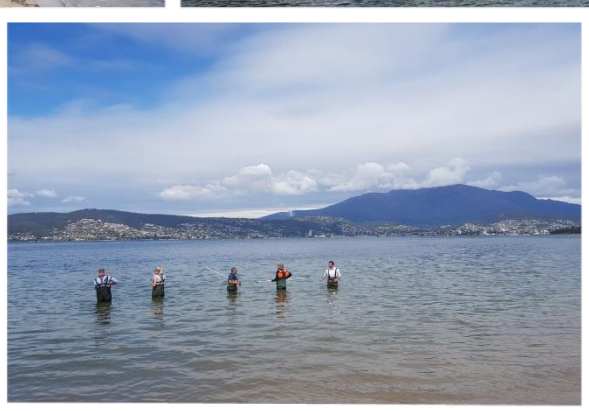
Derwent Estuary Recreational Water Quality Program

Annual Report 2020-21



Derwent Estuary Program

The Derwent Estuary Program (DEP) is a regional partnership between local governments, the Tasmanian State Government, businesses, scientists, and community-based groups to share science for the benefit of our estuary. The DEP was established in 1999 and has been nationally recognised for excellence in coordinating initiatives to reduce water pollution, conserve habitats and species, monitor river health and promote greater use and enjoyment of the foreshore.

Our major sponsors include Brighton, Clarence, Derwent Valley, Glenorchy, Hobart and Kingborough councils, the Tasmanian State Government, TasWater, Tasmanian Ports Corporation, Norske Skog Boyer, Nyrstar Hobart Smelter and Hydro Tasmania.

Contents

1 EXECUTIVE SUMMARY

This report presents results of the Derwent Estuary Recreational Water Quality Program (RWQ) 2020-21 season. The RWQ is a joint initiative between six local councils, the State Government of Tasmania, Environmental Protection Agency (EPA) and the Derwent Estuary Program (DEP). Water samples were collected weekly at 42 sites throughout the estuary between 1 December 2020 and 31 March 2021 and analysed for the faecal indicator bacteria, enterococci.

Whilst there were many good water quality swimming days this summer, overall, the quality of the water at the swimming sites was poorer this season, with 28 exceedances of the enterococci trigger level of 140 MPN 100 mL-1, compared to five during the last season. This was still substantially better than the 2018-19 season, which saw a record number of 52 exceedances and significant media and community interest due to the poor water quality. At the end of this summer, when the long-term classification was updated, there were eight swimming sites graded as Good, seven sites graded as Fair, one as Poor, and four sites not yet rated (all sites require five years of sampling data to calculate a long-term rating). The swimming sites that dropped in rating were the three Howrah Beach sites and Taroona. Windermere Beach was the only site to improve its rating, to Good.

The water quality at the 22 environmental sites was also mostly poorer compared to the previous season. On 40 occasions enterococci results over 140 MPN 100 mL^{-1} were recorded, compared to 18 times last season. These results led to three sites downgrading to Fair (Watermans Dock, Elwick Bay and Geilston Bay) and Regatta Pavilion dropping to Poor. No environment sites improved their grading.

Rainfall this summer was higher than average for the four BoM weather stations monitored during the RWQ season. There were six days throughout the summer with > 10 mm of rain recorded somewhere in the estuary, including some very heavy downpours above 40 mm. However, only a few of these rainfall events occurred within a 24-hour period prior to sampling. Analysis shows that while some results probably were influenced by rainfall, most were not.

Over the last few years, the DEP has been encouraging councils to become more proactive when it comes to dealing with polluted recreational water, primarily at Fair sites as they are at risk of becoming Poor. Once a swimming site has a long-term Poor rating there is invariably difficult public pressures to contend with at the same time as dealing with the pollution issue itself. When Blackmans Bay Beach (south) turned Poor a few seasons ago, Kingborough Council took a constructive approach and implemented two low-flow diversions to sewer and employed a dedicated stormwater investigation officer, who has been extremely successful in locating problem areas. Following this season's downgrading of all three sample sites along the popular Howrah Beach, Clarence City Council is taking a leaf out of Kingborough's book and will also be allocating resources towards a dedicated stormwater investigator. These are proactive responses, and it is encouraging to see councils turn a negative situation into a positive. DEP will continue to support all councils with advice and resources on how best to trace pollution sources.

1.1 Season follow-ups

1.1.1 To sample or not to sample

The issue of whether to sample when the risk of a failed enterococci result is high (e.g. heavy rain has been forecast or there is a known sewage leak) is raised during most seasons. It can seem unfair to have to include a high bacteria result in the long-term dataset when the cause of the result is known, particularly if the result risks pushing the site rating to Poor.

However, including all results gives a true representation of what happens in a catchment on a day-to-day basis, whether we are sampling or not. This is what a long-term data set is all about. The combination of good and bad results over a five-year period provides us with a long-term rating that can change over time as the situation in the catchment changes.

The best councils can do is to work proactively in their catchments; take a Fair rating as a warning sign that things might be deteriorating and take action to address the cause of contamination before that happens. If councils are ever in doubt about whether to sample on a given day during the RWQ season, please contact Department of Health ph 1800 671 738.

1.1.2 Stormwater communication

In a follow-up from the hectic 2018-19 RWQ season, which saw record number of exceedances and advisories, the need for new ways to communicate about stormwater became apparent. Now thanks to funding from the DoH, the DEP in cooperation with partners has developed a communications campaign to raise awareness of stormwater reaching our beaches and the actions we can all take to reduce any pollution entering our waterways.
The main objective is to inform and engage with stakeholders and the general community about:

- How pollution is picked up by stormwater and flows through a complex catchment and ends up in our creeks and at the beach.
- How we can make a positive difference to stormwater quality
- What the DEP and its partners are doing to help improve stormwater quality

Key concepts for the new strategy are the need for messages to be positive, flexible, simple, visual, universal and have impact. Short, funny educational cartoon videos are one of the outputs from this collaboration.

- https://www.facebook.com/watch/?v=1373815996325096
- https://www.facebook.com/350761111671410/videos/419313316023637
- https://www.facebook.com/derwentestuary/videos/1376995695992335

Other planned activities coming up will include a community event in Clarence and sharing of positive stories on social media and in local papers, including drain stenciling in Kingston prior to the next RWQ season.

1.1.3 Winter swimming

Following the 2020-21 RWQ season, DEP met with representatives from five councils and DoH to chat about the possibility of councils sampling selected swimming sites

outside the official RWQ program months and promoting those results. This meeting came about because we know people swim in the estuary outside the RWQ season, and some councils are occasionally queried about water quality at this time. Anecdotally, we are of the impression that since 'covid' more people are swimming in the estuary, at least they were early on when pool facilities were closed.

After considering the benefits of sampling, the risks from doing so, and the requirements connected with sampling (which are the same as during the summer in terms of re-tests and advisories), it was decided that now sampling during the off-season will not be undertaken. The consensus of the meeting was that council resources would be instead focus on stormwater investigations and remediation of infrastructure in troublesome catchments, with the aim of improving the recreational water quality. It was raised that there is a need to breach the gap in the management of stormwater and recreational water quality. **Action**: DEP will ensure, via the Derwent Stormwater Taskforce Group, that water quality issues continue to be raised and discussed with stormwater engineers across the estuary.

While we will not have enterococci results to share in the off-season, our main message to swimmers still stands:

Swimming in the Derwent estuary is not recommended for several days after heavy rain, and never in the vicinity of stormwater pipes or urban rivulets.

In addition, we can advise to avoid lengthy exposure to cold water (NHMRC, 2008).

2 INTRODUCTION

Water quality monitoring of beaches and bays in the Derwent estuary is coordinated by the DEP in collaboration with DoH, EPA and the six councils that border the estuary (Brighton, Clarence, Derwent Valley, Glenorchy, Hobart and Kingborough). The primary objectives of the program are to coordinate monitoring, investigations and assist councils and the DoH in managing human health risks associated with poor water quality. The DEP's role in the program is to:

- Coordinate recreational water quality monitoring in the Derwent estuary.
- Compile and analyse data, including classification of beaches and bays, annual reporting and analysis of long-term trends.
- Support and facilitate site specific investigations into poor or deteriorating water quality at targeted sites.

The water quality data is made publicly available via the DEP website and Facebook page on a weekly basis throughout the summer (December-March), to allow the community to make informed decisions as to where and when to swim. This data is also used to inform decision-making processes, by identifying stormwater and wastewater assets that require investigating.

2.1 Pathogens and health risks

Water contaminated by sewage and animal faeces may contain pathogenic micro-organisms (bacteria, viruses, protozoa), which pose a health hazard when the water is used for primary contact recreation, such as swimming. Infection may occur by swallowing, inhaling or by direct contact of contaminated water with ears, nasal passages, mucous membranes and cuts in the skin, which allow the pathogens to enter the body (N.Z. Ministry for the Environment, 2002). The most common health conditions associated with primary contact recreation in contaminated water are gastrointestinal disorders, respiratory illnesses, eye, nose and throat infections and skin disorders.

Direct detection of pathogens is not a feasible option for routine assessments since they occur intermittently and are difficult to recover from water. Thus water samples are analysed for the concentration of more easily detected microorganisms, which may indicate the presence of pathogens, referred to as faecal indicator bacteria (refer to Coughanowr et al. 2015 for more information). In the Derwent estuary, enterococci is sampled as the key faecal indicator bacteria, as required by the Tasmanian Recreational Water Quality Guidelines 2007 (DoH, 2007).

2.2 **Sources of contamination**

Key sources of faecal contamination in coastal waters can include untreated sewage or faecal contamination from a catchment transported via the stormwater system, animal faeces or resuspension of contaminated sediments:

- Stormwater systems in urban areas are often contaminated with sewage. The source for this contamination can be caused by a failure in the wastewater (sewage) system, including overflows during high rainfall events, or direct cross-connections, leakages, or animal faeces in low rainfall (or non-rainfall) events.
- Direct contamination can occur from animal faeces. High density animal aggregations, such as birds or dogs, on beaches can contribute to contamination.
- Resuspension of contaminated sediments by wind or wave action is also a possible source of contamination.

Differentiating between contaminant sources can be very difficult, however regular (and case-based) sanitary surveys, possibly combined with specialist laboratory techniques, such as sterol and DNA testing, can help advance our understanding.

2.3 **Recreational water quality guidelines**

Swimming and environmental sites in the Derwent estuary are graded as Good, Fair and Poor. This is in accordance with the Recreational Water Quality Guidelines for Tasmania (DoH, 2007), which were largely based on the National Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Both guidelines are currently under review. The guidelines are based on aseptic grab sample analysis for the faecal indicator microbial group enterococci, and the Tasmanian guidelines adopt a three-tiered approach to classifying the long-term (5 years of data) quality of a site based on available data. The tiers are:

- *Good*: rolling 5-year 95th Hazen percentile value of < 200 enterococci MPN (Most Probable Number) 100 mL^{-1}.
- *Fair*: rolling 5-year 95th Hazen percentile value of 200 - 500 enterococci MPN 100 mL^{-1}.
- *Poor*: rolling 5-year 95th Hazen percentile value of > 500 enterococci MPN 100 mL^{-1}. In this case, water at these sites is considered a threat to public health in the event of primary contact recreation and local councils are required to advise the general public and to erect warning signs.

In addition to long-term site classification, trigger levels have been set to manage public exposure to episodic or emerging water quality issues. If a sample exceeds 140 enterococci MPN 100 mL^{-1}, the council is required to resample, and if two consecutive samples return a result above 280 MPN 100 mL^{-1}, the public must be notified via signage on the beach in question. This signage can only be removed by Council's Authorised Officer in consultation with the Department of Health.

3 RECREATIONAL WATER QUALITY PROGRAM

3.1 Swimming and Environmental sites

Aseptic grab samples are collected each Tuesday by Council and the EPA/DEP throughout the Derwent estuary, during summer and early autumn each year (from 1 December to 31 March). Sites are categorised as either swimming sites or environmental sites as described below, and locations are shown in Figure 3.1.

- The 20 swimming sites monitored this season are in locations where a significant number of people swim or conduct other primary contact recreation. These sites are sampled by councils.

- The 22 environmental *sites* monitored this season, sampled by either councils or EPA/DEP were selected using the following rationale:
  - Bays and coves that are frequently used for secondary contact recreation and/or have foreshore parks.
  - Areas with potential sources of faecal contamination.
  - Sites with relatively low risk of contamination, sampled to contextualise swimming site results.
  - Sites associated with major swimming events, such as the Trans Derwent Swim.

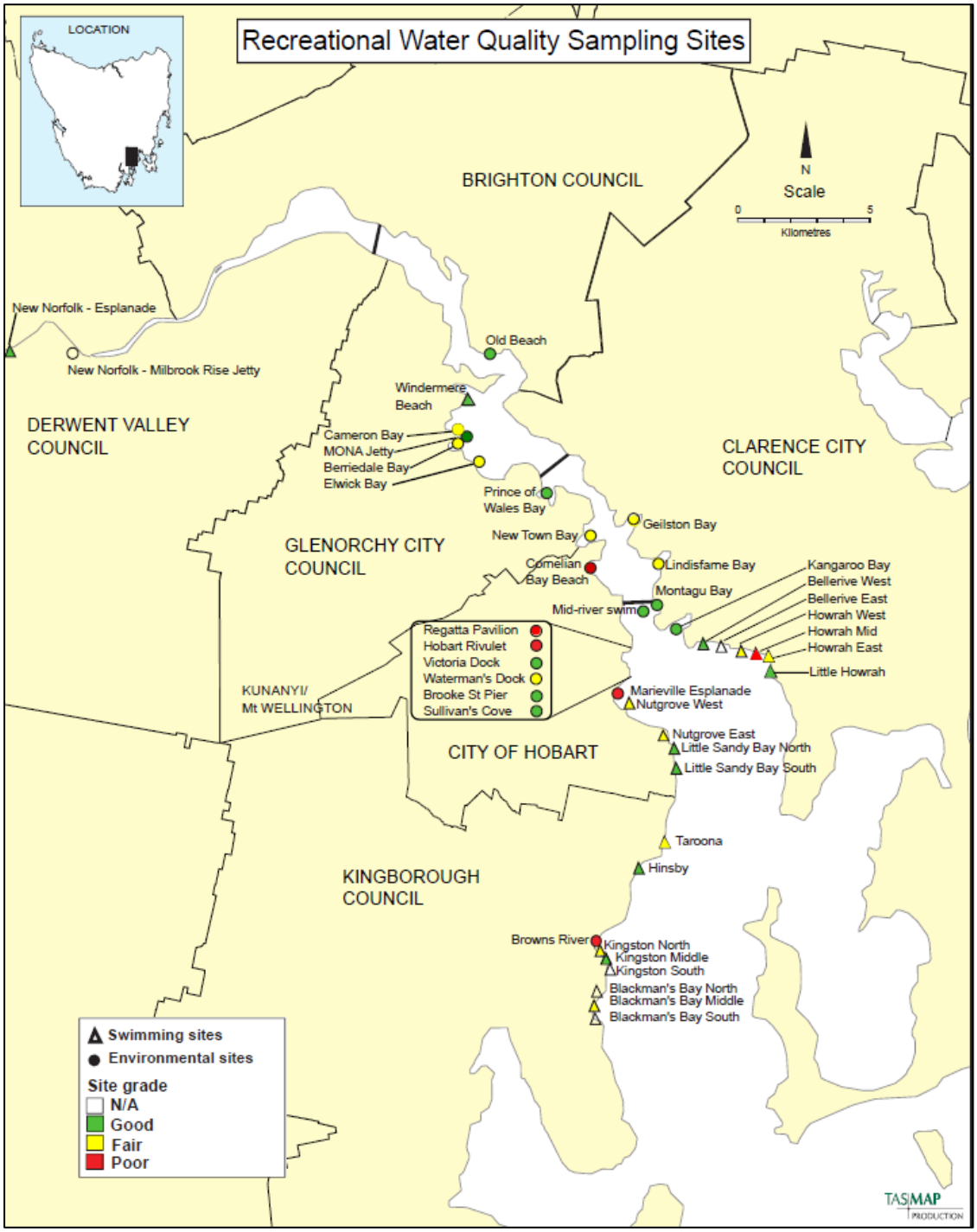


Figure 3.1 Recreational Water Quality sampling sites (swimming and environmental sites) with their current water quality classification based on data collected in the summer months between December 2016 and March 2021. Sites without five years of data (N/A) are depicted without a rating.

3.2 **Sample analysis**

All samples are analysed at the Public Health Laboratory (PHL) (St Johns Ave. New Town) using the Enterolert method, which provides confirmed results within 24 hours of analysis. For designated swimming sites, if the original sample exceeds the relevant trigger level (DoH, 2007), laboratory staff notify the councils so retesting can occur. Results are typically reported between 24 and 48 hours after sample submission to the laboratory.

Samples that exceed the prescribed DoH trigger levels will be provided with Measurement Uncertainty (MU) estimations *if* they fall within the MU range of the trigger levels. The MU ranges are currently between 99-197 for the trigger level of 140, and between 199-395 for the trigger level of 280. All other results will continue to be reported as either meeting, or not meeting, the Recreational Water Quality Guidelines 2007 (*Public Health Act 1997*).

Importantly, if a sample result exceeds a prescribed trigger level the DoH requires it to be retested, no matter whether the result falls within the MU range of that level.

3.3 Inter-calibration exercise

An inter-calibration exercise is organised by the DEP at the start of each season to ensure that all sampling officers are using the same protocols, thus minimising sampler bias. The sampling method is demonstrated, associated protocols are reviewed, and participants simultaneously sample from a designated location. Results are compared to identify any sampler bias and are also useful to better understand the degree of variability between water samples collected from a given site and/or between sites.

For a full report on this season's inter-calibration exercise results see Appendix 9.1. The next inter-calibration exercise will be conducted in November 2021.

Figure 3.2. EHOs sampling together as part of the annual inter-calibration exercise, at Howrah Beach on 24 November 2020.

4 2020-21 RWQ SEASON RESULTS

4.1 Long-term site classification

After each RWQ season, a new long-term rating is calculated for all swimming and environmental sites. This calculation is based on the immediate previous five seasons of sampling data for each site. Table 1 shows the updated rating after the 2020-21 season, thus with sample results from December 2016 to March 2021. The colours refer to Tasmanian *Recreational Water Quality Guidelines* (DoH, 2007), using the rolling 5-year 95th Hazen percentile for enterococci, where green denotes Good (< 200 MPN 100 mL^{-1}), yellow denotes Fair (200 - 500 MPN 100 mL^{-1}), and red denotes Poor (> 500 MPN 100 mL^{-1}).

The number of samples with enterococci results between 140 and 280 MPN 100 mL^{-1}, > 280 MPN 100 mL^{-1}, > 140 in 2018-19 and total number of samples, for the same 5-year period are also shown.

It is important to note, that for sites where there is not yet five years of data available, there is no long-term rating. The 95th Hazen percentile figure listed in Table 2 only provides an indication of a future rating for these sites. It is though very useful for councils to take note of early water quality trends, as they may indicate there are issues that require attention and action now.

Table 1. Long-term ratings for swimming and environmental sites as calculated after the 2020-21 RWQ season. N/A indicates that no long-term rating is available yet.

		Updated long-term rating	5-year 95th Hazen percentile	Samples between 140 and 280	Samples > 280	Total number of samples
Swimming sites	**Bellerive Beach (east)*	*N/A*	*84*	*0*	*1*	*36*
	Bellerive Beach (west)	Good	180	5	1	87
	Blackmans Bay Beach (mid)	Fair	328	4	6	87
	**Blackmans Bay Beach (north)*	*N/A*	*79*	*0*	*1*	*36*
	**Blackmans Bay Beach (south)*	*N/A*	*83*	*1*	*0*	*36*
	Hinsby Beach	Good	66	3	1	87
	Howrah Beach (east)	Fair	245	4	4	87
	Howrah Beach (mid)	Poor	537	5	10	87
	Howrah Beach (west)	Fair	234	1	4	87
	Kingston Beach (mid)	Good	161	3	2	87
	Kingston Beach (north)	Fair	297	4	6	87
	**Kingston Beach (south)*	*N/A*	*247*	*2*	*1*	*36*
	Little Howrah Beach	Good	172	2	3	87
	Little Sandy Bay Beach (north)	Good	96	2	1	86
	Little Sandy Bay Beach (south)	Good	52	1	0	86
	New Norfolk (Esplanade)	Good	134	2	1	74
	Nutgrove Beach (east)	Fair	220	6	3	86
	Nutgrove Beach (west)	Fair	365	3	5	86
	Taroona Beach	Fair	340	0	6	87
	Windermere Beach	Good	146	2	2	80
Environmental sites	Brooke Street Pier	Good	42	0	1	69
	Browns River	Poor	2442	10	31	87
	**Cornelian Bay	Poor	1675	10	15	68
	Elwick Bay	Fair	212	3	3	80
	Geilston Bay	Fair	275	4	3	69
	Hobart Rivulet	Poor	2189	10	25	69
	Kangaroo Bay	Good	164	3	1	69
	Lindisfarne Bay	Fair	463	2	4	69
	Marieville Esplanade	Poor	1856	12	12	86
	Mid-river swim	Good	30	2	0	68
	Berriedale Bay (MONA)	Fair	456	4	6	65
	Cameron Bay (MONA)	Fair	216	2	3	81
	MONA jetty	Good	143	1	3	76
	Montagu Bay	Good	65	1	1	68
	**New Norfolk (Millbrook Rise Jetty)*	*N/A*	*296*	*2*	2	*28*
	New Town Bay	Fair	427	4	5	69
	Old Beach Jetty	Good	193	3	3	78
	Prince of Wales Bay	Good	171	4	1	69
	Regatta Pavilion	Poor	2197	8	8	68
	Sullivans Cove	Good	53	0	1	69
	Victoria Dock	Good	161	2	2	69
	Watermans Dock	Fair	252	2	3	69

***** Indicates < 5 years of data available.
**Cornelian Bay is monitored intermittently when conditions allow, thus result is not robust.

4.2 Site results

4.2.1 Swimming Sites

This season saw no new swimming sites added to the sampling regime. There are still four sites with less than five years of data, thus without an assigned long-term rating. These sites are Bellerive Beach (east), Blackmans Bay Beach (north + south), and Kingston Beach (south). All sites require five years of sampling data to calculate a long-term rating. Updated ratings for all sites are listed in Table 1.

The water quality at the swimming sites was not as consistently good this summer as during the 2019-20 RWQ season. This season saw 28 exceedances (enterococci >140 MPN 100 mL^{-1}), compared with only five last summer, and 52 during the 2018-19 season (Appendix 9.3.1, DEP, 2020). At the end of this season, eight sites were graded as Good, seven sites graded as Fair, one as Poor, and four sites yet to be classified. The sites that dropped in their rating were Howrah Beach (east and west end) – both changed to Fair, Howrah Beach (mid) – changed to Poor, and a surprise change to Fair for Taroona Beach (Figure 4.1, Figure 4.2). All Fair sites should be viewed by councils as a warning of the risk of further decline.

Windermere Beach was the only swimming site that improved its long-term rating this year – from Fair to Good. Historically, this beach has not been popular for swimming, mostly frequented by dog walkers. But this location has a lovely park for picnics, a pretty beach, and now it can be promoted as Hobart's most northern swimming beach.

The two swimming sites with the consistently best water quality in the RWQ program are still Little Sandy Bay Beach (south) and Hinsby Beach. The site with the poorest Hazen percentile result at the moment is Howrah Beach (mid). This site has had five exceedances between 140 and 280 MPN 100 mL^{-1} and ten over 280 during the last five seasons (Table 1 and 5.1).

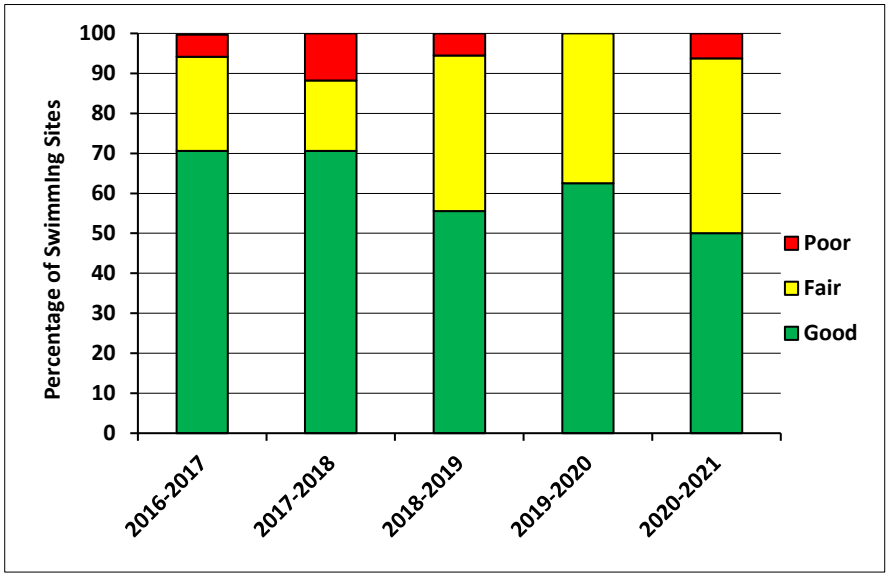


Figure 4.1 Proportion of Swimming Sites graded as Good, Fair, and Poor in the last five RWQ seasons. Proportions are only based on those sites with five years of data available.

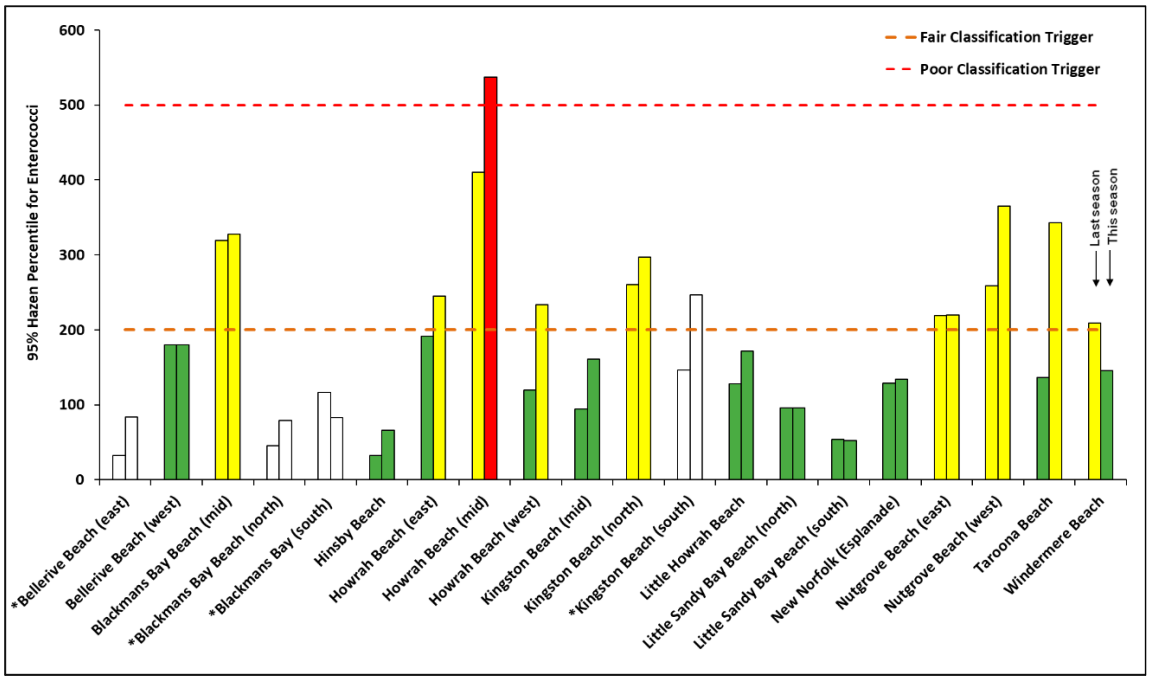


Figure 4.2: Comparison of rolling 5-year Hazen percentile enterococci result for swimming sites. Each site is presented as a pair of results, where the left bar represents 2019-20 RWQ season results, while the right bar represents 2020-21 season result. Green denotes Good (< 200 MPN 100 mL^{-1}), yellow denotes Fair (200 - 500 MPN 100 mL^{-1}), red denotes Poor (> 500 MPN 100 mL^{-1}), and the classification trigger lines are indicated with dotted lines. * indicates that less than five years of data is available, thus those results are less robust.

See the full list of enterococci results for all swimming sites in the 2020-21 season in Appendix 9.3.1, and read more details about Specific Investigations in Section 4.3.

4.2.2 **Environmental Sites**

There were no new environmental sites added to the sampling program this season; and the only site without a long-term rating is in New Norfolk at the Millbrook Rise Jetty, which was added the previous season.

The enterococci results from the environmental sites revealed there were 40 exceedances (enterococci >140 MPN 100 mL^{-1}), compared to 18 last summer, but less that the 51 exceedances during the 2018-19 season (Appendix 9.3.2, DEP, 2020). After updating the long-term ratings at the end of the 2020-21 season there are nine sites graded as Good, seven as Fair, and five as Poor. Three sites dropped from Good to Fair (Watermans Dock, Elwick Bay and Geilston Bay) and the Regatta Pavilion changed to Poor. After recent improvements at the Hobart Rivulet, water quality at this site declined with a change to the 95th Hazen percentile from 1080 to 2189 (Figure 4.3, Figure 4.4).

After this season, the Mid-river Derwent location is back as the environmental site with the best water quality, followed closely by Brooke St Pier and Sullivans Cove. Mid-river Derwent has only experienced two enterococci sample > 140 MPN 100 mL^{-1} over the past five seasons. Brooke St Pier have had one sample > 280 MPN 100 mL^{-1} in last the five years and Sullivans Cove had one (Table 1).

Unfortunately, four sample days were missed this season due to staff and boat availability. The DEP in cooperation with the EPA, take water samples at Montagu Bay, Geilston Bay, Mid-Derwent, Sullivans Cove, Brooke St Pier, Watermans Dock, Victoria

Dock, Hobart Rivulet, Regatta Pavilion, Lindisfarne Bay, Kangaroo Bay, New Town Bay and Prince of Wales Bay.

Sampling at Cornelian Bay has long been intermittent, due to tide and conditions, which makes the data from the site less robust. The bay is extremely silty, and problems with getting stuck in the mud when grabbing a sample is a real issue!

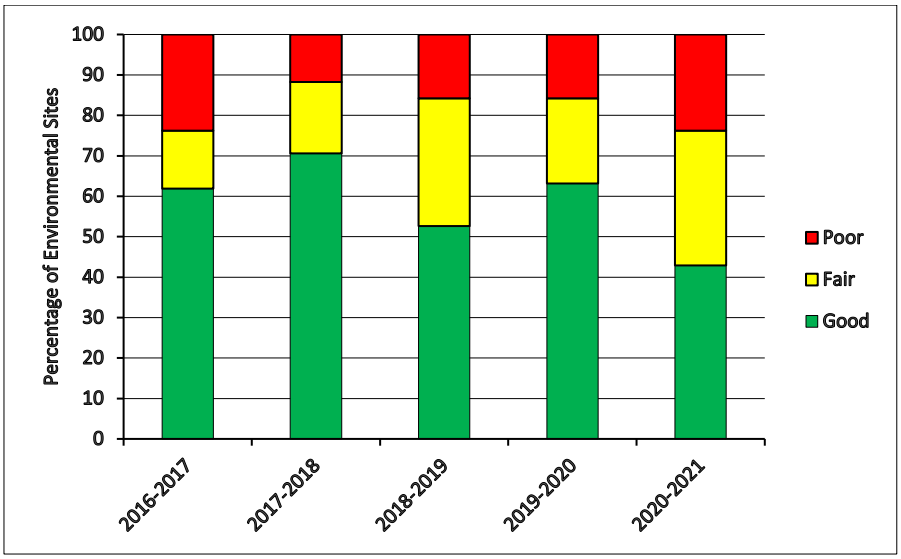


Figure 4.3 Proportion of Environmental Sites graded as Good, Fair, and Poor in the last five RWQ seasons. Proportions are only based on those sites with five years of data available.

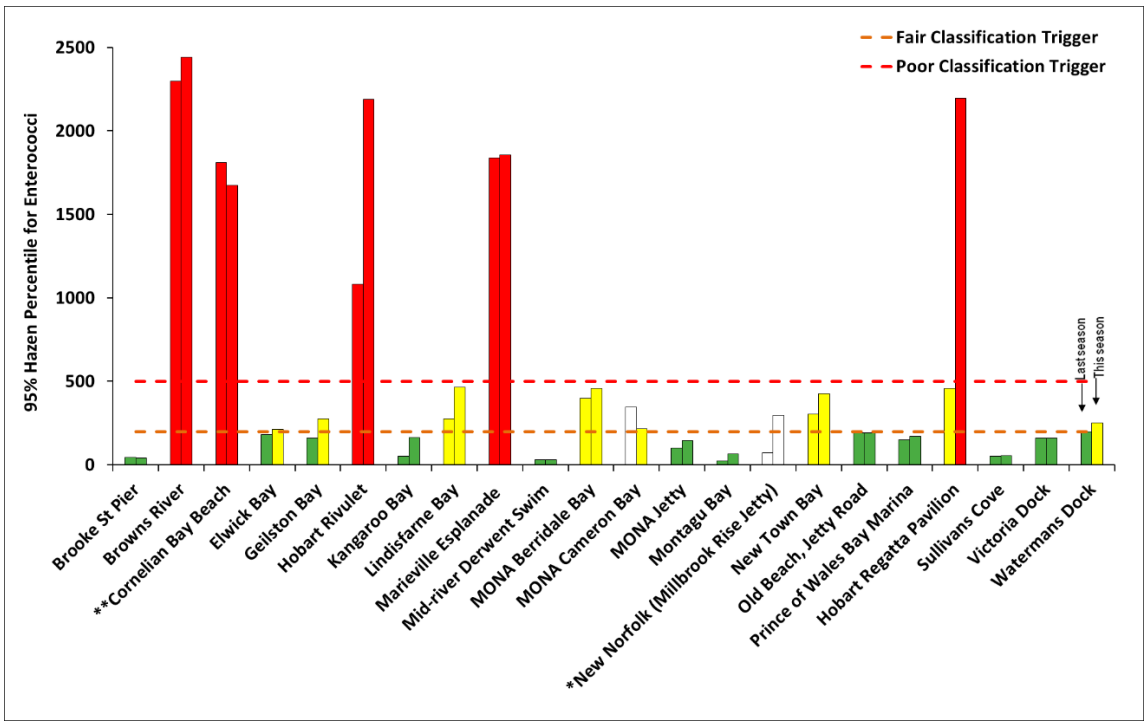


Figure 4.4 Comparison of rolling 5-year Hazen percentile enterococci result for the environmental sites. Each site is presented as a pair of results, where the left bar represents 2019-20 RWQ season results, while the right bar represents 2020-21 season result. Green denotes Good (< 200 MPN 100 mL^{-1}), yellow denotes Fair (200 - 500 MPN 100 mL-1), red denotes Poor (> 500 MPN 100 mL^{-1}), and the classification trigger lines are indicated with dotted lines. * indicates > five years of data available. **Cornelian Bay is monitored intermittently, when conditions allow, thus those results are less robust.

See the full enterococci results for all environmental sites in Appendix 9.3.2.

4.3 **Rainfall**

Rainfall is a driver of pollution at beaches and other recreational swimming areas as it generates potentially contaminated stormwater runoff and can trigger discharges and overflows from the wastewater (sewerage) system. The water quality of urban beaches and bays can therefore be strongly influenced by rainfall (NHMRC, 2008).

Rainfall data collected and reported by the Bureau of Meteorology (BoM) at four weather stations throughout the Derwent estuary catchment are used to compare rainfall throughout each RWQ season (December to March) against the long-term average rainfall for that period. Observations of daily rainfall are nominally made at 9 am and record the total for the previous 24 hours. Hobart (Ellerslie Road), Kingston (Greenhill Drive), Hobart Airport and New Norfolk (west) have been selected as representative of RWQ sampling sites in the Derwent estuary.

Rainfall varies considerably across the estuary, with long-term averages for the summer months ranging between 143.6 mm at New Norfolk and 203.1 mm at Kingston, the latter always experiencing more rain than all other sites (Figure 4.5). Some years the summer rain predominantly falls over a few days, but that was not the case this season. The rainfall was spread out across numerous days. All rainfall data for the four BoM stations that cover the Derwent estuary are listed in Appendix B 9.2.

During the 2020-21 season, total rainfall was above average for all four BoM weather stations (Figure 4.5). There were six days throughout the summer with > 10 mm recorded somewhere in the estuary, including four days with heavy rains (> 20 mm) recorded at most stations on 23 Jan, 16 Jan, 6 Feb and 25 Mar. None of these rainfall events occurred on or just prior to sampling days (Appendix B 9.2).

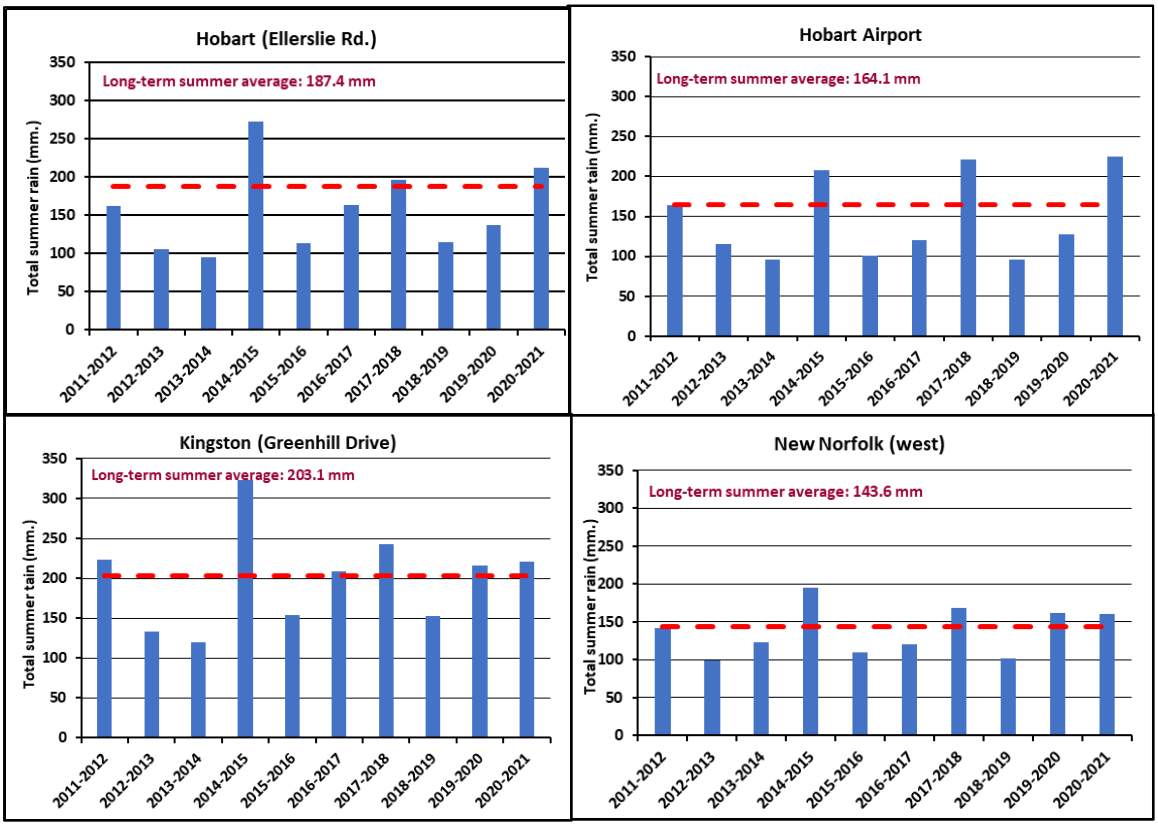


Figure 4.5 Total rainfall (in mm) at four weather stations in the Derwent estuary catchment during the last ten RWQ program seasons (between December and March), as recorded by the Bureau of Meteorology (2021). The latest long-term average rainfall figure for each location is indicated in red text and by dotted line.

4.3.1 Enterococci response to rainfall at swimming sites

As mentioned in the previous section it is long recognised that water quality at urban beaches can be strongly affected by stormwater runoff due to rainfall. The DEP this year again conducted a preliminary assessment of the season's results to identify possible relationship between enterococci concentration and rainfall.

The assessment includes all enterococci samples collected across all swimming sites this season, a total of 351 samples. Results were separated into two groups:

- **Group 1**. Enterococci results < 140 MPN 100 ml $^{-1}$: 323 samples.
- **Group 2**. Enterococci results > 140 MPN 100 ml $^{-1}$: 28 samples.

These two groups were separately assessed for a possible response to rainfall. Rainfall data was used from the four local BoM stations, outlined in the previous section.

Rainfall data included records for the 24 hours prior to 9 am on the day of sampling. Rainfall after 9 am on the day of sampling was not included. This decision was made based on other reports that take the same approach (DEP, 2013; DPIE, 2019).

The number of rainfall events in the 24 hours preceding sampling exceeded last season; on nine sampling days there was *some* rain recorded *somewhere* in the estuary, as opposed to four the previous summers (Appendix B, 9.2).

Group 1 (< 140 MPN):
- 323 samples.
- 80 % of the enterococci results (< 140 MPN 100 ml $^{-1}$) occurred when no rain fell in the preceding 24 hours (Figure 4.6).
- 18 % of results occurred on days when the total rainfall in the preceding 24 hours was < 5 mm.
- 2 % of results occurred on days when the total rainfall in the preceding 24 hours was between 5.1 and 10 mm.

Group 2 (> 140 MPN):
- 28 samples.
- 64 % of high enterococci values (> 140 MPN 100 ml $^{-1}$) occurred when no rain fell in the preceding 24 hours (Figure 4.6).
- 21% of high enterococci values occurred on days when the total rainfall in the preceding 24 hours was < 5 mm.
- 14 % of high enterococci values occurred on days when the total rainfall in the preceding 24 hours was between 5-10 mm.

Of the 351 swimming site samples collected this summer, 92 % of enterococci results were < 140 MPN 100 ml $^{-1}$. Low to medium rainfall (0.1 - 10 mm) did not appear to negatively influence most enterococci results, with 65 of all 75 rainfall events prior to sampling resulting in < 140 MPN 100 ml $^{-1}$ (Figure 4.6). Thus, while there were multiple rain events prior to sampling this season it had a negligible influence on results.

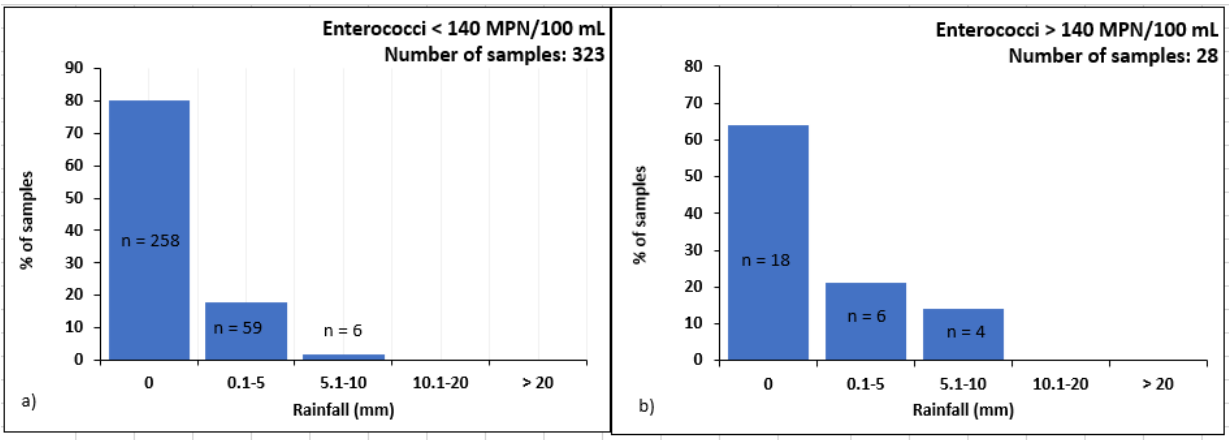


Figure 4.6 Proportion of enterococci sample results < 140 MPN 100 ml $^{-1}$ (a) and > 140 MPN 100 ml $^{-1}$ (b) matched with rainfall data from four BoM stations across the estuary. Graphs include all samples collected at swimming sites during the 2020-21 RWQ season.

It is recommended that this rainfall assessment be replicated at individual beaches. This robust approach would give greater confidence in the analysis. It is highly likely that beaches respond differently to rainfall depending on the proximity of sampling sites to stormwater outlets, activities in, and topography of, the catchment. Such analysis may assist decision-making and allocation of resources.

4.3.2 **Other climate events impacting results**

Research shows that in addition to rain, high flows and wind can also have significant impact on enterococci results, with high results being associated with resuspension of sediments: *Because of their close interaction with surface water, sediments play a major role in influencing shoreline water quality through the resuspension of the particle-bound bacteria in the water column* (Byappanahalli *et al.*, 2012).

On the 19th of January, 12 of 20 swimming sites exceeded the enterococci trigger limit of 140 MPN per 100 mL, many substantially so (Appendix 9.3.1) No rainfall was recorded over the two days leading up to the sampling (Appendix 9.2). However, strong winds with gusts of up to 96 km/hr were recorded on the afternoon prior to sampling (Monday 18th of January) (BoM, 2021b). Strong wind and uncharacteristically strong waves and swell were also recorded by some EHOs on lab submissions forms and anecdotally. The DEP hypothesise that strong weather conditions recorded prior to and during sampling the week of Monday 18 January may explain the high enterococci results whereby wind and wave action mobilised contaminated sediment that was then captured in the samples, resulting in enterococci exceedances. This hypothesis is consistent with literature, which documents enterococci's ability to persevere and proliferate in sediment (Byappanahalli *et al.*, 2012).

In the same week, there was only one exceedance among the environmental sites (Browns River). The DEP and EPA sample 13 of the 22 environment sites, and that week did so on the 20th of January, when there was less wind observed (BoM, 2021b). Bay sites are also likely to have recorded less exceedances dues to calmer wind and wave conditions, and because bays are more sheltered than beaches from wind and wave action.

5 SPECIFIC INVESTIGATIONS

The DEP recommends that councils view a Fair site classification as a warning that problems with poor water quality may escalate, and therefore warrants investigation. Water quality investigations are ongoing at various estuary sites as discussed below.

To assist councils with investigations of sites with Fair or Poor water quality ratings, the DEP, in March 2020, released a Source Tracking Framework and Toolkit, which outlines a standard process for identifying sources of faecal pollution in the Derwent estuary (at the beach) and in its sub-catchments (in the stormwater network). The information includes a flow chart to help investigators find the pollution source by taking them through easy-to-follow screening, tracing and remediation phases, and then provides detailed information about subsurface infrastructure investigation tools, water quality indicators, and microbial source tracking methods: https://www.derwentestuary.org.au/assets/Source_Tracking_Framework_and_Toolkit_Mar2020.pdf

5.1 Howrah Beach

Previous investigations have confirmed that the recreational water quality along the Howrah Beach is highly susceptible to stormwater contamination. Following the 2020-21 RWQ season the long-term ratings declined at all three sample sites along this popular swimming beach.

Clarence City Council (CCC) has extended funding for the Howrah Stormwater Investigation project for another 12 months to continue ongoing investigations and complete the sampling coverage of all the identified sub-catchments. To this end CCC will also employ a full time Stormwater Officer for that period to speed up the investigation.

The stormwater investigation program continued in the 2020-21 financial year with 38 bacterial samples taken so far. CCC have adopted ammonia testing as per the DEP Source-Tracking Toolkit, which has reduced the need for bacterial samples, and has made contamination tracing quicker as the results are almost instant. There have also been CCTV investigations conducted by NuJet in three areas, where potential contamination from TasWater sewers was identified.

One of the issues that requires investigation is an apparent lack of correlation between rain events and poor sample results, as there have been failed results this season where there was very little rainfall recorded in the 72 hours prior to sampling.

The decline in water quality along this busy beach provides CCC with a real impetus to continue investigations to identify the sources of contamination, with a renewed focus on the Howrah Salacia catchment area in particular.

5.2 Blackmans Bay Beach and Kingston Beach

The two previous RWQ seasons at Blackmans Bay Beach (south) have demonstrated an improvement in water quality to the previous years. Blackmans Bay now has three monitoring sites in total, as an additional northern site was also added to the monitoring program at the commencement of the 2020-21 season.

Kingborough Council in collaboration with TasWater have implemented two low-flow diversions to sewer in Blackmans Bay, which has reduced the amount of stormwater discharging to the recreational beach.

Council's Stormwater Investigation Officer continues to track sources of contamination back up the catchment to their source, using a combination of methods, including visual inspection as well as ammonia and bacterial testing. This has been successful in locating ageing sewer infrastructure impacting stormwater, as well as domestic cross connection issues, which can then be rectified by TasWater, Kingborough Council and property owners. Monitoring in the Blackmans Bay and Kingston Beach stormwater catchment areas are ongoing.

5.3 **Marieville Esplanade**

The environmental site Marieville Esplanade in Sandy Bay has been in the Poor section for many years. The sample site is by the rowing club house within the Short Beach Reserve, about 150m from the mouth of Sandy Bay Rivulet. The reserve is a very popular place for locals to meet up and walk their dogs (off lead area).

City of Hobart (CoH) has now decided to embark on an investigation into remediating the water quality at Marieville Esplanade. They are currently at project development stage, beginning with investigating target sources including, potentially, Sandy Bay rivulet. Coinciding with this investigation, CoH is working with TasWater in the dewatering of the upper Waterworks reservoir and subsequent monitoring program, to obtain catchment-specific guideline values for Sandy Bay rivulet. This is really positive news, and we look forward to following the progress.

5.4 **Cornelian Bay**

COH is looking to undertake an audit of Water Sensitive Urban Design infrastructure across all catchments, including a targeted examination of the Bell Street bioretention basin, which treats one of two stormwater lines entering Cornelian Bay. This may include water quality sampling to assess efficacy in reducing pollutant loads, including faecal contamination, and a review of the infrastructure design and condition to inform future management practices of the site.

5.5 **Hobart Rivulet/Regatta grounds**

A combination of aging infrastructure, a collection of discrete leaks and piping issues (both private and public), and the significant catchment size of Hobart Rivulet have led to the long-term poor water quality of grade the Hobart rivulet outfall and, more recently, the sample site near the Hobart Regatta grounds.

In response to this, the City of Hobart is currently working directly with TasWater to locate, source track and repair several leaks in the underground section of Hobart Rivulet.

6 SPECIAL STUDIES

As part of each RWQ season, the DEP, supported by DoH, conducts an additional special-interest project that supplements a particular current focus. This season this extra project was a follow-up from last seasons' special study, a workshop with the purpose of sharing knowledge between council officers and others on how to use ammonia test-kits in field stormwater system investigations.

The workshop was held in Mortyn Place Park, Howrah. The crux of the workshop was hearing from Simon Woodhead, Kingborough Council's full-time Stormwater Investigation Officer, who is using the ammonia kit with much success on a regular basis. Simon shared that, in part thanks to the kit, the council had at that stage

identified 70+ sewer intrusions to the stormwater network, including spills and blockages, failures in sewerage infrastructure and direct cross connections. He explained that ammonia investigations are best conducted in low flow conditions, and that generally, the ammonia signal is lower at the outfall (because it is diluted) and gets stronger closer to the point of intrusion. More details of Simon's learnings and about using ammonia as a chemical marker can be found in a DEP workshop summary report (DEP, 2020b).

The ammonia kit is one of tools in the Source Tracking Framework and Toolkit, produced by DEP and collaborators in 2020 to assist councils with beach and stormwater investigations. Given their price, speed, practicality and effectiveness, the DEP continues to support the use of ammonia test-kits in stormwater investigations as a broad-brush approach to identifying sewer intrusions.

Thank you for the ongoing support from DoH to cover associated sample testing at the Public Health Lab.

7 COMMUNICATIONS

7.1 Media

There was very little media about the RWQ program this season. This was probably largely due to having fairly good results across the estuary. See planned media regarding stormwater in section 1.1.1.

7.2 Website

Weekly RWQ results were reported via the DEP website on the *Beach Watch* page (for Swimming Sites) https://www.derwentestuary.org.au/beach-watch/ and the associated *Bay Watch* page (for Environmental Sites). These pages allow the public to locate a weekly sampling result and long-term rating for a particular beach or bay by clicking on an interactive map or looking at a table.

The Beach Watch page had over 2729 page views over the course of the 2020-21 RWQ season. This is comparable with last year's views, but significantly less than the hectic 2018-19 season.

7.3 Facebook

Weekly RWQ results are shared on the DEP Facebook page www.facebook.com/derwentestuary. This season, typically, the reach of these weekly posts was around 150 views; often more if there was an 'avoid swimming because of heavy rain' message. The greatest reach was for the first results of the summer, with 461 views.

Both website and Facebook views are likely to be higher than reported above, as many people are taking action to hide or clear their browsing history.

7.4 Weekend advisory

The most important message that we need to convey to the swimming public, is to not swim after heavy rains, due to the water quality of urban beaches and bays being often strongly influenced by stormwater run-off (NHMRC, 2008). We keep an eye on the weekend forecasts and can put out an advisory on the DEP Facebook page when

necessary, e.g. when recent or predicted rainfall is greater than 10 mm. This ‘protocol’ was conducted throughout the season (Figure 7.1).

Figure 7.1 DEP Facebook posting from 4 February 2021 referring to the weekly RWQ results during a week with poor weather forecast for the weekend.

7.5 Signage

The signs installed at Derwent estuary swimming sites are a useful source of information for beach users. The DEP recommends that local councils conduct an annual review of signage in their municipality to ensure that all signs are located in the most appropriate locations (i.e. visible to most visitors), are in good condition (e.g. free of graffiti and not obstructed by vegetation), and that they are replaced with new signs as required (i.e. when the water quality category changes). For new swimming sites, it is recommended that signs are only erected once a long-term rating has been established, which is after five seasons.

After updating the long-term ratings following the 2020-21 season, the following beach sign changes are recommended:

- Taroona – from Good to Fair
- Windermere Beach – from Fair to Good
- Howrah Beach (west) – from Good to Fair
- Howrah Beach (mid) – from Fair to Poor
- Howrah Beach (east) – from Good to Fair

Councils are not required to put up signs to indicate the water quality for environmental sites but may choose to do so in well-visited locations.

8 ACKNOWLEDGEMENTS

The DEP would like to sincerely thank all council environmental health officers and other council staff who have contributed to this RWQ season, as well as EPA staff who have assisted with boating requirements. Many thanks also go the staff at the Public Health Laboratory and the Department of Health for their ongoing participation and friendly support, and our industry partners, including TasWater.

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9.1 Appendix A - RWQ Intercalibration report 2020-21

9.1.1 Executive Summary

Recreational Water Quality (RWQ) monitoring in the Derwent estuary is conducted and reported in accordance with the Recreational Water Quality Guidelines 2007 (*Public Health Act 1997*). In order to ensure consistency of sampling methods and to assess the degree of variability between samples and samplers, the Derwent Estuary Program (DEP) coordinates an annual inter-calibration exercise.

On a warm sunny morning on 24 November 2020, environmental health officers from four councils, together with the DEP, collected water samples at two sites at the eastern end of Howrah Beach. Results were consistent between samplers and sites. Low results were reported at Site 1 (close to a stormwater outfall), as well as at Site 2 (~100 m west of the outfall), despite a high reading from the outfall pipe itself.

The sampling results demonstrated little variability between samplers and highlighted how quickly the marine environment can dilute localised pollution. Samplers adopted

good sampling technique, and showed satisfactory knowledge about field sheets, sample storage, wader safety, and potential sources of faecal contamination.

9.1.2 Introduction

The RWQ monitoring is conducted and reported in accordance with the Recreational Water Quality Guidelines 2007 (*Public Health Act 1997*). The guidelines recommend classifying primary contact recreation beaches using 5-year 95th Hazen percentile values for the faecal indicator bacteria enterococci:

- Good (surveillance mode) = < 200 MPN/100 mL.
- Fair (alert mode) = 200 - 500 MPN/100 mL.
- Poor (action mode) = > 500 MPN/100 mL.

The long-term beach classification guidelines do not take into account the possible influence of variability in the data due to differences in sampling techniques between samplers, or possible heterogeneity of the sampled water body. The RWQ program uses data provided by a number of different council environmental health officers, which increases the risk of variability due to sampling technique. Thus, the primary objective of the annual inter-calibration exercise is to review and practice sampling methods at the start of each season, in order to improve consistency of results. A secondary objective is to gain a better understanding of water quality at a particular site.

9.1.3 Methodology

9.1.3.1 Participants

The DEP (Inger Visby) coordinated the participation of the following:

- Kingborough Council (Michael Steele)
- Clarence City Council (Andrew Forshaw)
- Glenorchy City Council (Emma Richardson and Nick Cameron)
- Huon Valley Council (Ben Granger)
- DEP (Akira Weller-Wong)

Additional staff from Dept of Health, Glenorchy, Clarence and Huon Valley councils observed the sampling and contributed to the group discussion. There were apologies from Brighton Council and City of Hobart.

9.1.3.2 Location

Site 1 was off the beach near the stormwater outfall at the eastern end of Howrah Beach, and Site 2 was approx. 100 m. further west along the beach. An additional sample was taken by the DEP only, directly by the stormwater outfall on the beach, to assess this as a potential source of contamination (Figure 9-1).

Figure 9-1. Location of the three sites sampled for the RWQ inter-calibration exercise on 24 November 2020 at Howrah Beach (east).

9.1.3.3 Safety

Wader safety was discussed, including how valuable wader safety courses are. Wearing waders can be highly hazardous if water gets inside them, e.g. from boat wake or when bending to take water sample. The DEP recommends that everybody complete a Wader Safety course (the next courses run by Seafood & Maritime Training are on 28/4/21 and 25/5/21), and in the meantime watch this very useful short video on wader safety https://www.mast.tas.gov.au/guides/wader-safety/. As part of wader safety, it is important to wear a tight belt, and ideally also wear a personal flotation device (PFD).

For added security, it is also recommended that no one samples on their own. Always be aware of the surroundings and only conduct sampling if it is safe to do so.

9.1.3.4 Method

Filling in the laboratory submission form (for the Public Health Lab (PHL) in New Town) was discussed; including entering wind speed, wind direction, date and time of sampling, to be able to refer to if results are high. Participants were also encouraged to note other observations, such as discolouration, odour, construction activity, boat presence, density of wildlife, evidence of faeces, proximity to stormwater outfalls, or any other matters which might influence results. Officers were reminded to take a photo or make a copy of the lab submission form to file for their own records.

All bottles should be pre-sterilised and provided by PHL. They are dated by the lab, so ensure that you are not using old bottles. Just before sampling, bottles were labelled with the site, time, and the samplers' names.

All samplers concurrently collected a single sample at each site from an approximate water depth of 0.3 m. Bottles were only opened immediately prior to collecting the sample. Once the bottle cap had been removed, care was taken to ensure that this was not contaminated by fingers or by contact with surfaces. The bottle was quickly plunged to the required sampling depth, then it was tilted upward with the mouth pointed upward. The sample was brought to the surface and a portion of the sample tipped out so that the level in the sample container was at the bottle collar. The sample lid was screwed tightly shut before removing it from the sample pole and the sample was placed upright in a chilled esky ready for transport to the laboratory. Samples should be delivered to the laboratory ASAP after sampling, and on this day was delivered approx.1 ½ hour after sampling.

This year no multi-probes were compared (normally Clarence City Council and the DEP compare results from water quality multi-probes).

9.1.4 Results

The enterococci results from Site 1 varied between < 10 and 30 MPN/100 mL, and at Site 2 they were all 10 MPN/100 mL or less. At the outfall the enterococci result was 1565 MPN/100 mL (Table 2**Error! Reference source not found.**).

Table 2. Summary of enterococci concentration results (MPN/100 mL) sampled on 24 Nov 2020.

Sampler	Site 1: Howrah east (by outfall)	Site 2: Howrah west (100 m west of outfall)	Outfall pipe
Michael (KC)	< 10	< 10	
Emma (GCC)	20	10	
Nick (GCC)	< 10	10	
Andrew (CCC)	< 10	< 10	
Ben (HVC)	30	< 10	
Akira (DEP)			1,565

9.1.4.1 Rain, wind, tide conditions

According to the weather station at Ellerslie (BOM, 2020) there was no rain in the three proceeding days to the exercise.

At 9 am on the day of sampling, the wind was north easterly, with wind speeds ~ 9 km/hr, and the tide was outgoing at ~ 0.9 m at 10.12 am (WillyWeather 2020).

9.1.5 Conclusions

The water quality was excellent at the two beach sampling sites. The sampling results demonstrated homogeneous water quality conditions, with negligible variability between samplers.

Given that urban stormwater drains are a known source of faecal contamination, the higher enterococci results from the outfall pipe was expected. The low results at the beach, by the pipe, indicate significant dilution over a short distance. The difference between the < 10 and 30 MPN/100 mL enterococci results suggests there was little variability in the flow path and dilution rates.

Samplers adopted good aseptic grab sampling technique, removing bottle lids at the last moment before collecting a sample, protecting the bottle and lid from contamination, labelling bottles correctly and storing samples in a chilled esky for subsequent transport to the laboratory. Samplers were aware of potential sources of faecal contamination.

9.1.6 Acknowledgements

Thank you very much to all the EHOs who participated in this session with great enthusiasm and willingness to share their knowledge and experiences, and to the local councils for valuing and prioritising the RWQ program. It was very nice to see the keen interest by staff from the Dept of Health and to be able to share tricks of the trade with folks from Huon Valley Council.

9.1.7 References

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9.2 Appendix B – Rainfall data across the Derwent estuary

Table 3. Daily rainfall (up to 9 am) from December-March at four BOM weather stations across the Derwent estuary: Hobart Ellerslie Rd (HE); Hobart Airport (HA); Kingston Greenhill Drive (KG); and New Norfolk West (NN). RWQ sampling days are highlighted in yellow.

December 2020				
Date	HE	HA	KG	NN
1st	0	0	0	0
2nd	11	3.4	9.8	7
3rd	0	0	0	0
4th	0	0.4	0.4	1.2
5th	0	0	0	0
6th	8	6.2	8.2	8.8
7th	1.4	1	2	3.4
8th	0	0	0.2	0.2
9th	0	0	0	0
10th	0.2	1.8	1.6	0.4
11th	0.2	0	0	0
12th	0	0	0	0
13th	0	0	0	0
14th	0	0	0	0
15th	0	0	0	0
16th	0	0	0	0
17th	4.8	6.4	5.8	3.4
18th	6.4	9.6	6.4	4.8
19th	0.6	5	0	0
20th	0.8	0	2	0.6
21st	0.2	0	0	0.6
22nd	0	0	1	0
23rd	34	31.2	11	0
24th	0.8	0.6	0	0.4
25th	0.4	2	1	3.8
26th	0	0	0	0
27th	0	0	0	0
28th	3	9.6	7	2.4
29th	0	0	0	0
30th	0	0	0	0
31st	0.4	1.4	1.4	0.6

January 2021				
Date	HE	HA	KG	NN
1st	0	0	0	0
2nd	0	0	0	0
3rd	0	0	0	0
4th	0.2	0	0	0
5th	0.2	0	0	0
6th	0	0	0.8	0
7th	0	0	0.4	0
8th	0	0	0	0
9th	0	0	0	0
10th	0	0	0	0
11th	0	0	0	0
12th	3.6	6.8	4.4	5.2
13th	0.2	0	0	0
14th	8.6	5.6	4	5.4
15th	0	0.8	0	0.6
16th	8.8	27.4	5.6	2.4
17th	0.4	0	1.2	0.2
18th	0	0	0	0
19th	0	0	0	0
20th	0	0	0	0
21st	0	0	0	0
22nd	0	0	0	0
23rd	0	0	0	0
24th	0	0	0	0
25th	0	0	0	0
26th	4.4	6.6	3.2	5.4
27th	0.2	0	0	0
28th	0	0	0	0
29th		0	0	0
30th	2.2	3.4	2.2	2.6
31st	0	0	0	0

February 2021				
Date	HE	HA	KG	NN
1st	0	2.6	0	0
2nd	0	3.4	0	0.2
3rd	0	0	0	0
4th	1.8	2.2	3	0.6
5th	0.2	0	2.2	0.2
6th	41.2	15.2	44	42
7th	0.8	4.6	0.6	1.4
8th	0	0	0	0
9th	0	1	1	0
10th	0	0	0	0
11th	0	0	0	0
12th	6.6	10.6	4.4	8
13th	0.2	0	0.2	0.2
14th	0	0	0	0
15th	0.6	0.8	3.4	0
16th	0	0	0.2	0
17th	0	0	0	0
18th	0	0	0	0
19th	0	0	0	0
20th	0	0	0	0
21st	0	0	0.6	0
22nd	0	0	0	0
23rd	0	0	0.2	0
24th	0	1.4	0	0
25th	0	0	0	0
26th	0.6	2.2	3.8	3.6
27th	0	0.8	0	0
28th	0	0	0	0

March 2021				
Date	HE	HA	KG	NN
1st	1.2	0	0.4	0.2
2nd	6.6	7.2	8	7.2
3rd	0.6	0.6	1.8	0
4th	0	0	0	0
5th	0	0	0	0
6th	0	0	0	0
7th	0	0	0	0
8th	0	0	0	0
9th	0	0	0	0
10th	0	0	0	0
11th	0	0	0	0
12th	0	0	0	0
13th	0	0	0	0.2
14th	0.8	0	1	1
15th	0	0	0	0
16th	0	0	0	0
17th	0	0	0	0
18th	0	0	0	0
19th	0	0	0	0
20th	0	0	0	0
21st	0	0	0	0
22nd	0	0	0	0
23rd	0	0	0	0
24th	4.6	2	3.6	0.2
25th	39	33.6	57	27.8
26th	1	4.6	1	0
27th	6	3	3.8	6.4
28th	0.2	0.2	0.6	0.4
29th	0	0.2	0.6	1
30th	0	0	0	0
31st	0	0	0	0

Rainfall (mm)

- 5 - 10
- 10 - 20
- > 20

9.3 Appendix C – 2019-20 results for Swimming and Environmental sites

9.3.1 Swimming Sites

Swimming Site 2020-21																				
Date	CoH				CCC						KC								GCC	DVC	
	Little Sandy Bay Beach (south)	Little Sandy Bay Beach (north)	Nutgrove Beach (east)	Nutgrove Beach (west)	*Bellerive Beach (east)	Bellerive Beach (west)	Howrah Beach (east)	Howrah Beach (mid)	Howrah Beach (west)	Little Howrah Beach	*Blackmans Bay Beach (north)	Blackmans Bay Beach (mid)	*Blackmans Bay Beach (south)	Hinsby Beach	Taroona Beach	Kingston Beach (north)	Kingston Beach (mid)	*Kingston Beach (south)	Windermere Bay Beach	New Norfolk (Esplanade)	No.excedences over 140 MPN
01-Dec-20	10	10	10	355	>10	>10	10	>10	10	>10	>10	30	>10	>10	>10	>10	10	10	>10	n/a	1
08-Dec-20	>10	10	10	20	>10	10	>10	10	>10	10	10	>10	10	>10	52	20	10	10	20	20	0
15-Dec-20	>10	31	20	20	>10	>10	52	41	98	>10	20	31	20	>10	>10	780	63	41	>10	n/a	1
22-Dec-20	10	10	>10	>10	20	>10	41	>10	211	20	10	10	>10	52	>10	>10	10	20	>10	52	1
29-Dec-20	n/a	n/a	n/a	n/a	>10	>10	10	10	>10	41	>10	>10	>10	10	>10	>10	>10	>10	n/a	n/a	0
05-Jan-21	10	>10	10	10	>10	>10	>10	>10	>10	10	>10	20	>10	>10	10	>10	>10	>10	>10	122	0
12-Jan-21	41	20	31	30	20	31	97	315	20	52	20	73	10	530	331	20	256	10	161	97	5
19-Jan-21	10	20	211	246	399	31	327	144	120	187	63	520	30	148	2924	1012	933	272	>10	10	12
25-Jan-21	20	10	20	>10	52	41	20	20	52	20	>10	>10	10	>10	>10	20	20	10	10	41	0
02-Feb-21	>10	>10	>10	>10	>10	>10	10	10	10	>10	20	10	>10	10	>10	>10	>10	>10	>10	10	0
09-Feb-21	>10	20	>10	>10	>10	20	>10	63	1483	10	86	41	31	>10	>10	132	>10	20	31	97	1
16-Feb-21	10	>10	>10	>10	>10	>10	10	>10	20	>10	>10	>10	86	>10	>10	20	>10	41	>10	110	0
23-Feb-21	>10	75	>10	>10	>10	>10	>10	52	>10	20	>10	262	20	10	10	118	>10	20	10	20	1
02-Mar-21	10	84	>10	20	97	10	187	243	74	63	833	20	41	>10	10	51	41	52	31	n/a	3
09-Mar-21	20	>10	31	>10	>10	41	10	10	20	10	>10	75	41	>10	10	74	134	4884	20	120	1
16-Mar-21	41	41	>10	30	10	>10	10	>10	20	63	>10	10	31	10	20	10	>10	>10	>10	98	0
23-Mar-21	10	>10	>10	>10	10	>10	20	>10	10	>10	10	31	31	>10	52	>10	>10	>10	122	122	0
30-Mar-21	31	20	>10	10	31	20	>10	683	>10	>10	30	85	31	>10	10	>10	10	>10	10	228	2
																					28

Figure 9.2 2020-21 RWQ season swimming site results listed under each local council. Results are enterococci MPN per 100 mL. Last column lists the number of enterococci result exceedances above 140 MPN per 100 mL., which are also highlighted in red. * indicates sites with less than five years of data available.

9.3.2 **Environmental Sites**

	Environmental Site 2020-21																					
	Brooke St Pier	Browns River	Cornelian Bay Beach	Elwick Bay	Geilston Bay	Hobart Rivulet	Kangaroo Bay	Lindisfarne Bay	Marieville Esplanade	Mid-river Derwent Swim	MONA Berridale Bay	MONA Cameron Bay	MONA Jetty	Montagu Bay	*New Norfolk (Millbrook Rise Jetty)	New Town Bay	Old Beach, Jetty Road	Prince of Wales Bay Marina	Regatta Pavilion	Sullivans Cove	Victoria Dock	Watermans Dock	No.excedences over 140 MPN
01-Dec-20	<10	20	10	<10	<10	197	<10	31	121	<10	n/a	10	n/a	10	n/a	<10	<10	<10	10	<10	63	75	1
08-Dec-20	<10	31	31	<10	<10	86	10	20	62	20	<10	<10	<10	10	135	41	<10	20	2187	<10	10	30	1
15-Dec-20	10	132	86	20	41	288	10	30	120	<10	20	10	52	10	n/a	31	<10	134	41	132	10	62	1
22-Dec-20	20	63	<10	98	3873	1789	161	11198	20	10	<10	10	20	554	10	12997	<10	41	6131	<10	51	6488	8
29-Dec-20	n/a	148	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
05-Jan-21	n/a	20	31	<10	n/a	n/a	n/a	n/a	<10	n/a	<10	10	<10	n/a	41	n/a	10	n/a	n/a	n/a	n/a	n/a	0
12-Jan-21	10	1137	<10	20	98	243	31	<10	10	<10	644	41	158	10	10	31	98	243	31	<10	<10	41	5
19-Jan-21	<10	262	10	20	<10	63	10	<10	<10	<10	41	<10	31	<10	75	<10	<10	<10	<10	<10	10	<10	1
25-Jan-21	10	31	10	211	109	538	<10	97	171	<10	75	20	10	<10	63	<10	<10	<10	171	<10	10	95	4
02-Feb-21	<10	41	30	31	<10	84	<10	<10	83	<10	20	10	20	<10	41	10	20	<10	<10	<10	<10	<10	0
09-Feb-21	10	410	20	98	512	134	20	30	<10	<10	169	31	41	<10	171	10	75	41	10	10	10	218	5
16-Feb-21	<10	209	<10	10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	331	<10	<10	41	216	<10	<10	<10	3
23-Feb-21	20	158	n/a	41	52	10	<10	10	20	<10	63	<10	<10	84	63	85	<10	<10	<10	<10	10	52	1
02-Mar-21	63	3448	n/a	109	52	6131	256	135	20	<10	120	20	41	10	n/a	63	<10	199	121	31	20	52	4
09-Mar-21	n/a	602	n/a	75	n/a	n/a	n/a	n/a	<10	n/a	135	<10	<10	n/a	97	n/a	10	n/a	n/a	n/a	n/a	n/a	1
16-Mar-21	n/a	235	n/a	10	n/a	n/a	n/a	n/a	41	n/a	10	<10	<10	n/a	63	n/a	10	n/a	n/a	n/a	n/a	n/a	1
23-Mar-21	10	52	n/a	30	52	98	<10	<10	41	<10	160	10	10	10	189	<10	n/a	<10	109	<10	<10	10	2
30-Mar-21	n/a	<10	n/a	10	n/a	n/a	n/a	n/a	30	n/a	<10	<10	20	n/a	292	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
																							40

Figure 9.3 2020-21 RWQ season Environmental Site results. Results are enterococci MPN per 100 mL. Last column lists the number of enterococci result exceedances above 140 MPN per 100 mL, which are also highlighted in red. * indicates site with less than five years of data available.