CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

KNOW YOUR COAST, 2019

Key findings from over 10 000 sample bacterial tests at 90 sites along 307 km of coastline.

Making progress possible. Together.

Acknowledgements

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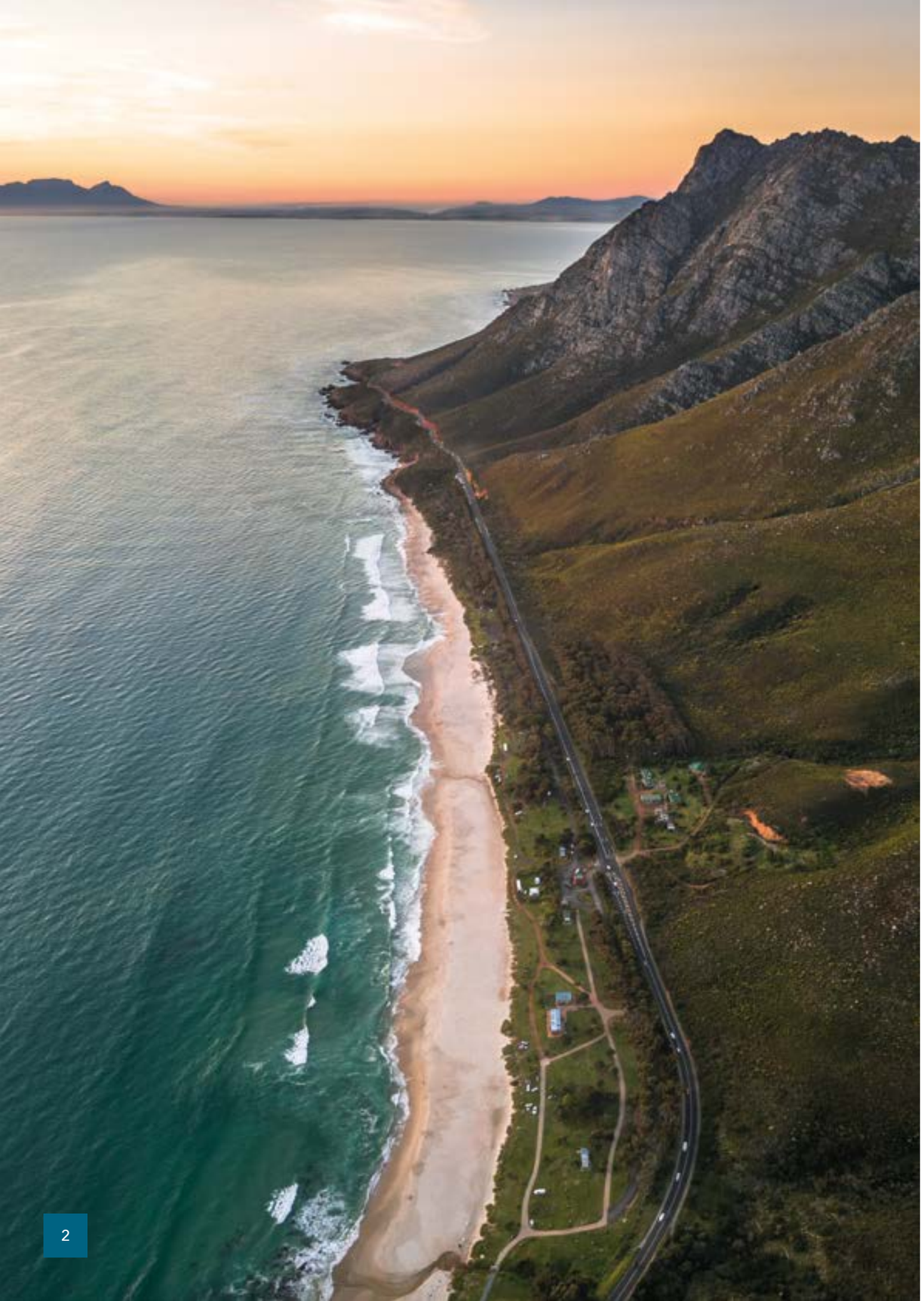


INTRODUCTION

Cape Town's 307 km of coastline extends from Silwerstroomstrand on the Atlantic side to Kogel Bay on the east side of False Bay. It is among the most ecologically diverse and productive in the world and contributes significantly to the city's economy. The spectacular scenery of this coast has not only established Cape Town as a destination of choice for tourists, but is also central to residents' identity and sense of place. Renowned for their natural beauty, Cape Town beaches offer opportunities for swimming, surfing, adventure sports and eco-tourism.

However, as in many other rapidly expanding coastal cities globally, waste streams associated with development and population growth pose a growing threat to Cape Town's valuable coastal and marine environment. If not managed and controlled, this may damage or even destroy one of our greatest economic, social and environmental assets – our coastal environment. Unsurprisingly, therefore, pollution and pollution-related problems along the city's coast have been generating an increasing amount of public interest and concern.

The City of Cape Town (hereinafter "the City") is committed to managing and protecting its valuable coastal and marine environment. To this end, amongst many other programmes, it has been conducting long-term coastal and marine water pollution monitoring programmes, including:

- the coastal recreational water quality monitoring programme;
- the Blue Flag monitoring programme, which includes a water quality component;
- the marine monitoring programme associated with the three marine outfalls along the Atlantic coast; and
- the marine monitoring programme associated with the two temporary seawater desalination plants.

The release of this report serves as a commitment from the City to, in future, provide annual feedback on the quality of our coastal waters. Going forward, the report will be released in the first quarter of each year, presenting the results from the preceding year.

The *KNOW YOUR COAST, 2019* report provides an overview of the 2019 results of our coastal recreational water quality monitoring programme, together with an abbreviated summary of findings from the Blue Flag monitoring programme. It reflects the outcome of over 10 000 sample bacterial tests from 90 sites along 307 km of coastline.

It is hoped that this annual review, along with the bi-weekly data updates via our web portal, will empower residents, visitors and tourists alike and will serve as a platform for a new partnership between the City, Capetonians and visitors to reduce the amount of pollution we are releasing into our natural environment.

In releasing this report, the City makes a new commitment that water pollution will be addressed as part of all of its daily operations and that we, in collaboration with residents, business, and visitors, accomplish continual improvement in our coastal water quality.

CATCHMENT TO COAST – THREATS TO COASTAL WATERS

In many countries, more people now live in cities than in rural areas. In coastal countries, more than 50% of the population generally live within 100 km of the coast. Cape Town is no exception, having seen its population more than double in the past 40 years.[1] Coastal environments are increasingly exposed to human population growth and urbanisation, which poses the risk of conflict and competition among users and uses of these environments.

One of the most significant threats to maintaining healthy coastal waters is pollutants. There are two broad classes of pollution, namely point-source and non-point-source pollution. Point-source pollution comes from discrete, easily identifiable sources. Examples include effluent discharge from wastewater treatment works and industries, directly into the sea. Although these sources do contribute to the deterioration of coastal water quality, pollution from non-point-sources is considered to be of greater concern in many coastal cities, as these sources are less easy to identify and difficult to control or manage. Non-point sources of pollution include overflows from sewage pump stations, sewage system failures, illicit and illegal discharges into the stormwater system, post-rainfall stormwater runoff from roads and built-up areas, and runoff and discharges from agricultural areas (such as dairy farms along rivers). Pollution from these non-point sources is released into the nearshore environment, where reduced dispersion rates and hydrodynamic processes may amplify its effect.

As the stormwater system has such a significant impact on the near shore, it is essential to start by distinguishing between regular stormwater and illegal discharges via the stormwater system. The only (legal) substance that should travel down the stormwater system into the sea is runoff from a rainfall event. In essence, if it has not been raining, nothing should flow from stormwater systems. Runoff after rainfall should be mostly rainwater, but will also contain some contaminants washed from roads and roofs.

The stormwater runoff should specifically not be carrying:

- any sewage, whether via illegal connections, blockages, pump failures or overflows;
- paints, solvents, oils, chemicals or any waste from homes, businesses, restaurants, garages, industrial parks, offices or individuals;
- waste of any kind from homes, farms, businesses, industries, including water from washing out a wheelie bin, for example; and
- litter, general refuse or waste from domestic animals.

[1] *Statistics South Africa - www.statssa.gov.za*

The quality of our freshwater systems and nearshore coastal water is a mirror of our urban and land-based activities, resource consumption patterns, waste streams and our urban growth and expansion.

These are all illicit or illegal discharges into the stormwater system, which ultimately end up in the coastal environment.

Activities in catchments adjoining the coast also contribute significantly to pollution in coastal areas, with pollutants entering estuaries and the sea through river flows. Therefore, managing water quality in coastal areas not only requires pollution prevention along the coast, but in adjoining inland areas as well that form part of these river catchments. This realisation has given rise to the "source-to-sea" concept for coastal water quality management.

Faecal pollution – more specifically, pollution by the pathogenic micro-organisms present in human faeces – is a pervasive, widespread and problematic form of coastal pollution. In the United States, for instance, pathogens (as estimated through faecal indicator bacteria) are the leading cause of violations of standards in coastal water quality. Faecal matter enters coastal waters from both point and non-point sources, including effluent outlets, stormwater runoff (washing the faeces of birds and domestic pets from roads and pavements into the stormwater system), sewer overflows, and illegal sewer connections to the stormwater system.

Dealing with such threats to coastal water quality is challenging for the City: Every day, it has to deal with the domestic wastewater, solid waste and contaminated stormwater runoff generated by Cape Town's four million people, and another one million bordering the city. The City responds to approximately 400 sewer system failures each day. About 75% of these are a direct result of abuse of the sewer system by the public, using it as a dump for anything from car engines to rags. The remaining 25% of failures are a result of infrastructure breakdowns, such as pump station failures (which increase with load-shedding) or sewer line failures.

Added to this, is the rapid expansion of informal settlements, where basic service provision at the household level is lower than in suburbs, which results in a marked deterioration in the quality of stormwater and rivers draining through or next to these settlements. The plethora of industries in and around Cape Town further contribute to these waste streams, as do several intensive agriculture practices inside and adjacent to the city's borders.

COASTAL PROCESSES – TRANSPORT AND FATE OF POLLUTANTS

Numerous physical processes are at play in the dilution, transport and fate of waste streams that enter coastal waters. These processes include local winds, ambient continental currents (such as the Benguela current), surf-zone longshore and rip currents (generated by waves), as well as tidal currents. Close to the coast, the seabed topography and the configuration of the coastline also strongly influence circulation patterns. For example, physical forces (including winds and waves) are much weaker in sheltered, semi-enclosed embayments and estuaries than along the open coastline. Above all, however, currents (i.e. their speed and direction) are the main oceanographic process influencing the dilution and subsequent transport of wastewater streams that enter coastal waters.

Water circulation in the surf zone (breaker zone) is often very complex and highly variable. Water exchange from the surf zone is poor, as wave action tends to trap water in these areas, resulting in alongshore transport of particles. As a result, breaker zones have little assimilative capacity for effective dilution and transport of effluents. Rip currents are usually responsible for transporting particles and pollutants out of the surf zone. Estuaries are sheltered waterbodies where circulation patterns depend largely on the river inflow and the state of the mouth. Water exchange, therefore, ranges from good when river inflow is high and water is continuously flushed from the system, to limited or non-existing when the mouth is closed. The latter is particularly relevant to South Africa, where more than 75% of estuaries temporarily close off from the sea. The offshore environment (typically defined as the zone beyond the surf zone) extends across a large area, and usually has strong, more uniform water circulation characteristics. These allow for more effective dilution, dispersion and transport of effluent plumes, provided that these factors were properly considered in the design of effluent disposal schemes.

Therefore, the extent to which pollutants may affect coastal waters is not only influenced by the volume and composition of the waste stream, but also by the prevailing physical processes and features of the coastal water into which the waste stream is discharged. For example, an offshore discharge into an area with strong currents is likely to have a smaller impact than a similar discharge into a sheltered estuary. In accordance with South Africa's policy on marine disposal, the design of wastewater discharges should consider the ambient characteristics of receiving coastal environments so as not to exceed their assimilative capacity.[2]

Put simply, coastal and marine environments do not have endless capacity to assimilate waste and waste streams produced by society. If this is not managed and controlled, we risk damaging or even losing one of our greatest economic, social and environmental assets – our coast. The City's role, therefore, is to monitor the impact of urban waste on the coastal and marine environment in order to ensure that the assimilative capacity of these environments is not exceeded to the detriment of the well-being of residents and the environment.

[2] *Department of Environmental Affairs. 2014. National Guideline for the Discharge of Effluent from Land-based Sources into the Coastal Environment. Pretoria, South Africa. RP101/2014 (https://www.environment.gov.za/sites/default/files/legislations/nationalguideline_landbasedinfluent_dischargecoastal_0.pdf)*

HOW IS COASTAL WATER QUALITY ASSESSED?

Swimming and surfing are some of the many water-based recreational and sport activities that take place along our coast. The accidental swallowing of contaminated seawater during these pastimes can result in gastrointestinal conditions (such as diarrhoea or vomiting), upper respiratory tract problems (such as throat infections) and other illnesses if the water contains large numbers of pathogenic (infectious) micro-organisms.

The most common reason for the presence of pathogenic micro-organisms in seawater is faecal contamination. Faecal matter can enter coastal waters from various sources, some of which are easier to identify and control than others. Since it is difficult and expensive to check for all possible pathogens, faecal bacteria are widely used to detect the presence of faecal matter pollution in coastal waters used for recreation. More specifically, intestinal enterococci and *Escherichia coli* (*E. coli*) are commonly used as indicators of faecal pollution. These bacteria occur naturally in the intestines of humans and are excreted in faeces, although they are also found in the faeces of warm-blooded animals such as dogs, cats, livestock, birds and rats. This is why they are known as "faecal indicator bacteria".

The bacteria themselves do not pose a risk to human health. Instead, they indicate the possible presence of pathogenic micro-organisms in human faeces that do lead to illness, such as the salmonella bacteria that cause gastroenteritis. However, studies have shown a stronger link between gastrointestinal and upper respiratory tract illnesses in swimmers and the number of faecal indicator bacteria in water, than the number of pathogenic micro-organisms. *E. coli* is not a reliable indicator of human health risks in coastal waters, as it does not survive for long in salt water. Enterococci, on the other hand, survive for longer and are therefore the preferred indicator for coastal waters.

The City monitors these indicator bacteria in seawater collected at 90 sites between Silwerstroomstrand on the Atlantic coast and Kogel Bay on the eastern shore of False Bay (figure 1). Some sites are at popular recreational beaches and in tidal swimming pools – these are known as recreational nodes. Other sites, known as coastal monitoring points, are intentionally positioned near potential or known sources of coastal water pollution (such as stormwater drains and sewer pump stations) to identify the extent of pollution from these sources.

FIGURE 1: RECREATIONAL NODES AND COASTAL MONITORING POINTS ALONG THE CITY'S ATLANTIC AND FALSE BAY COASTS

Water samples are collected in the surf zone and in tidal swimming pools, fortnightly. The City's Scientific Services Branch then counts the number of intestinal enterococci and *E. coli* colonies in the water samples. Water quality is assessed by comparing the number of enterococci in the water samples to the South African water quality guidelines for recreational use (table 1). These guidelines are based on research into whether people swimming in waters with different numbers of faecal indicator bacteria developed gastrointestinal illness. They define a "tolerable risk" instead of no risk at all. For most healthy people, water quality that meets the targets will pose little risk to their health, and any illness they might develop will usually be minor and short-lived. This is because humans can usually tolerate exposure to low numbers of pathogens. Toddlers, the elderly, people with weakened immune systems, as well as those that have not previously been exposed to the pathogens are more at risk. People who participate in high-exposure activities such as long-distance swimming and surfing are also at a higher risk, as they are likely to swallow more water than the ordinary person.

The number of bacteria in a water sample is counted as colony-forming units per 100 mℓ of the sample ("the count"). Percentiles of counts measured in many water samples collected over time are used to rate water quality as "excellent", "good", "fair" or "poor" by comparing them to the guidelines below. The minimum grade for South African coastal waters for recreation is "fair".

Internationally, water quality is rated using monitoring results over a rolling period of three to five years to provide a more consistent picture of water quality. However, since the use of long-term data poses challenges in areas where bacteria counts are highly variable, the South African water quality guidelines allow the rating of water quality using the results of (at least) fortnightly sampling over 12 months. The City rates annual water quality for the period 1 December to 30 November (for example, the 2019 water quality ratings were calculated using the results of water samples collected between 1 December 2018 and 30 November 2019). All available results for each beach were used in the calculations.

TABLE 1: RISK CRITERIA FOR RECREATIONAL USE OF COASTAL WATERS IN SOUTH AFRICA

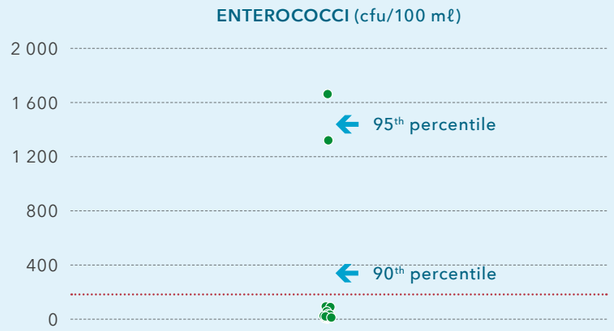
Grade	Estimated risk of illness per exposure*	Enterococci (cfu**/100 mℓ)	Escherichia coli (cfu/100 mℓ)
Excellent	<2,9% gastrointestinal (GI)	< 100 (95 percentile)	< 250 (95 percentile)
Good	<5% GI illness risk	< 200 (95 percentile)	< 500 (95 percentile)
Fair	<8,5% GI illness risk	< 185 (90 percentile)	< 500 (90 percentile)
Poor	> 8,5% GI illness risk	> 185 (90 percentile)	> 500 (90 percentile)

** Exposures are defined as 10 minutes of swimming with three head immersions.*
*** Colony-forming units.*

WHAT DOES 'POOR' WATER QUALITY MEAN?

Water quality is rated "poor" if the number of enterococci bacteria colonies in water samples exceeds the targets of the South African water quality guidelines for recreational use. If the 95th percentile (calculated using the Hazen method) of the data over a specific period is ≤100, water quality is rated "excellent"; if ≤200, it is rated "good", and if the 90th percentile over the period is ≤185, it is rated "fair". If none of these targets are met, the water quality is rated "poor".

This does not mean that the number of bacteria colonies in the water is consistently high, however. As few as two water samples with a high number of bacteria colonies can result in a "poor" water quality rating in an assessment period. This is because of the way in which water quality is rated, as the following example illustrates:



Over 12 months, 23 water samples collected from a beach presented enterococci counts of 2, 2, 4, 4, 4, 5, 8, 9, 11, 12, 12, 13, 14, 18, 22, 29, 32, 36, 56, 89, 93, 1 350 and 1 700 per 100 mℓ (see graph alongside). In this example, the 95th percentile came to 1 473, a value between the two highest counts (i.e. 1 350 and 1 700). Therefore, water quality did not achieve "excellent" or "good" ratings. The 90th percentile came to 344, which means water quality did not meet the "fair" rating either. In this example, water quality is thus rated "poor", even though 21 of the 23 samples fell in the "excellent" range. Of course, beach water quality might also be rated "poor" because a large number of samples contain high numbers of enterococci bacteria colonies.

WATER QUALITY ALONG THE ATLANTIC COAST

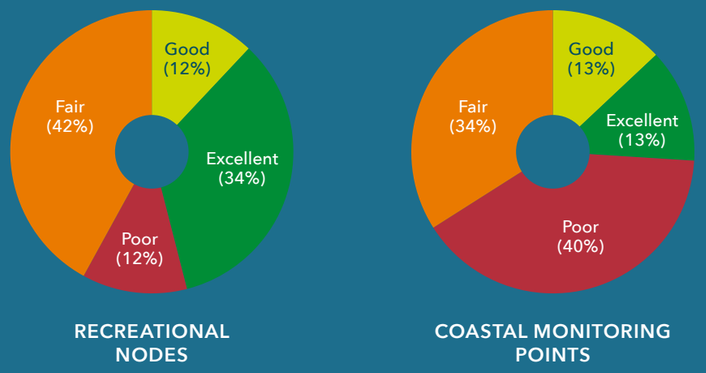
Water quality along the Atlantic coast is monitored at 26 recreational nodes and 15 coastal monitoring points (as illustrated in figure 1). Table 2 below provides an overview of water quality at these sites for the past five years (i.e. 2015 to 2019). The water quality rating for recreational nodes in 2019 is illustrated in figure 2.

Along this coast, water quality at 23 of the recreational nodes (88%) (see figure 3) met the minimum requirement for recreational use in 2019 (nine were rated "excellent", three "good" and 11 "fair"). Over the past five years, water quality improved at ten sites, especially at beaches along the northern Atlantic coast (Silwerstroomstrand, Van Riebeeckstrand, Melkbosstrand and Big Bay) as well as in some areas along the eastern shore of the Cape peninsula (Camps Bay tidal pool, Cosy Bay, Kommetjie and Scarborough).

No clear trends were evident at most of the other recreational nodes, either showing little change or varying randomly over this period. However, at three of the recreational nodes, water quality was rated "poor". These were Lagoon Beach, Three Anchor Bay and Beta Beach. The situation at these beaches is explored in greater detail below.

At the coastal monitoring points, water quality at nine (60%) of the points along the Atlantic coast also met the minimum requirement for recreational use in 2019 (two were rated "excellent", two "good" and five "fair") (see figure 3). At six (40%) of these sites, water quality was rated "poor". However, as noted above, these sites are intentionally situated near potential sources of pollution to establish the extent of their impact and, therefore, can be expected to reflect poorer water quality at times.

FIGURE 3: DISTRIBUTION OF 2019 COASTAL WATER QUALITY RATINGS, ATLANTIC COAST



Excellent
Good
Fair
Poor
1 Recreational node number (see table 2A on page 14)

FIGURE 2: WATER QUALITY RATINGS FOR RECREATIONAL NODES ALONG THE ATLANTIC COAST, 2019

TABLE 2A: ANNUAL WATER QUALITY RATINGS AT RECREATIONAL NODES ALONG THE ATLANTIC COAST, 2015–2019

▲ improved – no change ▼ regressed ~ variable

RECREATIONAL NODES	POTENTIAL FAECAL MATTER SOURCES				COASTAL WATER QUALITY RATING					TREND OVER 5 YEARS
	Stormwater runoff	Pump station	WWTW effluent	River inflow	2015	2016	2017	2018	2019	
1. Silwerstroomstrand resort		✔			Excellent	Excellent	Excellent	Excellent	Excellent	–
2. Silwerstroom					TFD*	Fair	Excellent	Excellent	Excellent	▲
3. Van Riebeeckstrand					Good	Excellent	Fair	Good	Good	▲
4. Melkbosstrand					Fair	Excellent	Excellent	Excellent	Excellent	▲
5. Big Bay					Excellent	Good	Good	Excellent	Excellent	▲
6. Small Bay		✔			Fair	Good	Fair	Good	Fair	–
7. Table View					Good	Good	Fair	Fair	Good	–
8. Milnerton lighthouse					Excellent	Excellent	Excellent	Excellent	Excellent	–
9. Lagoon Beach		✔	✔	✔	Poor	Poor	Poor	Poor	Poor	–
10. Three Anchor Bay	✔				Poor	Fair	Poor	Poor	Poor	–
11. Rocklands Beach	✔	✔			Poor	Fair	Excellent	Fair	Fair	▲
12. Milton Beach tidal pool	✔				Excellent	Excellent	Excellent	Excellent	Excellent	–
13. Saunders' Rocks tidal pool	✔	✔			Excellent	Fair	Fair	Good	Fair	▼
14. Clifton 1 – 4	✔	✔			Good	Fair	Fair	Excellent	Excellent	~
15. Maiden's Cove tidal pool 1					Excellent	Fair	Good	Fair	Fair	~
16. Maiden's Cove tidal pool 2		✔			Excellent	Poor	Excellent	Fair	Fair	~
17. Camps Bay	✔		✔		Fair	Fair	Fair	Fair	Fair	–
18. Camps Bay tidal pool A		✔			Fair	Poor	Excellent	Fair	Good	▲
19. Camps Bay tidal pool B		✔			Poor	Fair	Poor	Fair	Fair	▲
20. Beta Beach					Fair	Fair	Good	Poor	Poor	~
21. Bakoven bungalows		✔			Fair	Poor	Excellent	Fair	Fair	–
22. Cosy Bay (Oudekraal)					Fair	Fair	Excellent	Good	Excellent	▲
23. Llandudno beach				✔	Good	Excellent	Excellent	Fair	Fair	▼
24. Hout Bay beach	✔			✔	Poor	Fair	Fair	Fair	Fair	–
25. Long Beach, Kommetjie	✔	✔			Excellent	Good	Good	Excellent	Excellent	▲
26. Scarborough beach	✔			✔	Excellent	Good	Fair	Excellent	Fair	▲

** TFD – too few data.*

TABLE 2B: ANNUAL WATER QUALITY RATINGS AT COASTAL MONITORING POINTS ALONG THE ATLANTIC COAST, 2015–2019

▲ improved – no change ▼ regressed ~ variable

COASTAL MONITORING POINTS	POTENTIAL FAECAL MATTER SOURCES				COASTAL WATER QUALITY RATING					TREND OVER 5 YEARS
	Stormwater runoff	Pump station	WWTW effluent	River inflow	2015	2016	2017	2018	2019	
Granger Bay					Fair	Excellent	Fair	Excellent	Excellent	–
Mouille Point	✔				Fair	Excellent	Good	Good	Fair	~
Green Point pump station					Fair	TFD	Good	Fair	Good	▲
Park Road, Green Point	✔				Fair	Poor	Poor	Poor	Poor	–
Rocklands					Poor	Poor	Poor	Fair	Fair	▲
Milton beach tidal pool (outside)					TFD	Good	Good	Fair	Fair	–
Sunset beach tidal pool (outside)		✔			Excellent	Fair	Poor	Fair	Poor	~
Saunders' Rocks	✔	✔			Poor	Poor	Poor	Poor	Poor	▲
Saunders' Rocks tidal pool (outside)		✔			Poor	Good	Poor	Excellent	Poor	~
Maiden's Cove	✔				Good	Poor	Fair	Excellent	Poor	~
Maiden's Cove tidal pool 1 (outside)					Excellent	Good	Excellent	Fair	Excellent	~
Maiden's Cove tidal pool 2 (outside)					Fair	Excellent	Excellent	Fair	Fair	~
Camps Bay tidal pool (outside)	✔				Fair	Fair	Fair	Good	Fair	~
Horne Bay beach	✔				Excellent	Poor	Fair	Excellent	Good	~
The Kom	✔	✔			Poor	Poor	Poor	Poor	Poor	–

REASONS FOR AND RESPONSES TO INSTANCES OF "POOR" WATER QUALITY AT BEACHES ALONG THE ATLANTIC COAST

LAGOON BEACH

Lagoon Beach is located immediately south of the mouth of the Milnerton lagoon (also known as the Diep River estuary).

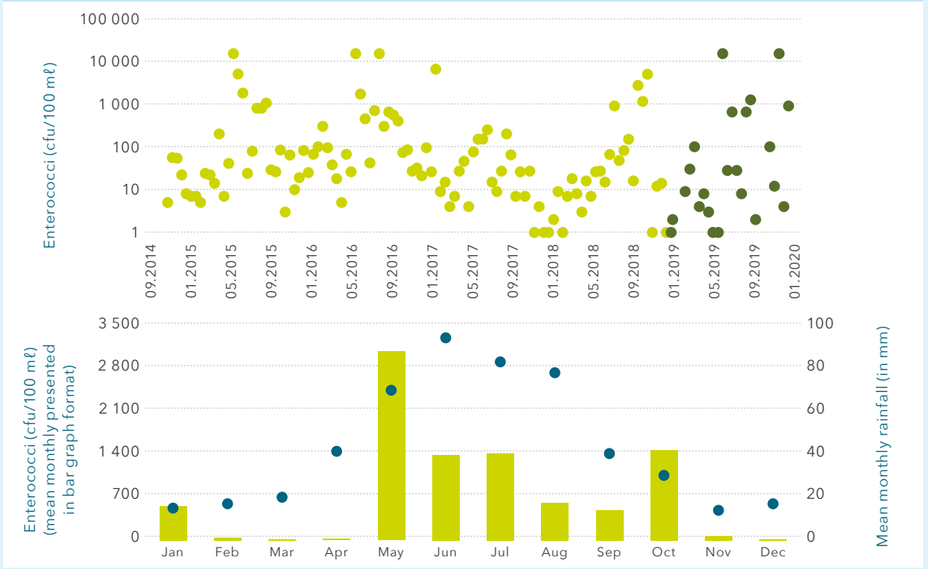
What is the extent and trend of "poor" water quality here?

Water quality in the Diep River and Milnerton lagoon has been a challenge for many years. Water quality at Lagoon Beach remained "poor" for the past five years, and pollution here is considered a chronic ongoing problem. Figure 4 shows the number of bacteria in water samples collected over the past five years (top) and the average number of bacteria colonies in samples collected in each month of the year (bottom). The bottom graph also shows the average rainfall in Cape Town in each month of the year in order to see whether the trend in the average number of bacteria and average rainfall might be related.

Even though the enterococci count in most surveys was below 100 colonies per 100 mℓ (the limit set for "excellent" water quality), the number of counts exceeding this limit is far too often. This is why it is rated "poor" and is considered a chronic pollution problem. For example, in 2019, the counts in six of 24 surveys were high (above 100 colonies per 100 mℓ). High enterococci counts at Lagoon Beach clearly also occur mostly in autumn and winter, coinciding with higher rainfall and higher river outflows.

About 800 m to the north of Lagoon Beach, water quality at Milnerton Beach consistently rated "excellent" over the past five years. This suggests that "poor" water quality is largely limited to the area near the Diep River mouth.

FIGURE 4: WATER SAMPLE RESULTS FOR LAGOON BEACH



Why is this the case?

Lagoon Beach is located at the mouth of the Diep River, which drains a highly polluted catchment (see figure 5). The catchment receives waste and contaminated runoff from a wide range of sources, including agricultural activities in the upper catchment urban runoff from significant urban expansion over the past 15 years, large growth in informal settlements and it is the receiving environment for the treated effluent discharged from the Potsdam wastewater treatment works.

FIGURE 5: INFLOW FROM THE DIEP RIVER, SHOWING TRAPPING IN THE SURF

Other contributors include sewer line failures and blockages, sewer pump station overflows and breakages as well as load-shedding causing sewer pump station failures, especially over the past 24 months. Illegal dumping of industrial and household waste in the river and stormwater system remains a problem.

Notably – in the past 12 months, the performance of the wastewater treatment works has been below optimal, contributing significantly to the problem in 2019. Finally, excessive water abstraction for agricultural use in the upper catchment amplifies the pollution levels as effluent from the wastewater treatment works is often the only flow entering the system during drier summer periods.

The way forward

The City considers the level of pollution in the Diep River to be unacceptable. In this regard, it has developed a comprehensive pollution abatement plan for the lower part of the catchment that falls in our boundary. This action plan details immediate, medium and long term actions with the most significant being the investment of over R1,7 billion in infrastructure improvements at Potsdam in the next five years. In the interim, public health warning signs are in place at Lagoon beach, at the mouth of Milnerton lagoon as well as in the lagoon itself. For the foreseeable future, the City advises against recreation in the lagoon and where it flows into the sea.

There are no quick fixes for the pollution problem at Lagoon beach, as the causes are wide and diverse. Improvements in water quality will be gradual, but the City is committed to ongoing improvements through interventions and actions that is in its control. The public can assist the City in improving the water quality at Lagoon beach by refraining from illegal dumping.

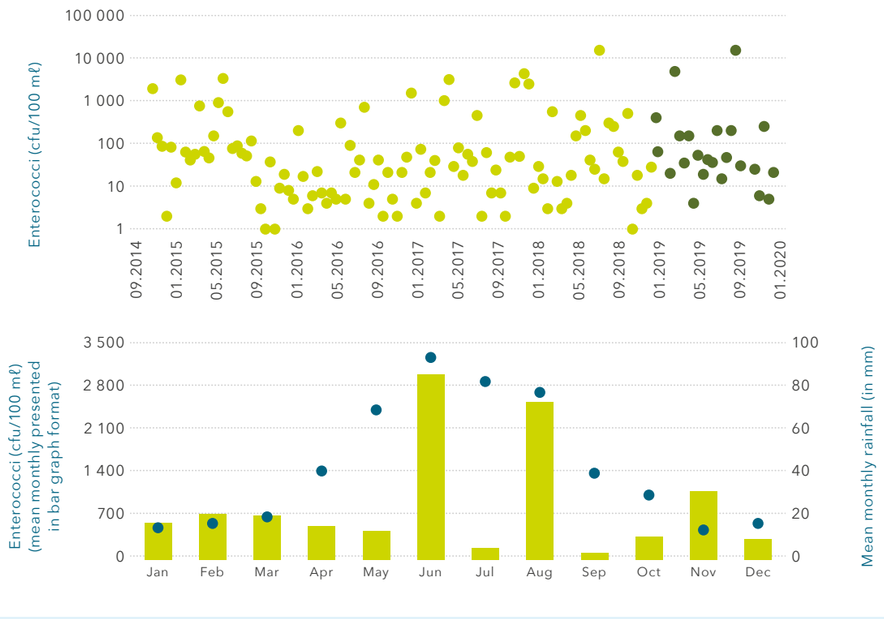
THREE ANCHOR BAY

Three Anchor Bay is a very small bay between Mouille Point and Sea Point.

What is the extent and trend of "poor" water quality here?

Water quality at Three Anchor Bay has consistently tested "poor", except in 2016, when it complied with the minimum requirement ("fair" rating). Pollution at this site is a chronic problem. A seasonal assessment shows that the worst conditions tend to prevail in the winter months (higher rainfall) (see figure 6).

FIGURE 6: WATER SAMPLE RESULTS FOR THREE ANCHOR BAY



Why is this the case?

Contaminants that illegally enter the stormwater system are a major source of pollution here. Three large stormwater pipes constantly discharge significant volumes of contaminated water from the surrounding city (see table 3).

TABLE 3: BACTERIA IN STORMWATER ON 18 SEPTEMBER 2019

Sampling point	*E. coli* (cfu/100 mℓ)	Enterococci (cfu/100 mℓ)
Three Anchor Bay stormwater drain A	35 000	20 000
Three Anchor Bay stormwater drain C	>1 000 000	36 000

Pollution from these stormwater drains at this beach is also amplified by prevailing weather and ocean conditions. In summer, south-easterly winds and smaller swells often trap the polluted water in the small, sheltered bay, preventing sufficient dispersion away from the site. Dense kelp beds near the entrance also tend to break free and accumulate on the shore to decompose, which aids the growth of bacteria communities.

The way forward

Water quality at Three Anchor Bay will improve significantly if the pollution source via the stormwater system can be identified and stopped. The stormwater pipes discharge water throughout the year. This shows that the discharge is not as a result of rainfall, as it should be, but because of ongoing illegal discharges. Rainfall, when it happens, flushes additional contaminants into the small bay. Previous attempts by the City to install ultraviolet light disinfectant systems in the stormwater pipes failed within a few hours, as the high fat and oil content smothered the systems. The City will continue its efforts to identify and control the illegal pollution sources via the stormwater system – meaning fat and oil are illegally discharged into the stormwater system. A task team of engineers and pollution control officials have been tasked to map and assess the entire stormwater system and identify the points of contamination. This assessment will be completed by June 2020.

It is unlikely that poor water quality at Three Anchor Bay is the result of the Green Point marine outfall and the City will report on the outcome as soon as the sampling is complete.

Three Anchor Bay is primarily used for the launching and retrieval of surf-skis and kayaks. These are considered non-contact activities, with a much lower risk of exposure to contaminated water. Public health warning signs are in place, and swimming is not recommendedat this bay.

BETA BEACH

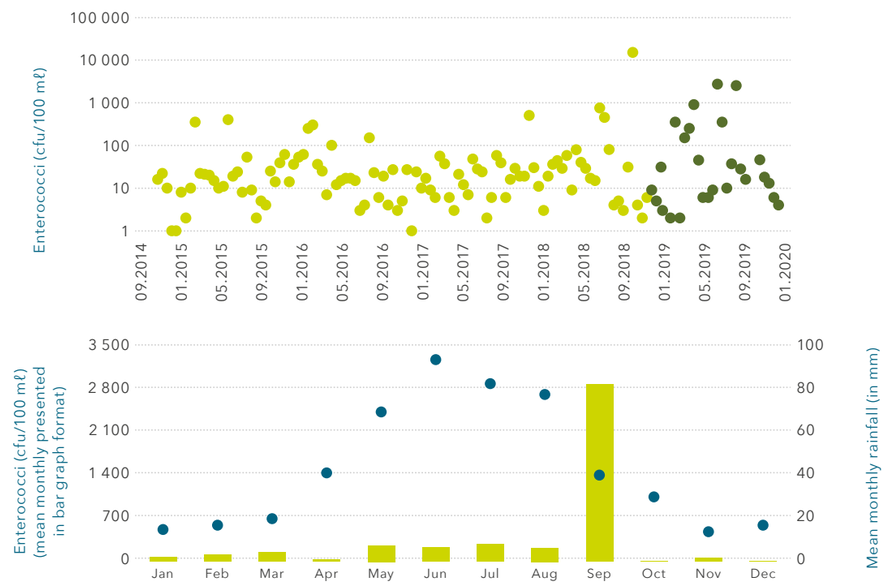
Beta Beach is a small, sheltered rocky bay adjoining the suburb of Bakoven.

What is the extent and trend of "poor" water quality here?

Water quality problems at Beta Beach only started occurring in the past two years. The challenge here is spikes in enterococci counts as opposed to persistently high counts.

There is no discernible negative trend over the past 13 years. Seasonal patterns suggest that rainfall events may not be the only reason for the spikes (see figure 7).

FIGURE 7: WATER SAMPLE RESULTS FOR BETA BEACH



Why is this the case?

Common to beaches adjacent to urban areas, the potential sources of bacteria spikes are numerous, and primarily enter the coastal area through stormwater drains. The sources of contamination typically include the flushing of catchments (especially after a dry spell), sewer system failures (breakdowns, blockages, pump station failures, overflows and power outages) and illegal sewer connections to the stormwater system. Poor pet hygiene practices by dog owners using this stretch of coast could also pose some risk. In addition, there is a sewer pump station at this location, which, if it fails, will discharge wastewater into the stormwater system directly at the beach.

A number of stormwater pipes drain into this small, sheltered bay (see figure 8). Similar to Three Anchor Bay, Beta Beach is relatively protected, especially in summer, which results in low dispersion and the trapping of pollutants that enter via the drains. Polluting events appear to be highly variable and depend on infrastructure flows and breakages/outages.

FIGURE 8: STORMWATER DRAINAGE INTO BETA BEACH

The way forward

The City is committed to reducing the number of sewer failures across Cape Town, including in the suburb of Bakoven, where Beta Beach is situated.

An updated coastal sewage spill protocol is also in place. In the event of a sewer break, spill or failure, this new protocol will ensure a rapid City response, closing the beach to bathing until such time that laboratory results show a return to normal bacteria counts.

A dedicated team has been tasked to map and assess the entire stormwater system and identify any points of contamination. This assessment will be completed by June 2020.

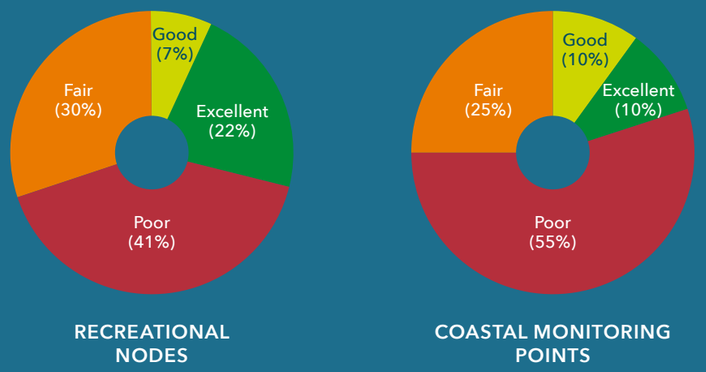
WATER QUALITY ALONG THE FALSE BAY COAST

Along the False Bay coast, water quality is monitored at 27 recreational nodes and 22 coastal monitoring points (see figure 1 earlier on). Table 4 provides an overview of annual water quality ratings at each of these sites for the past five years (2015 to 2019). The water quality rating for recreational nodes in 2019 is illustrated in figure 9 below.

In 2019, water quality at 59% (16) of the recreational nodes along the False Bay coast complied with the minimum requirement for recreational use (six tested "excellent", two "good" and eight "fair"). At four of these sites (Kalk Bay harbour, Kalk Bay tidal pool, Monwabisi tidal pool and Kogel Bay), water quality improved from 2015 to 2019. Water quality at the remaining ten sites either showed little change or varied randomly over this period.

However, water quality at 11 sites along the False Bay coast was rated "poor" in 2019, accounting for 41% of the recreational nodes in this area. These sites were mostly concentrated in the north-eastern (Monwabisi, Macassar, Strand and Gordon's Bay) and north-western (Fish Hoek and Sunrise Beach) parts of the bay (see figure 10). Water quality at beaches in the north-east has also regressed over the past five years. The situation at these beaches is explored in greater detail below.

FIGURE 9: DISTRIBUTION OF 2019 COASTAL WATER QUALITY RATINGS, FALSE BAY COAST



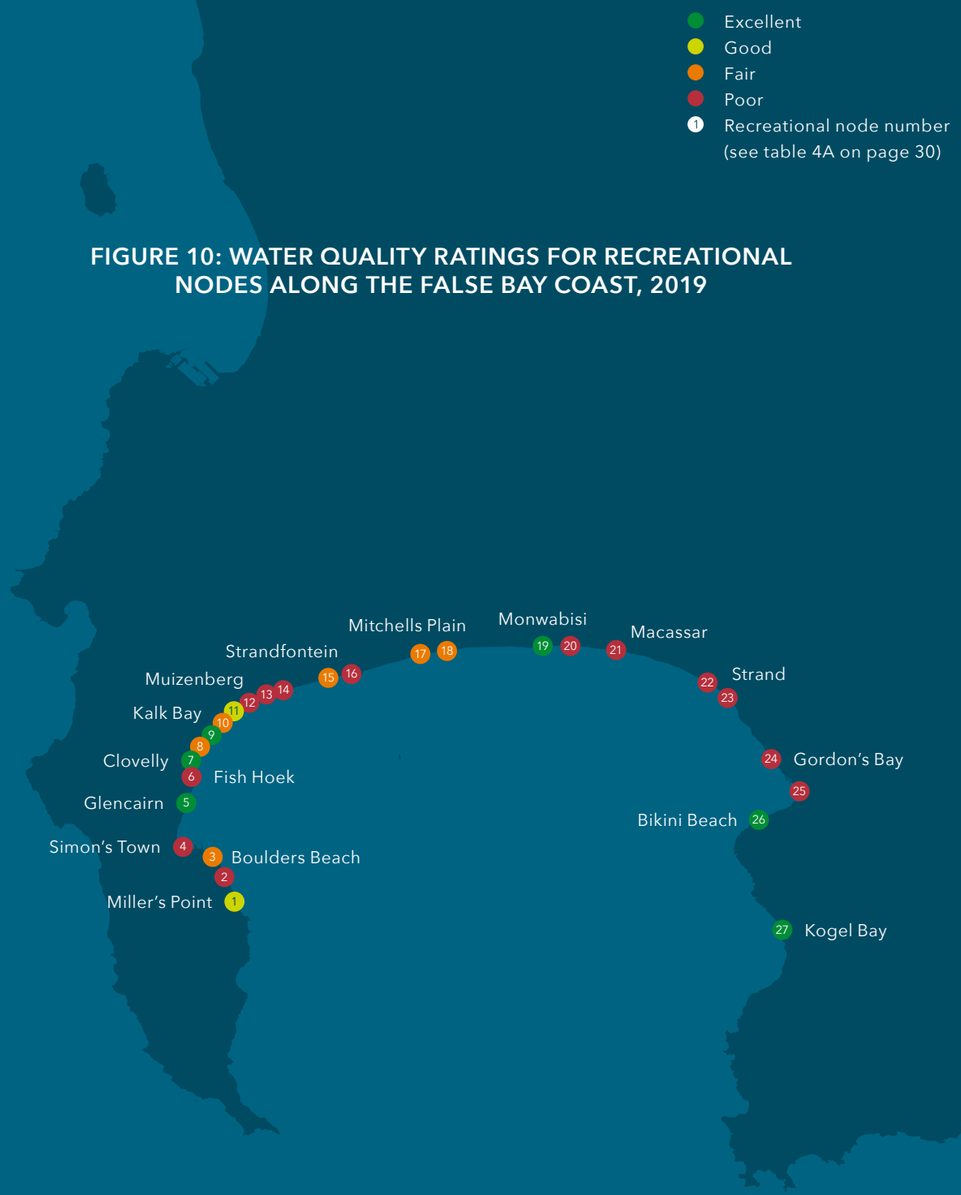


FIGURE 10: WATER QUALITY RATINGS FOR RECREATIONAL NODES ALONG THE FALSE BAY COAST, 2019

TABLE 4A: SUMMARY OF ANNUAL WATER QUALITY RATINGS AT RECREATIONAL NODES ALONG THE FALSE BAY COAST, 2015–2019

▲ improved – no change ▼ regressed ~ variable

RECREATIONAL NODES	POTENTIAL FAECAL MATTER SOURCES				COASTAL WATER QUALITY RATING					TREND OVER 5 YEARS
	Stormwater runoff	Pump station	WWTW effluent	River inflow	2015	2016	2017	2018	2019	
1. Frank's Bay	✔				Excellent	Good	Excellent	Excellent	Good	–
2. Seaforth Beach	✔	✔			Excellent	Fair	Excellent	Excellent	Fair	▼
3. Boulders Beach					Excellent	Fair	Fair	Fair	Fair	–
4. Simon's Town Long Beach	✔	✔			Poor	Poor	Fair	Poor	Poor	–
5. Glencairn beach					Excellent	Good	Fair	Excellent	Excellent	~
6. Fish Hoek beach	✔				Poor	Poor	Poor	Excellent	Poor	▼
7. Clovelly		✔		✔	Poor	Fair	Poor	Poor	Excellent	~
8. Kalk Bay harbour beach	✔				Poor	Poor	Poor	Poor	Fair	▲
9. Kalk Bay tidal pool	✔				Poor	Poor	Fair	Excellent	Excellent	▲
10. Dalebrook tidal pool					Fair	Good	Excellent	Excellent	Fair	~
11. St James tidal pool					Excellent	Excellent	Excellent	Excellent	Good	–
12. Muizenberg station	✔				Fair	Poor	Fair	Fair	Poor	▼
13. Muizenberg pavilion				✔	Poor	Fair	Fair	Fair	Fair	–
14. Sunrise Beach				✔	Poor	Poor	Poor	Fair	Poor	▼
15. Strandfontein	✔				Fair	Fair	Excellent	Excellent	Fair	~
16. Strandfontein tidal pool	✔				Fair	Fair	Good	Excellent	Poor	▼
17. Mnandi Beach west	✔				Poor	Excellent	Fair	Excellent	Fair	~
18. Mnandi Beach east	✔				Poor	Fair	Fair	Excellent	Fair	~
19. Monwabisi tidal pool					Good	Good	Poor	Excellent	Excellent	▲
20. Monwabisi beach	✔				Fair	Poor	Poor	Poor	Poor	–
21. Macassar beach			✔	✔	Fair	Fair	Poor	Poor	Poor	▼
22. Strand beach	✔				Fair	Excellent	Poor	Poor	Poor	▼
23. Strand Pavilion jetty	✔				Fair	Good	Poor	Poor	Poor	▼
24. Strand Harmonie Park	✔				Poor	Excellent	Poor	Poor	Poor	▼
25. Gordon's Bay	✔				Poor	Excellent	Poor	Fair	Poor	▼
26. Bikini Beach					Fair	Excellent	Poor	Excellent	Excellent	~
27. Kogel Bay				✔	Poor	Good	Poor	Excellent	Excellent	▲

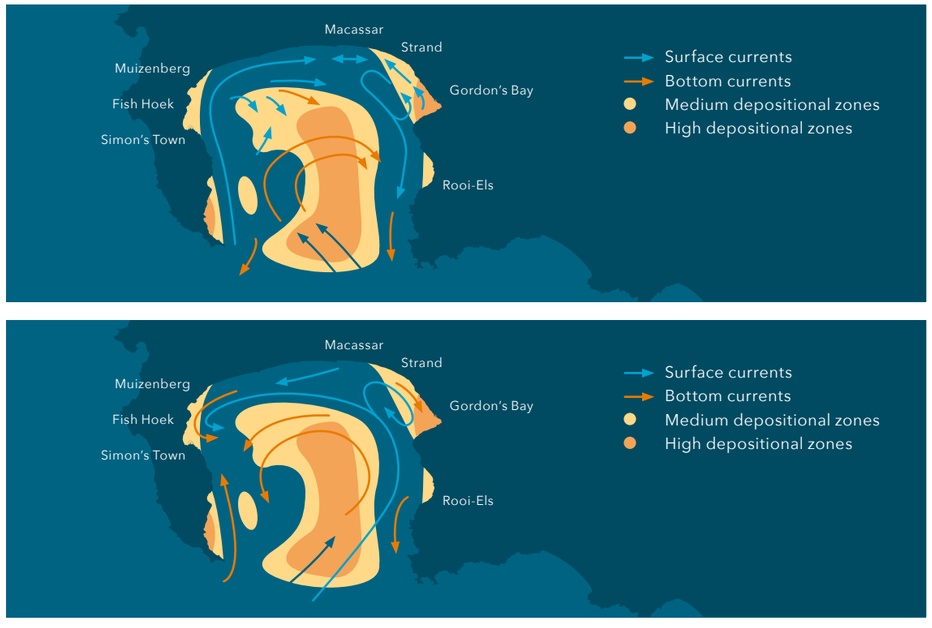
TABLE 4B: SUMMARY OF ANNUAL WATER QUALITY RATINGS AT COASTAL MONITORING POINTS ALONG THE FALSE BAY COAST, 2015–2019

▲ improved – no change ▼ regressed ~ variable

COASTAL MONITORING POINTS	POTENTIAL FAECAL MATTER SOURCES				COASTAL WATER QUALITY RATING					TREND OVER 5 YEARS
	Stormwater runoff	Pump station	WWTW effluent	River inflow	2015	2016	2017	2018	2019	
Miller's Point		✔	✔		Excellent	Excellent	Excellent	Excellent	Fair	–
Simon's Town Harbour	✔	✔			Good	Excellent	Fair	Fair	Excellent	▲
Simon's Town Diving School					Excellent	Excellent	Good	Good	Excellent	▲
Kalk Bay rocks	✔	✔			Excellent	Excellent	Fair	Excellent	Fair	~
Ex Sandown Hotel site					Good	Excellent	Excellent	Good	Good	–
Lifebox 21			✔		Poor	Poor	Poor	Poor	Poor	–
Lifebox 23			✔		Poor	Poor	Poor	Poor	Poor	–
Sonwabe			✔		Poor	Poor	Poor	Poor	Poor	–
Ribbon parking area			✔		Poor	Poor	Poor	Poor	Fair	–
Lifebox 30	✔				Poor	Poor	Poor	Poor	Poor	–
Lukannon Drive wastewater pump station	✔	✔			Poor	Fair	Fair	Good	Fair	~
Mitchells Plain wastewater effluent discharge			✔		Poor	Poor	Poor	Good	Poor	~
Mitchells Plain stormwater west discharge East	✔				Poor	Poor	Poor	Poor	Poor	–
Mitchells Plain stormwater west discharge West	✔				Poor	Poor	Poor	Poor	Poor	–
Mitchells Plain stormwater east discharge East	✔				Poor	Poor	Poor	Poor	TFD	–
Mitchells Plain stormwater east discharge West	✔				Poor	Poor	Poor	Poor	TFD	–
Strand opp Woltemade St	✔				Fair	Excellent	Poor	Poor	Poor	▼
Strand near Lourens River mouth	✔			✔	Poor	Excellent	Poor	Poor	Poor	▼
Gordon's Bay wastewater treatment works			✔		Poor	Poor	Poor	Poor	Poor	–
Gordon's Bay harbour island	✔				Poor	Poor	Poor	Good	Good	▲
Gordon's Bay harbour	✔				Poor	Fair	Poor	Fair	Fair	–
Near Sir Lowry's Pass river	✔			✔	Poor	Poor	Poor	Poor	Poor	–

While the deterioration in water quality in parts of False Bay is most likely a result of increased wastewater and/or discharges from the stormwater system associated with rapid urban development (including informal settlements), local water circulation processes (figure 11) exacerbate matters in these areas.

FIGURE 11: TYPICAL CURRENT PATTERNS AND DEPOSITIONAL ZONES IN FALSE BAY IN SOUTH-EASTERLY (TOP) AND NORTH-WESTERLY WIND CONDITIONS (BOTTOM)



Source: CSIR

When the southeaster blows (normally in summer), both the surface and deep flows are generally clockwise, with a strong and narrow outflow along the eastern shores of the bay. An exception to this is the north-eastern corner of the bay (Gordon's Bay area), which develops an anticlockwise gyre. On the other hand, when the northwester blows (normally in winter), this results in generally weaker flows, with an anticlockwise tendency at the surface, but a cyclonic tendency in the deeper waters. Again, the Gordon's Bay area tends to develop a closed circulation, which, in north-westerly wind conditions, is often cyclonic. These wind patterns influence the movement of sediment and other particles. In general, particles are transported northwards along the bay's western shores, turning eastwards along the northern shoreline, while transport along the eastern shores is northwards. As a result, a convergence zone develops in the north-eastern corner (in the vicinity of Gordon's Bay), which also becomes a depositional zone or "trap" for pollutants. Also, smaller embayments along the coast, such as sheltered areas in the north-western corner of the bay (Fish Hoek and Muizenberg areas), which are quieter environments, will almost certainly act as traps for fine particles. Therefore, it is not surprising that most of the poorly rated recreational nodes are concentrated in these areas of the bay.

In 2019, water quality at nine (45%) of the coastal monitoring points along the False Bay coast met the minimum requirement for recreational use (two tested "excellent", two "good" and five "fair"), while water quality at 11 sites (55%) was rated "poor". Many of these sites are not at recreational areas, but are intentionally situated near potential sources of pollution to establish the extent of their impact and, therefore, can be expected to reflect poorer water quality at times.

Overall, water quality along the Atlantic coast was better than along the False Bay coast in 2019. This is most likely a function of different levels of urban development pressures, but also of ambient water circulation processes, with False Bay being a much more sheltered waterbody with less assimilative capacity than Cape Town's more turbulent Atlantic shores.

The "brown water" along False Bay's northern shores

The water near the shore in parts of False Bay is occasionally dark brown. This is often misconceived as pollution. The discolouration is in fact caused by the proliferation of a small, singled-celled plant (phytoplankton) named *Anaulus australis*. These types of phytoplankton are widely distributed along continental coasts, but are most common in the southern hemisphere. *Anaulus australis* has adaptations that aid its retention in the broad, active surf zones of so-called dissipative[3] sandy beaches. They can alter their buoyancy,[4] allowing the cells to follow a pattern of inhabiting the sand during the night and increasing their buoyancy to float to the surface during the day to photosynthesise. Dense aggregations of these phytoplankton are not always present. At dissipative beaches in False Bay, the conditions most conducive to the formation of dense aggregations are high waves and strong rip currents that develop during onshore southerly to south-easterly winds. Offshore north-westerly winds are less conducive to this phenomenon. Spatial variability in aggregations is a result of beach morphology, which influences water circulation patterns and the development of rip currents. Smaller, pocket-beach-type surf zones do not usually support surf-zone phytoplankton aggregations, nor do rocky shores. Strandfontein, Mnandi west and east beaches, although sandy, are spatially constrained. St James and its tidal pool is located in a rocky shore area and, according to the above, should therefore not have surf-zone phytoplankton aggregations. An explanation for the presence of *Anaulus* at this location is advection[5] from Muizenberg beach via the rip current that develops on the extreme western side of the beach, at Surfer's Corner.

[3] *High-energy beaches where most wave energy is expended through the process of breaking.*
[4] *The ability or tendency to float.*
[5] *The transfer of heat or matter by the flow of a fluid.*

REASONS FOR AND RESPONSES TO INSTANCES OF "POOR" WATER QUALITY AT BEACHES ALONG THE FALSE BAY COAST

SIMON'S TOWN LONG BEACH

Simon's Town Long Beach is a long, narrow, sandy beach cut off from the broader environment by the main road and railway line. It ends at the start of the South African Naval area.

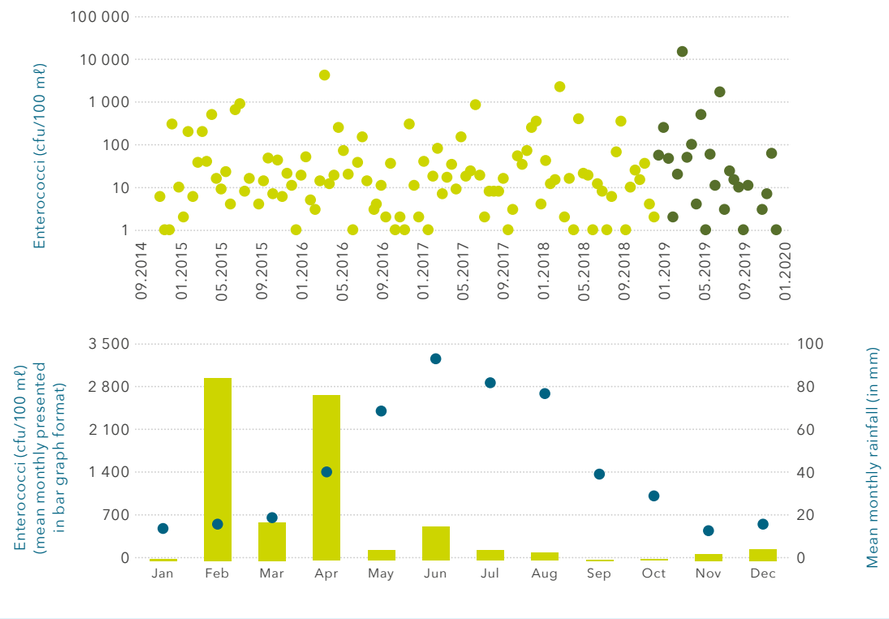
What is the extent and trend of "poor" water quality here?

Apart from 2016, water quality at this beach consistently tested "poor" over the period 2015–2019 (figure 12). Pollution here is considered chronic. This is mostly as a result of discrete spikes in bacteria counts, which are almost certainly linked to sewer pump station failure and overflow, and, possibly, effluent from the wastewater treatment works discharging under certain ocean conditions.

There is a slight long-term negative trend. This is likely due to increased pressure on the Simon's Town sewer system and pump station due to significant urban growth and development in the past 15 years.

Seasonal patterns show that rainfall events are not the only reason for the spikes.

FIGURE 12: WATER SAMPLE RESULTS FOR SIMON'S TOWN LONG BEACH



Why is this the case?

At this beach, in most instances, the spikes in bacteria counts are almost certainly due to one of two factors. Firstly, Simon's Town's main sewer pump station is located here. The pump station's overflow pipe discharges directly onto the shore. Pump station failure or overflow will therefore result in the discharge of sewage directly into the shore. The second factor relates to treated effluent from the Simon's Town wastewater treatment works being discharged near the Naval Battery. An unknown factor, however, is the status of the sewage system in the Naval dockyard and base, neither of which is under the City's management or control.

Simon's Town is a sheltered embayment in the north-western part of False Bay, which tends to have poor water exchange. This typically results in the accumulation of contaminants and trapping of pollutants in the nearshore area (as illustrated in figure 14 earlier on). This will amplify any pollution effect.

The way forward

The City will install a pump station overflow containment sump to stop the spillage of sewage directly into the shoreline in the event of a pump failure or overflow. The removal of the pump station overflow should significantly reduce discrete sewage pollution events and see a marked improvement in water quality at this beach.

FISH HOEK BEACH

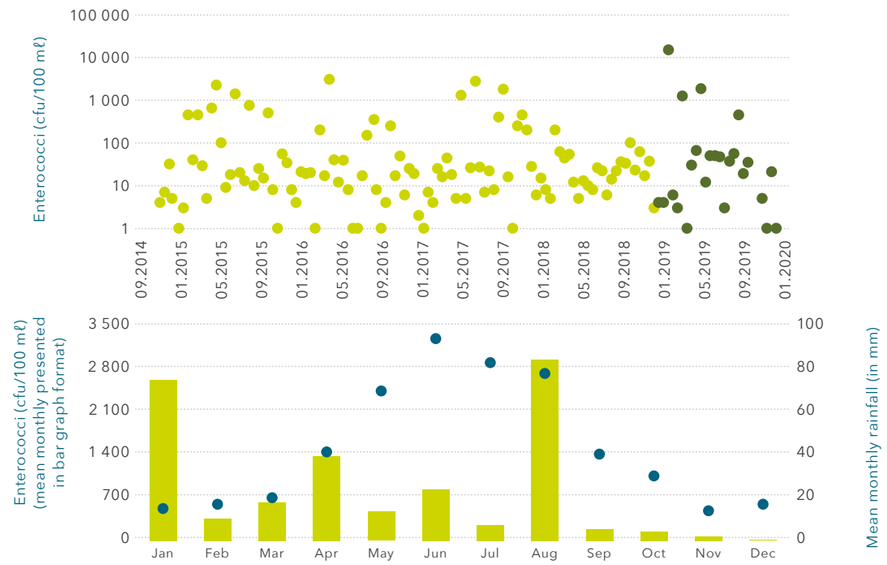
Fish Hoek beach is one of the most renowned recreational and tourist nodes in Cape Town, and a Blue Flag beach.

What is the extent and trend of "poor" water quality here?

Bar 2018, when Fish Hoek beach achieved a "good" water quality rating, water quality here consistently tested "poor" from 2015 to 2019 (figure 13). This is mostly a result of discrete spikes in bacteria counts (four in 2019) as opposed to consistently high counts. Seasonal patterns suggest that rainfall events are not the only reason for the spikes. Clovelly beach, which is part of Fish Hoek Bay, has an "excellent" rating for 2019, demonstrating the high variability of water quality, but is also indicative of the role stormwater discharges play in affecting results.

There is no discernible trend of a significant deterioration in water quality at Fish Hoek beach over the past 15 years.

FIGURE 13: WATER SAMPLE RESULTS FOR FISH HOEK BEACH



Why is this the case?

The only potential land-based sources of bacteria are two stormwater outlets near the sampling site. Water flowing from the outlets has been of a consistently poor quality over a number of years. The City performed numerous investigations to determine whether there are illegal sewage connections to the stormwater system, or whether the sewage reticulation system perhaps connects or leaks into the stormwater system. The Fish Hoek Ratepayers' Association also launched a private investigation and conducted regular analyses of samples taken along the main stormwater outlets, which showed very high bacteria counts.

The City's detailed inspections of the sewage reticulation system have not revealed any illegal sewage connections or leaks into the stormwater system. Therefore, the high bacteria counts in the stormwater system likely originate from direct discharges into the stormwater system at the Fish Hoek central business district, as the catchment is relatively small and comprises only residential and commercial developments.

Fish Hoek is also vulnerable to the accumulation and trapping of pollutants as described in figure 14, which will amplify any pollution problems.

How is it possible for Fish Hoek beach to have retained Blue Flag status?

Blue Flag status is awarded on a seasonal basis, which, for Cape Town, is 1 December to 31 March. Water quality is assessed from the month before Blue Flag season, and then once a month throughout the season. This means that, in Cape Town, Blue Flag status is awarded based on water quality results for the summer season only. As figure 17 shows, the frequency of "poor" results is far lower in summer due to significantly reduced or absent rainfall events. Therefore, based on the externally stipulated rules for Blue Flag status, Fish Hoek beach has met the water quality standards required for Blue Flag status for the summer monitoring period.

The way forward

Due to the poor water quality in the stormwater system in the central business district and Passenger Rail Agency of South Africa (PRASA) areas of Fish Hoek, coastal water quality will likely improve if water quality in the stormwater system improves. Therefore, as a point of departure to identify the source of pollution, the City collaborated with the Fish Hoek Ratepayers' Association and Stellenbosch University to conduct a visual inspection of the stormwater system. As shown in figure 14 below, it was found that manholes located downstream of the PRASA area adjacent to the taxi ranks and commercial activities along Beach Road showed much poorer conditions compared to manholes upstream. This work to address the pollution via the stormwater system continues and a report by the task team is due in June 2020.

FIGURE 14: FINDINGS OF FISH HOEK STORMWATER SYSTEM INSPECTION

Water quality at stormwater manholes based on visual assessment (i.e. smell, colour, oil, grease, etc.)

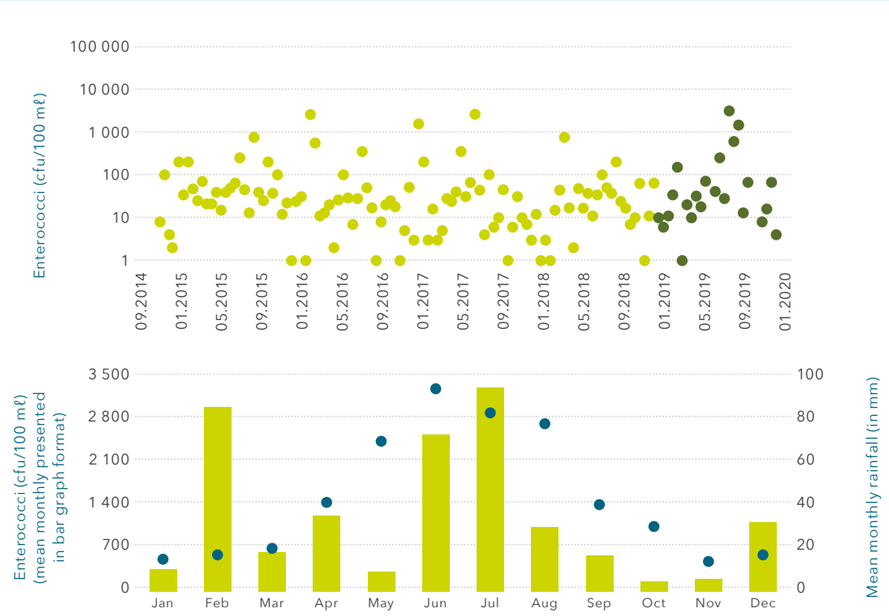
SUNRISE BEACH

Sunrise Beach is well known for the very popular Sunday informal market and is also a popular beach for dog walkers, as free-running dogs are allowed.

What is the extent and trend of "poor" water quality here?

Except for 2016, water quality at Sunrise Beach consistently tested "poor" from 2015 to 2019 (figure 15). Again, there is a clear pattern of bacteria spikes inter-mixed with "excellent" water quality results. Water quality is becoming more chronic, as is evident at other coastal monitoring sites along this part of the coast as well (such as Lifebox 21, Lifebox 23 and Sonwabe). Seasonal patterns suggest that rainfall is one reason for the bacteria spikes, as higher counts occurred more often in autumn and winter.

FIGURE 15: WATER SAMPLE RESULTS FOR SUNRISE BEACH



Why is this the case?

Large wastewater treatment works (such as the Cape Flats plant) release effluent to the northern shores of False Bay. Contamination at Sunrise Beach, therefore, is likely associated with effluent, as well as possible groundwater seepage from these works, along with significant urban expansion in the Vrygrond and Capricorn areas adjacent to the coastline. Contamination from poor pet hygiene practices by dog owners using this stretch of coast could also pose some risk, as it is a high-use dog zone.

Since 2005, conditions have been deteriorating. This seems to correlate with an increase in the volume of wastewater that enters the large wastewater treatment works, as well as significant growth in the urban population in Vrygrond and Capricorn over the same period.

The way forward

Poor water quality on the northern shores of False Bay is not a new problem, and investigations as far back as the 1980s showed similar results. Yet the City is constantly upgrading and increasing the capacity of its wastewater treatment works, which should halt further deterioration in water quality and, in due course, see an improvement. Significant infrastructure investment in the City's wastewater treatment works capacity is also planned. The City manages over 500 mega litres of wastewater per day, of which the bulk is managed and treated on the Cape Flats. This will have some impact on the northern shores of False Bay.

STRANDFONTEIN TIDAL POOL

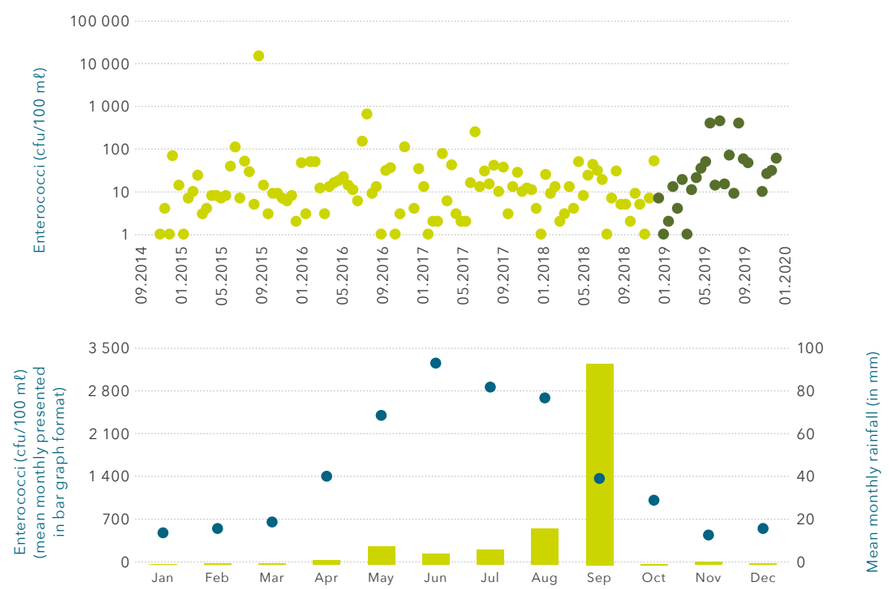
Strandfontein tidal pool is the second-largest tidal pool in Africa, and one of the most important coastal recreation assets in Cape Town. Located in an otherwise exposed area of False Bay, the tidal pool offers a calm, protected bathing area.

What is the extent and trend of "poor" water quality here?

Water quality in the tidal pool was rated "fair", "good" or "excellent" between 2015 and 2018, but declined to "poor" in 2019. As shown in figure 16, the "poor" rating resulted from three moderate spikes in bacteria counts (all below 450 colonies per 100 mℓ). Seasonal patterns suggest that rainfall is one cause of the contamination.

The results since 2005 show a very consistent pattern, with no negative trend (and, in fact, a slight improvement over the past ten years).

FIGURE 16: WATER SAMPLE RESULTS FOR STRANDFONTEIN TIDAL POOL



Why is this the case?

There are no stormwater drainage or effluent discharges directly into the tidal pool. Therefore, contamination is most likely associated with localised runoff from hard surfaces and ablution facilities surrounding the tidal pool, people using the pool (especially during periods of high use), or the high number of birds that roost on the tidal pool wall. As semi-enclosed waterbodies, tidal pools inherently do not have good dispersion properties and are vulnerable to any pollutant load.

The way forward

If the water quality trend at the tidal pool remains negative over the next few years, the City will investigate diverting runoff from the surrounding pavilion away from the tidal pool. This is not considered necessary at this stage based on the history of results, especially in the holiday season.

MONWABISI BEACH

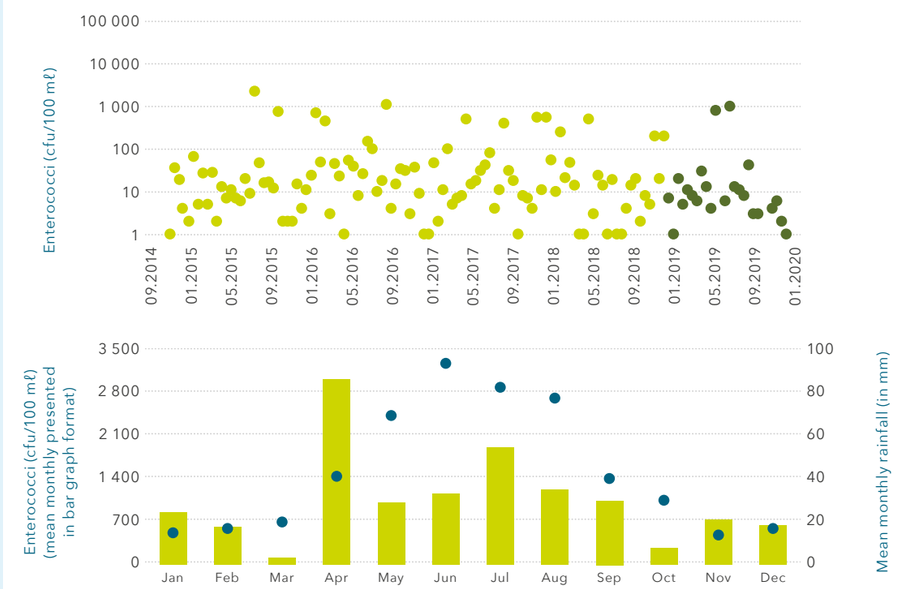
Monwabisi beach was formed after the construction of an erosion protection breakwater, which had trapped the sand.

What is the extent and trend of "poor" water quality here?

Water quality at this beach was rated "poor" for the past four years (figure 17), albeit mostly associated with spikes in bacteria counts instead of persistently high counts. In 2019, two spikes (24 April and 5 June) contributed to the "poor" rating. If it were not for these, water quality would have tested "excellent". The spikes did not occur in the summer months, and specifically not in the high-use December period, meaning the risk to most bathers was low. There is no clear seasonal trend evident at this beach.

The trend at Monwabisi beach, in fact, shows a gradual improvement over the past 15 years. Water quality of the adjacent tidal pool, which is the main swimming amenity, is rated "excellent".

FIGURE 17: WATER SAMPLE RESULTS FOR MONWABISI BEACH



Why is this the case?

Spikes in bacteria counts at this beach are a result of very poor water quality in a stormwater detention pond situated just east of Monwabisi. The pond water has some of the highest bacteria counts in Cape Town, and if it overflows during rainfall events, it will contaminate the shoreline. The water quality at Monwabisi beach, however, is not solely related to rainfall. There must be other bacteria sources that contribute to the "poor" water quality rating.

The way forward

The City is planning an entire beach precinct upgrade at Monwabisi and as part of this large investment, options to negate the impact of the stormwater pond to the east will be developed as part of the upgrade.

MACASSAR BEACH

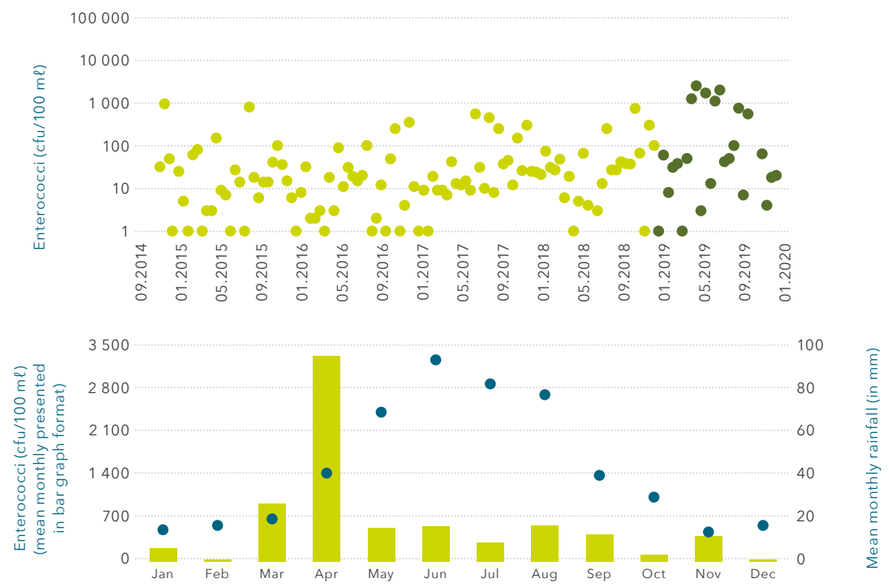
Macassar beach is a wide, sandy beach at the mouth of the Eerste River.

What is the extent and trend of "poor" water quality here?

Water quality at Macassar beach was consistently "poor" from 2015 to 2019 (figure 18). Seasonal patterns suggest that rainfall events are not the only reason for spikes in bacteria counts, and wider pollution sources, including wastewater treatment works and agriculture, are likely.

"Poor" water quality here is chronic and ongoing, if not deteriorating.

FIGURE 18: WATER SAMPLE RESULTS FOR MACASSAR BEACH



Why is this the case?

Bacteria contamination at Macassar beach is primarily associated with runoff from the Eerste River (see figure 19), which also drains the Kuils River catchment, and the discharge of wastewater from the Macassar wastewater treatment works into the Eerste River estuary. These catchments support densely populated urban areas, which produce large volumes of contaminated stormwater runoff. In addition, numerous large wastewater treatment works in both the City and neighbouring municipalities release effluent into the rivers. Moreover, significant runoff from agricultural areas introduces further pollutants to the rivers, which ultimately end up on the beach at Macassar.

FIGURE 19: INFLOW FROM THE EERSTE RIVER, SHOWING TRAPPING IN THE SURF ZONE

The way forward

The City is constantly upgrading and increasing the capacity of its wastewater treatment works, which should halt further deterioration in water quality and, in due course, see an improvement. The Zandvliet wastewater treatment works is currently undergoing a major upgrade and expansion.

Significant infrastructure investment in the City's wider wastewater treatment works capacity is also planned, which will reduce the pollution load in the system. However, pollution here is from a wide and diverse set of causes, including from the upper catchments outside the City's boundary. Complete reversal of pollution in this system would be unlikely, while improvements will be the target. A task team has been established to develop a pollution abatement plan for the Kuils River catchment.

STRAND TO GORDON'S BAY

As these beaches show similar causes and wider implications for coastal water quality, they are dealt with collectively.

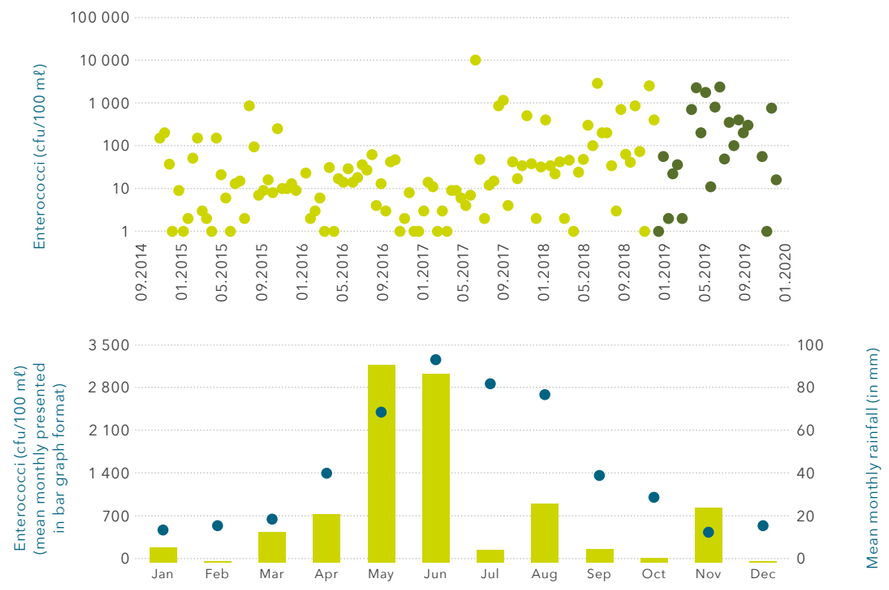
What is the extent and trend of "poor" water quality here?

Overall, water quality at beaches along this stretch of coastline, including Strand beach, the Strand Pavilion jetty, Harmony Park and Gordon's Bay, is rated "poor". Seasonal patterns show that some spikes in bacteria counts are linked to rainfall, as they mostly occur in the rainy season (autumn/winter). The spikes are not restricted to this season, however, particularly at Harmony Park. There must be other causes as well.

The "poor" water quality is chronic and ongoing, and the City has flagged this as a major concern.

The results since 2005 show a negative trend.

FIGURE 20: WATER SAMPLE RESULTS FOR STRAND BEACH



Why is this the case?

Urban development in catchments in the hinterland of the north-eastern False Bay coastline has grown rapidly over the past few years, including significant growth in the informal settlement of Lwandle. Especially challenging for the City is the rapid expansion of informal settlements, with lower level basic service provision at the household level, which results in a marked deterioration in the quality of stormwater runoff and river flow to coastal areas. There are also numerous new industrial developments in the catchments. This has resulted in significant urban runoff entering the coastal area via the Lourens, Soet and Sir Lowry's Pass rivers. In addition, the Gordon's Bay wastewater treatment works releases effluent along this coast, the volumes of which have increased markedly over the past few years. The Soet River in particular, is a highly polluted river system.

Moreover, coastal circulation processes in False Bay (illustrated in figure 11 on page 28) cause a convergence in this corner of the bay. This traps pollutants in the nearshore area, amplifying the effect of pollution.

The way forward

The City is very concerned about the level of pollution in this coastal strip. The City has established a task team to address the pollution in the Soet River catchment to map and assess the entire stormwater system and identify any points of contamination. In addition, the City is also constantly investing in and upgrading its wastewater treatment works, which should halt further deterioration in the water quality and, in due course, see to an improvement. However, improvements in water quality here will also require upgrades and investment in services in the Lwandle settlement.

FIGURE 21: WATER SAMPLE RESULTS FOR STRAND PAVILION JETTY

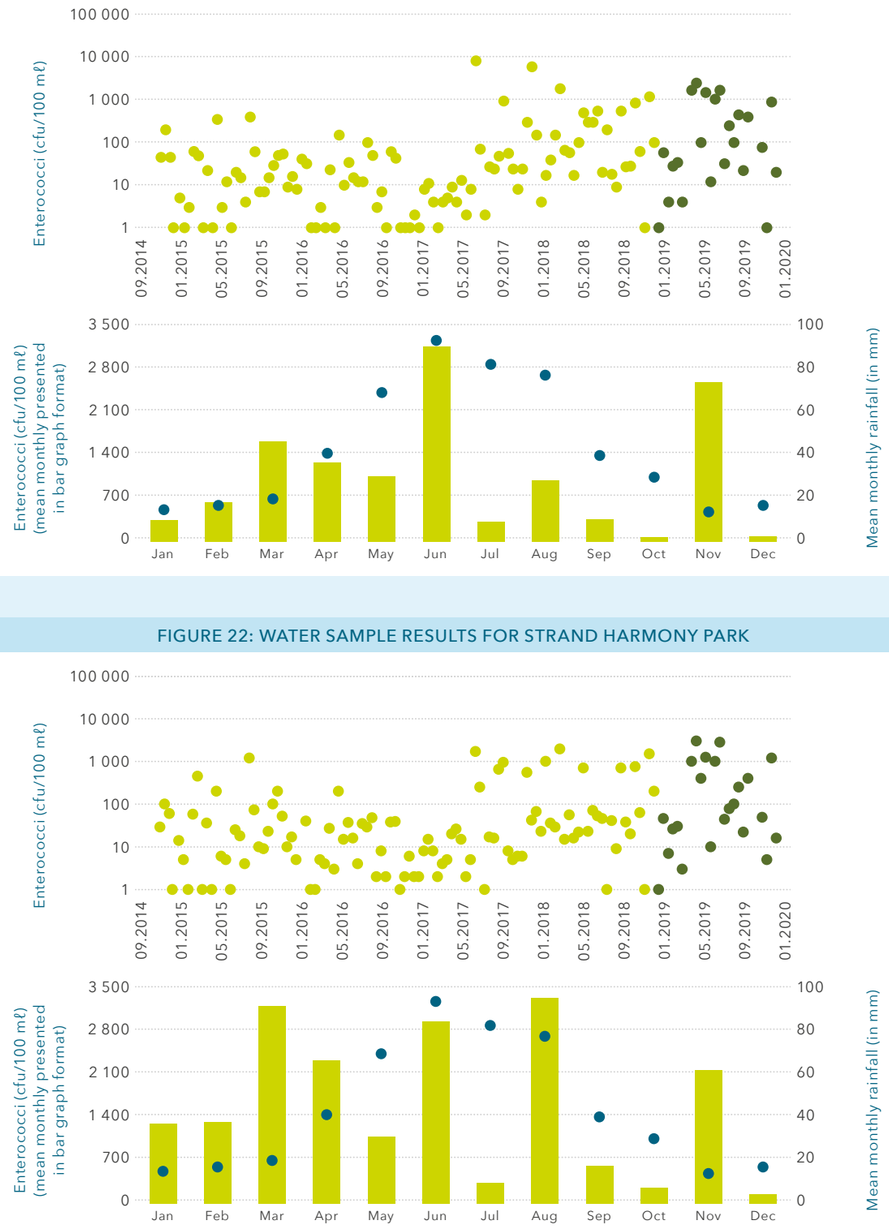


FIGURE 22: WATER SAMPLE RESULTS FOR STRAND HARMONY PARK

FIGURE 23: WATER SAMPLE RESULTS FOR STRAND NEAR LOURENS RIVER

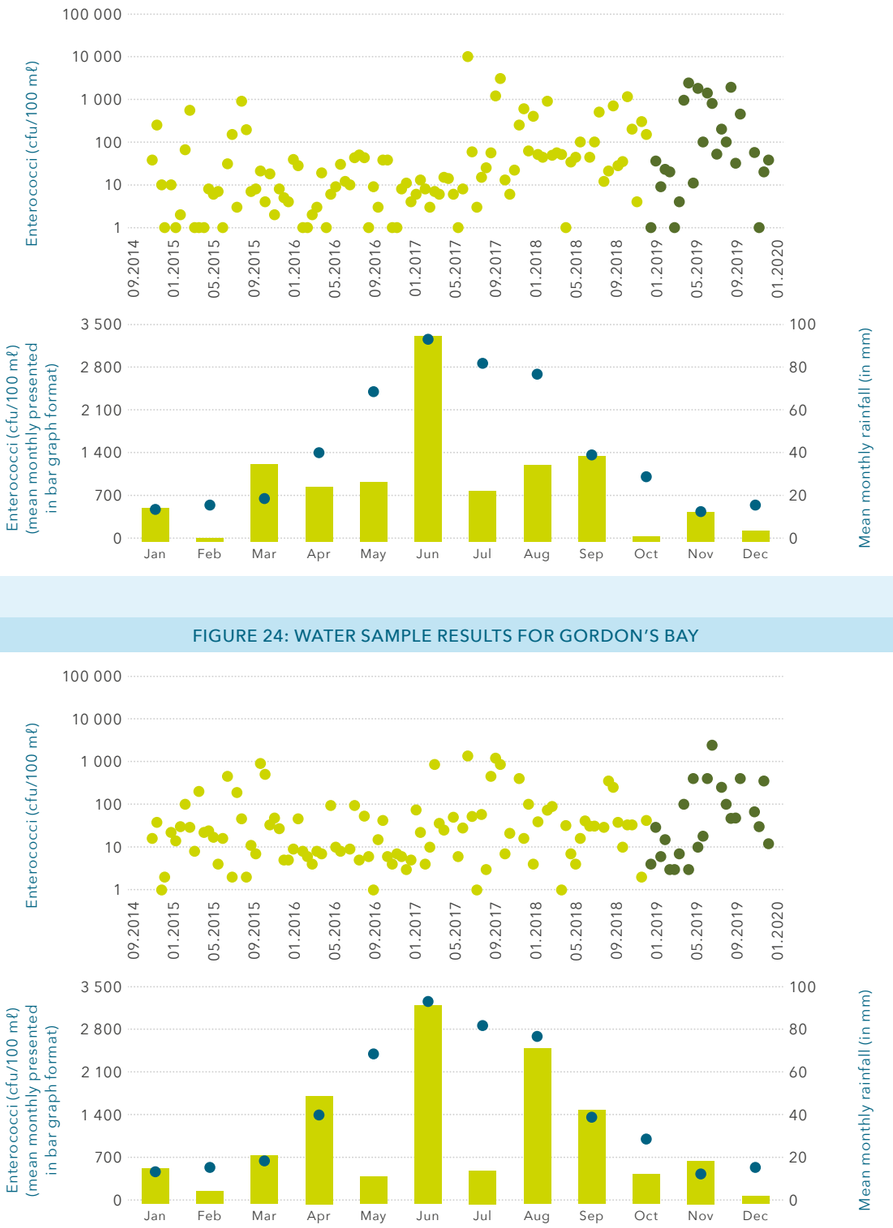


FIGURE 24: WATER SAMPLE RESULTS FOR GORDON'S BAY

CAPE TOWN'S BLUE FLAG BEACHES

The Blue Flag programme, a world-renowned eco-label established in 1987,[6] is operated under the auspices of the Foundation for Environmental Education headquartered in Copenhagen, Denmark. The programme aims to promote the sustainable growth and development of tourism in coastal areas. About 47 countries participate in the programme, and South Africa is the first country outside Europe to have been awarded Blue Flag accreditation. To qualify for this prestigious annual award, a series of stringent environmental, educational and safety and access-related criteria must be met.

Ten beaches in Cape Town currently have Blue Flag status, while one (Seaforth) has pilot status (see figure 25). Water quality at these beaches is monitored in accordance with Blue Flag programme specifications. Samples are collected regularly during the bathing season (1 November to 31 March) and analysed for enterococci and *E. coli*. Sample collection and analysis is performed by an independent organisation.

Water quality at Blue Flag beaches must achieve "excellent" ratings for both *E. coli* and enterococci (as indicated in table 1 on page 10), and not only "fair" ratings as per the national minimum requirement. The consistent award of Blue Flag status to nine of the ten accredited Cape Town beaches since at least 2014 means that water quality has consistently met this criterion during the bathing season (table 5).

TABLE 5: HISTORICAL OVERVIEW OF THE STATUS OF BLUE FLAG BEACHES ALONG CAPE TOWN'S COAST

BEACH	YEARS IN PROGRAMME	BLUE FLAG STATUS AWARDED					
		2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Silwerstroomstrand	6	✔	✔	✔	✔	✔	✔
Melkbosstrand	1	✔	✔	✔	✔	✔	✔
Clifton 4th Beach	13	✔	✔	✔	✔	✔	✔
Camps Bay Beach	9	✔	✔	✔	✔	✔	✔
Llandudno Beach	6	✔	✔	✔	✔	✔	✔
Seaforth Beach	Pilot					✔	✔
Fish Hoek Beach	1	✔	✔	✔	✔	✔	✔
Muizenberg Beach	8	✔		✔	✔	✔	✔
Strandfontein Beach	5	✔	✔	✔	✔	✔	✔
Mnandi Beach	6	✔	✔	✔	✔	✔	✔
Bikini Beach	13	✔	✔	✔	✔	✔	✔

[6] *https://www.blueflag.global/*

FIGURE 25: CAPE TOWN'S BLUE FLAG BEACHES

The City's coastal water quality monitoring versus Blue Flag monitoring

Discrepancies between the water quality rating obtained by the City's coastal water quality programme and the Blue Flag programme at some of Cape Town's Blue Flag beaches are often due to a technical difference in how the results are treated. In the event of high faecal indicator bacteria counts, the Blue Flag programme allows follow-up samples to be collected to show that a pollution event was short-lived (for instance, an event associated with rainfall). This is to prevent a few samples from influencing the water quality rating to such an extent that it does not reflect the long-term state. If the results of the follow-up samples show that a pollution event was short-lived and has passed, the original high count may be replaced with the results of a follow-up sample (but only to a maximum of 15% of samples, or one sample in a specific bathing season, whichever is greater). The City, however, does not follow such a discounting procedure in its coastal water quality monitoring programme. If it did, water quality at sites overlapping with Blue Flag beaches would likely also be rated "excellent". The following example demonstrates this point:

How is it possible for Camps Bay to have retained Blue Flag status if it rated "fair"?

To achieve and be awarded Blue Flag status, a beach must meet criteria that are set internationally and, in South Africa, implemented by the Wildlife and Environmental Society of South Africa (WESSA). The City has no say or part in the determination of the criteria. Furthermore, water quality samples for Blue Flag status are taken and assessed by an external laboratory. So, how is Blue Flag status at Camps Bay possible?

Key here is that Blue Flag status in Cape Town is awarded on a seasonal basis, for the period 1 December to 31 March. Water quality is assessed from the month before the Blue Flag season, and monthly throughout the season. This means that, in Cape Town, Blue Flag status is awarded based on water quality results for the summer season only, when the frequency of poorer results tends to be far lower, primarily due to significantly reduced or absent rainfall events.

The "fair" water quality reflected in the City's data is based on results for the entire year, not the summer bathing season alone. Based on the externally determined Blue Flag rules, Camps Bay consistently meets the water quality standards required for Blue Flag status during the summer monitoring period.

KEY FINDINGS

Reflecting on the City's coastal water quality monitoring programme, the following key findings emerge:

- Atlantic coastline: In 2019, water quality at 12 of the 26 recreational beaches and tidal pools along the Atlantic coast was rated "good" or "excellent". Water quality at another 11 recreational beaches and tidal pools was rated "fair", meaning 23 out of the 26 recreational nodes met the minimum requirement.
- False Bay coastline: In 2019, water quality at 18 of the 27 recreational beaches and tidal pools met the minimum requirement, with eight sites achieving "good" or "excellent" ratings.
- In most cases, the "poor" rating for water quality at recreational beaches in 2019 can be attributed to three of fewer samples where the bacteria counts were exceptionally high. This skewed the median score for these nodes for 2019, resulting in an overall "poor" water quality rating. Meaning, the "poor" water quality is mostly as a result of discrete spikes in bacteria counts, as opposed to consistently high counts of bacteria. Spikes in bacteria counts are common to beaches in most coastal cities worldwide.
- Beaches that do not have stormwater outlets or are far away from river mouths, usually have "good" or "excellent" water quality. This highlights the impact of:
  - urban pollutants on the coastline;
  - waste generated by residents, business and visitors; and
  - waste via the stormwater system and rivers on nearshore coastal water quality.
- Areas with chronic coastal water quality problems are:
  - Lagoon Beach;
  - Three Anchor Bay;
  - central False Bay; and
  - Macassar to Gordon's Bay.

The City is determined to improve water quality in these areas and will implement interventions to see an incremental improvement of the water quality along the False Bay coastline in particular.

RESPONSE TO FINDINGS:
CITY COMMITMENTS AND CITIZEN RESPONSIBILITY

Cape Town is a relatively large, industrialised city. All of us living and working here, and visitors to the city, eat, buy, produce and get rid of waste in this environment. Collectively, we produce 500 million litres of wastewater per day. All of this waste or pollutants find their way into sewers, the stormwater system, rivers, and ultimately the sea.

The City relies on its sewer network and wastewater treatment works, together with the assimilative capacity of the environment, to assimilate this wastewater effluent on our behalf. However, it is increasingly recognised around the world that this approach is not sustainable. Understanding the full dimensions of the challenge allows us to develop appropriate responses to try to limit our collective impact on our environment and coastal waters.

Clearly new approaches are needed.

Firstly, we all have to admit and acknowledge that we have an impact on the environment and we have to develop a collective understanding of the extent of this footprint. With this understanding comes the reality that we will have to change our collective behaviour in how we consume and produce, and get rid of waste. Then we need a shared sense of responsibility to work together to find and implement more sustainable solutions.

The City has committed itself, in its new Water Strategy, to transition to a Water Sensitive City by 2040 that integrates the urban water cycle, builds resilience and protects Cape Town's sensitive natural ecosystems. This is an ambitious undertaking, and one that will require the support from all Capetonians as it will only succeed if we change our behaviour and share the responsibility in doing so. While this is a long-term undertaking, there are a number of actions that the City can and will take in the short-term.

City commitments

a) Improved information and disclosure

The City will:

- improve information by increasing the number of water quality sampling points at recreational beaches, and introduce weekly sampling at popular swimming beaches;
- report annually on the quality of our coastal water;
- facilitate public access to information by creating a web-based portal where the public can access updated information on coastal water quality every second week;
- install signage at designated recreational nodes that are often impacted by poor water quality, to indicate the nature and extent of pollution;
- investigate the use of predictive modelling as a public coastal pollution warning system, as is already being done in the United States, Scotland, Australia and New Zealand; and
- publically report on the findings from the current three-year Marine Outfall Monitoring Programme once the findings and results are finalised.

b) Education, awareness, and enforcement

The City cannot address this challenge on its own. We are committed to finding and implementing solutions, in cooperation with key stakeholders, but we need residents to share this responsibility with us by changing their behaviour. To support and promote this behaviour change, the City will:

- develop and implement ongoing public education and awareness campaigns and programmes on citizen responsibility; and actions and behaviours to minimise and mitigate the pollution of Cape Town's waterways and beaches;
- begin labelling stormwater drains, grids, and covers with the message 'This drains to the sea' to bring home the message that whatever enters the stormwater system – be it runoff from rainfall events, illegally dumped waste, fat and oil, or sewage due to illegal connections – ultimately ends up in our oceans;
- strengthen our monitoring and enforcement capabilities related to illegal developments and activities affecting Cape Town's natural water ecosystems; and
- engage with the other appropriate regulatory bodies with a view to reduce pollution risks at source and through the product or service chain to Cape Town's natural water ecosystems.

c) Improved City operations and investment in the sewer network and wastewater treatment system

The City manages the sewer network, sewerage pump stations and treatment works. The operation of these facilities, and their capacity, affect the quality of water entering Cape Town's rivers and sea. The City is already engaged in, and will continue to:

- improve operations related to sewer pump stations, sewer blockages and overflows and treatment works performance; and
- increase the capacity of sewer lines, pump stations and treatment works. This commitment is already under way with the City's significant investment in increasing the capacity of wastewater treatment plants across Cape Town over the next ten years.

d) Addressing formal and informal growth

Cape Town's formal- and informal-built environment is expanding in response to population growth, migration, and increased economic activity. This presents both challenges and opportunities. The City will review and strengthen the regulations and incentives, particularly as these pertain to new developments, renovations and redevelopments, to support our transition to a water-sensitive city. These include:

- the integration of stormwater with water reuse and conservation; and
- reducing stormwater runoff and improving water quality through the use of permeable surfaces and other measures.

The City will attend to the challenges of informality as part of its broader human settlements policy and strategy, by:

- improving solid waste management in informal settlements; and
- improving sanitation and the management of human waste in informal settlements in line with its commitments in the City's Water Strategy.

e) Integrate and prioritise the management of inland water catchments

The City will strengthen and improve its management of inland waterways and catchments. Going forward we will:

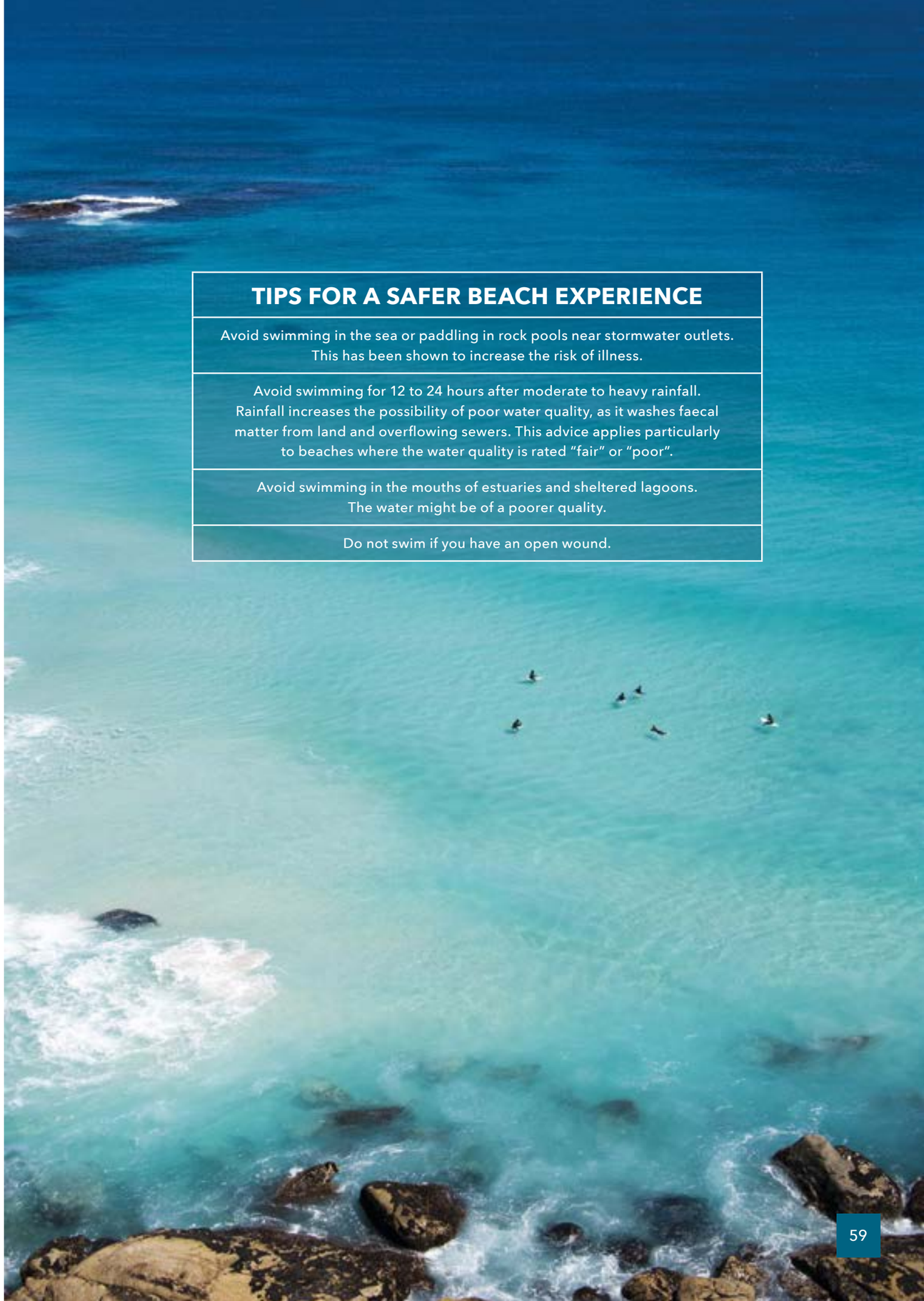
- improve the monitoring of and reporting on water quality in each catchment;
- identify sources and causes of water pollution in each catchment;
- develop an overall catchment management plan for each catchment to address the sources and causes of pollution, establish appropriate medium- and long-term goals, and integrate the existing pollution abatement plans into these plans;
- develop prioritised action plans to guide short- and medium-term actions in each catchment;
- appoint a project manager to lead the implementation of the action plan, working transversally within the city, and engage with external stakeholders;
- ensure that the action plans are suitably resourced with people and budgets, and prioritised, and that resources are suitably allocated between different catchments;
- monitor the implementation and effectiveness of the action plans, and the progressive achievement of the medium- and long-term goals set out in the catchment management plans; and
- within the above framework, undertake detailed assessments of stormwater systems where coastal water quality is rated 'poor' and where stormwater is implicated, in order to identify and control the sources of contamination.

What can you do to boost and maintain coastal water quality?

The City is committed to protecting Cape Town's coastal resources. However, it simply does not have the resources to control all sources of pollution to coastal waters. Here are some actions you can take at the beach, at home and at work to help improve coastal water quality.

- If you walk your dog on a dog-friendly beach,[7] remove and properly dispose of your animal's waste. Do not bury it in the sand. Dog waste contains high numbers of bacteria and pathogens, which affect water quality.
- Do not leave food and other waste on the beach. Food waste can attract birds and rats, which are sources of faecal bacteria and pathogens.
- If you enjoy beach walks, take a bag with you for collecting plastic and other trash during your walk. Even if you collect and properly dispose of only a few items of waste, every bit helps.
- Do not dispose of nappies, female hygiene products, ear buds and cigarette butts down the toilet. This can lead to sewer blockages and resultant overflows into the stormwater drainage system, with a subsequent impact on coastal water quality.
- Restaurants and households should properly dispose of fat, oil and grease. These substances should never be poured down the drain. This can lead to sewer blockages and overflows into the stormwater drainage system, affecting coastal water quality.
- Do not litter. Rain can wash litter items into stormwater systems, ultimately ending up in our rivers, estuaries or the sea. Plastic is a major pollutant of coastal waters.
- Do not throw anything into stormwater drains, including pet waste, garden clippings, street sweepings and other waste. Stormwater will ultimately flow into a river, estuary or the sea, transferring this foreign material and the associated contaminants into these waters.
- Keep the road verge near your home or business property clean. This will prevent foreign matter from causing blockages in the stormwater system or ending up on the coast.
- Stormwater is a major factor affecting coastal water quality in cities. Direct rainwater runoff from paved and tarred surfaces and roofs at your home and business property onto vegetated areas wherever possible. Use pavers with gaps on driveways. This will reduce the amount of runoff entering the stormwater system and retain contaminants in the runoff.
- Report any pollution incidents you might come across. Turn to the back page for contact details.

[7] *For information on Cape Town's dog-friendly beaches, go to www.capetown.gov.za/environment.*



TIPS FOR A SAFER BEACH EXPERIENCE

Avoid swimming in the sea or paddling in rock pools near stormwater outlets. This has been shown to increase the risk of illness.
Avoid swimming for 12 to 24 hours after moderate to heavy rainfall. Rainfall increases the possibility of poor water quality, as it washes faecal matter from land and overflowing sewers. This advice applies particularly to beaches where the water quality is rated "fair" or "poor".
Avoid swimming in the mouths of estuaries and sheltered lagoons. The water might be of a poorer quality.
Do not swim if you have an open wound.

LIST OF TABLES AND FIGURES

This report can be found online at:
www.capetown.gov.za

Information on Cape Town's coastline, beaches and coastal amenities is available on the City's website.

If you wish to report a pollution incident, please visit:
www.capetown.gov.za/ServiceRequests

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