CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

COASTAL WATER QUALITY INVESTIGATION

GREEN POINT PUMP STATION CASE STUDY

Compiled by

City of Cape Town

Coastal Management Branch

22 November 2024

Summary

Water quality directly adjacent to the Green Point Marine Outfall Pump Station as measured using daily Monday to Friday samples for the period August 2024 to November 2024 is rated as GOOD confirming that there is no wastewater discharge from the old outfall pipe (colloquially referred to as "Leaking Lucy"), there is no chronic or general wastewater contamination at this site and results show no evidence of wastewater from the offshore outfall reaching the shoreline here at any concentration which would impact on coastal recreational water quality.

Introduction

The Green Point Outfall pump station is situated along the promenade near the Green Point Lighthouse. The old outfall pipe, decommissioned and unused for decades, remains visible below the seawall. The pump station sump is located beneath the promenade, directly behind the sea wall. Wastewater odours are frequently noticeable around the pump station.

The Coastal Management Branch (CMB) sought to investigate whether there was any local discharge seeping through the sea wall or leaks into the nearshore coastal environment from the pump station. Additionally, the CMB also aimed to determine if there was any preliminary evidence that wastewater from the offshore outfall might be reaching the shoreline in concentrations that could affect coastal recreational water quality.

Public and social media speculation has heightened interest in this area, with the old pipe being dubbed "Leaking Lucy". This attention has been fuelled by observations of sea foam, changes in water colour along the seashore, and odours emanating from the pump station. These factors have made the site a popular subject for social media commentary and videos.

Although this specific sample location is not used for recreational water activities, assessing the water quality remains valuable given the public interest and the need to clarify potential environmental concerns.

Questions:

1. **If evidence of wastewater contamination is found, what is the source?**
2. **While not a recreation location due to high wave action and a rocky shoreline, what is the coastal water quality at this location as calculated by the National Water Quality Guidelines**
3. **Would short duration high intensity daily Monday to Friday sampling at a defined location on the shoreline at the old outfall pipe show evidence of wastewater contamination?**
4. **Is there any evidence of the Green Point marine outfall pipeline negatively affecting recreational water quality in the nearshore area?**

Approach

- Water samples collected were analysed by the SABS Laboratory and WALAB Laboratory, both of which are SANAS accredited for intestinal enterococci enumeration in sea water.
- Samples were collected consistently between 10am and 12pm, chilled, and submitted to the relevant laboratory within required time frames.
- Intestinal enterococci were enumerated in line with SANAS standard methodologies (using accredited membrane filtration methods for quantifying enterococci). Intestinal enterococci were used as they are the internationally accepted FIB for assessing levels of wastewater pollution and associated human health risk in coastal and marine environments. The rationale for using enterococci is provided in **Box 1.** Further information on the use of enterococci can be found in the CCT Know Your Coast 2023 report (page 9).
- In line with the South African Department of Environmental Affairs "South African Water Quality Guidelines for Coastal Marine Water - Volume 2: Guidelines for Recreational Use",

the upper limit for the 95th percentile of results indicating pollution is 200 CFU/100ml of intestinal enterococci. As a precaution, 200 CFU/100ml has also been used in this report for a single sample limit of good water quality. This is a more cautious approach than the 2012 Guidelines that recommend a single sample threshold of 240 CFU/100ml for the operational management of beaches in South African sea water.

- Recreational Water Quality categories are determined for each set of results as follows:
    - National Recreational Water Quality Guidelines recommend determining the 95th and 90th percentiles of intestinal enterococci counts to determine the recreational water quality of a given beach. The City has been using the Hazen method as it provides a conservative estimate of water quality, and the guidelines do not specify what method to use. The guideline thresholds are laid out below:
        - 95th Percentile should be ≤ 100 CFU for Excellent water quality
        - 95th Percentile should be ≤ 200 CFU for Good water quality
        - 90th Percentile should be ≤ 185 CFU for Sufficient water quality

- The 2021 World Health Organisation Guidelines on Recreational Water Quality use the below classification system. For this report, the rounded 95th percentile method has been used:
    - 95th Percentile for Category A: ≤ 40 CFU /100ml
    - 95th Percentile for Category B: 41-200 CFU /100ml
    - 95th Percentile for Category C: 201-500 CFU /100ml
    - 95th Percentile for Category D: >500 CFU /100ml
    - The WHO does not prescribe a specific acceptable class of water.
    - Class A and B are within tolerable levels of risk according to the South African (and most other) guidelines on recreational water quality.
- Rainfall data sourced from City of Cape Town's Woodhead weather station

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) illness risk	< 100 (95 percentile)	< 250 (95 percentile)
Good	<5% GI illness risk	< 200 (95 percentile)	< 500 (95 percentile)
Sufficient	<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*

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Percentiles and category calculations

Hazen Method

The Hazen method is a statistical approach used to analyse enterococci levels in water quality data. It is generally a very conservative way of determining water quality (i.e., it will err on the side of worse water quality estimates):

- **Ranking the Data**: All enterococci measurements are arranged in order from the smallest to the largest value. Each measurement is assigned a rank.
- **Percentile Calculation**: The method identifies the value at which a specified percentage of the data lies below it (e.g., the 90th or 95th percentile).
- **Interpolation**: To achieve greater precision, the Hazen method uses interpolation. This means it calculates a value that might fall between two actual measurements to give a more accurate percentile estimate.

For example: For an excellent rating, 95% of the data points must be below 100 cfu/100 ml. The Hazen method determines this cut-off point even if it doesn't align perfectly with an actual measurement.

BOX 1: ENTEROCOCCI: GLOBAL GOLD STANDARD AS FAECAL INDICATOR BACTERIA

Faecal indicator bacteria (FIB) are measured as a surrogate for a complex suite of pathogens (bacteria, viruses, and others) present in sewage and used to estimate the risk of gastrointestinal and other health effects in humans using recreational waters.

- The WHO guidelines 2003 stated "*Escherichia coli* is intrinsically suitable for fresh waters but not marine waters" (WHO 2003). The updated WHO 2021 guidelines also support using only intestinal enterococci as a FIB in marine environments.
- No statistical relationship has been established for *E. coli* that can support a clear dose–response guideline value in marine waters.
- At the time of writing these guidelines, only enterococci had been used in epidemiology studies addressing marine and fresh waters and shown to reflect, in a dose–response manner, gastrointestinal illness in recreational water users (Wade et al., 2010).
- These FIB are not themselves the causative agents of illness.
- Monitoring of two FIB introduces avoidable complexity in analysis and interpretation of results (WHO 2021), without improving the management of human health risk.

At present, most global health and environmental authorities agree on using intestinal enterococci as the sole FIB in marine environments in their respective guidelines for recreational water quality. This includes the World Health Organisation Guidelines on Recreational Water Quality (2021), United States Environmental Protection Agency (US EPA 2012), Heath Canada (2024), New Zealand Ministry of Health (2021), and Australian National Health and Medical Research Council (2008).

- A series of five epidemiological studies conducted by the US EPA between 2003 and 2009 (Wade et al 2010) confirmed that intestinal enterococci are the appropriate faecal indicator bacteria for seawater, and found that *E. coli* did not display a clear dose-response relationship between bacterial levels and the gastrointestinal illness risk to recreational users in seawater. These studies followed numerous others conducted in the 1980's that were the basis for intestinal enterococci being widely adopted as the main FIB in marine environments (Cabelli et al., 1982; Cabelli, 1983; Dufour, 1984).
- A 2019 report compiled for the government of New Zealand reviewed over 100 published scientific papers to determine whether enterococci are still the most appropriate FIB in coastal waters. The report recommended minor updates to thresholds but found enterococci to be effective for weekly monitoring of faecal contamination risk posed to recreational users of coastal waters (McBride et al. 2019).
- Any suggestion that enterococci are monitored in an effort to provide "better" results is not supported by long term data sets. Enterococci have been found to be a more sensitive indicator bacteria in seawater than *E. coli*, having been shown to exceed single sample standards most often during all weather and environmental conditions (i.e. dry weather, wet weather, along beach's, and near stormwater inputs) (Noble et al 2003).
- Intestinal enterococci's unique resistance to salinity (and ability to grow in saline environments) is thought to contribute to their "better performance as indicators of human health risk in marine recreational waters than members of the coliform group" such as *E. coli* (Byappanahalli et al. 2012). Past studies have demonstrated that intestinal enterococci have a significantly longer survival time in marine environments than *E. coli* (Fragala and Hanes, 1967; Sieracki, 1980; Noble et al. 2001). These studies also noted *E. coli* are more sensitive to sunlight than enterococci.

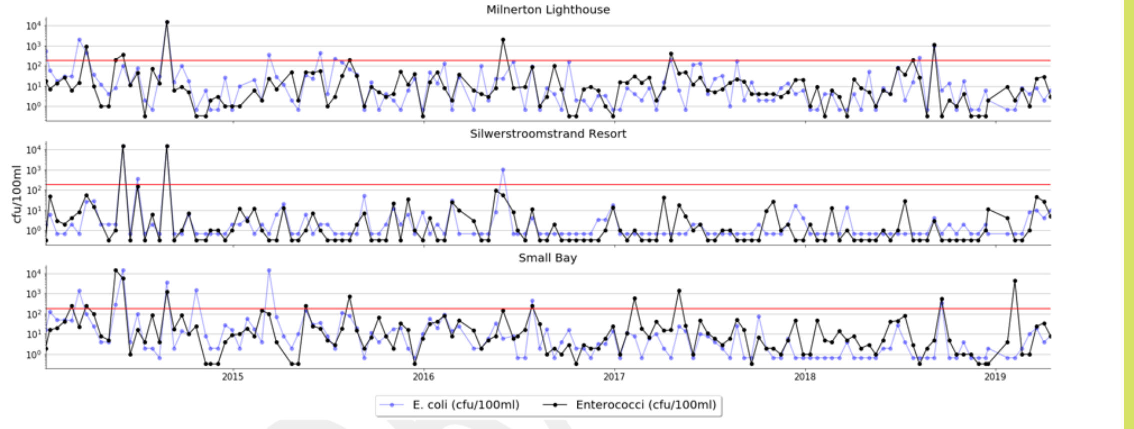

Figure 4.5: Time series of E. Coli and enterococci counts at recreational nodes within the Table Bay and West Coast area from January 2014 to May 2019. The red line indicates the 185 cfu/100 ml threshold used to classify the water quality as Poor based on enterococci 90th percentiles (DEA, 2012). The y axis is on a logarithmic scale.

Site Selection and Monitoring Frequency

The sample site was selected as the site at the base of the ladder on the Sea Wall where the old pipe joins the shoreline.

Figure 1. Location of Sample Site at Mouille Point Lighthouse, Green Point

Results

All data are presented in raw form in **Annexure A**. The certified laboratory datasheets are available for all data points on request.

Findings and Analysis

1) A total of 57 samples were taken between 21 August and 15 November 2024. Of those only two or 3.5% exceeded the upper limit of 200/100ml.
2) The one exceedance was on the 27th September. This aligns with a documented pump station failure that occurred at the Green Point Pump station. The pump station failure occurred from the 26th September 2024 (no evidence of wastewater in result) to the 27th September 2024 where data reflects the overflow. The 27th was a Friday and contamination may have occurred through the weekend however Monday 30th September shows that the repair had been completed and the contamination had cleared.

Using the National Water Quality Guidelines the water quality on the shoreline at the Green Point Pump Station for the period 21 August to 17 November is GOOD with a 95th percentile of 128 cfu/100ml and the Rounded 95th percentile is 97.

Method	95th Percentile	90th Percentile	Result
National Water Quality Guidelines Hazen Method	128	NA	**GOOD**
WHO Guidelines on Recreational Water Quality 2021 Rounded 95th Percentile	97		**B**

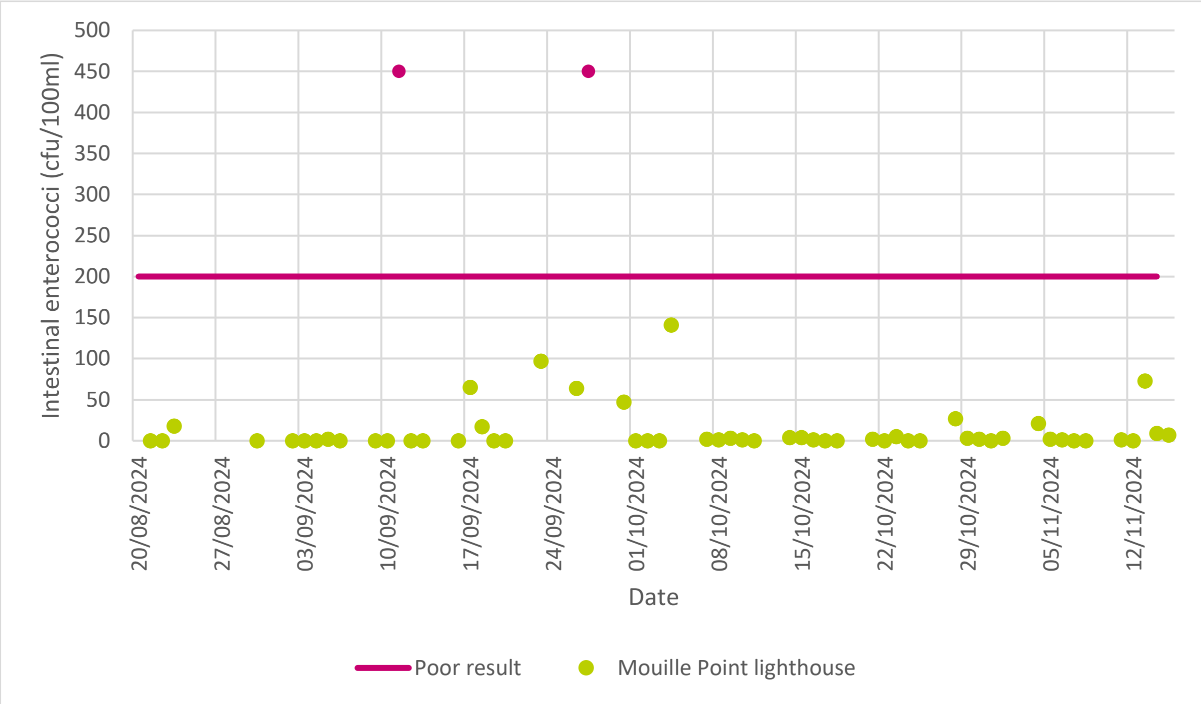

Figure 2. Daily results of intestinal enterococci monitoring at Green Point Lighthouse.

Overall Findings

1) There is no evidence based on this water quality data of any wastewater discharge or leaking from the old outfall pipe referred to as "Leaking Lucy".
2) High frequency daily testing shows no evidence of chronic or general wastewater contamination at this location.
3) High frequency daily testing shows no evidence of wastewater from the offshore marine outfall reaching the shoreline here at any concentration during the sampling period which would impact on recreational coastal water quality.
4) The sea foam and variation in water colour as shown in the aerial photograph is natural (plankton, algae and marine mucus) and normal along this stretch of rocky shoreline.
5) Pump station failures do contaminate the immediate nearshore and is evident in the water quality data. This pollution clears as soon as the repair is complete.
6) These results are limited to spring/summer and winter may demonstrate poorer outcomes due to increased storm water discharges in the vicinity.

Next Steps

The following recommendations are made based on the findings above:

1) Standard City coastal water quality sampling frequency at this location should continue at a low frequency for pollution monitoring purposes.
2) This current daily sampling research can be stopped but should be repeated in 2025 for a short duration to assess peak winter conditions and the impact of storm water discharges.

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ANNEXURE A: RAW COASTAL WATER QUALITY RESULTS FOR GREEN POINT

Table 1: Data table for daily sampling of Mouille Point

Date	Mouille Point Lighthouse
Wednesday, 21 August 2024	0
Thursday, 22 August 2024	0
Friday, 23 August 2024	18
Monday, 26 August 2024	*
Tuesday, 27 August 2024	*
Wednesday, 28 August 2024	*
Thursday, 29 August 2024	*
Friday, 30 August 2024	0
Monday, 02 September 2024	0
Tuesday, 03 September 2024	0
Wednesday, 04 September 2024	0
Thursday, 05 September 2024	2
Friday, 06 September 2024	0
Monday, 09 September 2024	0
Tuesday, 10 September 2024	0
Wednesday, 11 September 2024	>150
Thursday, 12 September 2024	0
Friday, 13 September 2024	0
Monday, 16 September 2024	0
Tuesday, 17 September 2024	65
Wednesday, 18 September 2024	17
Thursday, 19 September 2024	0
Friday, 20 September 2024	0
Monday, 23 September 2024	97
Thursday, 26 September 2024	64
Friday, 27 September 2024	>150
Monday, 30 September 2024	47
Tuesday, 01 October 2024	0
Wednesday, 02 October 2024	0
Thursday, 03 October 2024	0
Friday, 04 October 2024	141
Monday, 07 October 2024	2
Tuesday, 08 October 2024	1
Wednesday, 09 October 2024	3
Thursday, 10 October 2024	1
Friday, 11 October 2024	0
Monday, 14 October 2024	4
Tuesday, 15 October 2024	4
Wednesday, 16 October 2024	1

Date	Mouille Point Lighthouse
Thursday, 17 October 2024	0
Friday, 18 October 2024	0
Monday, 21 October 2024	2
Tuesday, 22 October 2024	0
Wednesday, 23 October 2024	5
Thursday, 24 October 2024	0
Friday, 25 October 2024	0
Monday, 28 October 2024	27
Tuesday, 29 October 2024	3
Wednesday, 30 October 2024	2
Thursday, 31 October 2024	0
Friday, 01 November 2024	3
Monday, 04 November 2024	21
Tuesday, 05 November 2024	2
Wednesday, 06 November 2024	1
Thursday, 07 November 2024	0
Friday, 08 November 2024	0
Monday, 11 November 2024	1
Tuesday, 12 November 2024	0
Wednesday, 13 November 2024	73
Thursday, 14 November 2024	9
Friday, 15 November 2024	7

**No data. **Research at this site temporarily suspended. ***Not yet monitored.*