 - 12
Median	9

4.12 Dissolved metal concentrations

Values in red exceed the trigger value

Dissolved metal concentrations (mg/L)						
Date sampled	Nickel	Cadmium	Chromium	Copper	Lead	Zinc
Caspian Street						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	**0.0015**	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	**0.0044**	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
Penguin Street						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	0.0012	< 0.0010	0.008
19-Oct-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	**0.0015**	< 0.0010	< 0.004
South New Brighton Park						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	0.001	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	**0.0033**	< 0.0010	< 0.004
Sandy Point						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	**0.0017**	< 0.0010	0.007
19-Oct-16	< 0.006	< 0.0002	< 0.0010	0.0011	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
Humphreys Drive						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	0.0011	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	**0.0017**	< 0.0010	0.005
15-Dec-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
Beachville Road jetty						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	**0.0014**	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	0.0012	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
Shag Rock @ high tide						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	**0.0024**	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	**0.0039**	< 0.0010	< 0.004
Shag rock @ low tide						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	**0.002**	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
Cave Rock						
8-Aug-16	< 0.006	< 0.0002	0.0013	**0.0023**	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	**0.0041**	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	**0.0057**	< 0.0010	< 0.004
Bridge Street bridge @ low tide						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
19-Oct-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
15-Dec-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	< 0.004
Ferrymead bridge @ low tide						
8-Aug-16	< 0.006	< 0.0002	< 0.0010	< 0.0010	< 0.0010	0.007
19-Oct-16	< 0.006	< 0.0002	< 0.0010	0.0014	< 0.0010	0.009
15-Dec-16	< 0.006	< 0.0002	< 0.0010	0.0012	< 0.0010	0.012

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