



V&A WATERFRONT GRANGER BAY PRECINCT: RECREATIONAL WATER QUALITY MONITORING AND MANAGEMENT PROTOCOL

V1
JULY 2026

Prepared by



DOCUMENT DETAILS

V&A WATERFRONT GRANGER BAY PRECINCT: RECREATIONAL WATER QUALITY MONITORING AND MANAGEMENT PROTOCOL

PREPARED FOR

V&A Holdings (Ltd) Pty
PO Box 50001, Cape Town, 8001



PROFESSIONAL SERVICE PROVIDER

Infinity Environmental (Pty) Ltd.

Contact person: Jeremy Rose



jeremy@infinityenv.co.za

021 834 1600

Authors

Tom Smyth (Bsc. Hons.)
Francois van Schalkwyk (Bsc. Hons.)
Jeremy Rose (B.Sc. Hons Pr.Sci.Nat. EAP)

RECORD OF REVISIONS

Version No.	Reason for Revision	Section Revised	Effective Date
01	Drafted	All	July 2026

© Infinity Environmental 2026. This report has been prepared for the V&A Waterfront with reasonable skill, care, and diligence, and in accordance with generally accepted professional practices. The information, data, and opinions contained herein are based on sources believed to be reliable at the time of preparation. No responsibility is accepted to any third party who may use or rely on this report, in whole or in part, without the express written consent of the authors.

CONTENTS

DOCUMENT DETAILS.....	2
Contents	3
1 Introduction.....	4
1.1 Background	4
1.2 Basis of the Monitoring Programme.....	4
1.3 Rationale for Water Quality Monitoring	4
1.4 Faecal Indicator Bacteria Selection	5
1.5 Classification of Recreational Water Quality	6
2 Monitoring Protocol.....	7
2.1 Site context and contaminant sources.....	7
2.2 Parameters to be monitored	7
2.3 Initial site assessment	8
2.4 Sampling locations	9
2.5 Sampling frequencies and scheduling	10
2.6 Sampling methods.....	11
3 Data Stewardship	14
3.1 Data Capture	14
3.2 Data Storage	14
3.3 Data Processing	14
4 Management Actions.....	15
4.1 FIB data interpretation & subsequent management	15
5 Seasonal / Annual Reporting	20
5.1 Immediate Notifications.....	20
5.2 Continuous Passive Reporting	20
5.3 Weekly Reporting.....	20
5.4 Annual Reporting	21
6 References	22
Appendices.....	23
Appendix A: Metadata Templates.....	23
Appendix B: Sign Board Templates.....	27

1 INTRODUCTION

1.1 Background

The V&A Waterfront intends to develop a new recreational coastal precinct at Granger Bay, including public spaces, coastal promenades, ocean access, and tidal pools that will facilitate a variety of recreational uses.

The City of Cape Town (CCT), as the management authority for recreational beaches across the City, monitors coastal water quality at public beaches along its coastline. In response to the proposed Granger Bay development, the CCT required a recreational water quality monitoring and management protocol for the new coastal amenities. Specifically, the CCT requested:

- Detailed method statements for the water quality sampling regime;
- Details of communication protocols for conveying water quality results to the public; and
- Details of how public advisories relating to pollution incidents or poor water quality results will be communicated

This monitoring programme has been compiled for the V&A Waterfront in response to that request.

1.2 Basis of the Monitoring Programme

The CCT implements a year-round Recreational Coastal Water Quality Monitoring Programme, designed to actively monitor the recreational quality of coastal waters around recreational nodes, in order to limit risk to the public using these waters as far as reasonably possible. The CCT programme is based on Volume 2 of the 2012 Department of Environmental Affairs "South African Water Quality Guidelines for Coastal Marine Waters: Guidelines for Recreational Use" (DEA, 2012), as well as more recent globally accepted guidelines that have updated best practices since the publishing of the 2012 South African guidelines.

Since the 2012 DEA guidelines were published, several international environmental and health agencies have released updated guidance on the monitoring of coastal recreational waters. These include guidelines from the World Health Organisation (WHO, 2021), United States Environmental Protection Agency (US EPA, 2012, 2017), Health Canada (Health Canada, 2021), and the New Zealand Ministry for the Environment (Leonard & Eaton, 2021).

Accordingly, this monitoring programme is based on the South African DEA 2012 guidelines and the CCT's current monitoring protocols, whilst drawing on the latest applicable internationally accepted conventions where relevant.

1.3 Rationale for Water Quality Monitoring

Water based recreation is associated with inherent levels of risk, as with most recreational activities. These risks are multifaceted, including physical hazards (waves, currents, etc) and physiological hazards (hypothermia). These physical risks are generally observable, allowing recreational users to make informed judgements regarding their ability to use the water safely.

Risks associated with water quality, on the other hand, are often invisible, making these risks difficult for the average member of the public to evaluate. For many recreational waters in urban areas, pathogenic microorganisms introduced through human and/or animal faecal pollution are a concern (DEA, 2012; US EPA, 2012; Health Canada, 2021; WHO, 2021). The potential for exposure to these pathogens during water-based recreation necessitates a structured management approach in order to mitigate risk to the public as far as reasonably possible.

Testing for pathogens associated with faecal contamination (and ensuing illness) is often impractical, costly and slow. Instead, faecal indicator bacteria ('FIB') may be used as a cost effective, timely and practical indicator sign of faecal contamination, and associated risks of illness for humans (Health Canada, 2021; WHO, 2021). Elevated numbers of FIB generally signal faecal contamination, and an associated increased risk of illness for those exposed to the water. Not all faecal contaminant sources present the same level of risk – faeces from humans and ruminant animals represent a higher risk level to human health than other sources of faeces, such as birds, or non-ruminant mammals (Health Canada, 2021). This means that in addition to monitoring of FIB, a detailed site survey should be conducted at each monitoring site, to identify likely primary and secondary sources of FIB, thus informing management decisions for the area (DEA, 2012; Health Canada, 2021; WHO, 2021).

1.4 Faecal Indicator Bacteria Selection

An appropriate FIB for inclusion in a recreational water quality monitoring programme should be **directly linked to defined water quality targets** (guideline values) which are **based on health outcome targets** (tolerable burdens of disease). In the case of water based recreation, links between FIB and burdens of disease generally focus on Gastrointestinal Illness (GI), and sometimes Acute Febrile Respiratory Illness (AFRI) (DEA, 2012; US EPA, 2012; Health Canada, 2021; WHO, 2021). It should be highlighted that most strains of FIB in themselves are not pathogenic – they just demonstrate characteristics that make them good indicators of pathogens associated with faecal contamination that may cause GI (US EPA, 2012).

Historically, *Escherichia coli* (*E. coli*) has been a frequently referenced FIB, becoming a common term used by the general public to discuss water quality across all environments, including marine and freshwater systems. In reality though, there is not sufficient evidence to support a statistically significant dose-response relationship between *E. coli* and faecal-associated illnesses in seawater (DEA, 2012; US EPA, 2012; Health Canada, 2021; WHO, 2021). Enterococci are the preferred FIB for marine environments, as numerous epidemiological studies have demonstrated a statistically significant dose-response relationship between their concentrations (in colony forming units per 100 ml – CFU/100 mL) and the risk of GI and AFRI.

The South African guidelines (DEA, 2012) recommend both *E. coli* and enterococci for monitoring marine recreational water quality. The guidelines do note, in line with the previously mentioned large body of global literature, that there is considerable evidence that thermotolerant coliforms (ie. *E. coli*) are not well correlated with health risks, and that *E. coli* “die off faster than some pathogens under certain circumstances and may, therefore, go undetected during beach monitoring programmes, resulting in disease risks not being detected” (DEA, 2012).

The rationale for the inclusion of *E. coli* in the guidelines was to accommodate certain edge cases – none of which are applicable to the proposed Granger Bay precinct. Based on this, only enterococci will be used as a FIB for this monitoring programme. This is in line with most recent updates to numerous large scale coastal recreational water quality monitoring programmes (US EPA, 2012, 2017; Health Canada, 2021; WHO, 2021), as well as extensive published literature. This recommendation is based on two main factors:

1. The World Health Organisation states based on extensive literature that “No statistical relationship has been established for *Escherichia coli* that can support a dose response guideline value” (WHO, 2021);
2. Numerous guidelines highlight the drawbacks of the associated complexity in the interpretation of results and subsequent management decisions where more than one FIB is used for a given monitoring programme.

Enterococci are defined clearly in the DEA 2012 guidelines:

“Enterococci and faecal streptococci refer to vaguely defined groups of Gram-positive spherical bacteria, some of which are of human and/or animal faecal origin, and some of which are members of the natural flora of various environments. Because of the limited specificity of tests commonly used in these groups, they can, for all practical purposes, be considered the same” (DEA, 2012).

1.5 Classification of Recreational Water Quality

Classification of recreational water is used to assign “grades” or ratings to recreational sites. These ratings are based on differing levels of risk of infection or illness, based on epidemiological studies (DEA, 2012; US EPA, 2012; Health Canada, 2021; Leonard & Eaton, 2021; WHO, 2021). This classification is generally based on a combination of FIB criteria and a qualitative assessment of the likelihood of a recreational water area being impacted by faecal contamination – an assessment often referred to as a sanitary survey. Although not all guidelines require a sanitary survey, the V&A Waterfront will conduct a sanitary survey to inform management and monitoring at Granger Bay. This is in line with the DEA 2012 Recreational Water Quality guidelines, and the 2021 WHO guidelines.

Each jurisdiction or management authority defines slightly different health targets for acceptable water quality, and thus define different FIB concentrations as acceptable. Furthermore, some guidelines take into account both the risk of GI (gastrointestinal illness) and AFRI (acute febrile respiratory illness), while others solely focus on GI. Whilst acceptable health targets differ slightly between countries, all previously mentioned guidelines are broadly based on an overlapping group of epidemiological studies on the relationship between various FIB and the occurrence of GI (and in some cases AFRI too). Some of the key studies that set the groundwork for current enterococci based guidelines in marine waters are listed below for reference:

- National Epidemiological and Environmental Assessment of Recreational Water (Wade et al. 2010);
- Five further epidemiological studies conducted for the US EPA, assessing both fresh and marine recreational waters.
- Predicting likelihood of gastroenteritis from sea bathing; results from randomized exposure (Kay et al 1994);
- Ambient water quality criteria for bacteria (US EPA 1986);
- Bacterial indicators of recreational water quality (Dufour 1984);
- Health effects criteria for marine recreational waters (Cabelli 1983); and
- Swimming associated gastroenteritis and water quality (Cabelli et al 1982).

In line with the CCT's own protocols, the 2012 DEA guidelines have been used to define acceptable risk levels for enterococci for recreational waters in the coastal marine environment for this monitoring programme (see Section 0).

It is important to note that FIB may also be derived from natural sources, and thus may not always reflect direct or harmful faecal contamination of a given sample. However, on the precautionary principle and in the context of a highly urbanised environment, where an elevated enterococci reading is found faecal contamination should be assumed and appropriate action taken. It is worth noting that while water exceeding guideline values for FIB is likely to pose an unacceptable health risk, the converse is not necessarily true. Even where FIB are absent, other pathogens (ex: viruses, protozoa) may still be present in harmful numbers (DEA, 2012).

2 MONITORING PROTOCOL

The FIB monitoring programme must be representative of spatial patterns (stormwater drains, etc), and the range of conditions (weather, density of people etc) in the recreational water environment while it is being used. Certain aspects of the site design are not yet finalised, and this programme will therefore be updated prior to the opening to the public of new in-water recreational spaces at Granger Bay.

2.1 Site context and contaminant sources

The Granger Bay precinct is located at the southwestern side of Table Bay, along a highly dynamic coastline characterised by strong onshore winds in winter and offshore winds in summer. Dense urban areas surround the precinct, and the coastline receives direct stormwater runoff from Cape Town's CBD, the urban areas of Sea Point and Green Point, as well as significant river flows from the Diep River and Black River which empty into the bay. The Port of Cape Town to the east, and the Green Point Marine Outfall to the northwest, represent point sources of contamination in the marine environment in addition to the plethora of diffuse pollutant inputs.

Granger Bay has not historically formed part of routine monitoring by the CCT, but the nearest sites at which routine coastal monitoring for recreational water quality take place are at Mouille Point and Three Anchor Bay to the west (City of Cape Town, 2025). The CCT also implements ongoing monitoring of water quality in the nearshore environment as part of the marine outfalls Receiving Environment Monitoring Programme (CSIR, 2017; CLS, 2022; Rose et al., 2025).

Contaminant sources at Granger Bay include the following:

- Diffuse, nearshore and longshore transport of urban-derived point-source and non-point-source contamination dispersed along the coastline.
- Highly diluted wastewater from the Green Point marine outfall, which under certain weather conditions is expected to reach the Green Point shoreline at concentrations well below those at which a significant risk to recreational users is expected. The dispersion of wastewater has been extensively monitored and modelled, and all available data (e.g. PRDW (2020), CSIR (2017), CLS (2020; 2021, 2022), Infinity (2025)) indicate that the plume does not reach the shoreline in detectable concentrations.
- Direct discharge of stormwater from the site itself and the areas drained by the stormwater outfalls in Granger Bay, including parts of Green Point and the northern slopes of Signal Hill: this may at times include sewage contamination arising from spills, surcharges, and legacy cross-connections in these networks.

The latter source is expected to have the most significant effect on recreational water quality in the bay, and based on trends and monitoring data from elsewhere in Cape Town is expected to peak during and after significant rainfall events, but to return to acceptable levels shortly thereafter.

2.2 Parameters to be monitored

In addition to the consistent collection of water samples for the enumeration of FIB as described in section 2.6, various other parameters were considered for inclusion in this monitoring programme. The South African guidelines provide rough guidance on objectionable matter (litter, unnatural scum, oil, floating debris etc) and physico-chemical parameters (pH and temperature), as well as algal blooms. Regular testing will not be implemented for physico-chemical parameters or algal bloom

presence, in line with the guidelines (DEA, 2012). However, during regular sampling, any observations of significant quantities of objectionable matter or of large algal blooms should be recorded, and addressed by management where necessary.

Where toxic substances are suspected to have polluted a recreational area, based either on an identified input, or presence of objectionable matter, targeted monitoring will be undertaken and any relevant immediate risk mitigation measures (advisory notices etc) will be implemented. This will necessarily be based on the actual nature of the incident and is not detailed in this protocol.

On each sampling visit to each site, a meta-data sheet should be completed, which includes observations around litter, possible pollution, and algal blooms. See **Appendix A2** for a datasheet template.

2.3 Initial site assessment

Prior to commencement of recreational uses on the site and when any new recreational site (e.g. a new tidal pool) is added to the monitoring programme, an in-depth sanitary survey will be conducted prior to commencing with FIB monitoring. This survey should be updated at least annually, at the beginning of each summer season, to ensure no significant changes have occurred at the site.

In addition, the intensity of monitoring for the first year should be increased, in order to provide a robust baseline on which to assign recreational water quality ratings to each site.

2.3.1 Sanitary Survey

The objective of the sanitary survey is to identify all potential sources of human faecal pollution to a recreational area. This serves to qualitatively assess the extent of influence human faecal material is expected to have in a given site.

The most important sources of human faecal contamination in an urban context are likely to be:

- Sewage (in this case, failed pump stations, sewer to stormwater overflow, pipe breakages etc)
- Stormwater runoff (surface runoff contamination, sewer overflows, illegal connections)
- Riverine discharges (contaminated)
- Contamination from bathers

Special attention should be given to these potential sources of contamination when conducting a sanitary survey at each site.

See **Appendix A3** for a template of a Sanitary Survey sheet to be completed.

Due to the limited number of sites in this monitoring programme, the findings of the sanitary survey should be used to interpret the FIB monitoring results with site context (it is assumed the manager will have a detailed understanding of each site, due to the small sample site count). In the context of a larger programme, a matrix, similar to that recommended in the DEA 2012 or WHO 2021 guidelines would be more appropriate.

An example of interpreting FIB monitoring results in the context of the site based on the Sanitary Survey is included below:

- Multiple readings of 150-200 CFU/100 mL of enterococci should be more concerning to a manager at a beach noted to have numerous potentially contaminated stormwater outlets, than at a beach with no likely sources of faecal contamination, and just a large seal colony

next door. Such a trend should warrant further investigation of the likely sources of faecal inputs, and into whether the rainfall events are connected to observed exceedances.

2.3.2 Spatial variation

Where a point-source input (such as a stormwater outfall) is suspected to be driving spatial variation in water quality, initial sampling may target areas immediately adjacent to these point sources to investigate whether spatial variation is indeed present. A minimum of 10 paired samples over one month should be collected for this purpose.

2.4 Sampling locations

An indicative set of sample locations has been defined at this stage based on preliminary concept designs for the recreational spaces in the precinct. These will be updated prior to implementation to more accurately reflect proximity to point sources, the actual locations of expected concentrations of recreational use (particularly full-contact recreational uses such as swimming) and any other factors that may affect risk.

Preliminary sites are shown in Figure 1 and tabulated below.

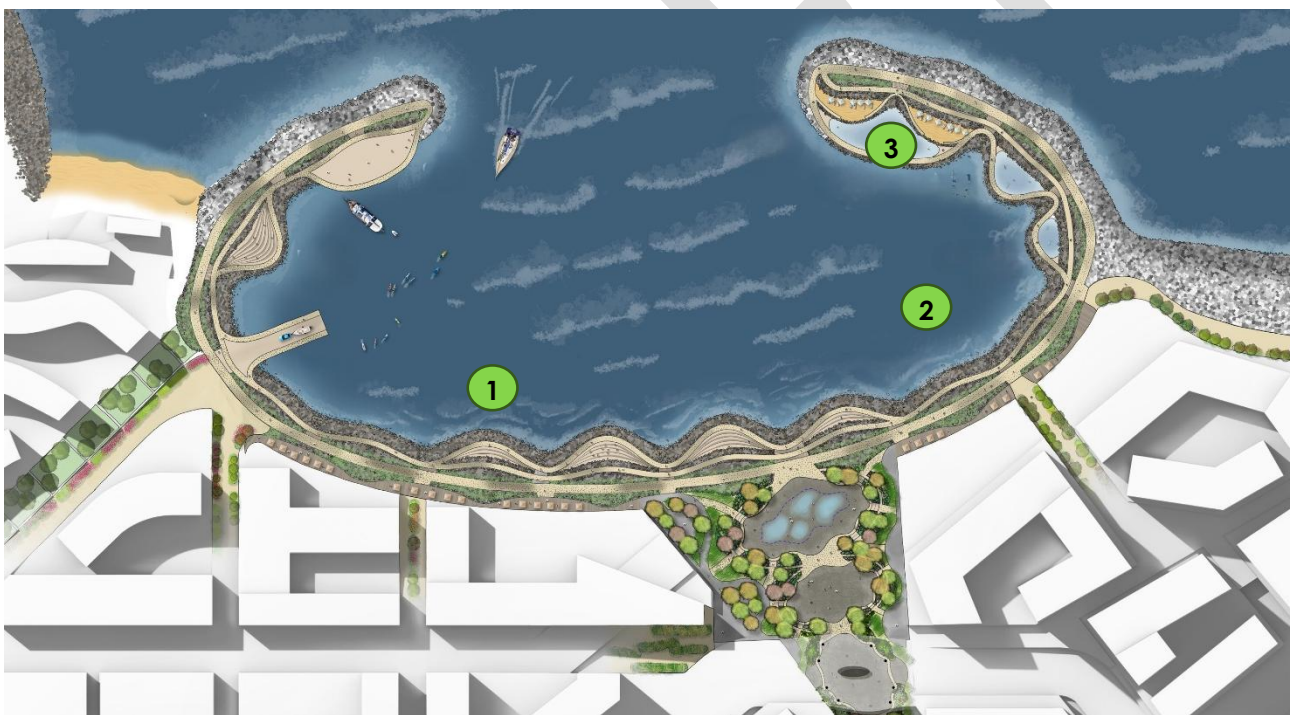


Figure 1. Preliminary indicative sample sites in the Granger Bay precinct

Site	Location	Comments
1	East of the slipway, at launch jetty or nearby	Exact location to be confirmed based on detailed designs
2	Near proposed swimming area in eastern part of the bay	
3	In tidal pool	One site per tidal pool, to be confirmed based on final designs

Sampling sites will be situated at all points that are designated for, or commonly used for, recreational activities. Should initial high-intensity sampling show there not to be significant variation across a designated recreational area, one representative monitoring site for the bay as a whole may be substituted for the two currently planned. In the case of tidal pools, at least one permanent monitoring point should be established per pool. Each monitoring site should be at least 0.5 m deep under all tidal conditions (DEA, 2012). Each site should consist of a fixed point which can be easily identified by all samplers working on the project.

Where threshold exceedances increase in frequency or intensity, or where physical changes in the environment occur, additional monitoring points may be added, at least temporarily, to investigate the source of pollution. For example, sampling from stormwater outfalls may be implemented when flows are present. If few to no FIB are detected during initial sampling, the frequency of this sampling may be reduced.

2.5 Sampling frequencies and scheduling

2.5.1 Sampling frequency

Recreational water quality has the potential to change rapidly over various time scales, especially in a high-density urban environment. Water quality may change in response to daily cycles of effluent discharge into the marine environment, stormwater runoff during rainfall or changes in weather and wind conditions. Until sufficient data are collected to understand the daily, seasonal and annual water quality patterns at a given site, increased frequency of sampling is advantageous.

For the first year of monitoring, water samples will be collected twice per week from each designated recreational water use area. This will provide sufficient data to classify the risk level of each recreational area during winter, during summer, and over the course of a representative year. This recommendation is based on the WHO 2021 guidelines which stipulate that an initial microbial water quality assessment should be based on at least 100 samples. Thereafter, weekly sampling of each site will be implemented as this is generally considered sufficient (Health Canada, 2021), and is in line with the CCT Coastal Water Quality Monitoring Programme.

An ideal sampling regime would include randomly selected days within a given week. However, given the constraints around laboratory availability (restricted to Monday – Friday), and knock-on implications for follow-up samples where necessary, samples will be collected on the same day each week, regardless of weather conditions (where safe to do so). Tuesday is planned for, as results will then be received by Thursday afternoon, and if necessary, a follow-up sample can be collected and submitted for analysis before the end of the same week.

Sampling days will not be selected based on weather conditions as this poses the risk of capturing water quality data in only a subset of the conditions that may be encountered by water users. Samples will be collected during daylight hours, ideally during peak recreational use times where feasible.

Where sites often display poor water quality, sampling frequencies will be temporarily increased in order to investigate and ideally identify factors driving temporary declines in water quality. In such cases, management actions should be considered to mitigate hazards associated with decreased recreational water quality. For example, in cases where rainfall is identified as a driver of declining recreational water quality, advisory notices may be posted to warn against swimming during and immediately after significant rainfall events. Assuming these management actions are applied

consistently, monitoring does not need to include rainfall events, and may rather be restricted to times that the recreational areas are open and considered safe for recreation.

2.5.2 Scheduling

A schedule will be produced at the start of each year of sampling. The schedule should be communicated to supervisors, samplers and laboratory staff in advance.

All laboratory results should be cross-checked against the schedule as they are received to ensure all samples that were planned and sampled were also processed by the lab and the results received. Due to the rate at which samples are collected and processed, and the volume of data received from the laboratory, an automated system is recommended for reconciling all sample results against the schedule and chain-of-custody forms.

In the case that a follow-up sample is required (see Section 0), a sample will be collected either on or after the day that the result is received.

2.6 Sampling methods

The collection of water samples forms the basis of the monitoring protocol. Microbiological samples can easily be contaminated by incorrect sampling methods. Water quality sampling may be outsourced to a suitably qualified service provider, or may be conducted internally by the V&A Waterfront as operational requirements permit. In either case, samplers will be trained in all aspects of sampling and sample handling and methods will be checked regularly to ensure samples are being collected in a manner that minimises contamination and ensures long-term consistency.

The management of chain-of-custody and cold chain ensures that samples are correctly stored during transport and easily traceable. It is also important that the required consumables and equipment be carefully managed to ensure consistency in the monitoring protocol.

Table 2-1. Checklist specifying required for microbiological sampling at each monitoring site

Item	Notes / quantity
Sterile sample bottles (pre-labelled)	One per monitoring point, plus spares for ad-hoc samples or follow-ups
Cooler box	Clean; capacity sufficient for the full sampling run
Ice bricks / ice	Enough to hold samples at 2–8 °C until laboratory hand-over
Temperature logger	One per cooler box; check the logger is recording
Nitrile gloves	At least one pair per site
Chain-of-custody form	Paper or digital; one per sample batch
Field datasheet / metadata sheet	For site observations (litter, scum, oil, algal blooms, weather, polluted inflows)
Permanent marker	For recording collection time on each bottle
Disposable gloves	Fresh pair per site
Safety / PPE equipment	Wetsuit and footwear appropriate to site and sea conditions
Sampling pole (optional)	May make sampling easier during poor weather

2.6.1 Water sample collection

Water samples must be collected at a location that is representative of the entire area where recreational contact takes place. Samples are to be collected 15 to 30 cm below the surface, and the water should be 0.5 m or deeper. Care should be taken not to touch the inside of the lid, or the rim of the bottle. In an area with wave action, the samples should not be collected just behind a breaking wave. Care must be taken not to sample the water that is backwashing off the shore. Appropriate safety equipment should be used, and the sea should be carefully observed during sampling.

Sampling steps are specified below:

1. Arrive at the site, with all necessary equipment (checklist in Table 2-1)
 - a. Ensure the fixed locations for monitoring are known to all samplers
2. Ensure your hands are clean. Put on a new pair of nitrile gloves.
3. Once in the water at the monitoring point (in water consistently at least 0.5 m deep), remove the lid of the pre-labelled, sterile sample bottle. Take care not to touch the inside of the cap, or to breath in it.
4. Invert the bottle completely and insert into the water, until your elbow is just above the surface of the water (15 – 30 cm deep).
 - a. Where there are waves, wait for a wave to pass, and sample just behind the wave.
 - b. Do not sample the backwash coming back down the beach from the shore
5. Once at the correct depth rotate the bottle to face upright, and allow it to fill with water.
6. Promptly remove from the water, facing up, and discard the top 2-3 cm of water to ensure sufficient headspace is left in the bottle.
7. Replace the cap, tightening completely until the seal has locked.
8. Using an appropriate permanent marker, write the time of collection of the sample.
9. Place the sample in the cooler box, which is packed with sufficient ice and a temperature logger. Place the sample underneath ice bricks to ensure it is sufficiently chilled.
10. Record relevant meta-data on the COC and datasheet (**Appendix A2**)

2.6.2 Chain-of-custody

A suitable chain-of-custody (paper or digital) will accompany the samples from the time of collection to the time at which the samples are handed over to laboratory staff. The following information needs to be captured on the form or in the system:

1. Date and time of sample collection
2. Name of sampler/s
3. Name of laboratory staff
4. Date and time of sample receipt by the laboratory

If samples are handed over to another party for temporary storage (e.g. an interim storage refrigerator), an additional record is required for handover between the samplers and the parties storing the samples, as well as between the parties storing the samples and the driver, and the driver to the laboratory staff etc. A record must be generated every time the samples change custody.

See **Appendix A1** for a Chain of Custody template for this monitoring programme.

2.6.3 Cold-chain and logistics

Samples should be stored between 2 and 8 degrees Celsius from the time of sampling to the time of analysis. This can usually be achieved by placing the sample directly into a cooler box with sufficient

ice bricks, before transferring the sample either into a refrigerator for temporary holding or directly to the laboratory.

A temperature logger with downloadable data, should accompany the samples from the time of sampling to the time when the samples are received at the laboratory. Since the temperature logger measures air temperature, and not the actual temperature of the sample, the temperature of the cooler box may on occasion drop below 2 degrees. It should not, however, be above 8 degrees. If in doubt, an infrared thermometer should be used on an ad-hoc basis to ensure samples are stored under optimal conditions.

The cold-chain data will be regularly processed and uploaded to the database to allow for automated notifications of high or low temperature alerts in the cold-chain.

2.6.4 Laboratory analysis

Samples for Enterococci analysis should ideally be analysed on the day of collection, with a maximum holding time of 24 hours. A laboratory accredited for the enumeration of Enterococci in seawater will be used. A laboratory that uses the membrane filtration method will be used to ensure comparability with guidelines and with CCT data from other recreational beaches in the vicinity.

3 DATA STEWARDSHIP

The purpose of the data management system is to ensure that the information required for decision making is reliably and efficiently passed from the water samplers through to the decision makers, covering data capture, storage and processing. Section 5 sets out how data are subsequently communicated to stakeholders through immediate, regular, and annual reporting.

3.1 Data Capture

Information gathered in addition to the results of the water quality analyses is crucial not only for basic record-keeping and quality control but also to contextualise the results relative to the events occurring at the site during the day of sampling. Capturing basic metadata, such as the time at which a sample is collected, is essential when it comes to water quality monitoring because water quality can be highly variable on a given day. Other data collected from site assessments or sanitary surveys need to be captured into an appropriate digital format to make the data easily accessible for reporting.

Sample metadata can be captured and digitised in any of the following ways:

1. The laboratory can capture basic metadata such as sample time from the chain of custody forms that accompany the samples and include these in sample reports;
2. Data can be captured digitally during sampling;
3. Data can be captured manually after sampling into an appropriate spreadsheet template or digital form.

3.2 Data Storage

All data, including the microbiological laboratory reports, the sample metadata, the cold-chain data and other data such as the results of sanitary surveys or site assessments, will be uploaded to a suitable database management system paired with a regular backup and data security protocol.

3.3 Data Processing

The raw data need to be processed into various forms before it can be used for decision making and subsequent reporting. Data processing can be done by automated processes in the database to make the end products available to API endpoints and alerting systems immediately, or can be processed by data analysts during regular reporting.

See Section 5 for how immediate alerts, weekly updates and annual metrics are each derived from this processed data.

4 MANAGEMENT ACTIONS

The purpose of this monitoring protocol is to inform appropriate management actions and interventions, in order to mitigate risks to the general public associated with faecal contamination of recreational water bodies.

4.1 FIB data interpretation & subsequent management

Since microbiological analyses do not produce instant results, there will always be a lag between the time at which the sample is collected and the time at which the results are reported to the water user. The time between a sample being collected and the results being received from the laboratory is approximately 48 hours. As Cape Town's Atlantic seaboard is a highly dynamic environment, water quality may change before the result of a sample is reported.

It is thus considered important that:

- The latest results be communicated as quickly as possible after the receipt of the laboratory results, so that end users can be informed about risk; and
- Longer-term reporting be made available in a form that communicates clearly whether particular sites have a tendency towards better or worse water quality over time, and what the associated risk category for each site is likely to be.

These objectives can be achieved by splitting water quality monitoring and reporting into two separate systems (DEA, 2012; Health Canada, 2021; WHO, 2021):

1. **Microbiological quality assessment:** A system that utilises all available recent data, often data from the previous 365 -day period, to assign each site monitored a categorical rating. Each of these ratings is based on quantitative epidemiological studies in sea water, which enable estimation of the degree of health protection (or burden of disease) associated with the range of FIB at each site (WHO, 2021).

*Microbiological quality assessments of each site are based on all scheduled monitoring data, and intended to **inform a single classification microbiological risk level associated with a site under normal conditions.***

2. **Operational management system:** A system that defines immediate management action for a recreational water body based on the most recent available microbiological results. This system is crucial for the effective day-to-day management of recreational waters (DEA, 2012; Health Canada, 2021; WHO, 2021).

The defined thresholds for management actions are often referred to as Beach Action Values (Health Canada, 2021; WHO, 2021), or Single Sample Thresholds (DEA, 2012). For the purposes of this protocol, Beach Action Values are utilised.

*This monitoring is conducted **to give timely warning to managers and users of exceedances beyond normal conditions at a given site.***

4.2 Microbiological quality assessment

The microbiological quality assessment assigns each site a single categorical rating, which corresponds to the risk of GI to recreational users under normal recreational conditions. Unlike the operational management system, which responds to individual results, this assessment integrates all scheduled monitoring data collected from a site into a single statistic that is comparable between sites and over time.

Following the DEA 2012 approach, the rating of each site is derived from the 95th or 90th percentile of the enterococci dataset for each site. The percentile method is preferred over the mean or median because it reflects the upper range of concentrations to which users may be exposed, and because it is less sensitive to the large number of low results typical of a well-performing site (DEA, 2012). There are many ways to calculate a given percentile value, and no one way of doing this is perfect. In line with the DEA 2012 approach, the ratings for sites in this monitoring programme should be derived using the Hazen method – this is considered the “middle of the road” option, striking a balance between over cautious and too lenient (DEA, 2012). See DEA 2012 (Page 17) for further information on different percentile calculation methods, as well as clear instructions on how to implement the Hazen method in the context of a recreational coastal monitoring programme.

At least one full year of monitoring should be completed before an initial classification can be assigned with confidence. Thereafter the classification should be recalculated and published on an annual basis. Where temporary water quality impairment is suspected to be related to rainfall and associated runoff, a separate summer and winter categorisations should be undertaken as well as the annual rating, in order to provide more detailed information to users of the site.

Where seasonal classifications of a site highlight significant impairment of water quality (rating of Poor) on a seasonal basis, an advisory notice should be posted for the duration of the season to allow the public to make an informed decision on whether to use the water for recreation. If a management decision is taken at a given site to prevent recreation during certain periods (such as winter, or restricting recreation for 24 – 48 hours after rainfall), scheduled samples collected during these periods should not be included in the quality assessment determination of the site, as these readings are not representative of conditions during which recreation is being undertaken. Recent results should still be communicated to the public via the sign-board system discussed below (Section 0).

Once available, the current microbiology quality assessment classification will be displayed on the site information board or electronic equivalent alongside the most recent operational result, so that users can distinguish the general standard of a site from its status on a given day. A brief annual report will also be compiled and published for access by users.

Table 4-1. Risk-based ranges for enterococci for recreational waters in the coastal marine environment, as defined by DEA 2012. Note ratings switch from 95th to 90th percentile between “good” and “fair”.

Category	Estimated risk per exposure	Enterococci (count per 100 ml)
Excellent	2.9% GI risk	<= 100 (95 percentile)
Good	5% GI risk	<= 200 (95 percentile)
Fair (minimum requirement)	8.5% GI risk	<= 185 (90 percentile)
Poor (unacceptable)	> 8.5% GI risk	> 185 (90 percentile)

4.3 Operational management thresholds

Beach action values (BAVs) will be used to inform day-to-day beach management. If enterococci concentrations exceed a set threshold (or BAV), then the corresponding management action will be taken. This action will depend on site-specific considerations, such as the extent of the exceedance, and the suspected source of faecal contamination.

BAVs are specified in Table 4-2, based on the thresholds defined in the South African guidelines (DEA, 2012). The actions associated with each BAVs are a set of minimum actions that should be taken when an exceedance occurs, in line with the pre-cautionary principle.

Where the V&A has reason to believe an exceedance is worse than indicated by the data, or a sewage spill has occurred and results have yet to be received, immediate action should be taken to mitigate the risk. This may include temporarily closing the recreational area until such time that the contamination has been removed, and FIB samples demonstrate the area is free of unacceptable levels of faecal contamination.

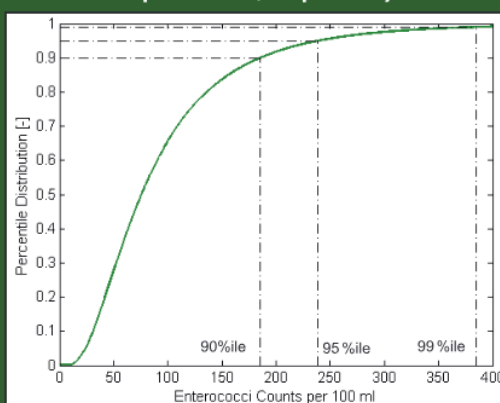
This monitoring protocol proposes a traffic light system for operational management and associated sign posting of recreational water status, based off the BAVs. A fourth, "Closed" state has also been included for use during extenuating circumstances (Table 4-2).

1. **A green sign if the most recent sample was below the first threshold. This sign should include the most recent result.**
2. **An orange sign if the most recent sample was above the first threshold (>240 CFU / 100 mL). The sign should remain until such time that the status can be reverted to green, or upgraded to red, based on follow-up sample results.**
3. **A red sign if the most recent sample was above the second threshold (380 CFU / 100 mL). The sign should remain until the water is designated safe once again, and a result comes back below 240 CFU / 100 mL.**

See Box 1 for an explanation on how the single sample target values were derived.

Box 1. Explanation from the DEA 2012 guidelines on how single sample thresholds were derived.

The preliminary single sample target values proposed for the operational management system (Figure 6.3) uses a similar approach to that of New Zealand (NZME, 2003). Recognising numerous limitations the single sample target values were obtained by assuming that intestinal enterococci distributions would be lognormal, that the standard deviation of the logarithms of intestinal enterococci concentration is 0.7 and that intestinal enterococci concentration limit is at a 90 percentile limit of 185 counts per 100 ml (corresponding to a minimum target recommended for recreational waters). Solving the cumulative distribution frequency of the lognormal and using the bisection method, the alert and action limits were taken as the 95% and 99%, upper one-sided tolerance limits for that distribution, calculated as 239 and 384 enterococci per 100 ml, respectively.



Acknowledging the uncertainty in estimating the standard deviation of the logarithms was considered appropriate to round these values to 240 and 380 enterococci per 100 ml, respectively.

Table 4-2. Beach action values for the operational management of recreational use in Granger Bay. Thresholds values are based on risk level deemed acceptable in the 2012 DEA guidelines.

Enterococci thresholds	Corresponding risk	Action required
< 240 enterococci / 100 mL	<i>Enterococci concentrations below this level are within acceptable limits for risk of GI illness.</i>	No action needed. Maintain weekly reporting to ensure the public can make an informed decision on recreation in the area.
Single sample > 240 enterococci / 100 mL	<i>95 % upper one-sided tolerance limit for 8.5 % GI illness risk. Single values between 240 – 380 enterococci / 100 mL likely correspond to a tolerable risk of illness (>8.5 %).</i>	- Increase sampling to daily. - Post “Alert” signage to inform the public of the exceedance, so they can make an informed decision on whether to swim (Appendix B). - Consult sanitary survey to assist with problem identification. If exceedances continue (after the first result), conduct a site visit to identify possible sources of contamination.
Single sample > 380 enterococci / 100 mL	<i>99 % upper one-sided tolerance limit for 8.5 % GI illness risk. Values over 380 enterococci / 100 mL are almost certain to correspond to an unacceptable risk of illness (>8.5 %).</i>	- Increase sampling to daily. - Consult sanitary survey to assist with problem identification. - Post “Warning” signage to inform the public of the exceedance, and recommend not entering the water (Appendix B). - Conduct a site visit to identify possible sources of contamination.
Two consecutive samples > 380 enterococci / 100 mL		- Post “Closed” sign to inform the public of the exceedances, and prohibit entering the water (Appendix B).
Or		- Continue sampling daily.
Known sewage related spill likely to affect water quality		- Investigate possible causes of the pollution to prevent future contamination events.

4.4 Operational management actions

Two key components underpinning a successful recreational water quality monitoring protocol are education and communication. The combination of public awareness around how monitoring works, and access to the most recent monitoring data provides a solid base on which to undertake monitoring and mitigate the risk of illness associated with water based recreation in urban areas.

To this end, the V&A will have an information sign board erected at a clearly visible location near water access points. This sign will include an overview of the monitoring programme, as well as recent results from the past 4-6 weeks of monitoring, and the long-term classification of the site, once available (after the first season of monitoring).

This information board will have a secondary sign that can be adjusted easily, based on the current status of the recreational water quality (as outlined below):

Samples below 240 CFU / 100 mL: In the case a result is received that is below 240 CFU / 100 mL, monitoring can continue as scheduled, and the “**Surveillance**” sign (Appendix B) should remain posted at the site (next to the information sign). This sign should indicate the following:

- Date and time of last sample collected, and the FIB concentration;
- Date and time of the next scheduled sample, and expected result date.
- Explanation of what the **Surveillance** means, so that recreational users may make an informed decision on whether to enter the water.

Samples exceeding 240 CFU / 100 mL (BAV 1): In the case a result is received that exceeds 240 CFU / 100 mL, a follow-up sample needs to be collected as soon as possible, and an **Alert** sign posted at the site.

An **Alert** sign (Appendix B) must be posted clearly at the recreational site which indicates the following:

- Date and time of last sample collected, and the FIB concentration;
- Date and time of follow up sample, and expected result receipt date;
- Explanation of what the **Alert** means, so that recreational users may make an informed decision on whether to enter the water.

Samples exceeding 380 CFU / 100 mL (BAV 2): In the case a result is received that exceeds 380 CFU / 100 mL, a follow-up sample needs to be collected as soon as possible, and a **Warning** sign posted at the site.

A **Warning** sign (Appendix B) must be posted clearly at the recreational site which indicates the following:

- Date and time of last sample collected, and the FIB concentration;
- Date and time of follow up sample, and expected result receipt date;
- Explanation of what the **Warning** means, including a strong recommendation that users not enter the water for recreational purposes.
- **If the follow-up sample is also above 380 CFU / 100 mL, the area should be closed to water based recreation until it is deemed safe, and a follow result has come back below 240 CFU / 100 mL.**
 - o A **Closed** sign must be posted (Appendix B), with all relevant information as listed above.

Known faecal pollution event: In the case of a known faecal contamination event, such as a sewer spill or pump station failure that discharges into the recreational environment, the manager should not await the results of the samples. **The beach should be closed until the source of the pollution has been addressed, and a follow-up sample has shown the contamination has been sufficiently diluted by the environment to no longer pose an unacceptable level of risk to recreational users. A black and red “Closed” sign, with all relevant information should be clearly displayed at the site** (Appendix B).

5 SEASONAL / ANNUAL REPORTING

In addition to timely alerting about poor water quality at a given site, longer-term reporting based on a larger set of data can provide managers and users with insights into trends across seasons and isolated events.

For sites where the water quality is good, long-term data provide assurance to the public that they can continue to enjoy the site and that there are no major problems at or near the site causing adverse water quality.

Conversely, long-term data may also highlight problems at certain sites, which is the first step in risk mitigation. These findings should be used to investigate any problems with water quality in order to mitigate risks accordingly.

Various indices and metrics have been used to provide overviews of coastal water quality based on faecal indicator bacteria results. These metrics are often based on percentile calculations and provide a long-term summary of the water quality at a given site. They can, however, be disproportionately affected by a few poor results (See Section 4.2 for further details). Considering these ratings together with other simple metrics, such as the percentage of samples that exceed a given threshold, can provide a better estimate of the true nature of the water quality at the site. It is very important to ensure that sufficient samples are used to generate summary statistics for faecal indicator bacteria results.

5.1 Immediate Notifications

Once data have been processed and validated per Section 3, it is important that all stakeholders are notified of impaired water quality as soon as practicably possible, with automatic notifications provided to the appropriate managers.

The responsibility rests with the V&A to ensure sign posting is updated in line with the most recent results on the same day that results are received from the laboratory. See Section 4.1 for further details.

5.2 Continuous Passive Reporting

Web-based dashboards are a popular tool for reporting and communicating information to an anonymous audience on demand, and should be considered for this programme.

Water quality dashboards are commonly used to present raw data, simple analyses and metrics. If these are hosted on a well-known public platform they can serve as an important point of discourse and enhance the trust and public view of the recreational water bodies.

5.3 Weekly Reporting

Updating information sign boards at each recreational site during the peak recreational season is a helpful tool to provide users with deeper insights on risks to the public (see the template Sign Board in Appendix B).

Internal weekly reporting for management decisions is important, especially during peak recreation season. Some aspects of this reporting may be automated, but consideration of key events and drivers of water quality in the reporting period should provide insight to the manager about recent trends and specific sites that may be experiencing impaired water quality.

5.4 Annual Reporting

Reporting water quality data annually provides the opportunity to use summary statistics and annual metrics that are only appropriate for larger datasets to inform long term management of recreational water sites. The following metrics are appropriate for long-term data sets based on many samples for a particular site (ideally >50 - 60 samples for each reporting period).

Risk-based classification using epidemiological risk categories: As discussed in Section 4.2. These categories are prone to being disproportionately influenced by high outliers, especially at small sample sizes, and thus should be interpreted in conjunction with percentage exceedance for a given site.

Percentage of samples that exceed a given threshold: A commonly-used threshold for Enterococci in coastal waters is 240 CFU/100 mL (Department of Environmental Affairs, 2012). This is not always an appropriate metric as it does not distinguish between sites that have very little contamination, and sites that have regular low-levels of contamination, but it does give an estimate of which sites are regularly polluted vs rarely polluted. Although there are various limitations associated with this method, it is a useful metric when interpreted in the context of other data, namely the risk based annual and/or seasonal classifications of each site.

These metrics, in tandem with the results of site assessments and sanitary surveys, will allow the V&A to detect long-term or seasonal trends at the sites, and apply reasonable management actions.

6 REFERENCES

City of Cape Town. 2025. *Know Your Coast 2025*. (Annual Report). Cape Town: City of Cape Town.

CLS. 2021. *City of Cape Town Marine Outfalls Seawater Quality Monitoring Annual Report 02*. (LT-839 ANNUAL SPR 02 V1.0).

CLS. 2022. *City of Cape Town Marine Outfalls Seawater Quality Monitoring Annual Report 03*. (LT-839 ANNUAL SPR 03 V1.0).

CSIR. 2017. *Cape Town Outfalls Monitoring Programme: Surveys made in 2015/2016*. (CSIR/NRE/ECOS/IR/2017/0035/B). CSIR.

DEA. 2012. *Guidelines for Recreational Use: SAWQGCMW*. (Volume 2). Department of Environmental Affairs.

Department of Environmental Affairs. 2012. *Volume 2: Guidelines for Recreational Use*. Department of Environmental Affairs: Ocean and Coast Branch.

Health Canada. 2021.

Leonard, D.M. & Eaton, D.C. 2021. *Recreational Water Quality Guidelines Update New Zealand*.

Lwandle. 2020. *City of Cape Town Marine Outfalls Seawater Quality Monitoring Annual Report 01*. (LT 839 ANNUAL SPR 01 V2.0).

PRDW. 2020. *Sampling and Analysis of the City of Cape Town's Marine Outfalls at Green Point, Camps Bay and Hout Bay: Final Report on Dispersion Model Calibration and Results for Green Point*. (Final S2101-RP-CE-007-R0).

Rose, J., Smyth, T., van Schalkwyk, F., Daniels, R., Clark, B., Dawson, J. & Jackson, M. 2025. *City of Cape Town Marine Wastewater Outfalls: Receiving Environment Monitoring Report 2024/2025*. (19060b/10/2025). Cape Town: Infinity Environmental & Anchor Environmental.

US EPA. 2012. *Recreational Water Quality Criteria - US 2012*.

US EPA. 2017. *5-Year Review of the 2012 Recreational Water Quality criteria*.

WHO. 2021. *Guidelines on Recreational Water Quality. Volume 1: Coastal and Fresh Waters (2021)*. 1st ed edn. Geneva: World Health Organization.

APPENDICES

Appendix A: Metadata Templates

The following templates are functional starting points for field and laboratory record-keeping. They are intended to be adapted to the site and, where practical, replaced by an equivalent digital form. Print on A4.

A.1 Chain-of-Custody (COC) sheet

One per sampling batch. Accompanies the samples from collection to laboratory hand-over. A new custody record is required every time the samples change hands.

Sampler(s)		Date	
Site / programme		Temp Logger (code)	

Sample code	Monitoring point / location	Time collected	Type (scheduled / follow-up)	Notes

Custody transfer

Released by (name)	Received by (name)	Date & time	Signature

Received at laboratory by	Date & time of receipt	Cooler temperature on receipt (°C)

A.2 Field data sheet

Completed on each sampling visit to each site. Records the conditions and any objectionable matter or possible pollution observed at the time of sampling.

Site		Monitoring point	
Date		Time	
Sampler(s)		Weather / wind	
Last rainfall (time and quantity)		Sea state	

Site observations (tick and add detail where present)

Observation	Yes	No	Detail / location
Litter or floating debris			
Unnatural scum or foam			
Oil slick or sheen			
Discoloured water			
Visible algal bloom			
Suspected chemical pollution			
Discharge flowing into the recreation area			
Stormwater pipe(s) discharging			
Foul smell			
Unusual water appearance			

General notes

A.3 Sanitary survey sheet

Completed when a site is added to the programme and reviewed at least annually. The objective is to identify and rank potential sources of human faecal contamination affecting the recreational area.

Site		Date	
Surveyor(s)		Coordinates description	/

Potential source	Present	Absent	Description / distance & direction from site	Estimated influence (Low / Med / High)
Sewage (pump-station failure, sewer-to-stormwater overflow, pipe breakage)				
Stormwater runoff (surface runoff, illegal connections)				
Riverine / canal discharge				
Contamination from bathers				
Other (specify)				

Overall assessment

--

Appendix B: Sign Board Templates

B.1 Monitoring summary information board

Permanent board at the entrance to each site. Design shown at template scale — print at A1. The current-status sign (B.2–B.5) is displayed alongside and switched out as results change. All signs should be printed on metal, with erasable sections for handwriting specific details.

RECREATIONAL WATER QUALITY MONITORING

This water body is monitored for faecal indicator bacteria (enterococci) to help you make an informed decision about swimming. Bacteria levels can change from day to day. Always visually evaluate the water and check the current-status sign next to this board before entering the water. Report any concerns to *(insert contact details of manager here)*

Recent results

Date sampled								
Result (enterococci CFU / 100 mL)								
Status								

Long-term site classification (updated annually): _____

What the status colours mean

Surveillance	Routine monitoring. Most recent result within acceptable limits (< 240 CFU / 100 mL).
Alert	A recent sample exceeded 240 CFU / 100 mL. Follow-up sampling under way. Consider before swimming.
Warning	A recent sample exceeded 380 CFU / 100 mL. Recreation not recommended.
Closed	Water body closed due to faecal contamination or a known spill. Do not enter the water.

More information / live dashboard: _____ Managing authority contact: _____

B.2 Surveillance sign

Displayed when the most recent result is below 240 CFU / 100 mL. Print at A3 size and post beside the information board.

SURVEILLANCE

Water quality is being monitored. The most recent result is within acceptable limits for recreational use.

Date of last exceedance (and value):

Date last sampled:

Last result (CFU / 100 mL):

Next sample due:

Notes (write with marker): *e.g. any site-specific information for water users.*

B.3 Alert sign

Displayed when a single result exceeds 240 CFU / 100 mL. Print at A3 size and post beside the information board.

ALERT

A recent sample exceeded the first guideline threshold. Follow-up sampling is under way. Consider this before entering the water.

Date last sampled:

Last result (CFU / 100 mL):

Problem first identified:

Follow-up sample due:

Notes (write with marker): *e.g. reason for the alert, if known.*

B.4 Warning sign

Displayed when a single result exceeds 380 CFU / 100 mL. Print at A3 size and post beside the information board.

WARNING

Recent results indicate poor water quality. Avoid entering the water for recreation until further notice.

Date last sampled:

Last result (CFU / 100 mL):

Problem first identified:

Follow-up sample due:

Notes: *e.g. reason for the warning, if known.*

B.5 Closed sign

Displayed after two consecutive results above 380 CFU / 100 mL, or a known sewage-related spill. Print at A3, laminate, and post beside the information board.

CLOSED

This water body is closed to recreation due to faecal contamination. For your safety, do not enter the water.

Date closed:

Reason:

Last result (CFU / 100 mL):

Date of next expected result:

Notes (write with marker): e.g. "Closed due to sewer overflow".
