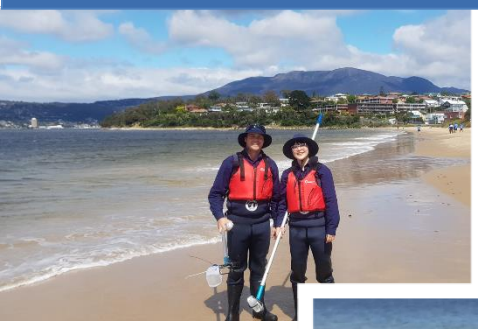
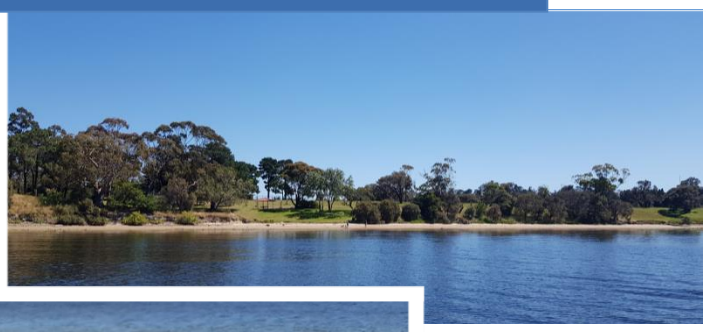
Derwent Estuary Recreational Water Quality Program

Annual Report 2022-23





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, Hydro Tasmania, EPA Tasmania, NRM South and the Institute for Marine and Antarctic Studies.

Contents

1 EXECUTIVE SUMMARY

This report presents results of the Derwent Estuary Recreational Water Quality Program (RWQ) 2022-23 season. The RWQ program is a collaborative initiative between six local councils, the State Government of Tasmania, Environmental Protection Authority Tasmania (EPA) and the Derwent Estuary Program (DEP). Water samples were collected weekly at 38 sites throughout the estuary between 1 December 2022 and 31 March 2023 and analysed for the faecal indicator bacteria, enterococci.

This summer, the water quality at almost all of our 19 swimming sites was significantly better than the last monitoring season, with less than half the number of failures, which occurs when the enterococci results exceed the prescribed trigger level of 140 MPN 100 mL^{-1} set by the Tasmanian Recreational Water Quality Guidelines 2007 (DoH, 2007), thus requiring retesting. This season saw 22 exceedances, compared with 49 last summer. At the end of this season, five swimming sites were graded as Good, nine sites graded as Fair, one as Poor, with four sites yet to be classified. The sites that improved their rating were Bellerive Beach (west), from Fair to Good, and Howrah Beach (mid), from Poor to Fair. The only site to drop its rating was Hinsby Beach, from Good to Fair. Little Sandy Bay Beach continues to have the consistently best water quality in the program, and Kingston Beach (north) is currently the only site with a Poor rating.

The water quality at the 19 environmental sites was similar to previous season. On 56 occasions, enterococci results over 140 MPN 100 mL^{-1} were recorded, compared to 51 times last year. There are now seven environmental sites with Good long-term ratings, two as Fair, and nine as Poor. Two sites dropped their ratings, i.e. Prince of Wales Bay (from Good to Fair) and Victoria Dock (from Fair to Poor). No sites improved their rating following this summer's sampling. The Mid-river Derwent sampling location continues to be the environmental site with the consistently best water quality, followed by Montagu Bay and now Elwick Bay.

Overall, it was a dry summer for western Tasmania with closer to average rainfall in the east, including in the Derwent Estuary where the first half of December was very wet followed by almost no rain until late January and largely only two rain periods in February and March. While rainfall is a common driver of pollution at our swimming sites, it is difficult to draw definite conclusions between rainfall and enterococci results. Many of this summer's environmental site failures appear linked with rain, whereas the swimming site failures probably less so.

The improvement to long-term ratings following this season is encouraging and councils and TasWater are congratulated for their persistence and dedication to targeted pollution source-tracking, especially the build-up of local expertise and knowledge-sharing we have seen over the last couple of years. One of the major benefits of the RWQ program has always been how it focusses attention on the link between the estuary and the stormwater and sewage systems for the benefit of the environment and hence the swimming public.

2 INTRODUCTION

Water quality monitoring of beaches and bays in the Derwent Estuary is coordinated by the DEP in collaboration with Department of Health (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 (using methods outlined Tasmanian Recreational Water Quality Guidelines 2007(DoH, 2007).
- Support and encourage 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 (DEP, 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 can be 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 can help advance our understanding. Systematic investigation is critical to locate a pollution source. See the DEP Source Tracking Framework and Toolkit https://www.derwentestuary.org.au/assets/Source_Tracking_Framework_and_Toolkit_Mar2020.pdf.

2.3 Recreational water quality guidelines

Swimming and environmental sites in the Derwent Estuary are graded as Good, Fair or Poor. This is in accordance with the Recreational Water Quality Guidelines for Tasmania (DoH, 2007), which are 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 as soon as possible, and if two consecutive samples return enterococci results above 280 MPN 100 mL^{-1}, the public must be advised directly via signage on the beach in question. This signage can only be removed by Council's Authorised Officer in consultation with DoH.

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 19 swimming sites monitored this season are in locations where a significant number of people swim or conduct other primary contact recreation. Primary contact refers to where recreational water is used for whole-body contact, i.e., where there is a risk of swallowing water (NHMRC, 2008). These sites are sampled by councils.

- The 19 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. Secondary contact refers to incidental contact, i.e., activities where only the limbs are regularly wet and in which greater contact (including swallowing water) is unusual, such as boating and fishing (NHMRC, 2008).
  - 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.

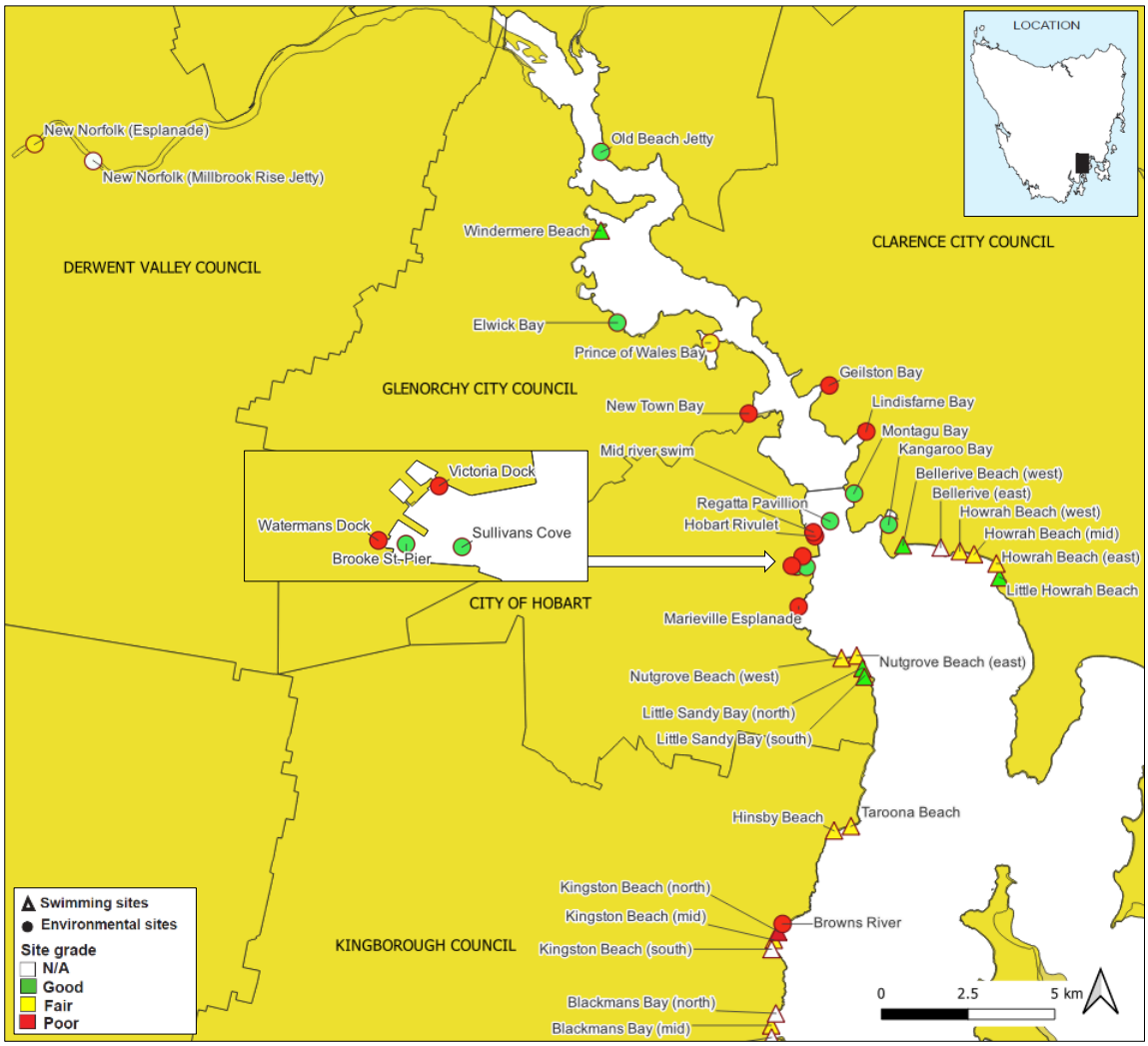


Figure 3-1. Recreational Water Quality sampling sites (swimming and environmental sites) with their current water quality classification based on data collected in the summer months between December 2018 and March 2023. Sites without five years of data (N/A) are depicted without a rating.

3.2 **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.

The exercise is also a good opportunity to talk about any concerns and finer details of sampling both by new and more experienced samplers, and good questions are always brought up for discussion. For a full report on this season's inter-calibration exercise see Appendix 9.1. The next inter-calibration exercise will be conducted in November 2023.

Figure 3-2. EHOs sampling together as part of the annual inter-calibration exercise, at Bellerive Beach on 30 November 2022.

4 2022-23 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 below shows the updated rating after the 2022-23 season. The colours refer to Tasmanian *Recreational Water Quality Guidelines* (DoH, 2007), calculating a 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 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 final long-term rating. The 95th Hazen percentile figure listed in Table 2 for these sites (in italics) only provides an indication of a future rating, with such indications comparitively high due to the fewer samples. 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 choose to action them now rather than later.

Table 1. Long-term ratings for swimming and environmental sites as calculated after the 2022-23 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*	*97*	*1*	*1*	*70*
	Bellerive Beach (west)	Good	173	4	1	87
	Blackmans Bay Beach (mid)	Fair	396	5	8	87
	**Blackmans Bay Beach (north)*	*N/A*	*134*	*1*	*2*	*70*
	**Blackmans Bay Beach (south)*	*N/A*	*538*	*4*	*5*	*70*
	Hinsby Beach	Fair	220	6	2	87
	Howrah Beach (east)	Fair	222	3	3	87
	Howrah Beach (mid)	Fair	475	7	9	87
	Howrah Beach (west)	Fair	280	5	4	87
	Kingston Beach (mid)	Fair	228	6	2	87
	Kingston Beach (north)	Poor	622	6	8	87
	**Kingston Beach (south)*	*N/A*	*262*	*4*	*2*	*70*
	Little Howrah Beach	Good	192	3	3	87
	Little Sandy Bay Beach (north)	Good	97	0	2	85
	Little Sandy Bay Beach (south)	Good	98	1	1	86
	Nutgrove Beach (east)	Fair	256	4	4	84
	Nutgrove Beach (west)	Fair	226	5	3	86
	Taroona Beach	Fair	365	1	6	87
	Windermere Beach	Good	126	2	1	81
Environmental sites	Brooke Street Pier	Good	124	1	1	66
	Browns River	Poor	2188	9	32	87
	Elwick Bay	Good	110	2	1	80
	Geilston Bay	Poor	1152	2	7	66
	Hobart Rivulet	Poor	1148	7	21	66
	Kangaroo Bay	Good	195	6	1	66
	Lindisfarne Bay	Poor	2219	2	6	66
	Marieville Esplanade	Poor	775	6	11	86
	Mid-river swim	Good	30	1	0	64
	Montagu Bay	Good	66	0	1	65
	New Norfolk (Esplanade)	Fair	273	7	4	76
	**New Norfolk (Millbrook Rise Jetty)*	*N/A*	*276*	*7*	*3*	*60*
	New Town Bay	Poor	657	3	6	66
	Old Beach Jetty	Good	196	1	3	71
	Prince of Wales Bay	Fair	208	4	1	66
	Regatta Pavilion	Poor	840	7	6	67
	Sullivans Cove	Good	134	1	1	66
	Victoria Dock	Poor	663	1	4	66
	Watermans Dock	Poor	933	4	6	66

***** Indicates < 5 years of data available.

4.2 Site results

4.2.1 Swimming Sites

This season again 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), which will all have a full data set next year.

The water quality at the swimming sites was overall better than the last two seasons. This season saw only 22 exceedances (enterococci >140 MPN 100 mL^{-1}), compared with 49 last summer and 28 the previous season (Table 2). See the full list of enterococci results and exceedances for all swimming sites in the 2022-23 season in Appendix 9.3.1.

Table 2. Number of swimming sites from the last seven RWQ seasons triggering a retest under the Tasmanian Recreational Water Quality Guidelines by exceeding enterococci >140 MPN 100 mL^{-1} (DoH, 2007).

RWQ season	Number of exceedances
2022-23	22
2021-22	49
2020-21	28
2019-20	5
2018-19	52
2017-18	23
2016-17	24

At the end of this season, five sites were graded as Good, nine sites graded as Fair, one as Poor, and, as mentioned, four sites yet to be classified. Only one site dropped its rating following this season: Hinsby Beach, from Good to Fair; and two sites improved their rating: Bellerive Beach (west), from Fair to Good; and Howrah Beach (mid), from Poor to Fair (Figure 4-1).

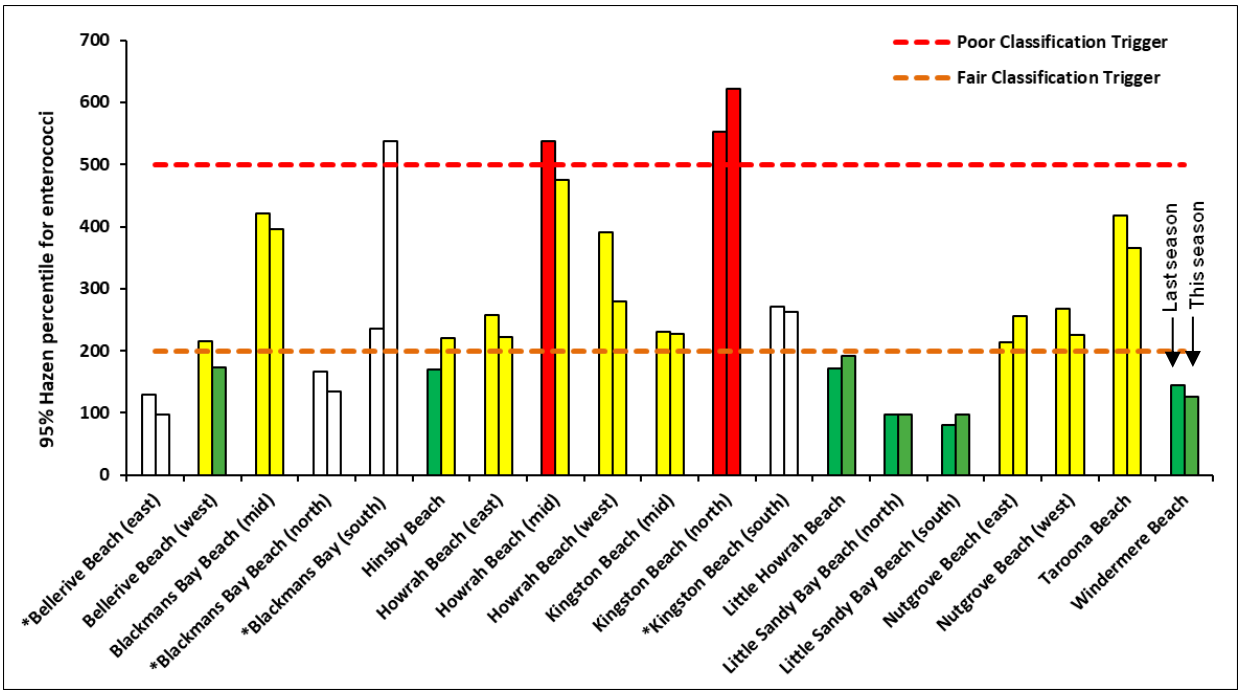


Figure 4-1: Comparison of rolling 5-year Hazen percentile enterococci result for swimming sites. Each site is presented as a pair of results, where the left bar represents 2021-22 RWQ season results, while the right bar represents 2022-23 season result. Green denotes Good (< 200 MPN 100 mL^{-1}), yellow 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.

The two swimming sampling sites with the consistently best water quality in the RWQ program is still the Little Sandy Bay Beach sites (south and north). The only swimming site currently in Poor is Kingston Beach (north), located near the Poor environmental sampling location in the Browns River mouth. Blackmans Bay Beach (mid and south) had some persistent problems at the end of this season, which Kingborough Council are doing their best to resolve. Read about specific site investigations in Section 5. Windermere Beach has stayed firmly in the Good category.

Figure 4-2 highlights the proportion of Good, Fair and Poor swimming sites over the last eight RWQ seasons, showing a decrease in Good sites over the last couple of seasons, and that there are now more Fair than Good sites in the program.

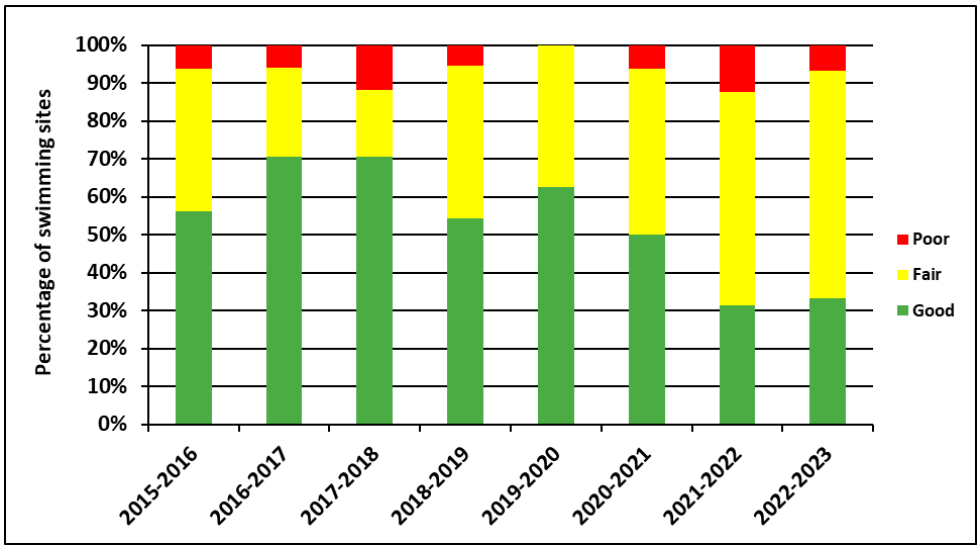


Figure 4-2 Proportion of swimming sites graded as Good, Fair, and Poor in the last eight RWQ seasons. **Note** that proportions are now only based on those sites with five years of data available – thus four swimming sites have not been included in the 2022-23 calculation (Bellerive Beach (east), Blackmans Bay Beach (north), Blackmans Bay Beach (south), and Kingston Beach (south).

4.2.2 **Environmental Sites**

Four environmental sites dropped out of the program this season, with MONA deciding to no longer sample at their jetty and at Cameron and Berridale bays; and City of Hobart no longer including Cornelian Bay due to the hazards associated with sampling at this muddy location. The sample site at New Norfolk's Esplanade has been reallocated from a swimming to an environmental site, after the discovery of a nearby very low-lying stormwater pipe (see more details in 5.1). There were no other sites added to the sampling program this summer; and there is still only one site without a long-term rating, i.e. Millbrook Rise jetty at New Norfolk.

The enterococci results from the 19 environmental sites showed 56 exceedances (enterococci >140 MPN 100 mL^{-1}), compared to 51 during the last summer and 40 the previous season (Appendix 9.3.2).

After updating the long-term ratings at the end of the 2022-23 season, there are now seven sites graded as Good, two as Fair, and nine as Poor. One site dropped from Good to Fair (Prince of Wales Bay), and one site changed from Fair to Poor (Victoria Dock). There were no improvements in ratings following this recent season (Figure 4-4). Figure 4-4 shows the proportion of Good, Fair and Poor swimming sites over the last

eight RWQ seasons, highlighting the change over the years to the current situation of more Poor than Good environmental sites.

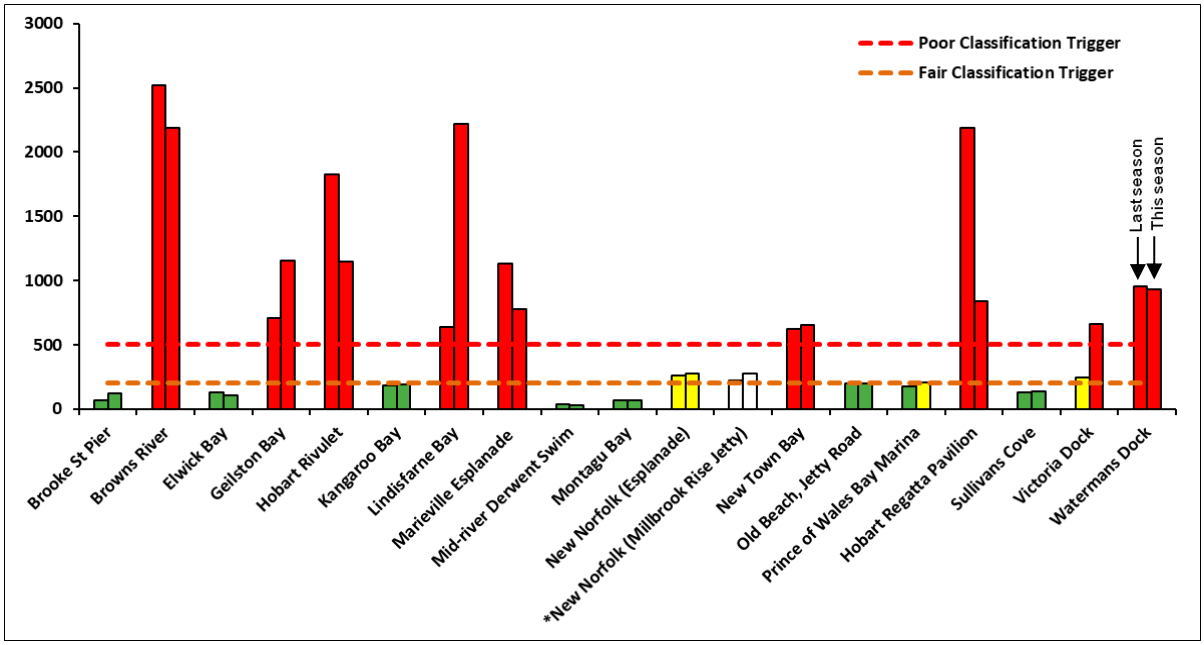


Figure 4-3 Comparison of rolling 5-year Hazen percentile enterococci result for the environmental sites. Each site is presented as a pair of results, where the left bar represents 2021-22 RWQ season results, while the right bar represents 2022-23 season result. Green denotes Good (< 200 MPN 100 mL^{-1}), 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.

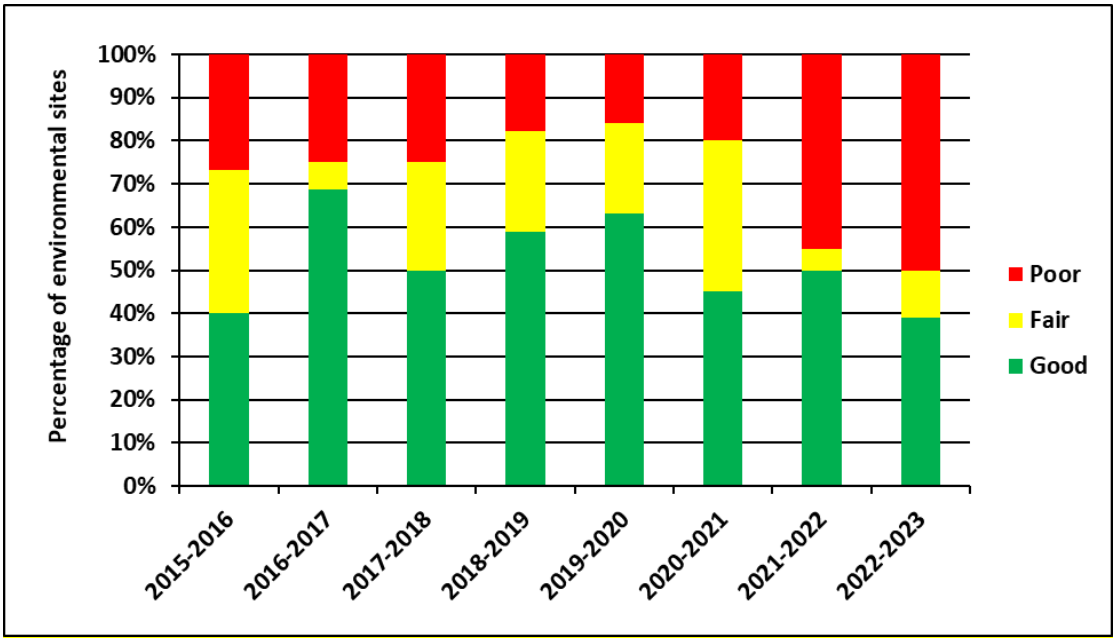


Figure 4-4 Proportion of Environmental Sites graded as Good, Fair, and Poor in the last eight RWQ seasons. **Note** that proportions are only based on those sites with five years of data available.

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After this season, the Mid-river Derwent location continues to be the environmental site with the best water quality, followed by Montagu Bay and Elwick Bay. The Mid-river Derwent site has only experienced one enterococci sample > 140 MPN 100 mL^{-1} over the past five seasons (Table 1). Browns River had a poor season this summer with 11 fails out of 17 sample events, followed by Hobart Rivulet with seven fails. Victoria Dock went to Fair following the 2021-22 season and is now Poor following the recent season, following the recent trajectory by Geilston and Lindisfarne bays.

DEP, in collaboration with the EPA, sample 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. Unfortunately, two and a half sample events were missed this season due to poor weather and boat availability. Also, due to such restrictions boat sampling may sometimes be conducted on a different day, which can be apparent in the results (see more in Rainfall section below).

See this season's complete list of 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). We also know that our beaches can respond very differently to rainfall depending on the proximity of sampling sites to stormwater outlets, activities in, and topography of, the catchment.

Rainfall varies considerably across the Derwent Estuary, with rainfall data collected and reported by the Bureau of Meteorology (BoM). Observations of daily rainfall are nominally made at 9 am and record the total rainfall for the previous 24 hours. RWQ Tuesday sampling mostly occur between 9 and 10.30 am, but can be later in the day, especially DEP/EPA boat sampling, which means that at times the rainfall records for the following day are relevant when investigating why particular enterococci results are high.

Four weather stations in the Derwent Estuary catchments, Ellerslie Road (Hobart), Greenhill Drive (Kingston), Mount Rumney and New Norfolk west, have been selected as relevant when considering rain impact on the RWQ sampling sites. Mount Rumney is just useful post-season, and not on a daily basis, as its records are only updated monthly (BoM, 2023).

Long-term rainfall averages for the program months are currently ranging between 140.70 mm at New Norfolk and 201.30 mm at Kingston, the latter generally experiencing more rain than the other sites. During the 2022-23 RWQ season, total rainfall was close to average for all four stations Figure 4-5.

The complete 2022-23 summer rainfall data for the four BoM weather stations that cover the Derwent Estuary are listed in Appendix B 9.2.

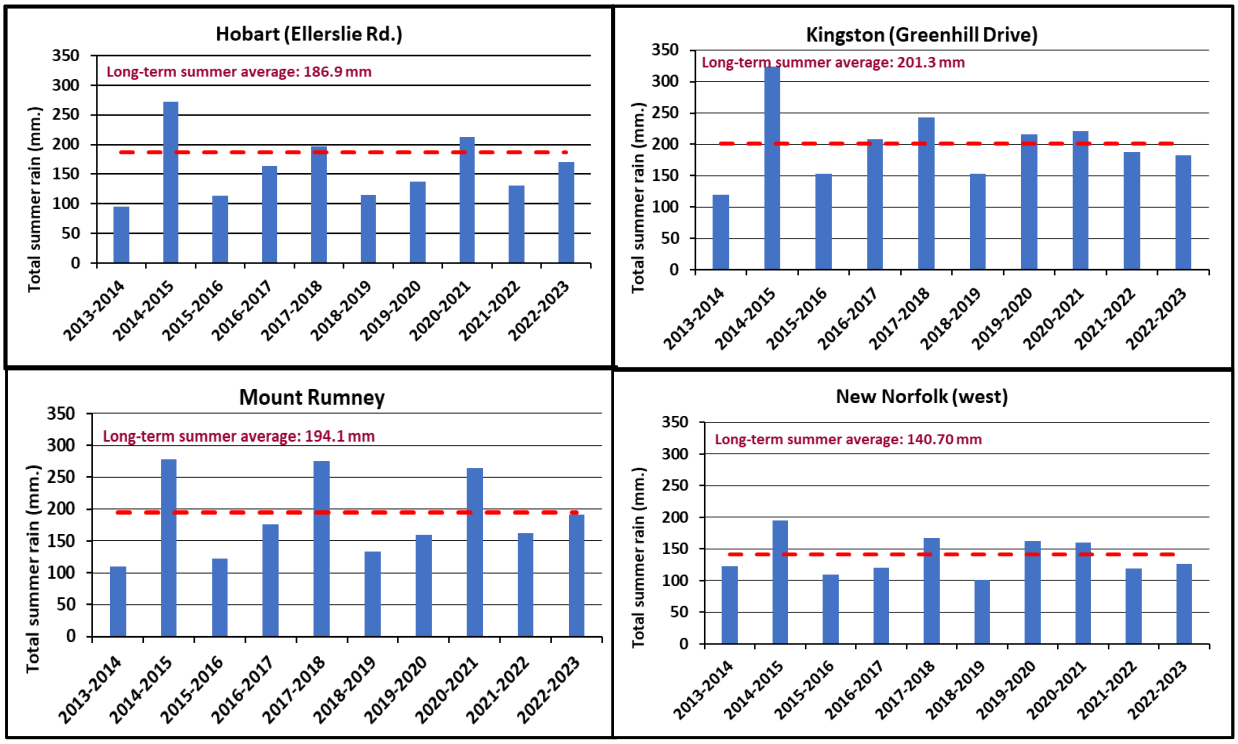

Figure 4-5 Total rainfall (in mm) at four weather stations in the Derwent Estuary catchments during the last ten RWQ program seasons (between December and March), as recorded by the Bureau of Meteorology (2023). The long-term average rainfall is indicated in red text and by a dotted line.

Overall, it was a dry summer for western Tasmania, with closer to average rainfall in the east (BoM, 2023b). As is often the case, rainfall varied greatly between the summer months in the estuary. The first half of December was very wet, and this was followed by almost no rain until late January. February and March both had roughly two periods of rain (Appendix B 9.2).

4.3.1 Rainfall vs enterococci

A limited assessment of the relationship between enterococci results and recorded rainfall data has been conducted. The assessment includes all enterococci samples collected across the swimming sites this season, a total of 322 samples. Results are separated into two groups:

- **Group 1**. Enterococci results < 140 MPN 100 ml $^{-1}$: 300 samples.
- **Group 2**. Enterococci results > 140 MPN 100 ml $^{-1}$: 22 samples.

These two groups were separately assessed for a possible response to rainfall (Figure 4-6). Rainfall data was used from the three local BoM stations covering the swimming sites, with 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 in this assessment, and neither was rainfall from the previous days, which both could potentially have a significant impact.

Group 1 (enterococci < 140 MPN):

- 300 samples.
- 61 % of the enterococci results (< 140 MPN 100 ml $^{-1}$) occurred when no rain fell in the preceding 24 hours.
- 31 % of results occurred on days when the total rainfall in the preceding 24 hours was > 0 and < 5 mm.

- 8 % of results occurred on days when the total rainfall in the preceding 24 hours was between 5.1 and 10 mm.

Group 2 (enterococci > 140 MPN):

- 22 samples.
- 59 % of high enterococci values (> 140 MPN 100 ml $^{-1}$) occurred when no rain fell in the preceding 24 hours.
- 23 % of high enterococci values occurred on days when the total rainfall in the preceding 24 hours was >0 and < 5 mm.
- 18 % of high enterococci values occurred on days when the total rainfall in the preceding 24 hours was between 5.1 and 10 mm.

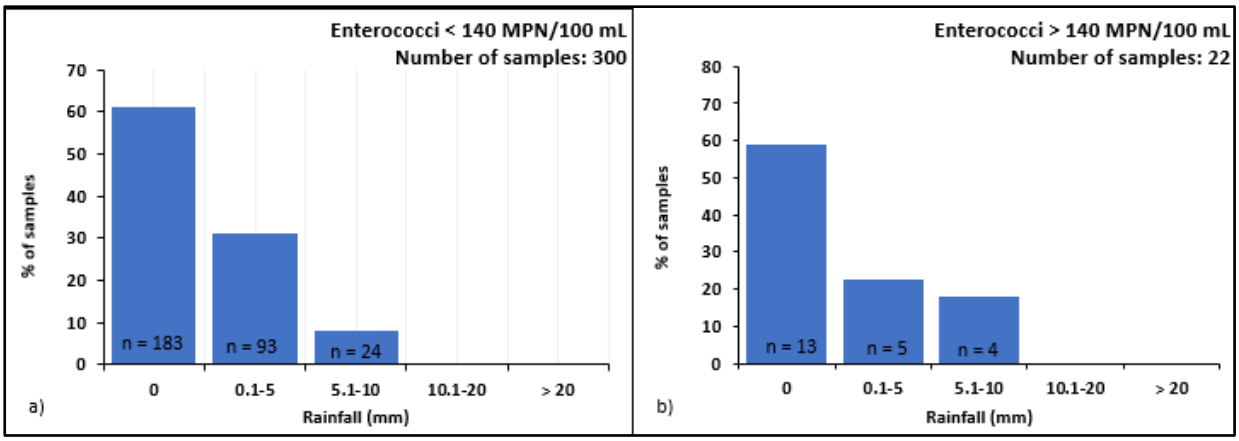

Figure 4-6 Proportion of enterococci sample results < 140 MPN 100 ml $^{-1}$ (a) and > 140 MPN 100 ml $^{-1}$ (b), matched with rainfall data recorded in sampling day, from three BoM stations across the estuary. Graphs include all samples collected at swimming sites during the 2022-23 RWQ season. n = number of samples.

As Figure 4-6 shows, of the 322 swimming site samples collected this summer, 93 % of enterococci results were < 140 MPN 100 ml $^{-1}$ (300 samples). Rainfall did not appear to negatively influence most enterococci results, with 117 of *all* 126 rainfall events (> 1 mm) resulting in enterococci result below 140 MPN 100 ml $^{-1}$; including 24 samples taken when rainfall of between 5 and 10 mm was recorded.

On two days this season DEP/EPA sampling of environmental sites took place outside the usual time, which likely showed up in the results. DEP/EPA sampled on Monday 12 of December. It had rained significantly just before and during Monday's sampling, and there was a dry gap before Tuesday's council sampling. All Monday-sampled sites failed (except Montagu Bay) – and all council-sampled environmental and swimming sites passed (except Browns River and Kingston Beach (north)). On the last day of sampling, DEP/EPA sampled mid-afternoon after it had rained most of the day. The results were mostly very high, whereas councils' morning sampling of beaches and environmental sites were generally much lower. See all enterococci results and rainfall data in Appendices 9.2, 9.3.

Summing up, on nine sampling days there was *some* rain recorded *somewhere* in the estuary the previous 24 hrs (Appendix B, 9.2). It is difficult to say with certainty whether any of these rain events directly led to high enterococci results, but very likely some of them did. But no doubt multiple fails will have been caused by locally specific problems unrelated to the rainfall. There can be numerous reasons for dry weather fails, including sewage cross-connection, sewage spill, sewer leak, residential or business discharge, as well as swell and high winds resuspending sediments.

5 SPECIFIC INVESTIGATIONS

Water quality investigations are occurring at various estuary sites as discussed below. The DEP recommends that councils view a Fair site classification as a forewarning that problems with poor water quality may escalate, and therefore warrants investigation. It is very encouraging that several councils now have stormwater investigation officers dedicated to such work.

Link to the DEP 2020 Source Tracking Framework and Toolkit, which outlines a standard process for identifying sources of faecal pollution in the Derwent Estuary: https://www.derwentestuary.org.au/assets/Source_Tracking_Framework_and_Toolkit_Mar2020.pdf

The following site-specific information has been provided by individual councils.

5.1 Esplanade (New Norfolk)

The recreational water sampling site has been at the New Norfolk Esplanade (where the rowing pontoon currently sits) for a number of years. The recreational water sampling site for New Norfolk changed approximately 10 years ago from further upstream and from the middle of the river. The site is complemented by an environmental sampling site at Millbrook Rise.

The overall water quality rating for New Norfolk was downgraded from “Good” to “Fair” at the conclusion of the 2021-2022 Recreational Water Quality Program based on the sampling program for the last 5 years.

When Council Officers undertook a sanitary survey of the area in 2022 it became apparent that a stormwater outfall was located directly adjacent the pontoons. It is considered that the combination of the reduced flow of water around the pontoons and intermittent pollution attributed to the stormwater outfall, may have contributed to the poor sampling results in recent years. The Department of Health have suggested that, regardless of the sampling results, swimmers should be advised that it is recommended not to swim near a stormwater outfall and consequently the site has been downgraded to an environmental sampling site only.

Council have installed a new sign at the pontoon, in front of the Rowing Club, on the Esplanade. The sign advises that there is a stormwater outlet discharging into the river, and due to potential contaminants associated with stormwater, Public Health recommends not to swim at this location. Council is currently considering the feasibility of relocating the stormwater outlet in order to return the site to a recreational swimming site.

5.2 Blackmans Bay Beach

Kingborough Council is conducting extensive out-of-season sampling and investigations into the Blackmans Bay catchment. Bacterial sampling of beach sites, visual inspection and ammonia testing of the stormwater network is being utilised to identify potential sources of contamination that may impact the marine environment. Management options for the large seagull population currently residing on the beach are also being considered.

5.3 **Clarence beaches**

Continuing into the 2022-23 season, Clarence City Council's (CCC) stormwater investigations have been successful in improving water quality at some degraded RWQ sampling sites. Following this season, both Howrah Beach (mid) and Bellerive Beach (west) have seen their long-term grades improve as a result of Council's continued commitment to improving water quality at identified swimming beaches.

Stormwater sampling has continued as part of Council's investigations at Howrah Beach and Bellerive Beach. Outfall samples have been collected and tested for the faecal indicator bacteria (FIB) *E. coli* and Enterococci weekly between March 22, 2022 and March 28, 2023 in Howrah and between October 11, 2022 and March 28, 2023 in Bellerive. During this time, investigations were ongoing in the catchments to find sources of sewage contamination within the stormwater network. This was largely done through on-the-spot tests for ammonia in the stormwater, with follow up laboratory testing for confirmation.

Regarding the quality of stormwater reaching the beach, it was discovered that if sampling takes place during an extended dry weather spell, bacteria levels are expected to be low. If an elevated result is detected during this scenario, it has typically been the result of a specific event in the catchment – such as a sewer blockage and spill. If sampling takes place during an intense rainfall event, bacteria levels are expected to be elevated at all outfalls. If sampling takes place in the days following a rainfall event, it is unpredictable whether bacteria levels will be elevated and whether they are from increased human faecal matter, non-human matter, or a combination of both. There have also been some unexplained and isolated high bacteria results throughout the season, which haven't been identified using ammonia testing. This adds further complexity to predicting the quality of stormwater reaching the beach at a given time.

Between August 2021 and April 2023, 74 issues relating to sewage contamination in stormwater were found across Howrah and Bellerive. Of these 74, one remains under investigation while all others have been resolved. This is in large part due to the collaborative work between TasWater and CCC to promptly address issues once identified. It is also appropriate to note the proactive response of many residents to resolve identified issues on private property. Without resident support, these improved results would not be achieved as quickly.

With regard to what types of issues have led to contamination, the breakdown is as follows:

- 2 cross-connections of sewer into stormwater
- 39 defects in sewer mains
- 15 defects in sewer lines between houses and mains
- 17 sewer blockages resulting in spills above and below ground.

Public education on stormwater pollution and appropriate remediation, and intervention measures upstream of the beach, will continue in the 2023-24 financial year. These intervention measures may include the creation of bioretention basins and installation of strategically placed Gross Pollutant Traps (GPTs) upstream in the stormwater network, to reduce larger polluting material from reaching the beach.

With the positive results seen at Howrah and Bellerive resulting from the success of council's investigative works, Council is now better prepared to respond to future pollution events and mitigate any future risks to public health.

Council will continue to develop appropriate initiatives and commit to long-term improvements to the stormwater network, to minimise the environmental and public health impact stormwaters have on the River Derwent and the identified swimming beaches within the river.

5.4 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 designed a sampling plan to investigate point sources of pollution that may be impacting upon the water quality at Marieville Esplanade. This sampling operation has been developed to understand and address the impact of sewage into stormwater contamination in the Sandy Bay Rivulet catchment on the Marieville Esplanade area. Previous investigations in 2021 and 2022 focused on the New Town Rivulet and Providence Rivulet respectively, however, the Sandy Bay rivulet has been identified as a high priority now the current investigation has been completed.

5.5 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. The Stormwater team is currently reviewing all current WSUD asset infrastructure and the Bell St Bioretention system will be audited at the end of April, and a management plan will be produced as a result of this audit.

6 SPECIAL STUDIES

As part of each RWQ season, the DEP, supported by DoH, usually conducts an additional special-interest project that supplements a particular current focus.

This season, all efforts went into conducting a season-long trial of whether forecasting recreational water quality here in the estuary is possible. A separate internal stakeholder report is being produced about this trial.

7 COMMUNICATIONS

There was occasional TV, radio, and newspaper media about the RWQ program throughout the summer. But more and more people obtain general information and news via social media rather than such traditional sources, including websites, which is also apparent for the RWQ program. As can be seen below, the DEP Facebook posts have significantly more reach than the Beach Watch website. Both website and Facebook reach is possibly higher than reported, as some people hide or clear their browsing history. Both outreach methods have increased significantly from last year.

7.1 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 5923 page views over the course of the 2022-23 RWQ season, which is up 2143 views from last season. 27 December and 8 January saw the most page views, 293 and 192 respectively.

7.2 **Facebook**

Weekly RWQ results are shared on the DEP Facebook page www.facebook.com/derwentestuary and Instagram https://www.instagram.com/derwentestuaryprogram/. This season again saw an increase in Facebook reach from previous summers, with an average post reach of around 580 (up from around 340). The greatest reach was from a post in mid-January with 8206 views (up significantly from last season, where the greatest reach was 2085 views). Again, it really helps when our partners and friends share our posts (Figure 7).

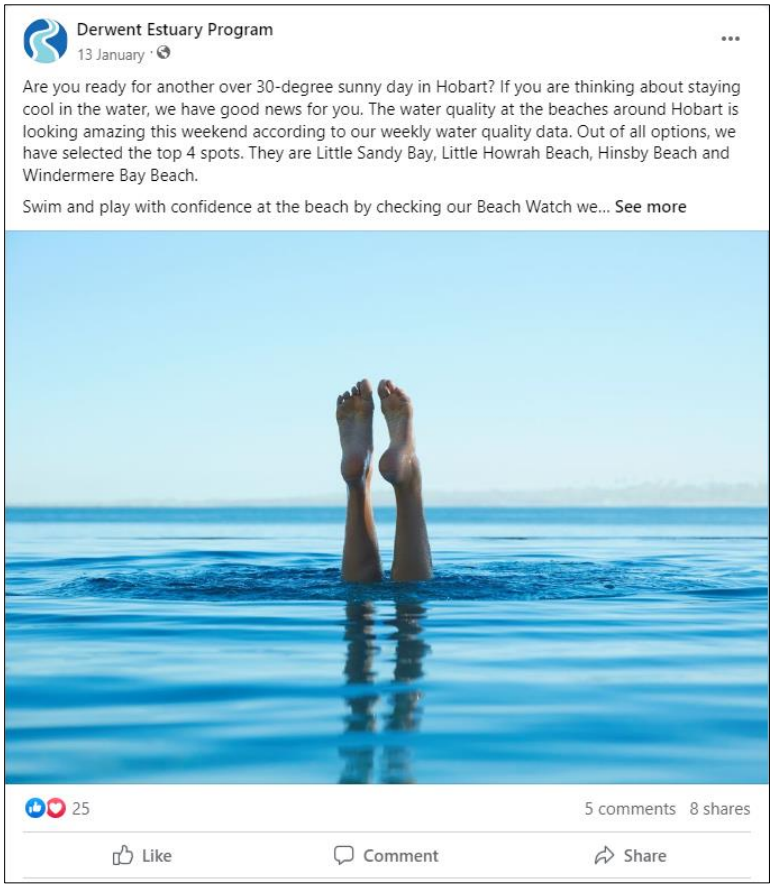

Figure 7. DEP Facebook post on 13 January 2023, which was reached by 8206 people.

7.3 **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 2022-23 season, the following beach sign changes are recommended:

- Bellerive Beach (west) – from Fair to Good
- Hinsby Beach – from Good to Fair
- Howrah Beach (mid) – from Poor 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

As always, the DEP would like to sincerely thank all council environmental health officers and other council staff and management who have supported the annual RWQ season, as well as EPA staff who have assisted with boating requirements. Many thanks also to the staff at the Public Health Laboratory and the Department of Health for their ongoing participation and assistance, and our industry partners, including TasWater.

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9.1 Appendix A - Intercalibration report, RWQ season 2022-23

9.1.1 Summary and conclusions

Recreational Water Quality (RWQ) monitoring in the Derwent Estuary is conducted and reported on in accordance with the Recreational Water Quality Guidelines 2007 (DoH, 2007). The latest annual program report (from season 2021-22) can be viewed here. To guarantee correct and consistent water sampling technique, to assess the degree of variability between samples, samplers and various nearby locations, and importantly, to ensure trust in the data gathered, the Derwent Estuary Program (DEP) coordinates an

annual inter-calibration exercise with local councils prior to the start of each RWQ season.

On a mild, sunny morning on 30 November 2022, environmental health officers from four estuary councils, together with the DEP, collected water samples at two sites at the western end of Bellerive Beach. Results were consistent between samplers and sites. Low results were reported at both Site 1 and Site 2, and only a slightly higher reading directly from a chosen stormwater outfall.

The water quality was excellent at both two sampling sites. The results demonstrated homogeneous water quality conditions, with negligent variability between samplers. Given that urban rivulets and stormwater drains are a known source of faecal contamination, the higher enterococci result from the outfall was expected. The low results in the water out from the outfall (sample Site 2) indicate dilution of pollution over a short distance (though low pollution level on this occasion).

All 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.

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 (Phillip Pennisi, Haruhi Wabiko)
- Glenorchy City Council (Allison Ayres, Kris Ethell)
- Derwent Valley Council (Ken Lyall)

There were apologies from Brighton Council and City of Hobart.

9.1.3.2 Location

Sample 1 was taken in the water out from the Beach Street Bellerive outfall. Sample 2 was obtained approx. 75 m. west of the first sample. An additional sample was taken directly by the outfall pipe, to assess this as a potential source of contamination (Figure 9-1).

Bellerive Beach is one of the RWQ program's most popular swimming sites. The western end of the beach (close to sample 2) went from Poor to Fair for its long-term rating following the last RWQ season's results. Considerable effort has, and is, taking place in both the Howrah and Bellerive catchments to identify and rectify any issues.

Figure 9-1. Location of the three sites sampled for the RWQ inter-calibration exercise on 30 November 2022 at Bellerive Beach.

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 a water sample. The DEP recommends that everybody complete a Wader Safety course. In the meantime, watch this very useful short video on wader safety https://www.mast.tas.gov.au/guides/wader-safety/. Furthermore, as part of wader safety, it is important to wear a tight belt, and ideally also wear a personal flotation device (Figure 2).

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. Always use common sense and don't take risks - personal safety is more important than sampling.

Post-exercise: Surf Life Saving Tasmania has produced an excellent Water Sampling Guide for Clarence City Council, which goes into detail explaining rips, waves, sun safety, life jackets, cold water emersion and marine creatures we might come across. A generic version has now been sent around to Hobart, Kingborough and Glenorchy who also conduct sampling directly from the beach.

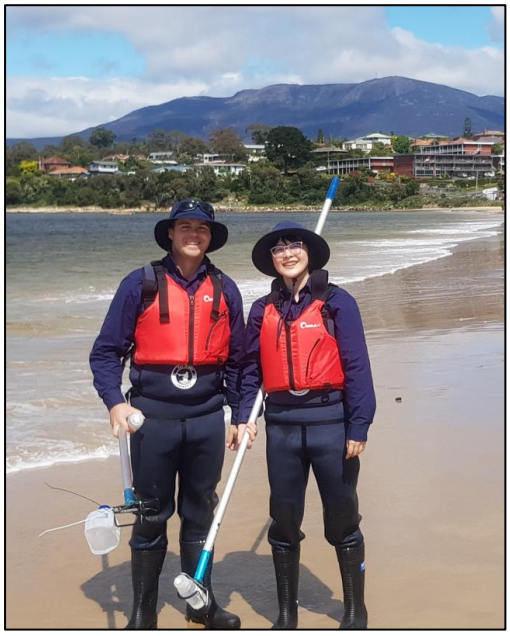

Figure 2.Phillip and Haruhi from Clarence City Council get top marks for being perfectly kitted out for recreational water sampling. Note sun safe with long sleeves and hats, and sea safe with waders, belt and life jackets.

9.1.3.4 Method

Filling in the laboratory submission form was discussed, including entering wind speed, rain, wind direction, date and time of sampling. Can be useful to look up climate data just prior to sampling. This becomes important if results are high and we need to look back at conditions at sampling time. 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. Participants can 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. Always worth having a spare bottle, should one become compromised (e.g., by touching the inside of the lid by mistake when sampling).

Samplers waded out to about 1 m depth, and 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 (24 hr max.), and on this day they were delivered approx. 1 hour after sampling.

This year there was no multi-probe comparison exercise, as Clarence City Council no longer collect physio-chem data.

9.1.4 **Results**

The enterococci results from Site 1 and 2 varied only between 10 and < 10. At the outfall pipe the enterococci result was 161 MPN/100 mL.

Table 3. Summary of enterococci concentration results (MPN/100 mL) sampled on 30 November 2022

Sampler	Outfall pipe below Beach Street	Sample 1 (in water by outfall)	Sample 2 (~ 75 m west of outfall)
Phillip (CCC)	161	10	<10
Ken (DVC)		10	10
Allison (GCC)		<10	<10
Chris (GCC)		<10	10
Michael (KC)		<10	<10
Haruhi (CCC)		<10	10

9.1.4.1 Rain, wind, tide conditions

According to the Hobart weather station at Ellerslie Road, there was 0 mm of rain in the 24 hours prior to 9am on sampling day and only 0.4 the previous day (BoM, 2022)

At 10.30 am on the day of sampling, it was mild and sunny, the wind was north westerly with wind speeds ~ 33 km/hr, and the tide incoming around 1.1 m (WillyWeather, 2022).

9.1.5 **Additional issues**

These are issues from last year's exercise that are worth repeating:

Thanks Paul Grey (PHL) and Scott Burton (DoH) for helping answer the questions.

Why do samples have to be kept cold?

- Samples must be kept cold (but not frozen) and delivered for testing within 24 hours to reduce the likelihood of unpredictable changes in bacterial numbers between sampling and testing. If samples are warm, bacteria will be more active metabolically and may die-off in clean waters or increase in numbers in nutrient-rich waters.
- The PHL may reject samples that have not been kept cold.

If weather conditions don't allow for wading out to the prescribed 0.5-1.0 m water depth to take a sample, should council still sample?

- If able to sample, you must sample.
- If not able to wade out to 0.5 m, go out as far as is safe and reach out as far as possible with your pole, to get that little more sampling depth.
- Always wait a moment for any sediments to settle before sampling, especially in shallow water. Using a pole to reach away from your body also helps avoid sampling resuspended sediments.
- Safety is paramount, and if it is not safe to sample on a Tuesday, don't sample, and try for Wednesday as a last resort (inform PHL).

9.1.6 **Acknowledgements**

Thank you very much to the new EHOs and cadets who participated in this session with great enthusiasm and willingness to learn, share and contribute to group discussion, and to all our councils for valuing and prioritising the RWQ program.

9.1.7 References

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9.2 Appendix B – Rainfall data across the Derwent estuary

Table 4. Daily rainfall (up to 9 am on sample days) between December and March at four BOM weather stations across the Derwent estuary: Hobart's Ellerslie Rd (HE); Mount Rumney (MR); Kingston's Greenhill Drive (KG); and New Norfolk West (NN). RWQ sampling days are highlighted in yellow.

December 2022				
Date	HE	MR	KG	NN
1st	0	0	0	0
2nd	0	0	0	0
3rd	0	0	0	0
4th	0	0	0	0
5th	12	↓	6.6	0
6th	4.2	↓	4.6	0.8
7th	0	↓	0	0
8th	4.6	↓	6	4.6
9th	0.6	13.6*	0.8	0
10th	3.6	0.2	1.2	0
11th	0	0	0	0
12th	10	13.4	8	12.2
13th	3.4	6	8.6	1.4
14th	24	42	20	12.4
15th	3.6	7	6.6	3
16th	1.2	2	2.6	0.2
17th	1.4	6.8	2	0
18th	0.2	0.2	0	0
19th	0	0	0	0
20th	0.2	0	0.6	0
21st	0	0	0	0
22nd	0	0	0	0
23rd	0	0	0.2	0
24th	2	8.4	1.8	4
25th	0.2	0	0	0
26th	0	0	0	0
27th	0	0	0	0
28th	0	0	0	0
29th	0	0	0	0
30th	0	0	0	0
31st	4.2	1.6	3	4.4

January 2023				
Date	HE	Mr	KG	NN
1st	0	0	0	0
2nd	0	0	0	0
3rd	0	0	1	0
4th	0	0	0	0
5th	0	0.4	0	0
6th	0	0.2	2.8	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
14th	0	0	0	0
15th	0	0	0	0
16th	0	0	0	0
17th	0	0	0	0
18th	1.2	1	1.4	0.8
19th	0.2	0	0	0
20th	0	0	0	0
21st	0	0	0	0
22nd	9.4	1.6	7	0
23rd	0.2	0.8	0	10.4
24th	0	0.4	0.2	6.2
25th	0	0	0	0
26th	0	0	0.4	0
27th	0	0	0	0
28th	0	0	0	0
29th	0	0	0	0
30th	0	0	0.4	0
31st	0	0	0	0

February 2023				
Date	HE	MR	KG	NN
1st	0	0	0	0
2nd	0.8	6.4	1.8	0
3rd	10.4	5.2	2.8	8
4th	6.8	4.8	4.6	3.6
5th	1	6.2	6	0.8
6th	0	0	0	0
7th	0	0	0	0
8th	0	0	0	0
9th	0	0	0	0
10th	4.2	7	2.2	3.2
11th	0.6	1.2	1.4	0.8
12th	0	0	0.4	0
13th	0	0	0	0
14th	0.2	0	0	0
15th	0	0	0	0
16th	0	0	0	0
17th	1.4	1.2	0.2	1.8
18th	0	0	0	0
19th	0.2	1.4	4	1
20th	0	0	0	0
21st	4	3.2	5.2	0
22nd	0.8	0	0	0
23rd	0	0	0	0
24th	0	0	0	0
25th	0	0	0	0
26th	15.6	11.4	23	6.6
27th	2.4	6.6	8.8	0.4
28th	0.2	0	0	0

March 2023				
Date	HE	MR	KG	NN
1st	0	0	0	0
2nd	0	0	0	0
3rd	0	0	0	0
4th	0	0	0	0
5th	0.4	0	0	0
6th	5	5.6	1.2	6.6
7th	0.6	0	0	1.2
8th	10	5.4	10	19
9th	0	0.4	0	2.2
10th	0	0	0.4	0.2
11th	0	0	0	0
12th	0	0	0	0
13th	0	0	0.4	0
14th	0	0	0	0
15th	0	0	0	0
16th	0	0	0.2	0.4
17th	0	0.6	0.4	0.2
18th	0	0	0	0
19th	1.2	0.8	0	0
20th	0.8	0.4	0.4	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	0	0	0	0
27th	0	0	0	0
28th	2.6	5.6	4.8	7
29th	13	10.6	17	3
30th	0.4	0	0.6	0
31st	0.2	1.4	0	0

Rainfall (mm)

- 5 - 10
- >10 - 20
- > 20

* Five days of rain are included in the 13.6 mm.

9.3 Appendix C – 2022-23 enterococci results

9.3.1 Swimming sites

Date	CoH				CCC						KC								GCC	
	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	No.excedences over 140 MPN
06-Dec-22	<10	10	<10	31	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	41	<10	<10	85	0
13-Dec-22	<10	20	41	20	10	20	20	20	52	20	<10	63	<10	10	<10	602	110	110	41	1
20-Dec-22	<10	63	10	<10	20	<10	<10	10	10	<10	<10	10	10	10	20	10	<10	10	86	0
28-Dec-22	<10	10	52	175	<10	20	63	<10	<10	<10	<10	<10	61	<10	10	<10	31	<10	N/A	1
03-Jan-23	<10	20	<10	20	<10	98	<10	31	265	<10	31	20	20	41	10	388	187	<10	228	4
10-Jan-23	31	<10	10	<10	<10	<10	<10	<10	20	<10	10	31	<10	10	20	10	<10	10	31	0
17-Jan-23	10	<10	<10	<10	<10	10	10	<10	<10	<10	<10	<10	135	<10	<10	41	10	10	20	0
24-Jan-23	31	10	10	52	<10	<10	<10	<10	<10	<10	<10	10	20	52	<10	<10	<10	31	31	0
31-Jan-23	<10	10	20	<10	<10	30	<10	<10	<10	31	30	31	31	10	<10	63	20	20	<10	0
07-Feb-23	10	10	41	<10	<10	10	97	31	31	10	52	97	31	<10	<10	20	<10	<10	<10	0
14-Feb-23	63	10	<10	98	<10	<10	<10	<10	<10	20	<10	189	63	231	<10	86	<10	<10	31	2
21-Feb-23	722	<10	20	52	<10	<10	85	146	201	10	31	135	<10	20	10	146	241	<10	<10	4
28-Feb-23	52	97	20	221	<10	<10	<10	<10	63	<10	134	86	98	<10	10	63	97	10	20	1
07-Mar-23	31	31	1935	110	<10	<10	20	<10	10	218	10	309	426	<10	<10	10	<10	20	31	4
14-Mar-23	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	31	41	538	<10	<10	10	<10	31	63	1
21-Mar-23	31	<10	10	121	10	<10	<10	<10	<10	<10	<10	213	2143	<10	<10	<10	<10	135	<10	2
28-Mar-23	52	41	<10	<10	<10	<10	<10	132	216	10	41	110	959	<10	31	52	10	41	20	2
																				22

Figure 9-3 2022-23 RWQ season swimming site results listed under each local council. Results are enterococci MPN per 100 mL. The last column lists the number of enterococci result exceedances above 140 MPN per 100 mL., which are also highlighted in red.

9.3.2 **Environmental sites**

Date	CoH							GCC			KC	CCC				BC	DVC			
	Brooke St Pier	Hobart Rivulet	Marieville Esplanade	Regatta Pavilion	Sullivans Cove	Victoria Dock	Watermans Dock	*New Town Bay	Elwick Bay	Prince of Wales Bay Marina	Browns River	Geilston Bay	Kangaroo Bay	Lindisfarne Bay	Montagu Bay	Old Beach, Jetty Road	New Norfolk (Esplanade)	New Norfolk (Millbrook Rise Jetty)	Mid-river Derwent Swim	No.excedences over 140 MPN
06-Dec-22	10	266	749	10	20	20	<10	75	10	31	2247	74	20	31	<10	<10	75	62	<10	3
**13/12/2022	594	988	10	602	504	1081	842	480	52	259	1664	886	241	3654	63	10	72	63	171	13
20-Dec-22	10	63	41	10	10	<10	10	52	10	10	231	122	158	135	10	10	75	10	<10	2
28-Dec-22	N/A	N/A	41	N/A	N/A	N/A	N/A	N/A	N/A	N/A	81.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
03-Jan-23	N/A	N/A	20	N/A	N/A	N/A	N/A	N/A	10	N/A	323	N/A	N/A	N/A	N/A	52	86	75	N/A	1
10-Jan-23	N/A	N/A	<10	N/A	N/A	N/A	N/A	N/A	20	N/A	72	N/A	N/A	N/A	N/A	<10	134	121	N/A	0
17-Jan-23	<10	399	86	20	<10	<10	31	52	10	10	294	20	41	52	<10	435	63	10	<10	3
24-Jan-23	<10	309	110	52	<10	10	<10	20	20	10	62	10	<10	30	<10	31	98	428	<10	2
31-Jan-23	<10	63	41	62	<10	10	10	31	52	10	31	10	<10	10	<10	<10	75	52	<10	0
07-Feb-23	10	473	20	10	<10	<10	10	259	31	10	86	109	10	41	N/A	10	189	173	N/A	4
14-Feb-23	20	10	63	75	<10	602	148	20	10	10	231	41	31	10	<10	20	262	96	<10	4
21-Feb-23	<10	10	169	<10	10	<10	20	<10	10	10	292	85	10	52	20	N/A	75	20	<10	2
28-Feb-23	<10	443	10	20	20	10	20	20	63	96	2178	10	145	187	10	N/A	183	98	20	5
07-Mar-23	N/A	N/A	187	N/A	N/A	N/A	N/A	N/A	30	N/A	1169	N/A	N/A	N/A	N/A	75	109	199	N/A	3
14-Mar-23	31	122	10	<10	<10	10	175	<10	10	10	933	10	<10	20	<10	10	108	148	<10	3
21-Mar-23	122	75	41	<10	<10	30	10	<10	10	86	160	41	20	20	<10	10	20	52	<10	1
28-Mar-23	52	906	313	231	134	243	1043	41	108	1100	109	8664	408	5172	75	31	97	262	<10	10
																				56

Figure 9-4 2022-23 RWQ season environmental site results listed under each relevant 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.

* New Town Bay is located between Hobart and Glenorchy municipalities.
** All the failed sites (except Browns River) were sampled on Monday 12th of December instead the 13th, which is the regular sample day.