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Beach Report and Yarra Watch results, 2019–20

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Executive summary

Beach Report and Yarra Watch programs help the community make informed decisions about swimming and other recreational water-based activities. The programs are conducted at 36 beaches in Victoria's Port Phillip Bay and four sites on the Yarra River. Beach Report is run by Environment Protection Authority Victoria (EPA), while Yarra Watch is a partnership program with Melbourne Water. The focus of both programs is microbial water quality during the summer period (1 December to 9 March (Labour Day)) when recreational water use is highest.

Beach Report and Yarra Watch remain two key community-focused programs. EPA issues daily water quality forecasts and manages weekly monitoring of microbial levels. Forecasting and monitoring over summer continues to provide a valuable service to the public, with over 10,000 subscribers to the Beach Report SMS service and over 8,000 Twitter followers receiving forecasts daily.

This report provides results for microbial sampling and water quality forecasting accuracy for the 2019-20 summer season.

Microbial sampling results: Sampling results are compared to the State Environment Protection Policy (Waters) (SEPP (Waters)) short-term microbial objectives. Sampling results below short-term objectives are considered suitable for recreation. In 2019-20, Beach Report weekly sampling results showed that 94 per cent of samples had microbial levels that were below (SEPP (Waters) short-term microbial objectives. Yarra River sampling results showed that 84 per cent of the samples had microbial levels that were below the SEPP (Waters) short-term microbial objectives. Most of the sampling results that exceeded the short-term objectives were due to stormwater pollution following rainfall.

Swim advisories are online alerts issued when weekly sampling results do not meet SEPP (Waters) short-term microbial objectives during times of dry weather. There were four advisories issued for Beach Report this summer and one advisory for Yarra Watch.

Forecasting: Forecasts predict 'Good', 'Fair' or 'Poor' water quality based on meteorological data; primarily rainfall. During the summer season of 2019-20, there was an increase in 'Fair' and 'Poor' forecasts compared with the 2018-19 summer, mostly due to higher rainfall this summer.

Beach Report forecasting provided appropriate advice to community for the recreational use of Port Phillip Bay beaches 88 per cent of the time. Inaccurate forecasts (for instance predicting 'Good' water quality when microbial levels were high) were largely due to high microbial sampling values from unexpected pollution incidents, and the considerable rainfall this summer leading to larger magnitude and longer duration stormwater inputs to the Bay.

More stringent short-term microbial objectives from the new SEPP (Waters) were applied to the Yarra Watch forecasting model in 2019. The new short-term objectives represent best practice and refer to the most relevant national guidelines adopted in other states. However, these new objectives produced more conservative and inaccurate forecasting, as most of the microbial sampling results indicated 'Good' water quality when forecasts predicted 'Poor' water quality. Eighty-five per cent of Yarra Watch forecasts were 'Poor'. EPA is continually working to improve Beach Report and Yarra Watch. Investigations into forecasting inaccuracies, as well as results of source tracking and sanitary inspections, can ensure EPA continues to provide appropriate public health information

Beach water quality (not necessarily microbial levels) can be affected by localised pollution events, with forecast outputs amended manually by a Forecast Officer to reflect this when pollution is reported at a site. The two events this summer season that resulted in amended forecasts were dredging in Patterson River during December 2019 and an algal bloom in Hobsons Bay in January 2020.

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1. Introduction and objectives

EPA's Beach Report and Yarra Watch programs provide community-focused water quality information about swimming and other recreational water-based activities. The programs monitor 36 beaches around Port Phillip Bay and four sites on the Yarra River. Both programs run over the summer period when recreational water use is highest, from 1 December 2019 to 9 March 2020 (Labour Day).

This report details the sampling and forecasting results for the 2019-20 summer season for Beach Report and Yarra Watch. This report is supported by the *Water Monitoring and Assessment Plan* (an Environment Protection Authority Victoria (EPA) internal document which can be provided on request), which details more specific methodology for how data were collected, and how results were derived. These methods can be accessed by contacting EPA on 1300 372 842.

2. Methods

This section summarises the sampling, analysis and forecasting methods used to generate results for the 2019-20 summer period, including:

- Microbial sampling, analysis, and data interpretation (for enterococci and *E. coli*)
- comparison of enterococci and *E. coli* concentrations to guideline objectives used for:
    - short-term objectives used to assess recreation suitability and issue Swim advisories
    - long-term objectives used to understand trends and contribute to understanding of ecosystem condition reported in the State of the Environment Reporting by Commissioner for Environmental Sustainability Victoria.
- Forecasting at 36 Port Phillip Bay sites and four Yarra River sites based on:
    - the Beach Report Forecasting Matrix (BRFM)
    - the Yarra Watch forecasting model
    - Yarra and Bay water quality alerts.

2.1. Microbial sampling, analysis, and data interpretation

Water samples were collected weekly by contracted samplers from Australian Laboratory Services (ALS). Beach water samples for Port Phillip Bay were tested for enterococci, recognised as the best indicator in measuring faecal contamination of marine recreational waters. Water samples for the Yarra River were tested for *E. coli*, the preferred indicator of faecal contamination in freshwaters (State Environment Protection Policy (Waters), 2018).

2.1.1. Comparison of enterococci and *E. coli* concentrations to guideline objectives

Sample concentrations were compared with short-term microbial objectives from the State Environment Protection Policy (Waters), 2018 (SEPP (Waters)). The short-term objectives provide guidance on whether microbial levels in water are suitable for recreation. More information on short term objectives are provided in the *Water Monitoring and Assessment Plan* (an EPA internal document that can be provided on request).

2.1.2. Swim advisories

Swim advisories are issued when weekly microbial sampling results in Port Phillip Bay and/or the Yarra River are above the short-term microbial objectives during dry weather (Glossary definition, **Section 7**). This is because microbial levels are considered above safe human health levels for swimming (SEPP (Waters), 2018). Following or during rainfall (during wet weather), swim advisories are not issued. Stormwater pollution, including high microbial levels, is expected in wet weather. Forecasting protects human health in wet weather by predicting a deterioration in water quality.

For Beach Report, swim advisories are issued when SEPP (Waters) short-term objective levels are exceeded during dry weather, which may be:

- a single sample of enterococci greater than 500 orgs/100 mL
- two consecutive samples of enterococci which are each greater than 200 orgs/100 mL, determined by re-sampling in the same week

For Yarra Watch, swim advisories are issued when SEPP (Waters) short-term objective levels are exceeded, which may be:

- a single sample of *E. coli* greater than 550 orgs/100 mL
- two consecutive samples of *E. coli* which are each greater than 260 orgs/100 mL, determined by re-sampling in the same week.

2.2. Forecasting

2.2.1. Producing forecasts

Forecasts provide a prediction of short-term microbial water quality. Forecasts are issued twice daily at 10:00 am and 3:00 pm (**Table 1**).

Table 1. Daily forecasts and the time period each forecast covers.

Forecast	Time forecast is issued	Time that forecast predicts water quality
Morning forecast	10:00 am	10:00 am to 3:00 pm
Afternoon forecast	3:00 pm	3:00 pm to midnight
Next day forecast	3:00 pm	Midnight to 10:00 am the following day

There are three forecast categories, shown in **Table 2**.

Table 2. Forecast categories.

Forecast	Colour	Description	Rationale
Good	Green	Suitable for swimming	Microbial levels are likely to be below the short-term microbial objective.
Fair	Orange	May not be suitable for swimming	Increased likelihood that microbial levels are above short-term microbial objective, typically due to stormwater inputs.
Poor	Red	Not suitable for swimming	Significant likelihood that microbial levels are above short-term microbial objective, either due to stormwater inputs or elevated microbial levels detected during weekly sampling.

Beach Report forecasts are generated using the Beach Report Forecasting Matrix (BRFM) established in the early 2000s. The BRFM generates forecasts based on historical microbial water quality data; observed and predicted rainfall; and cloud cover conditions. Historical microbial data is sourced from EPA. Weather conditions data are sourced from Bureau of Meteorology (BoM).

Yarra Watch forecasts are generated from a site-specific model developed by EPA in 2013 and updated in 2019 to reflect the new short-term objectives in SEPP (Waters), 2018. This meant the short-term objective input to the forecasting model in 2019-20 was a lower *E. coli* value than previous years (from 500 orgs/100 mL previously to 260 orgs/100 mL). The Yarra Watch site-specific model generates forecasts based on historical microbial water quality data and rainfall data. Historical microbial data is sourced from EPA. Rainfall data is sourced from Melbourne Water gauges.

After the BRFM or Yarra Watch model produces a forecast output of ‘Good’, ‘Fair’ or ‘Poor’, these are assessed against:

- microbial sampling results from that weeks’ sample (**sub-section 2.1**)
- extreme weather patterns, either observed or forecast, such as ≥25 mm rainfall in the last five days (Beach Report only)
- Yarra and Bay website alerts (**sub-section 2.2.2**).

The assessment could result in downgrading a forecast from ‘Good’ to ‘Fair’ or ‘Poor’ based on a sample result exceeding short-term objectives, significant rainfall over the last five days, or where a sewage spill has occurred. These events are not included as inputs to the forecast models but are used to manually adjust the preliminary forecast.

2.2.2. Yarra and Bay water quality alerts

EPA issues alerts online to provide the community with information on issues affecting Port Phillip Bay and its catchment waterways. Alerts can include pollution, fish deaths or algal blooms. This information may be sourced from pollution reports to EPA from the public; inter-agency communication such as a water authority reporting a sewage spill; or from EPA Environment Protection Officers' observations in the field. If an alert is describing an event occurring at a Beach Report or Yarra Watch monitoring site, the forecast for that site may be downgraded (i.e. 'Fair' or 'Poor' instead of 'Good').

While alerts may not always relate to a deterioration in microbial water quality, they represent over-arching reduced water quality condition. The downgrading of forecasts based on alerts means that the water quality forecasting captures observed pollution events at monitoring sites in Port Phillip Bay and/or Yarra River.

2.2.3. Forecasting accuracy

Weekly microbial sampling results provide an opportunity to assess how accurate forecasting outputs were, by comparing morning forecasts with microbial results from the same day. The accuracy of Beach Report and Yarra Watch forecasts is calculated using the methods described in the *Water Monitoring and Assessment Plan* (EPA internal document). Three different metrics are produced: 'appropriate advice', 'missed alarms' and 'false alarms'.

3. Results and discussion

3.1. Microbial sampling

3.1.1. Beach Report: enterococci results

Full sampling results summarised by geographical region (Melbourne; Mornington Peninsula; and Geelong and Bellarine regions are shown in **Appendix 1** – Beach Report microbial sampling results.

Low microbial levels were generally recorded in the Bay, with 36 per cent of all sample results below the limit of detection for enterococci (less than 10 orgs/100 mL). Ninety-four per cent of samples returned results ≤200 orgs/100 mL, below SEPP (Waters) short-term consecutive objective.

Only two per cent of the data (12 out of 487 samples) exceeded the short-term objective of 500 orgs/100 mL. Four of these occurred during dry weather and therefore swim advisories were issued (**sub-section 3.1.3**). The other eight samples with results greater than 500 orgs/100 mL occurred during wet weather, when the forecast was 'Poor', therefore no advisories were issued.

All dry weather sample results between 200 orgs/100 mL and 500 orgs/100 mL were re-sampled to determine if the SEPP (Waters) short-term consecutive objective was exceeded. All these repeat samples returned results below 200 orgs/100 mL. No swim advisories were issued for these samples.

3.1.2. Yarra Watch: *E. Coli* results

Full sampling results are shown in **Appendix 2** – Yarra Watch microbial sampling results.

Sixteen percent of samples (nine out of 56) exceeded the short-term objective of 550 orgs/100 mL. However, these all occurred during wet weather and, therefore, no swim advisories were issued.

All dry weather sample results between 260 orgs/100 mL and 550 orgs/100 mL were re-sampled to determine if the SEPP (Waters) short-term consecutive objective was exceeded. This included two samples from Launching Place and one from Kew. Launching Place was issued with a swim advisory on one occasion (**sub-section 3.1.3** below) for breaching the consecutive objective. None of the other repeat samples returned results above 260 orgs/100 mL. No swim advisories were issued for these samples.

3.1.3. Swim advisories

Beach Report

For Beach Report in 2019-20, there were four samples that exceeded SEPP (Waters) short-term objectives during dry weather. These exceedances were all greater than 500 orgs/100 mL. Councils were contacted about these samples and signs were placed at affected beaches. Signs were removed when re-sampling results indicated safe microbial levels for swimming.

On 30 December, Canadian Bay recorded a sampling result of 1,200 orgs/100 mL.

- Re-sample results collected on 31 December were less than 10 orgs/100 mL (the laboratory defined limit of detection).
- ALS samplers measured wind speed of 8.0 knots (14.8 km/h) on site. This is below the maximum wind gust speeds recorded for all December 2019 days at Cerberus (relevant BoM automated station), so it is unlikely that winds caused elevated re-suspension of sediment compared to normal conditions.
- ALS samplers noted there were dogs and people present on the beach. Sampling may have contained dog faecal matter.
- There was no record of any works or issues with on-site toilet facilities located in the Canadian Bay Electric Car Park.
- The cause of Canadian Bay's dry weather exceedance could not be determined through desktop investigation.

On 14 January, Mornington recorded a sampling result of 1,100 orgs/100 mL.

- Re-sample results collected on 15 January were 70 orgs/100 mL.
- ALS samplers measured wind speed of 5.6 knots (10.3 km/h) on site. This is below the maximum wind gust speeds recorded for all January 2020 days at Cerberus (relevant BoM automated station), so it is unlikely that winds caused elevated re-suspension of sediment compared to normal conditions.
- Cerberus rain gauge recorded 15.0 mm of rain three days prior to sampling. For context, the 95th percentile for January rainfall at Cerberus was 15.8 mm. This rainfall three days prior may have caused stormwater flows in the contributory drainage catchment that transported stormwater pollution to Mornington Beach and raised enterococci values at the sampling site.

On 14 January, Altona recorded a sampling result of 1,200 orgs/100 mL.

- Re-sample results collected on 15 January were less than 10 orgs/100 mL (the laboratory defined limit of detection).
- ALS samplers recorded wind speed of 3.6 knots (6.7 km/h) on site. This is well below the maximum wind gust speeds recorded for all January 2020 days at Laverton (relevant BoM automated station), so it is unlikely that winds caused elevated re-suspension of sediment compared to normal conditions.
- Samplers noted that a large amount of seaweed extended along the full length of the beach and 5 m into the water on 14 January. The water was a brown colouration. Samplers noted water was clear when re-sampling occurred on 15 January.
- There were approximately 150 birds noted in a 200 m radius around the sampling site on 14 January.
- On both sampling and re-sampling days, swimmers were observed on site.
- Laverton rain gauge recorded 15.4 mm of rain three days prior to initial sampling, and 0.4 mm two days prior. This may have led to stormwater flows in the contributory drainage catchment that transported stormwater pollution to Altona Beach and raised enterococci values at the sampling site.
- The nearby Williamstown Beach also recorded an elevated result of 190 orgs/100 mL. While not high enough to require re-sampling, this may indicate that rainfall in the area affected other beaches.
- The most likely cause of elevated enterococci was the recent rainfall.

On 11 February, Mornington recorded a sampling result of 640 orgs/100 mL.

- Re-sample results collected on 12 February were 10 orgs/100 mL.
- ALS samplers recorded wind speed up to 4.3 knots (8.0 km/h) on site. This is below the maximum wind gust speeds recorded for all February 2020 days at Cerberus, so it is unlikely that winds caused elevated re-suspension of sediment compared to normal conditions.
- Cerberus rain gauge recorded 0.4 mm of rain the day before sampling. This is unlikely to be the cause of elevated results
- The cause of Mornington’s dry weather exceedance could not be determined through desktop investigation. Mornington Beach does have a history of elevated enterococci, including being the only beach to fail to meet long-term State Environment Protection Policy (Waters of Victoria) objectives in 2018-19. Tanti Creek is 140 m from the sampling site and a likely cause of pollution from stormwater and other land run-off discharging onto the beach.

Yarra Watch

For all Yarra Watch sampling in 2019-20, there was one set of consecutive samples exceeding SEPP (Waters) short-term objectives during dry weather (consecutively greater than 260 orgs/100 mL). There were no single dry weather samples exceeding 550 orgs/100 mL.

On 18 December, Launching Place recorded a sampling result of 270 orgs/100 mL.

- Re-sample results collected on 20 December were 450 orgs/100 mL. Re-sample results on 22 December were 240 orgs/100 mL.
- Four days prior to initial sampling, there was 0.6 mm rain recorded at the Coldstream Melbourne Water gauge. Three days prior to this 0.2 mm rain was recorded. Rainfall was too low to have conclusively affected microbial levels.
- The cause of Launching Place's dry weather exceedance could not be determined through desktop investigation. The Microbial Source Tracking investigations currently being conducted in partnership with Melbourne Water and Monash University will assist in the identification of key dry weather sources of pollution in this area. This information, available later in 2020, will inform desktop investigations in future summers.

3.2. Forecasting

3.2.1. Beach Report forecasting results

Table 3 shows the breakdown of morning Beach Report forecasts for each month by forecast category. As a comparison, 2018-19 values are given in brackets. Each summer, forecasts are made over the same period from 1 December to Labour Day (second Monday in March). The difference in total number of forecasts issued each summer is due to the date that Labour Day falls upon in any particular year.

Table 3. Number of forecasts issued for 2019-20 summer period by month and category. In parenthesis, number of forecasts for the 2018-19 summer period.

Month	Forecast classification		
	'Good'	'Fair'	'Poor'
December	958 (572)	119 (337)	39 (207)
January	509 (1038)	413 (71)	194 (7)
February	619 (775)	230 (211)	195 (22)
March	159 (364)	93 (32)	72 (0)
% of all forecasts	62% (76%)	24% (18%)	14% (6%)

The 2019-20 summer showed more 'Fair' forecasts, and over double the percentage of 'Poor' forecasts compared with the 2018-19 summer. As outlined earlier, this was due to an increase in significant rainfall events this summer.

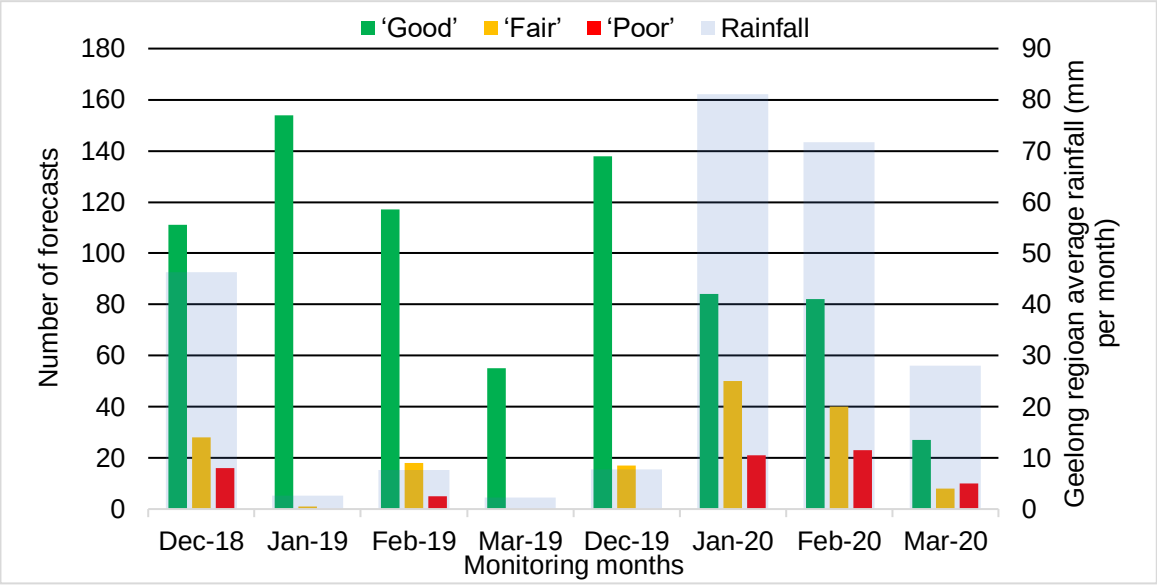

Figure 1. Rainfall from BoM rain gauges compared to forecasts at Melbourne region beaches between 1 December and Labour Day, 2018-19 to 2019-20 summers. Note: Rainfall value is an average of total monthly rainfall at Melbourne (Olympic Park), Moorabbin and Laverton gauges. These gauges all cover Melbourne region beaches in BRFM.

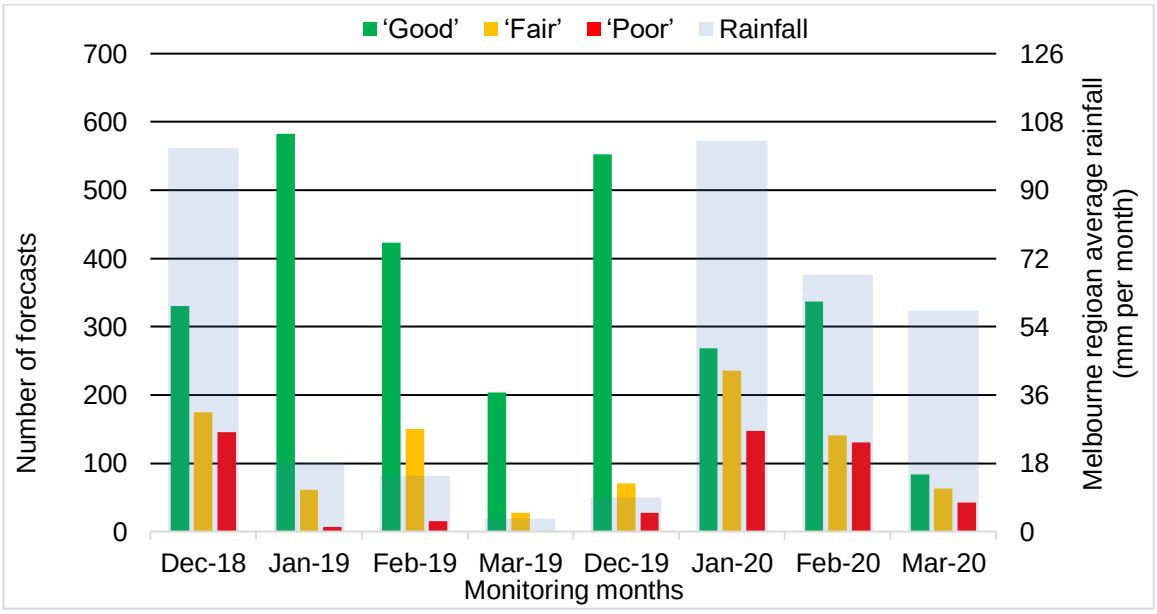

Figure 2. Rainfall from BoM rain gauges compared to forecasts at Geelong region beaches between 1 December and Labour Day, 2018-19 to 2019-20 summers. Note: Rainfall value is an average of total monthly rainfall at Avalon and Geelong Racecourse gauges. These gauges both cover Geelong region beaches in BRFM.

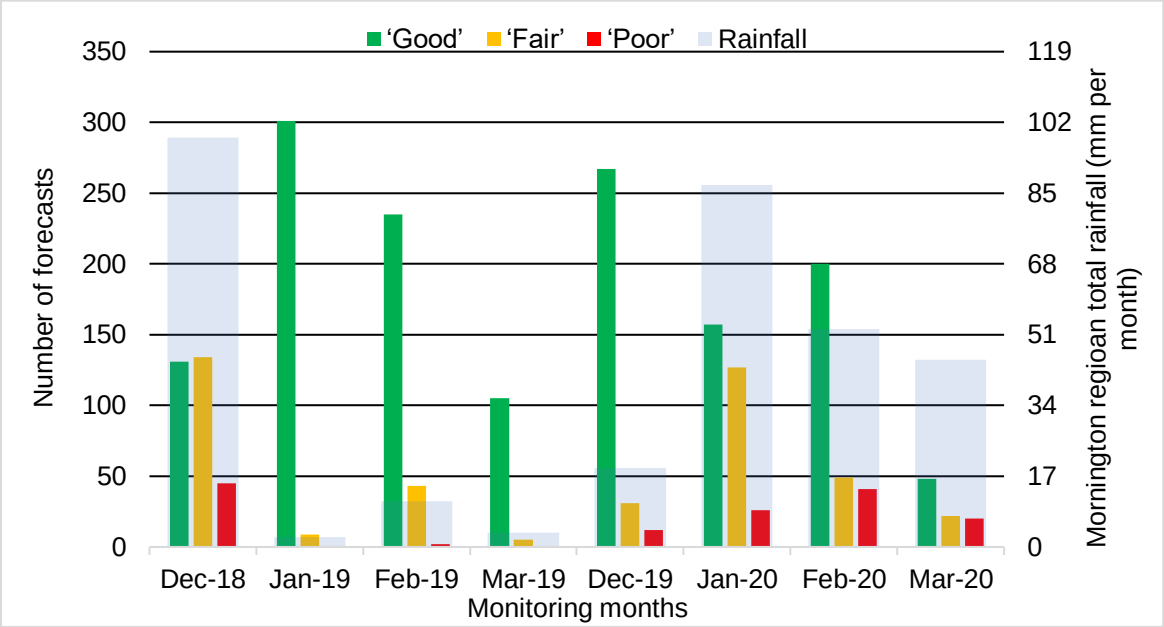

Figure 3. Rainfall from Cerberus BoM rain gauge compared to forecasts at Mornington region beaches between 1 December and Labour Day, 2018-19 to 2019-20 summers.

Figure 1, **2** and **3** show rainfall for each Beach Report gauge comparative to forecasts, comparing 2018-19 summer and 2019-20. **Appendix 3** – Comparison of rainfall in 2018-19 and 2019-20 summers shows the full rainfall dataset, broken down by rain gauge and month (as Melbourne and Geelong regions are represented by multiple gauges). Every gauge had increased rainfall this summer compared with the previous season. Avalon received more than four times as much rainfall in 2019-20 (187.6 mm) compared to 2018-19 summer (46.6 mm). Geelong and Moorabbin received more than double the rainfall this summer compared to the previous summer, while Melbourne came close to double. Cerberus and Laverton increased to a lesser degree.

This increased rainfall between January and March in 2019-20 summer accounts for most of the increased 'Fair' and 'Poor' forecasts during those months when compared to the previous summer (**Figure 1**, **2** and **3**). In December, on the other hand, the amount of rainfall in 2019-20 summer period was less than in 2018-19 and this was reflected in the forecasts. The number of 'Good' forecasts in December 2019-20 was higher than in 2018-19.

Other 'Fair' forecasts were related to two incidents that resulted in manual change of forecast outputs. They are discussed in more detail in Yarra and Bay alerts (**sub-section 3.2.5**).

3.2.2. Beach Report forecasting accuracy

Accuracy metrics (comparing sample results to forecasts) for Beach Report are shown in **Table 4**. **Appendix 4** – Beach Report forecast accuracy resultsshows the full results set.

Table 4. Forecast accuracy metrics for 2019-20 summer period, Beach Report.

Metric	Result
Appropriate advice	Appropriate advice was provided in 88 per cent of Beach Report forecasts. Of the 487 forecasts, 429 forecasts gave appropriate advice to protect human health.
Missed alarms	Missed alarms accounted for three per cent of all forecasts (and 47 per cent of 'Poor' sampling results). This means they were forecast as 'Good'.
False alarms	False alarms accounted for nine per cent of all 'Poor' forecasts. (i.e. sampling results showed water quality was either 'Fair' or 'Good').

The BRFM generally provided appropriate advice to the community during times of good water quality, but work is needed to improve appropriate advice and accuracy during times of poor water quality. The BRFM can predict background microbial water quality well (microbial levels of less than 10 orgs/100 mL and 10 orgs/100 mL made up 56 per cent of sampling results). However, 'Poor' water quality events are less frequent and more often incorrectly forecast.

To put the 'Appropriate advice' and 'Missed alarms' into context for the 2019–20 summer:

- Dry weather pollution accounted for 11 'Missed alarms'. These events cannot be predicted by the BRFM. Often forecasting accurately during these events requires either knowledge of a pollution incident, or site-specific data such as isolated rainfall at a single site that is not recorded by the BoM weather stations used as part of the wider program.
- On six Tuesdays over summer (there were 14 Tuesdays in total), appropriate advice was not provided for one to four beaches per day. This means as a worst-case scenario, 32–35 beaches out of 36 were issued with appropriate advice on each of these occasions.

EPA is continually working to improve the accuracy of forecasting and is making a series of improvements based on the 2019-20 results.

With the high levels of rainfall recorded this summer (**Appendix 3** – Comparison of rainfall in 2018-19 and 2019-20 summers), it is possible that stormwater pollution affected beaches via runoff from drains and creeks for extended periods. The manual amendments of BRFM outputs did account for some prolonged stormwater pollution, however this rainfall may have had a greater effect.

EPA is undertaking work to better understand sources of faecal pollution at beaches to predict actual risk to human health, rather than relying on indicators. Some of this work includes on-site sanitary surveys to investigate site-specific pollution sources; and microbial source tracking sampling to predict actual health risk associated with high enterococci results.

3.2.3. Yarra Watch forecasting results

Table 5 shows the breakdown of morning Yarra Watch forecasts for each month by forecast category: 'Good', 'Fair' and 'Poor'.

Table 5. Number of forecasts issued for 2019-20 by month and category, Yarra Watch.

Month	Forecast classification		
	Good	Fair	Poor
December	0	27	97
January	0	13	111
February	0	19	97
March	0	2	34
% of all forecasts	0%	15%	85%

There is no 2018-19 comparison for Yarra Watch forecasting, as 2018-19 was forecast based on previous EPA internal objectives. Following the update to SEPP (Waters) objectives in 2019, Kew, Healesville and Launching Place were not allocated any forecast other than 'Poor'. This is due to historical microbial data input to the site-specific model showing that, even in dry weather, these sites would breach the 260 orgs/100 mL trigger over 20 per cent of the time. However, Warrandyte was allocated 'Fair' forecasts during dry weather and minimal rainfall conditions. For summer 2019-20, Warrandyte received 'Fair' forecasts 61 per cent of the time, while all other forecasts were 'Poor'. For more information on the Yarra forecast model, please contact EPA to access the *Water Monitoring and Assessment Plan*.

EPA is working with local council and Parks Victoria who are responsible for land management at Yarra Watch sites to have signs placed at recreational sites to advise recreational users of the potential for poor water quality.

3.2.4. Forecast accuracy for Yarra Watch

Accuracy metrics (comparing sample results to forecasts) for Yarra Watch are displayed in **Table 6**.

Appendix 5 – Yarra Watch forecast accuracy results shows the calculations.

Table 6. Forecast accuracy metrics for Yarra Watch, 2019-20.

Metric	Result
Appropriate advice	Appropriate advice was provided in 45 per cent of Yarra Watch forecasts (25 out of 56).
Missed alarms	As missed alarm results are based on 'Good' forecasts, Yarra Watch does not have any results (due to no 'Good' forecasts).
False alarms	False alarms accounted for 55 per cent of all forecasts.

The forecasting model for Yarra Watch was updated in 2019 to reflect SEPP (Waters) short-term objectives. This meant the short-term objective input to the forecasting model was a lower *E. coli* value than previous years (from 500 orgs/100 mL previously to 260 orgs/100 mL). The 2019-20 summer season was the first to apply this updated model.

Based on the accuracy measures (**Table 6**), the model using new short-term objectives (260 orgs/100 mL) appears conservative. The majority of forecasts were 'Poor' and only Warrandyte received 'Fair' forecasts. However most sampling results were graded as having 'Good' water quality. The updated model meant no 'Poor' water quality events were missed, however it meant all 'Good' samples at Kew, Launching Place and Healesville were forecast 'Poor'. Across all four sites, most of the 'Poor' forecasts (55 per cent) were actually 'Good', based on water sampling results.

As this season was the first summer using the SEPP (Waters) short-term objectives, EPA is investigating how to forecast more accurately as follows:

- The forecasting model was developed using all the available sampling historical data (from 2005). However, work has occurred to improve Yarra River water quality in recent years. The model could be updated to include the recent, more representative data.
- Microbial Source Tracking investigations being conducted currently in partnership with Melbourne Water and Monash University will assist in the identification of key dry weather sources and their relative load contribution of faecal matter into the Upper Yarra.

These improvements will assist forecasting for Yarra Watch to remain protective of human health without being overly cautious.

3.2.5. Yarra and Bay website alerts in 2019-20 summer

Most alerts reported to Yarra and Bay website did not occur directly in the Yarra River or Port Phillip Bay beaches, but rather in smaller waterways in the catchment. For this reason, alerts did not always affect forecasting.

All alerts for the summer season are shown in **Appendix 6** – Pollution alerts for 2019-20 summer(pollution), **Appendix 7** – Fish death alerts for 2019-20 summer(fish deaths) and **Appendix 8** – Algal bloom alerts for 2019-20 summer(algal blooms).

There were three pollution alerts that affected beaches in Port Phillip Bay (**Appendix 6** – Pollution alerts for 2019-20 summer).

- A pollution alert was issued on 10 December 2019 due to dredging of Patterson River. This alert was re-issued on 24 February 2020 when dredging occurred again:
  - Parks Victoria undertook dredging in Patterson River to remove hazards and maintain the channel for safe navigation.
  - The initial alert also resulted in changing the forecast of Carrum Beach to 'Poor', and nearby Seaford Beach to 'Fair'. This forecast change followed reports from concerned community members of brown water at the beach. The forecasts for the two beaches were changed to encourage recreational users to avoid contact with discoloured water.
  - The second alert did not result in changing forecasts as no reports of discoloured water were received.
- A pollution alert was issued on 21 January 2020 due to a cloudy brown substance that was observed discharging to Parkdale Beach:
  - EPA officers attended the site but could not determine a pollution source. It was likely something disposed of in the up-gradient stormwater network.
  - The alert did not affect forecasting as Parkdale Beach is not one of the Beach Report sites. The adjacent sites of Mentone and Mordialloc Beaches were already forecast 'Poor' at this time due to recent rainfall.
  - The alert was removed on 30 January when no more pollution reports had been received.

One algal bloom occurred in Port Phillip Bay (**Appendix 8** – Algal bloom alerts for 2019-20 summer).

- On 13 January 2020, an algal bloom alert was issued for Hobsons Bay. This bloom was detected via EPA's Ships of Opportunity monitoring system, installed on the Spirit of Tasmania.
  - ALS samplers attending beaches for routine Beach Report sampling took additional samples at Port Melbourne, South Melbourne, St Kilda, Elwood and Brighton Beaches. This sampling confirmed several species of algae were present, including levels above 'alert' of *Pseudo-nitzschia delicatissima* group, which is harmful to consumers of shellfish.
  - The Department of Environment, Land, Water and Planning (DELWP) were informed of the bloom and issued a media release (available on DELWP's website).
  - This bloom resulted in changing forecasts for Hobson Bay beaches in Beach Report (Port Melbourne, South Melbourne, Sandridge, Williamstown and St Kilda) to 'Fair' from 13 January. This event correlated with heavy rainfall on 16, 21, and 23 January when forecasts were already 'Fair' or 'Poor'.
  - The alert was removed on 28 January 2020, after sampling confirmed the bloom had dispersed.

There were two pollution alerts for the Yarra River (**Appendix 6** – Pollution alerts for 2019-20 summer). Yarra River alerts did not affect forecasting, as forecasts were already 'Poor' or 'Fair'.

- A pollution alert was issued on 10 January 2020 due to an oil slick observed in the Yarra River near Burnley Golf Course. EPA field officers attended but could not find a source of the oil slick. The alert was removed on 17 January once the pollution had dispersed.
- A pollution alert was issued on 17 January 2020 for a 'summer fresh' water release into the Yarra River. This was not regarded as a pollution incident, but a notification that it was occurring was issued in case the community observed differences in water quality during this period.

4. Conclusions

This report summarises the forecasting and sampling results for Beach Report and Yarra Watch in the 2019-20 summer season.

Most of the sampling results this summer were below SEPP (Waters) short-term microbial water objectives. This means the results were suitable for recreation. High microbial levels were mostly associated with rainfall, with five swim advisories issued for dry weather pollution during the summer (four for Beach Report and one for Yarra Watch).

Beach Report forecasting overall provided appropriate advice to protect community health this summer. Forecasting classifications this summer contained more 'Poor' and 'Fair forecasts than last summer. This is mainly due to the significant rainfall from January to March. Forecasts provided appropriate advice 88 per cent of the time. Forecasts were more accurate when predicting 'Good' water quality rather than 'Poor' water quality. Planned improvements to forecasting methods are designed to enable better prediction of water quality in times of poor water quality.

Yarra Watch forecasts in 2019-20 summer period were produced based on a new short-term objective from SEPP (Waters). The model produced 'Poor' forecasts 85 per cent of the time, however sampling results indicated actual water quality was mostly 'Good'. This means the forecasting model was conservative when predicting *E. coli* levels. Input from current Microbial Source Tracking research with Melbourne Water and Monash University will update the Yarra Watch forecasting with the intention of providing more accurate estimates that more closely reflect sampled water quality.

Most pollution alerts did not affect forecasting over the summer, however, there was an algal bloom in Hobsons Bay between 13 and 28 January, and dredging at Patterson River in December, that caused forecasts to be downgraded to 'Poor' and 'Fair'.

Beach Report and Yarra Watch remain two key community-focused programs for EPA. Forecasting and sampling over summer continues to provide a valuable service to the public, with over 10,000 subscribers to the Beach Report SMS service and over 8,000 Twitter followers receiving forecasts daily. Improvements to and continuation of the programs will ensure water quality advice remains available to protect public health over peak use times in the summer period.

EPA is continually working to improve Beach Report and Yarra Watch. Investigations into forecasting inaccuracies, as well as results of source tracking and sanitary inspections, can ensure EPA continues to provide appropriate public health information. Additionally, EPA will continue to work with partner agencies and organisations to ensure widespread distribution of forecasting and sampling results.

5. List of tables and figures

6. Acronyms and abbreviations

ALS	Australian Laboratory Services
BRFM	Beach Report Forecasting Matrix
EPA	Environment Protection Authority Victoria
orgs/100 mL	Organisms per 100 mL
SEPP (Waters)	State Environment Protection Policy (Waters), gazetted in 2018

7. Glossary

Dry weather (Beach Report)	≤1 mm rain at the specific gauge for a beach site in the 48 hours before sampling. All other times are considered **wet weather**.
Dry weather (Yarra Watch)	0 mm at the relevant gauge for a Yarra River site in the 48 hours before sampling. Any rainfall is considered **wet weather**.
Primary contact recreation	An activity (such as swimming) in which the whole human body or face and trunk are frequently immersed, or the face is frequently wet by spray, and where it is likely that some water will be swallowed or inhaled, or come into contact with ears, nasal passages, mucous membranes or cuts in the skin.
Secondary contact recreation	An activity (such as boating, fishing or wading) where the human limbs are regularly wet and in which greater contact (including swallowing water) is unusual, and includes occasional and inadvertent immersion through slipping or being swept into the water by a wave.

Appendix 1 – Beach Report microbial sampling results

Greyed out cells indicate samples were not taken at that site. A lower number of sampling results for a single week indicates the water was unsafe for sampling (for example due to rough tide).

The fifth week of sampling for beaches in Mornington Peninsula and Melbourne took place on 30 December 2019, while Geelong and Bellarine region sampling for the fifth week occurred on 2 January 2020. This discrepancy was due to lab preferences around public holidays. Werribee South in Melbourne region was also sampled on 2 January (indicated with asterisk in **Table 8**). Werribee South is sampled alongside Geelong and Bellarine due to being on the western arm of Port Phillip Bay.

Table 7. Enterococci sampling results for 2019-20 summer, Beach Report, Mornington Peninsula region.

Weekly microbial sampling results (orgs/100 mL)															Number of samples below or over the SEPP (Waters) short-term objectives		
Beach	03/12/2019	10/12/2019	17/12/2019	23/12/2019	30/12/2019	07/01/2020	14/01/2020	21/01/2020	28/01/2020	04/02/2020	11/02/2020	18/02/2020	25/02/2020	03/03/2020	≤200 orgs /100 mL	>200 orgs /100 mL	>500 orgs /100 mL
Safety Beach		10	<10	<10	31	≥10	<10	96	20	10	31	<10	10	63	13	0	0
Blairgowrie	310	30	31	20	<10	<10	<10	<10	20	<10	63	<10	<10	<10	13	1	0
Sorrento	31	10	20	<10	<10	170	10	<10	20	20	20	<10	10	10	14	0	0
Portsea		20	20		31	<10	<10	20			<10	<10	20		9	0	0
Rye	390	74	120	52	10	<10	20	52			20	31	<10	<10	11	1	0
Dromana		52	<10	<10	380	10	<10	110	10	20	10	<10	20	31	12	1	0
Canadian Bay	620	<10	<10	20	1200	30	86	84	<10	<10	52	<10	52	<10	12	2	2
Mornington	160	30	<10	20	96	20	1100	210	20	<10	640	<10	86	<10	11	3	2
Rosebud	600	41	<10	<10	41	<10	10	31	<10	<10	390	<10	10	10	12	2	1
Mt Martha		<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	10	10	13	0	0
														Total:	120	10	5

Table 8. Enterococci sampling results for 2019-20 summer, Beach Report, Melbourne region.

Weekly microbial sampling results (orgs/100 mL)															Number of samples below or over the SEPP (Waters) short-term objectives		
Beach	03/12/2019	10/12/2019	17/12/2019	23/12/2019	30/12/2019	07/01/2020	14/01/2020	21/01/2020	28/01/2020	04/02/2020	11/02/2020	18/02/2020	25/02/2020	03/03/2020	≤200 orgs /100 mL	>200 orgs /100 mL	>500 orgs /100 mL
Port Melbourne	52	10	<10	<10	130	41	52	780	<10	73	20	41	86	30	13	1	1
Hampton	10	<10	10	<10	<10	10	<10	160	20	10	<10	<10	<10	<10	14	0	0
Half Moon Bay	<10	10	<10	<10	10	<10	98	52	130	20	41	140	10	<10	14	0	0
Mentone	10	<10	<10	<10	20	10	420	210	20	31	41	10	41	41	12	2	0
Seaford		<10	<10	10	10	20	20	130	20	<10	10	<10	<10	<10	13	0	0
Frankston Life Saving Club	260	74	10	10	<10	41	86	74	10	<10	20	52	74	10	13	1	0
Frankston Coast Guard	20	41	52	<10	<10	20	31	74	63	<10	110	<10	74	10	14	0	0
Mordialloc		30	<10	<10	10	41	280	1500	10	130	31	10	160	20	11	2	1
Sandringham		10	<10	<10	10	<10	10	98	<10	<10	230	<10	10	<10	12	1	0
Elwood	10	<10	<10	10	<10	140	<10	1600	10	74	10	20	20	<10	13	1	1
St Kilda	20	31	10	10	<10	52	<10	2100	20	74	98	<10	200	62	13	1	1
Sandridge	20	<10	10	<10	20	120	63	98	<10	10	<10	10	10	10	14	0	0
Williamstown	10	<10	<10	<10	10	20	190	430	20	63	<10	20	41	<10	13	1	0
Altona	<10	<10	<10	<10	<10	41	1200	97	<10	41	10	2800	41	10	12	2	2
Werribee South	200	84	<10	10	<10*	20	20	41	30	41	98	20	210	20	13	1	0
Beaumaris	<10	<10	<10	<10	<10	10	74	10	<10	20	63	<10	<10	10	14	0	0
Brighton	<10	10	<10	20	<10	10	<10	160	10	10	20	31	<10	<10	14	0	0
Carrum	<10	10		<10	310	10	<10	52	20	<10	<10	<10	20	31	12	1	0
Aspendale	210	10		<10	<10	<10	20	41	<10	20	20	10	10	<10	12	1	0
South Melbourne	52	10	<10	<10	<10	30	<10	490	<10	<10	10	<10	<10	10	13	1	0
Black Rock		<10	<10	10	<10	10	20		<10	20	260	<10	10	<10	11	1	0
														Total:	270	17	6

Table 9. Enterococci sampling results for 2019-20 summer, Beach Report, Geelong and Bellarine region.

Weekly microbial sampling results (orgs/100 mL)															Number of samples below or over the SEPP (Waters) short-term objectives		
Beach	03/12/2019	10/12/2019	17/12/2019	23/12/2019	02/01/2020	07/01/2020	14/01/2020	21/01/2020	28/01/2020	04/02/2020	11/02/2020	18/02/2020	25/02/2020	03/03/2020	≤200 orgs /100 mL	>200 orgs /100 mL	>500 orgs /100 mL
The Dell	410	<10	10	86	52	10	30	30	10	<10	<10	<10	10	10	13	1	0
Eastern	1400	<10	31	20	31	10	20	31	41	41	10	20	220	20	12	2	1
Portarlington	340	98	110	20	63	150	20	110	31	200	10	170	30	10	13	1	0
St Leonards	<10	<10	52	150	<10	10	10	10	10	41	<10	10	10	10	14	0	0
Santa Casa	51	<10	<10	<10	<10	<10	10	<10	20	<10	10	<10	<10	<10	14	0	0
														Total:	66	4	1

Appendix 2 – Yarra Watch microbial sampling results

Table 10. *E. coli* sampling results for 2019-20 summer, Yarra Watch.

Weekly microbial sampling results (orgs/100 mL)															Number of samples below or over the SEPP (Waters) short-term objectives		
Site	04/12/2019	11/12/2019	18/12/2019	22/12/2019	02/01/2020	08/01/2020	15/01/2020	20/01/2020	29/01/2020	03/02/2020	12/02/2020	19/02/2020	26/02/2020	04/03/2020	≤260 orgs /100 mL	>260 orgs /100 mL	>550 orgs /100 mL
Kew	52	130	84	85	310	52	250	4400	98	460	85	10000	1900	86	9	5	3
Warrandyte	86	10	10	85	160	190	31	390	98	180	210	910	85	41	12	2	1
Healesville	310	110	120	120	85	160	250	200	130	610	430	2500	200	230	10	4	2
Launching Place	210	340	270	240	96	130	230	640	180	640	360	2600	360	230	7	7	3
														Total:	38	18	9

Appendix 3 – Comparison of rainfall in 2018-19 and 2019-20 summers

March data is calculated up to the Labour Day Monday for each year. In 2019, this was Monday 11 March. In 2020, this was Monday 9 March.

Table 11. Rainfall at each Bureau of Meteorology gauge used in BRFM, comparing 2018-19 and 2019-20 summer rainfall.

BoM rain gauge	2018-19 total summer rain by month (mm)		2019-20 total summer rain by month (mm)		Difference in rainfall between 2018-19 and 2019-20 (mm)
Cerberus	Dec	98.4	Dec	19.0	-79.4
	Jan	2.4	Jan	87.0	84.6
	Feb	11.0	Feb	52.4	41.4
	Mar	3.4	Mar	45.0	41.6
	Total	115.2	**Total**	203.4	**88.2**
Geelong Racecourse	Dec	61.0	Dec	8.6	-52.4
	Jan	2.0	Jan	74.0	72.0
	Feb	6.4	Feb	83.4	77.0
	Mar	1.6	Mar	23.4	21.8
	Total	71.0	**Total**	189.6	**118.4**
Avalon	Dec	31.6	Dec	7.0	-24.6
	Jan	3.2	Jan	88.2	85.0
	Feb	8.8	Feb	60.0	51.2
	Mar	3.0	Mar	32.6	29.6
	Total	46.6	**Total**	187.8	**141.2**
Laverton	Dec	100.6	Dec	6.2	-94.4
	Jan	29.8	Jan	87.0	57.2
	Feb	16.0	Feb	49.8	33.8
	Mar	4.0	Mar	48.6	44.6
	Total	150.4	**Total**	191.6	**41.2**
Moorabbin Airport	Dec	98.2	Dec	14.6	-83.6
	Jan	13.8	Jan	106.8	93.0
	Feb	9.6	Feb	77.0	67.4
	Mar	2.4	Mar	61.2	58.8
	Total	124.0	**Total**	259.6	**135.6**
Melbourne (Olympic Park)	Dec	104.8	Dec	6.2	-98.6
	Jan	11.2	Jan	115.2	104.0
	Feb	18.6	Feb	76.2	57.6
	Mar	3.8	Mar	64.8	61.0
	Total	138.4	**Total**	262.4	**124.0**

Appendix 4 – Beach Report forecast accuracy results

Appropriate advice

Light blue highlighted cells in **Table 12.** *Enterococci sampling data with corresponding forecast, Appropriate advice highlighted.*indicate appropriate advice (i.e. when actual water quality was 'Good', EPA issued either 'Good' or 'Fair' forecasts; and when water quality was 'Poor', EPA issued either 'Poor' or 'Fair' forecasts).

Table 12. Enterococci sampling data with corresponding forecast, Appropriate advice highlighted.

		Weekly enterococci sample result (orgs/100 mL)	
Tuesday morning forecast		≤200 orgs/100 mL (Good)	>200 orgs/100 mL (Poor)
	Good	281	15
	Fair	132	8
	Poor	43	8
	Total	456	31

Missed alarms

The light blue highlighted cell in **Table 13.** *Enterococci sampling data with corresponding forecast, missed alarms highlighted.* indicated missed alarms forecasts – when the forecast was Good, but actual water quality was found to be Poor.

Table 13. Enterococci sampling data with corresponding forecast, missed alarms highlighted.

		Weekly enterococci sample result (orgs/100 mL)	
Tuesday morning forecast		≤200 orgs/100 mL (Good)	>200 orgs/100 mL (Poor)
	Good	281	15
	Fair	132	8
	Poor	43	8

False alarms

The light blue highlighted cell in **Table 14.** Enterococci sampling data with corresponding forecast, false alarms highlighted. indicated false alarms forecasts – when the forecast was Poor, but actual water quality was found to be Good.

Table 14. Enterococci sampling data with corresponding forecast, false alarms highlighted.

		Weekly enterococci sample result (orgs/100 mL)	
Tuesday morning forecast		≤200 orgs/100 mL (Good)	>200 orgs/100 mL (Poor)
	Good	281	15
	Fair	132	8
	Poor	43	8

Appendix 5 – Yarra Watch forecast accuracy results

Appropriate advice

Light blue highlighted cells in **Table 15** indicated appropriate advice – when actual water quality was Good, EPA issued either Good or Fair forecasts; and when water quality was Poor, EPA issued either Poor or Fair forecasts.

Note that 'Good' is removed from forecast section and there are no 'missed alarm' results, as no 'Good' forecasts are produced with new objective levels.

Table 15. *E. coli* sampling data with corresponding forecast, Appropriate advice highlighted.

		Weekly enterococci sample result (orgs/100 mL)	
Wednesday morning forecast		≤260 orgs/100 mL (Good)	>260 orgs/100 mL (Poor)
	Fair	7	
	Poor	31	18
	Total	38	18

False alarms

The light blue highlighted cell in **Table 16.** E. coli *sampling data with corresponding forecast, false alarms highlighted.* indicated false alarms forecasts – when the forecast was Poor, but actual water quality was found to be Good. False alarms were the most frequent type of forecast this season.

Table 16. *E. coli* sampling data with corresponding forecast, false alarms highlighted.

		Weekly enterococci sample result (orgs/100 mL)	
Wednesday morning forecast		≤260 orgs/100 mL (Good)	>260 orgs/100 mL (Poor)
	Fair	7	
	Poor	31	18

Appendix 6 – Pollution alerts for 2019-20 summer

Table 17. Pollution alerts posted on Yarra and Bay between 1 December 2019 and 9 March 2020.

Date	Location	Text on website
03/12/2019	Eumemmerring Creek	There are confirmed reports of a blue-purple substance at Eumemmerring Creek at Abbotts Road, Dandenong South. EPA is investigating. Avoid contact with water until further notice by EPA Victoria.
04/12/2019	Kororoit Creek	There are unconfirmed reports of sediment discharging into Kororoit Creek at Racecourse Road, Williamstown. EPA is investigating. Avoid contact with water until further notice by EPA Victoria.
10/12/2019	Patterson River	Maintenance dredging is occurring at the entrance to Patterson River, Carrum and is expected to continue for 2 – 4 days (weather dependant). Sand is used to replenish the beach south of the River. Beach and waterway users are reminded to keep clear of the dredge and the sand placement area. Freshly dredged sand may contain organic material, mostly seaweed, which will give it a dark colour and mildly unpleasant odour when it first comes out of the water. After a few days of exposure to the air and sun, the sand will bleach to a normal colour and lose any odour.
26/12/2019	Moorpanyal Park Beach	A large industrial fire at wood chipper Midway (Corio Quay, North Shore, Geelong) is generating large amounts of fire water. The fire water is thought to have been contained, however EPA advises to avoid contact with nearby water until further notice. Moorpanyal Park Beach may become affected.
27/12/2019	Cherry Creek	A discharge of fire-fighting water from the fire at Encore Tissues has been reported in Cherry Creek near Gilbertson Road, Laverton North. EPA is investigating. Avoid contact until further notice.
02/01/2020	Gardiners Creek	White foam pollution has been reported in Gardiners Creek near Glengarry Ave, Burwood. EPA is currently investigating. Avoid contact until further notice.
09/01/2020	Moonee Ponds Creek	A sewer spill has been reported at Moonee Ponds Creek near 7 Eldorado St, Strathmore VIC 3041. EPA is currently investigating. Avoid any contact with water until further notice.
09/01/2020	Steele Creek	Discharge of a white foamy substance from a stormwater outlet into Steele Creek has been reported near 208 Rachelle Rd, Keilor East. EPA is currently investigating. Avoid contact until further notice.
10/01/2020	Yarra River	An oil slick has been reported in the Yarra River near Burnley Golf course. EPA is currently investigating. Avoid contact until further notice.
14/01/2020	Greater Melbourne	Air quality in Melbourne is likely to be very poor this week due to smoke from bushfires. EPA suggests minimising time spent outside in these areas over the coming days. Please consider water and air quality before deciding whether to go swimming. For more information refer to: https://www.epa.vic.gov.au/EPAAirWatch
15/01/2020	Stony Creek	A sewage spill has been confirmed near 30 Lenne Street, Beaconsfield Upper. Impact to a nearby dam has been confirmed. Sewage may have entered Stony Creek. EPA and South East Water are currently investigating. Avoid contact with creek water until further notice.
16/01/2020	Stony Creek	A hydrocarbon discharge has been confirmed at Stony Creek near St Leonards Ave, Yarraville. EPA is currently investigating. Avoid all contact until further notice.
17/01/2020	Yarra River	Melbourne Water is planning a 'summer fresh' water release into the Yarra River from the 22nd January to the 3rd February. Peak flows of up to 750 megalitres per day are expected at Warrandyte around the 28th and 29th January. Final details will be released on Tuesday the 21st of January. For more information call 131 722 or visit https://www.melbournewater.com.au.
17/01/2020	Gardiners Creek	White foam pollution has been reported in Gardiners Creek near Glengarry Ave, Burwood. EPA is currently investigating. Avoid contact until further notice.
18/01/2020	Sanctuary Lakes	There are unconfirmed reports of a sewer spill potentially entering to Sanctuary Lakes, near Springbank Court, Point Cook. EPA is investigating. Avoid contact until further notice by EPA Victoria.

Date	Location	Text on website
21/01/2020	Parkdale Beach	There have been confirmed reports of a cloudy brown substance discharging into Parkdale Beach near Parkers Road, Parkdale. EPA is currently investigating. Avoid contact until further notice.
24/01/2020	Croydon Hills	A sewer spill has been confirmed at Croydon Hills Drive, Croydon Hills. Sewage has entered the creek near Croydon Hills Walk. EPA is currently investigating. Avoid contact with creek water until further notice.
28/01/2020	Werribee River	Melbourne Water is planning a 'summer fresh' water release into the Lower Werribee River on the 29th of January and the 30th of January. The release will commence from Melton Reservoir along the Lower Werribee River and over the Lower Werribee River Diversion Weir at a rate of 80 megalitres per day. For more information call 131 722 or visit https://www.melbournewater.com.au.
31/01/2020	Darebin Creek	White foam has been reported at Darebin Creek, Preston near 58 Chifley Drive. EPA is currently investigating. Avoid contact until further notice.
04/02/2020	Stony Creek	There are confirmed reports that turbid water is discharging into Stony Creek near Francis St, Yarraville. City West Water are currently investigating. Avoid contact until further notice.
06/02/2020	Stony Creek	There are unconfirmed reports of a milky substance discharging at Stony Creek near Paramount Rd & Somerville Rd, West Footscray. EPA is investigating. Avoid contact until further notice by EPA Victoria.
06/02/2020	Eumemmerring Creek	A white cloudy substance has been reported discharging into Eumemmerring Creek near Kimberly Rd, in Dandenong South. EPA is currently investigating. Avoid contact with creek water until further notice.
08/02/2020	Merri Creek	A sewage spill has been reported at Merri Creek, near the end of Willowbank Road, North Fitzroy. EPA is currently investigating. Avoid contact until further notice.
10/02/2020	Skeleton Creek	Blue discolouration has been reported at Skeleton Creek near Linmax Court, Point Cook. EPA is currently investigating. Avoid contact until further notice.
12/02/2020	Werribee River	Melbourne Water is planning a 'summer fresh' water release into the Lower Werribee River on Wednesday 12 and Thursday 13 February. The release will commence from Melton Reservoir along the Lower Werribee River and over the Lower Werribee River Diversion Weir at a rate of 80 megalitres per day. For more information call 131 722 or visit https://www.melbournewater.com.au.
12/02/2020	Mile Creek	White pollution has been reported in Mile Creek near Springvale Road, Mulgrave. EPA is currently investigating. Avoid contact with creek water until further notice.
14/02/2020	Langwarrin	There are confirmed reports of turquoise pollution entering a small creek from a stormwater drain, near Shute Drive in Lloyd Park Reserve, Langwarrin. EPA is investigating. Avoid contact until further notice.
24/02/2020	Patterson River	Maintenance dredging of the entrance to Patterson River, Carrum will occur during late February and early March. Dredging activities may result in discoloured water and deposition of darker sediments onshore. Avoid contact with discoloured water and sediment.
25/02/2020	Dandenong Creek	A white, foamy substance has been reported at Dandenong Creek near Dandenong Creek Trail, Heathmont. EPA is currently investigating. Avoid contact with creek water until further notice.
28/02/2020	Steele Creek	A sewer spill has been reported at the corner of Assembly Drive and Tullamarine Park, Tullamarine. Steele Creek may have been affected. Avoid contact with creek waters until further notice.
03/03/2020	Darebin Creek	There are confirmed reports of an oily sheen in Darebin Creek at Abercorn Avenue, Ivanhoe. EPA is currently investigating. Avoid contact until further notice.
04/03/2020	Darebin Creek	An oily sheen has been reported at Darebin Creek near Gooch Street, Thornbury. EPA is currently investigating. Avoid contact until further notice.

Appendix 7 – Fish death alerts for 2019-20 summer

Table 18. Fish death alerts posted on Yarra and Bay between 1 December 2019 and 9 March 2020.

Date	Location	Text on website
16/01/2020	Werribee River	Fish deaths have been confirmed at Werribee River, near Werribee Park Golf Club. Victorian Fisheries Authority and EPA Victoria are investigating. Avoid contact with water until further notice by EPA.

Appendix 8 – Algal bloom alerts for 2019-20 summer

Table 19. Algal bloom alerts posted on Yarra and Bay between 1 December 2019 and 9 March 2020.

Date	Location	Text on website
10/12/2019	Jake Roper Reserve Lake	An algal bloom is affecting Jack Roper Reserve Lake, Broadmeadows. If the water looks murky or discoloured, people are advised to avoid contact as it may cause skin irritation. If contact does occur, wash with clean water.
13/01/2020	Hobsons Bay	An algal bloom is affecting the Hobsons Bay area in Port Phillip Bay. If the water looks murky or discoloured, people are advised to avoid contact as it may cause skin irritation. If contact does occur, wash with clean water.
12/02/2020	Werribee River	A Blue Green Algae bloom is affecting Werribee River. Melbourne Water will be monitoring the bloom. If the water looks murky or discoloured, people are advised to avoid contact as it may cause skin irritation. If contact does occur, wash with clean water.