



CITY OF CAPE TOWN  
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## **CITY OF CAPE TOWN INLAND WATER QUALITY REPORT: FOCUS PERIOD 1 OCTOBER 2022 TO 30 SEPTEMBER 2024 (2023 AND 2024 REPORTING PERIODS)**



JUNE 2025

### **TECHNICAL REPORT**

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## READER GUIDE

Not everyone will have the time or inclination to read through all of the details of water quality analyses and interpretation that are presented in this report, and which are necessary to inform the contents of the summary overview report.

Those interested in particular aspects of water quality and not wanting to read the report in detail should refer to the following Reader Guide to navigate the report more quickly:

- **Executive Summary** for a brief overview of the main findings of the report;
- **Section 2** where **Figure 2.1** shows the locations of all of the sub-catchments included in the City's area and referred to throughout this report;
- **Section 3** where **Section 3.7** provides an explanation of the water quality categories that are used in this report and **Section 3.8** explains how data were treated / analysed;
- **Section 4** for a discussion of rainfall data;
- **Section 5**, where the colour-coded compliance graphs give a quick visual overview of which sub-catchments or listed vleis and other standing water areas had water quality that generally met or failed to meet Target criteria. These graphs are presented towards the end of each of the subsections on *E. coli*, sources of sewage, orthophosphate and nitrogen enrichment; ammonia; dissolved oxygen; chlorophyll-a and salinity (estuaries only);
- **Section 6** for discussions around the condition of the City's main recreational vleis, and their condition with regard to human health;
- **Section 7** for a brief overview of some of City's current and planned programmes to address water quality in the City and/or improve other aspects of watercourse condition;
- **Section 8** focuses on the City's Priority Catchments, and provides brief, illustrated descriptions of the main factors affecting water quality in these catchments. Most useful in this section are maps showing each priority catchment (and the surrounding area) with the locations of routine water sampling points in the map colour coded to represent the water quality category assigned to annual data for three key variables, namely orthophosphate (as PO<sub>4</sub>-P), ammonia (as NH<sub>3</sub>) and *E. coli*;
- **Section 9** summarizes the main findings and recommendations of the report as a whole;
- **Appendix A** presents a table showing the locations and site codes for all of the sample points, in their different sub-catchments;
- **Appendix B** provides an explanation of the derivation of the thresholds that were used in the analyses of ecosystem condition and human health risk from recreational use of waterbodies.
- **Appendix C** presents summary annual data for key water quality variables for each sub-catchment and sample point. These have all been colour-coded for ease of interpretation and include symbols showing trajectory between reporting periods. These tables allow readers to look up data relating to particular monitoring points of interest.
- **Appendix D** presents boxplots of annual data for the variables considered in this report, comparing catchments for flowing water systems and individual vlei systems for standing waterbodies.



## EXECUTIVE SUMMARY OF THE TECHNICAL REPORT

### E1 CONTEXT

#### E1.1 Background

The City of Cape Town ('the City') is responsible for the management of numerous rivers and wetlands, including open water vlei systems, estuaries and coastal lakes, within its municipal boundaries. The City's Catchment, Stormwater and River Management Branch (CSRM) provides ongoing internal reporting on inland water quality to various City branches. In addition, independent assessments and overviews of all water quality data collected for the City's routine monitoring sites is undertaken on an annual basis. This is the fourth such report and covers the 2023/2024 Reporting Periods (October 2022 to September 2024). In order to give these data context, they are analysed against a backdrop of data going back to October 2019.

#### E1.2 City catchments and Stormwater Planning Regions

The City's numerous watercourses drain 21 major catchment areas, as shown in **Figure E1**. Some of these areas in fact include a number of relatively small catchments, which are grouped together for management purposes, and some have no discrete watercourses other than stormwater ponds, pipes and outlets into the sea.

The City manages its watercourses through Stormwater Planning Regions. There are four such regions - Northern, Southern, Eastern, Central and Western - each region with a separate manager. The regional boundaries do not, unfortunately, take account of the major river sub-catchments and, in many cases, cut through sub-catchments, assigning sections of a river and its tributaries in some cases to two or even three different managers, hampering the management of stormwater and its associated water quality issues from a catchment perspective.

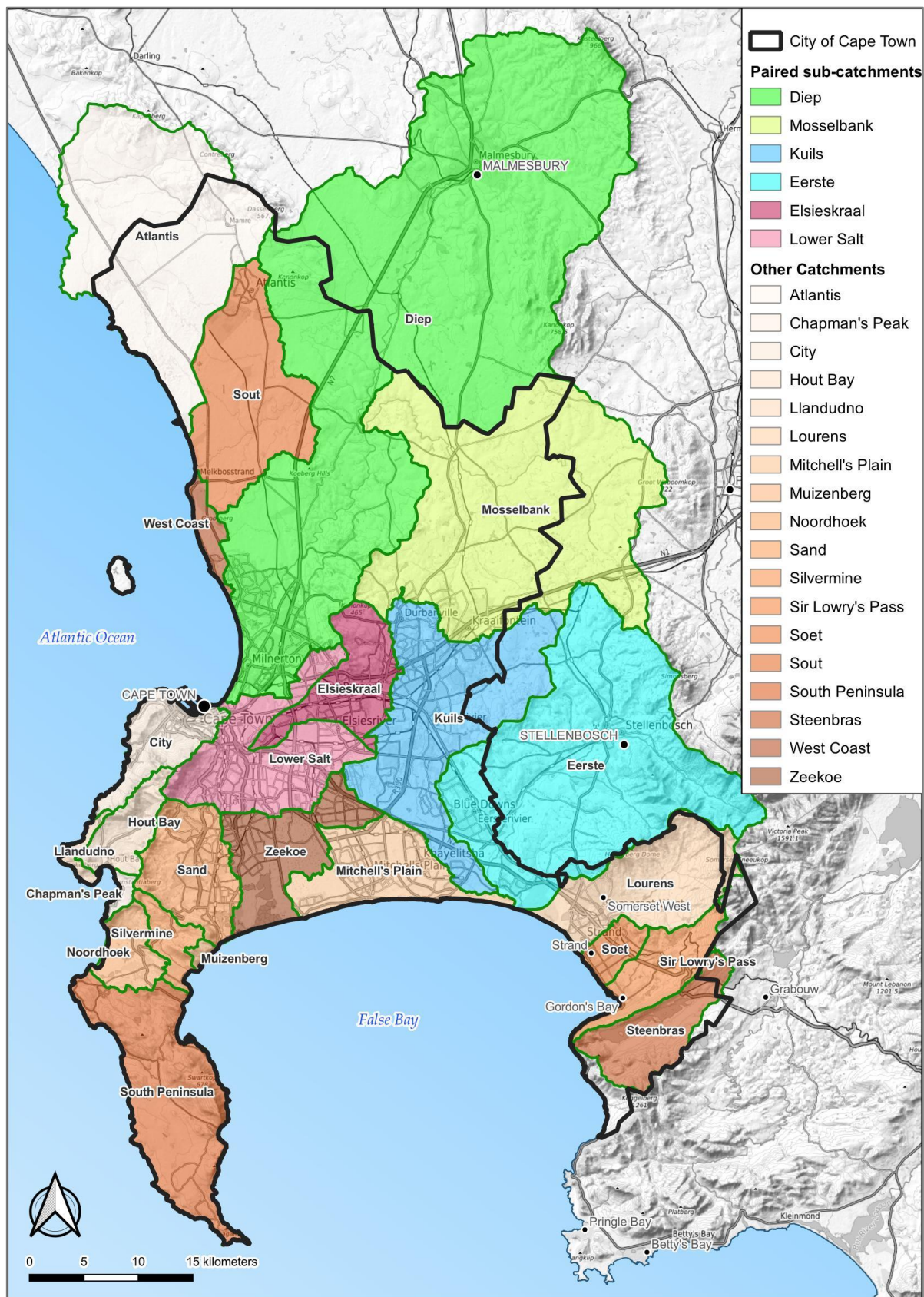
#### E1.3 The City's priority sub-catchment areas

Seven priority catchment areas have been identified by the City for focused interventions intended to improve river and wetland ecosystem function and, through this, bring about an improvement in water quality. The priority sub-catchments are:

- The Lower Diep River (upstream of Milnerton Lagoon)
- The Soet River
- The Lower Salt River
- The Kuils / Eerste Rivers
- The Hout Bay River
- The Big and Little Lotus Rivers (within the Zeekoe catchment)
- The Sand catchment (upstream of Zandvlei).

The above catchments also form the focus of three major City programmes, namely the City's Water Quality Improvement Programme (WQIP); the Liveable Urban Waterways (LUW) Programme and the Mayor's Priority Programme (MPP) on Sanitation and Inland Water Quality.

**City of Cape Town**  
Inland Water Quality Report covering rivers and major vleis  
with a focus on the period October 2022 to September 2024 (2023 and 2024 Reporting Periods)



**Figure E.1**  
**Catchments referenced in the City's Inland Water Quality Report.**

## E1.4 Monitoring points in the City's Inland Water Quality Monitoring Programme

To date, the City's water quality monitoring programme has been designed to monitor changes in watercourses where water quality is likely to be a cause for concern. Many of the monitoring points are therefore downstream of WWTW effluent discharge points, and in river reaches in catchments where runoff is likely to be contaminated. Some sampling points are located in watercourses that are used for religious rituals (e.g. baptisms) and/or recreational purposes (e.g. sailing, rowing and kayaking). Water quality data for such systems are thus used to provide information as to the fitness for use of these systems.

An important point is, however, that since the sampling points used by the City have historically focused on problem areas, water quality data over-emphasize problem areas, and do not provide an over-arching view of water quality in the City's rivers and wetlands as a whole. In order to try to address this issue, the City has included an additional 65 monitoring points, intended to provide more holistic water quality monitoring. The data for these points will be included in subsequent annual reporting. **Figure E.2** illustrates the locations of the various sampling points.

## E1.5 Water quality variables considered in this report

The following water quality variables are used in this report (abbreviations are shown in brackets):

- Major nutrients
  - Phosphorus in orthophosphates (PO<sub>4</sub>-P)
  - Phosphorus in total phosphorus (Tot-P)
- Un-ionised (or 'free') ammonia (NH<sub>3</sub>)
- Dissolved oxygen (DO)
- *Escherichia coli* bacteria (*E. coli*)
- Microcystin concentrations
- Chlorophyll-*a* (Chl-*a*)
- pH as an indicator of ammonia toxicity risk
- Electrical conductivity (EC) as a measure of salinity, specifically for vlei systems in the City that were delineated as estuaries in the Berg RQO study.

The following additional water quality variables were obtained by calculation from existing data:

- Total Inorganic Nitrogen (TIN) – through addition of NH<sub>4</sub>-N and (NO<sub>3</sub>+NO<sub>2</sub>)-N
- NH<sub>4</sub>:TIN – the ratio of NH<sub>4</sub>-N:TIN
- TIN: PO<sub>4</sub>P – as a ratio of TIN to PO<sub>4</sub>-P

Note that Tot-P data have not been available since December 2022, because of equipment breakdown at the City's Scientific Services Branch (SSB).

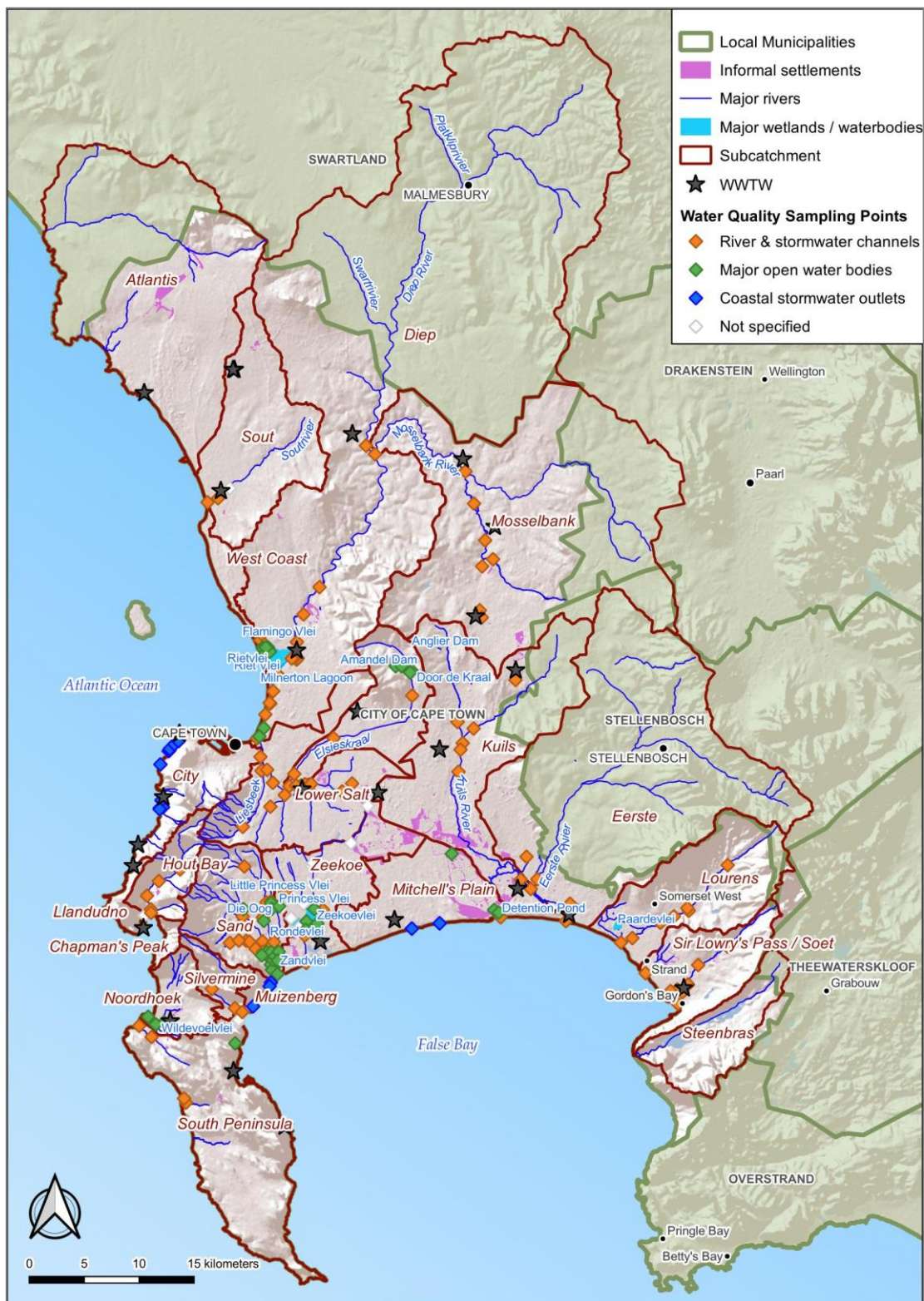
## E1.6 Water quality thresholds to guide data interpretation

**Tables E1 and E2** outline the ranges in concentrations of key water quality variables used to guide data interpretation in this report, with regard to their implications for aquatic ecosystem condition. The ranges and thresholds distinguish between flowing water systems (rivers, channels and canals) and open water systems (dams, vleis, detention ponds and coastal lakes). Data for stormwater outlets to the sea were also analysed separately. These comprised *E. coli* data only.

**Tables E3 and E4** present the thresholds used to determine risks to human health on the basis of monitoring of two key variables, namely *E. coli* bacteria (an indicator of exposure to raw sewage and other faecal sources from warm-blooded animals) and microcystin toxins, which can be associated with cyanobacteria (also called blue-green algae). Concentrations of these variables are evaluated with respect to the level of risk they pose to people undertaking 'intermediate contact' recreational activities.



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Inland Water Quality Report covering rivers and major vleis  
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**Figure E.2**  
Sample locations for the City's water quality monitoring programme, showing river and stormwater channels/canals, standing water (vlei and dam), and coastal stormwater pipeline sampling points.



**Table E.1**

Rating ranges for variables considered in this assessment of water quality in Cape Town's rivers.

Note: PO4-P= orthophosphate phosphorus; TIN=Total inorganic Nitrogen; DO=Dissolved oxygen; N:P= ratio of TIN:PO4-P; NH<sub>3</sub> = un-ionised ammonia. Note also that the terms 'PO4-P', 'TIN' are abbreviations and are not the full chemical notation for these variables.

| City Water Quality Categories (CWQC) | Interpretation of CWQC | PO4-P<br>Mg P/l                  | TIN<br>Mg N/l                                                              | DO<br>mg/l              | N:P   | NH <sub>3</sub><br>mg/l           |
|--------------------------------------|------------------------|----------------------------------|----------------------------------------------------------------------------|-------------------------|-------|-----------------------------------|
| GOOD                                 | TARGET                 | ≤ 0.015<br>(oligotrophic)        | ≤ 0.70<br>(oligotrophic - mesotrophic)                                     | >7                      | >25   | ≤ 0.007                           |
| FAIR                                 |                        | > 0.015 - 0.025<br>(mesotrophic) | >0.70-1.00<br>(mesotrophic)                                                | >6-7                    |       | > 0.007 -0.015                    |
| POOR                                 | POOR                   | > 0.025- 0.125<br>(eutrophic)    | >1.00 -4.00<br>(mesotrophic - eutrophic)                                   | >4 -6<br>OR<br>>12 - 15 | 10-25 | > 0.015-0.1<br>(chronic toxicity) |
| UNACCEPTABLE                         | UNACCEPTABLE           | > 0.125<br>(hypertrophic)        | > 4.00<br>(eutrophic - concentrations > 10mg/L classified as hypertrophic) | ≤ 4<br>OR<br>>15        | < 10  | > 0.1<br>(acute toxicity)         |

**Table E.2**

Rating ranges for variables considered in this assessment of water quality in Cape Town's vleis and dams.

Note: TP= total phosphorus; TIN=Total inorganic Nitrogen; DO=Dissolved oxygen; N:P= ratio of TIN:PO4P; NH<sub>3</sub> = un-ionised ammonia; CHL-A= Chlorophyll-a. Note also that the terms 'PO4-P', 'TIN' etc are abbreviations and are not the full chemical notation for these variables.

| City Water Quality Categories (CWQC) | Interpretation of CWQC | TOTAL PHOSPHORUS<br>mg P/l       | TIN<br>mg N/l | DO<br>mg/l              | N:P   | NH <sub>3</sub><br>mg/l            | RUNNING MEAN ANNUAL CHL-A<br>µg/l |
|--------------------------------------|------------------------|----------------------------------|---------------|-------------------------|-------|------------------------------------|-----------------------------------|
| GOOD                                 | TARGET                 | ≤ 0.015<br>(oligotrophic)        | ≤ 0.7         | > 7                     | >25   | ≤ 0.007                            | ≤ 5                               |
| FAIR                                 |                        | > 0.015 – 0.047<br>(mesotrophic) | >0.7 -1       | >6-7                    |       | > 0.007 - 0.015                    | >5 - 10                           |
| POOR                                 | POOR                   | >0.047 - 0.130<br>(eutrophic)    | >1.0-4.0      | >4 -6<br>OR<br>>12 - 15 | 10-25 | > 0.015- 0.1<br>(chronic toxicity) | > 20 - 30                         |
| UNACCEPTABLE                         | UNACCEPTABLE           | >0.130<br>(hypertrophic)         | > 4           | ≤ 4<br>OR<br>>15        | <10   | > 0.1<br>(acute toxicity)          | > 30                              |

**Table E.3**  
**Approach to the interpretation of microbial data (faecal coliforms including *Escherichia coli*).**  
See Appendix B for derivation of threshold values.

| Interpretation                                                 | Inland systems<br>Faecal Coliform Count (including <i>E. coli</i> ) <sup>1</sup> |
|----------------------------------------------------------------|----------------------------------------------------------------------------------|
| TARGET FOR MAXIMUM ACCEPTABLE RISK FOR FULL CONTACT RECREATION | ≤ 400 <sup>2</sup> cfu/100 ml                                                    |
| ACCEPTABLE RISK INTERMEDIATE CONTACT                           | 1 001 – 2 500 cfu/100 ml                                                         |
| TOLERABLE RISK - INTERMEDIATE CONTACT                          | > 2 500 – 4 000 cfu/100 ml                                                       |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT– LEVEL 1              | > 4 000 – 10 000 cfu/100 ml                                                      |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT– LEVEL 2              | > 10 001 - 100 000 cfu/100 ml                                                    |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT– LEVEL 3              | > 100 000 cfu/100 ml                                                             |

**Table E.4**  
**Water quality grades and corresponding threshold concentrations for microcystin toxins for inland waters adopted for this project.**

| Interpretation              | Microcystin concentration |
|-----------------------------|---------------------------|
| TARGET (ACCEPTABLE)         | ≤ 20 µg/L                 |
| MEDIUM RISK (UNACCEPTABLE)  | >20- 30 µg/L              |
| HIGH RISK (UNACCEPTABLE)    | >30-40 µg/L               |
| EXTREME RISK (UNACCEPTABLE) | >40 µg/L                  |

## E1.7 Reporting periods and seasonality

The annual reporting period used in the Inland Water Quality Annual Report series comprises the period from 1 October to 30 September in any given cycle and is given the YEAR identity of the end of the period. The Scope of Works for the present report requires a focus on water quality data for the 2023 and 2024 reporting periods (1 October 2022 to 30 September 2024). These data are assessed in the light of data over a five-year period (i.e. from 1 October 2019 through until 30 September 2024).

Seasonal variability has also been taken into account in some analyses as follows:

- Winter (typically the 'wet season' in Cape Town) = April to September
- Summer (typically the 'dry season' in Cape Town) = October to March.

## E2 CURRENT STATE AND TRAJECTORIES OF CHANGE IN WATER QUALITY IN CAPE TOWN'S MAJOR WATERCOURSES

### E2.1 Rainfall patterns

Analyses of rainfall data were included to provide background understanding of rainfall patterns in different City catchments, both over the current reporting period and over a longer-term period.

The data showed that cumulative winter rainfall at most stations was similar in the 2023 and 2024 reporting periods; generally greater than that of the other 3 years in the period of analysis (2020-2022 reporting periods); and (with a few exceptions) above the long-term (20-year) mean winter rainfall of 414 mm recorded at Intaka Island. Total summer rainfall was generally significantly lower than total winter rainfall at most of the selected rain gauging stations during most of the reporting periods. At most of the gauging stations, the total summer rainfall in the 2024 reporting period (<100 mm) was significantly lower than that of the four preceding reporting periods considered.

Particularly high rainfall was recorded at most gauging stations in June and September 2023, and

again in July 2024, with daily rainfall maxima of 50 mm or more (indicative of flood events) having been recorded at many stations during these months. These events would have affected water quality in most catchments across the city.

## **E2.2 *Escherichia coli* bacterial counts as an indicator of sewage contamination**

*Escherichia coli* measurements are used primarily as an indicator of human health risk, particularly for drinking or recreational use of a waterbody.

Sewage contamination in Cape Town's sub-catchments arises from multiple sources, including sewer blockages and manhole overflows caused by *inter alia* aging sewer infrastructure, pump station failures (exacerbated by load-shedding); contaminated runoff from poorly serviced informal settlements and backyard dwellings; as well as illegal and/or outdated sewer-to-stormwater connections.

Data for the 2024 reporting period show a marked increase in both the frequency and the magnitude of sewage contamination in Cape Town's rivers between 2020 and the 2023 and 2024 reporting periods, with 2024 showing a similar proportion of sites falling within the "Unacceptable" range compared with 2023 (60 %) but with a higher proportion of these showing an increased magnitude of exceedance of the "Level 2" Unacceptable threshold (52% in this category or higher in 2024 versus 39% in 2023).

Overall, of the 18 catchments / sub-catchments assessed, the 2024 reporting period showed a reduction in the frequency and/or magnitude of measured *E. coli* contamination in only 5 catchments. All of the remaining catchments showed further degradation, often off an already low base, and the City's 60% Acceptable target was achieved in only four catchments in the 2024 reporting period (Schusters, Lourens, Silvermine and Sout Catchments), with the last three of these still showing deterioration compared with the 2023 and 2020 reporting periods.

With regard to the routinely monitored standing-water systems in the City, and with the exception of Zoarvlei and the highly contaminated Mew Way and Mitchell's Plain detention ponds, these waterbodies generally showed relatively low levels of sewage pollution as measured by *E. coli* counts, with > 60% of samples in all systems lying within the Acceptable range for *E. coli* during the 2024 reporting period. The data do however indicate that all systems were subject to periodic sewage pollution incidents. These affected the fitness of these systems for recreational activities, at least at times.

Bacteriological water quality in outflows into the sea via stormwater pipelines were assessed in this report only for the 2024 reporting period. The data showed that the only sites that had no measured *E. coli* in the 2024 reporting period were those in the Lourens Catchment and draining into Bakoven (City Bowl Catchment). All of the other sites draining from the City Bowl included high frequencies of highly contaminated flows (Level 3 Unacceptable) and only three of the 24 sites monitored had ≤ 50% of their samples rated Unacceptable, while the remaining sites all had between 65% and 90% of their samples rated Unacceptable, reflecting inflows of water contaminated with sewage.

Outside of the City Bowl area, stormwater runoff from the Mitchell's Plain catchment was most contaminated, with the outlet from the Khayeltisha detention ponds off Baden Powell Drive and immediately downslope of the Monwabisi pump station having samples that were never better than Unacceptable Level 2. All of the other catchments, with the already noted exception of the Lourens River, showed periodic episodes of highly polluted outflows, that would contribute to the pollution of coastal waters..

## **E2.3 Other sewage contamination indicators**

Informal settlements, as well as any areas with unserviced back-yard settlements, contribute permanent streams of raw sewage into watercourses, usually by way of formal or informal stormwater systems. However, by far the greatest loading of sewage-associated pollutants into the City's watercourses stemmed from the formal sewage reticulation and treatment systems, as a result of the sheer volumes generated.



The main findings in terms of the **quality of inflows of treated effluent from Cape Town's (inland) WWTWs** were as follows:

- Only six of the City's WWTWs generally produced effluent that had been treated to levels where *E. coli* had been effectively removed, to (generally) below the general limit of 1000 cfu/100 ml for this variable. These comprised the Zandvliet, Potsdam, Gordon's Bay, Melkbosstrand, Wesfleur Domestic, Wesfleur Industrial, and Wildevoëlvlei WWTWs.
- COD data arguably present the most useful single variable for highlighting the magnitude of downstream chemical risk to aquatic ecosystems. These data indicate that the most poorly performing WWTWs in terms of COD feed into the following river systems:
  - Eerste River estuary (Macassar WWTW);
  - Black River and Salt River canal (Athlone and Borchard's Quarry WWTWs);
  - Diep River estuary and Milnerton Lagoon (Potsdam WWTW);
  - Zeekoe canal (Cape Flats WWTW); and
  - Mosselbank River (and lower Diep River) (Klipheuwel WWTW) – note however that the effluent volume from this system was relatively low, so downstream loading was not marked).

Of the above, the impacts of the Potsdam and Macassar WWTWs on the downstream systems are considered most significant, as these WWTWs directly impact on what were largely functional estuarine habitats. In the case of the Potsdam WWTW, this has been shown to have contributed largely to the collapse of this estuary and its once-important nursery for juvenile fish.

Improved performance in some WWTWs was apparent in both loading and effluent quality data, in particular at the Zandvliet WWTW following its major upgrade in 2023. High concentrations of phosphorus were, however, apparent in the final effluent data from all WWTWs, despite compliance with regulated general limits.

With respect to **pump station failures** (which typically result in overflows of raw sewage into stormwater systems), over the 2023 and 2024 reporting period a total of 875 pump station failures were recorded. 309 spills occurred in the 2023 period and 566 in the 2024 hydrological year. Over both reporting years, there were a total of three catastrophic and 31 major pump station failures. Of the three catastrophic spill events, two were in the Diep catchment - Koeberg Road and Table View East pump stations. Both spills occurred in the 2024 reporting year, and lasted more than 24 hours. The data showed that the Diep sub-catchment was by far the most impacted by pump station failures, accounting for 19.6% of all failures in the two-year period, while the Lower Salt and Kuils sub-catchments were also subjected to notably higher levels of pump stations failures than other catchments.

Another measure of sewage spill frequency in Cape Town is provided by **records of reporting on sewage spills by members of the public, through submission of the City's C3 reporting forms**. These data indicated that, over the 2024 reporting period, the hotspots for sewage overflows, based on reported incidents, lay in the Lower Salt, Zeekoe, and Elsieskraal Catchments. However, under-reporting of overflows is also an issue (e.g. in the Diep Sub-catchment). Areas with the most intense levels of sewage overflows tended to be those with high levels of informal settlement and/or backyard dwellings.

## **E2.4 Major nutrients (phosphorus and nitrogen)**

The nutrient (or 'trophic') status of freshwater ecosystems allows them to be broadly classified into one of four trophic categories - oligotrophic, mesotrophic, eutrophic, and hypertrophic – respectively associated with low, moderate, high and extremely high levels of nutrients (mainly phosphorus and nitrogen nutrients).

The key take-away points from the assessment of nutrient data were as follows:

- **Phosphorus enrichment** remains a key concern, affecting the condition of all of Cape Town's watercourses and with no real improvement evident in the 2024 reporting period, where 77%

of “flowing” (river / stormwater) samples were rated “Unacceptable” (hypertrophic) and median orthophosphate concentrations lay well above the hypertrophic threshold for this variable in all catchments save the Lourens and Silvermine Catchments.

- **Nitrogen enrichment**, measured as Total Inorganic Nitrogen (TIN), was generally less severe than phosphorus pollution across Cape Town’s water systems. Nevertheless, in the 2024 reporting period, 54% of water quality samples from routinely monitored river / stormwater sites were rated Unacceptable with regard to their TIN concentrations (a four percent increase from 2023 data), while standing water bodies (vleis, dams) showed higher compliance with TIN targets than rivers and stormwater systems, with only 8% of samples rated Unacceptable in the 2024 reporting period.
- Most standing water bodies also had low N:P ratios, indicating their susceptibility to blue-green algae blooms, with those most at risk being Wildevoelvlei, Zeekoevlei, Zoarvlei, Rondevlei, Zandvlei, Rietvlei and the Mew Way and Mitchell’s Plain detention ponds; while vleis such as Little Princessvlei and Princess Vlei were likely to be more resilient;

The above findings highlight how catchment condition reflects in river water quality, with the least developed catchments usually having the least impacted water quality while catchments subject to the accumulation of organic waste, treated and untreated sewage inflows and other sources of contaminated stormwater including fertilisers, are characterized by impacted river waters.

## **E2.5 Chlorophyll-a**

The main findings in terms of algal productivity, as reflected in chlorophyll-a measurements from standing water bodies were:

- Considering all the data from standing water systems together, only 35 to 40% of the samples were within the Target range for Chl-a in the 2023 and 2024 reporting periods, which was slightly less than the proportion of 40-45% recorded for the 2020-2022 reporting period;
- The most problematic systems, where the risk of algal blooms would have been high during both the 2024 reporting period and the previous reporting periods considered, were Zeekoevlei, Princess Vlei and Wildevoelvlei;
- The situation was also problematic in terms of Chl-a levels at Westlake and Rietvlei in the 2024 reporting period.

## **E2.6 Dissolved oxygen**

The main findings with respect to dissolved oxygen levels in the monitored water bodies across the City were as follows:

- The level of non-compliance in relation to the Target range of values for DO concentrations was more problematic for the monitored flowing water sites than it was for standing water sites (45-50% vs. 65-75% compliance) but this could have been, at least partly, the result of many of the flowing system sites being purposefully located immediately downstream of known pollution sources, and because of photosynthesis by excessive algal growth in many of the standing waterbodies causing elevated daytime DO concentrations to be recorded in some of these systems;
- The worst-performing catchment with respect to DO compliance in flowing systems during Reporting Year 2024 was the Soet Catchment, where >80% of the collected samples were in the Unacceptable category, representing a significant (20-30%) decrease in compliance compared to the previous reporting periods;
- Low to very low DO levels were also prevalent in the Diep, Eerste, Kuils, Lower Salt, Mosselbank, Mitchell’s Plain and Zeekoe catchments in Reporting Year 2024 (with 60% or more of the samples from flowing-water sites falling into the Poor and Unacceptable categories combined).

## E2.7 Ammonia toxicity

The main findings with respect to the potential for toxic conditions for aquatic fauna in monitored aquatic ecosystems across the City resulting from elevated levels of un-ionised ammonia were:

- Potentially toxic conditions associated with elevated NH<sub>3</sub> concentrations were more prevalent in flowing water systems than they were for standing water systems, partly attributable to the dilution effect of large standing water bodies;
- There was a negligible risk of ammonia toxicity for monitored flowing water systems in the Hout Bay, Lourens, Schusters, Silvermine and Sout catchments during all of the reporting periods assessed and there was a relatively low risk of ammonia toxicity for flowing water systems in the Sand catchment;
- The most problematic catchments were the Mitchell's Plain and Soet catchments, while potentially toxic conditions were also prevalent in the Diep, Eerste, Kuils, Lower Salt and Zeekoe catchments during the 2024 reporting period, with elevated NH<sub>3</sub> concentrations in the Poor and Unacceptable categories recorded for close to 70% or more of the flowing-water samples that were collected;
- For standing water systems, potentially toxic conditions were prevalent at Wildevoelvlei and at the Mitchell's Plain and Mew Way detention ponds, where all of the recorded NH<sub>3</sub> concentrations were in the Poor and Unacceptable categories (indicating chronic to acute toxicity);
- Potentially toxic conditions were also often present in Rietvlei and, particularly, Zeekoevlei during the 2024 reporting period.

## E3 CURRENT STATE OF RECREATIONAL WATERS

This section was included in the report to deal specifically with the current state of established recreational waterbodies in Cape Town from the perspective of the risk, if any, that they pose to human health. Five main waterbodies are considered, namely:

- Rietvlei
- Milnerton Lagoon
- Princess Vlei
- Zeekoevlei
- Zandvlei

With the exception of Princess Vlei, these vleis and estuaries are used for various water sport activities. Princess Vlei is not used for water sports. It is however used periodically for baptism ceremonies, requiring full immersion. All of these activities expose users to some level of health risk if water quality is compromised.

Assessment of human health risk at each waterbody entailed an analysis of the percentage of samples that exceeded the target value for safe intermediate contact recreation in terms of *E. coli*, and microcystin concentrations. The latter is a toxin produced at times by *Microcystis* algae under bloom conditions. All the assessments assume intermediate contact use only – that is, excluding swimming.

- ***Escherichia coli*** data show that all of the City's recreational water bodies experienced periodic inflows of raw sewage at various frequencies and magnitude. More specifically:
  - **Milnerton Lagoon** experienced very high levels of sewage contamination over all three reporting periods, with data showing a major increase in the magnitude of sewage pollution in the 2024 reporting period. This was assumed to be driven mainly by near-continual inflows of raw sewage from pump station failures (particularly the Koeberg pump station in the 2023 and 2024 reporting periods) and often non-compliant treated



effluent from the WWTW;

- For most of the 2023 and 2024 reporting periods, Milnerton Lagoon was thus not a safe waterbody for even intermediate recreational use (and was closed for such use by the City);
  - **Rietvlei** by contrast appears to have been rarely exposed to high magnitudes of raw sewage inflows over the three assessed reporting periods, and appears to have provided a relatively low-risk environment to recreational users, at least from the perspective of exposure to raw sewage;
  - The frequency of measured *E. coli* at Unacceptable levels reduced slightly in **Princess Vlei** over the 2024 reporting period, compared with 2023, although just under 30% of samples in both summer and winter were still rated as Unacceptable. Nevertheless, the vlei appears to have provided a relatively low-risk environment to intermediate contact users generally.
  - **Zandvlei** data showed some reduction in the magnitude of sewage inflows during the 2024 reporting period compared with those of 2023, reflecting *inter alia* a reduced frequency of pump station failures in the catchment, attributed largely to the positive impact of repairs and upgrades to key previously poorly performing pump stations. On the basis of measured water samples, recreational users of Zandvlei were probably not exposed to unsafe conditions as a result of exposure to raw sewage, particularly in summer when water use was likely to be highest.
  - Users of **Zeekoevlei** were exposed to more frequent *E. coli* inflows of a higher magnitude during the 2024 reporting period than over the previous reporting periods, with in-vlei data indicating a clearly deteriorating trajectory since the 2020 reporting period. Winter samples were particularly problematic, and are assumed to reflect a combination of wash-off from a generally dirty catchment and increased frequency of pump station failure as a result of stormwater ingress. Although the vlei remained usually safe for intermediate recreational use, the data indicate an increased frequency of times when exposure to this water would have been unsafe. At times, high measurements of *E. coli* in the vlei have led to its partial closure and to the cessation of water hyacinth removal;
  - Generally, the data suggest that all of the City's recreational water bodies periodically posed risks to human health during the 2023 and 2024 reporting periods, but were largely in an Acceptable condition, conducive to their recreational use. Milnerton Lagoon was however mostly in an Unacceptable condition, and its use for recreation would have posed likely risks to human health most of the time.
- **Microcystin** data showed that, while all five of the City's recreational waterbodies have been impacted by high levels of orthophosphate contamination, making many of them prone to algal blooms, the only recreational vlei in which **microcystin toxins** were recorded at concentrations of any concern in the 2024 reporting period concern was Rietvlei, where a single sample was rated as of Medium risk. This means that, despite periodic blue-green algal blooms, Cape Town's recreational watercourses were assumed to have been relatively safe for human use over the 2023 and 2024 reporting periods, from the perspective of exposure during intermediate contact use to microcystin toxins.

## E4 WATER QUALITY IN PRIORITY CATCHMENTS ADDRESSED BY THE CITY'S WATER QUALITY IMPROVEMENT PROGRAMMES

The priority catchments that were given focussed consideration in this report were the following:

- The Lower Diep River (upstream of Milnerton Lagoon) (Central and Northern Stormwater Regions);
- The Soet River (Eastern Stormwater Region);
- The Lower Salt River (Northern and Central Stormwater Regions);
- The Kuils / Eerste Rivers (Eastern Stormwater Region);
- The Hout Bay River (Southern Stormwater Region);
- The Big and Little Lotus Rivers (within the Zeekoe catchment) (Southern Stormwater Region); and
- The Sand catchment (upstream of Zandvlei) (Southern Stormwater Region).

For each of the priority catchments, the report provides a catchment overview, followed by information on the major sources of pollution in the catchment, its water quality status in terms of current state and trajectory of change, and the focus areas of the City's water quality interventions. This is followed by discussion of the major challenges in implementing necessary interventions in the catchment and recommendations for going forward.

The following key points emerged from these discussions:

- The most serious issues affecting water quality in the Cape Town's rivers and wetlands comprise **solid waste and sewage**, and the passage of the latter into watercourses by way of dry-weather flows from settlements; stormwater flows; sewage pump station overflows; sewer manholes and failed sewer lines. These issues are controlled by other line departments, but catchment managers and their teams are often at the receiving end of failed reticulation, WWTW and solid waste management systems, and thus are accountable for polluted watercourses and the ecological and other impacts of this pollution, while being powerless to effect change at source.
- All of the City's priority catchments include runoff from informal settlements with poor access to sewerage systems. This means that water quality in stormwater systems is in many areas compromised, to levels where standard application of SUDS and other stormwater quality polishing / improvement approaches are unlikely to be effective – the Sand Catchment is the exception to this, but even this includes small areas of informality and some suburbs with extensive backyard dwellers.
- Solid waste in the sewerage system is a major contributor to blocked sewers and pump stations, resulting in added watercourse pollution – the passage of inappropriate waste into sewers via toilets or manholes is an issue that cuts across all sectors of Cape Town's communities, regardless of income, although the problem materials themselves differ. Addressing this issue through significantly ramped-up solid waste collection and educating communities in all areas as to the impacts of foreign material in sewerage systems is strongly recommended.
- The City's current regional stormwater management system results in some catchments extending across two or more Stormwater Planning Regions. This means that in some cases, river catchments are managed by two or more catchment planners, making integration of projects and responsibilities unwieldy, and accountability for catchment condition difficult to achieve.
- Similarly, sewerage reticulation activities are also not carried out on a (river) catchment basis – this again means that efforts in one part of a reticulation zone may be negated by a lack of co-ordination with upstream reticulation managers, or by different strategies and levels of effort in different areas.
- While progress has been made in many catchments, and in priority catchments in particular, with regard to the development of PASAPs and increasingly detailed TAPs, discussions with regional stormwater management teams highlighted the importance of ensuring buy-in from transverse City Directorates or branches outside of CSRMS (who develop the TAPs), to ensure that the required interventions are feasible and, if not, to ensure that feasible alternatives are identified

and incorporated into the TAPs, along with assigned (and agreed-on responsibilities, to ensure that implementation of the TAPs has support across the multiple City Directorates for which the S&IWQP MMP has relevance.

- In areas not subject to high levels of sewage-impacted stormwater, the City is encouraged to implement or require implementation of SUDS-type interventions and implement pollution tracking when water quality deterioration is detected. These measures will help to maintain the current relatively good status of water quality in these catchments, which comprise:
  - The Silvermine Catchment
  - The Lourens Catchment
  - The Schusters Catchment and
  - The Liesbeek River and its tributaries within the Lower Salt Sub-catchment;
  - Parts of the Sand Catchment.
- The City's re-activation of the planned LUW projects in the Sand Catchment (as of the first quarter of 2025) is strongly supported in this report, as a vehicle to achieve measurable water quality improvement from catchment-scale interventions in moderately impacted catchments, carried out in combination with pollution abatement strategies such as sewer and pump station upgrades and repairs.

## **E5 CONCLUSIONS**

The report concludes that the most problematic and pervasive water quality issue almost throughout the City's monitored rivers and other watercourses was (and remains) orthophosphate enrichment. No real improvement was evident in data from the 2024 reporting period, where 77% of "flowing" (river / stormwater) samples were rated "Unacceptable" (hypertrophic) and median orthophosphate concentrations lay well above the hypertrophic threshold for this variable in all catchments save the Lourens and Silvermine Catchments.

Hypertrophic conditions in aquatic ecosystems, and slow-flowing or standing water systems in particular, contributed towards ecosystem deterioration as a result of *inter alia* rapid growth of aquatic and emergent vegetation, requiring on-going control, and accumulation of organic material from decaying algae and other material in standing water bodies (including some of the recreational vleis). These were in turn also often associated with knock-on socio-economic and human health impacts, such as vlei closures due to high microcystin concentrations (Zeekoevlei), and high costs of vlei dredging and plant clearing.

Compounding problems with the monitoring and management of phosphorus contamination in the City's waterbodies were problems with the data themselves, in that the City has been unable to analyse samples for total phosphorus since December 2022, and the equipment used for the analysis of orthophosphate has a relatively high detection limit, above the threshold for "Poor". This means that early identification of deteriorating water quality in few better -performing catchments such as the Silvermine and Lourens Catchments, is not possible.

Not only was orthophosphate enrichment a problem throughout most of the City's catchments, but the data further suggest that there was substantial deterioration (>25% year-on-year increase) in this critical variable in some of the catchments (Lower Salt, Mosselbank and Soet). With regard to the City's standing waterbodies, these were also characterized by very low N:P ratios, conducive to dominance by blue-green algae (Cyanobacteria). This was evidenced in chlorophyll-a data for standing waterbodies, with only 35 to 40% of samples lying within the Target range for this variable in the 2023 and 2024 reporting periods. The most problematic systems, where the risk of algal blooms would have been high during the 2024 and previous reporting periods considered were Zeekoevlei, Princess Vlei and Wildevoelvlei. Despite these data and although blue-green algal blooms were clearly present on numerous occasions over the 2023 and 2024 reporting periods, the only recreational vlei in which microcystin toxins were recorded at concentrations of any concern in the 2024 reporting period concern was Rietvlei, where a single sample was rated as of Medium risk.

Nutrient enrichment in many areas stemmed from variously treated sewage effluent discharges and inflows of raw sewage and grey water, mainly from informal settlements. This means that these flows were also often associated with high chemical and biological oxygen demand, reflecting in some systems having very low levels of dissolved oxygen to support desirable aquatic life. The worst hit of the assessed systems considered in this study comprised Milnerton Lagoon, the Soet Catchment, Zoarvlei and the highly contaminated Mitchell's Plain and Mew Way detention ponds. All assessed standing water bodies were however at times and in places affected by low DO that would have affected their suitability as habitats for moderately sensitive taxa.

Summary *E. coli* data highlight how problematic raw sewage was, across the City's waterbodies, with 60% of river samples rated Unacceptable in the 2023 and 2024 reporting periods. Standing water bodies were generally less impacted, and data showed that 80% of standing water sites were in the Acceptable range for *E. coli*. Non-compliance was, moreover, driven by a few sites only (the Mitchell's Plain and Mew Way ponds for example had zero compliance over the 2024 reporting period). Lower levels of *E. coli* in standing waterbodies are often driven by dilution within the system as well as by extended exposure to sunlight, which breaks down *E. coli* (but not the nutrients and other pathogens associated with raw sewage).

Of concern is the fact that *E. coli* data show a marked increase in both the frequency and the magnitude of sewage contamination of Cape Town's rivers between 2020 and the 2023 and 2024 reporting periods, with 2024 showing a similar proportion of sites falling within the "Unacceptable" range compared with 2023 but with a higher proportion of these showing an increased magnitude of exceedance of the Unacceptable threshold. Increasing frequency of *E. coli* concentrations in the Unacceptable range were noted in the usually best-performing Silvermine and Lourens Catchments, and these are flagged as particular concerns in these generally least-polluted systems, which are assumed to still have high ecological sensitivity to nutrient enrichment.

While the recreational vlei data that were analysed show that all of the City's recreational water bodies periodically posed risks to human health during the 2023 and 2024 reporting periods, they were largely in an Acceptable condition, conducive to their safe recreational use. Milnerton Lagoon was, however, mostly in an Unacceptable condition, and its use for recreation would have posed likely risks to human health most of the time – for this reason, the lagoon has in fact been closed by the City for recreation for several years.

The key sources of pollution were identified as follows:

- Inflows of treated effluent from WWTWs across the City result at best (if licensing requirements are met) in permanent flows of nutrient-enriched effluent into sometimes seasonal or small river systems, and downstream vleis or estuaries. However, not all (or even most) of the City's 17 inland discharging WWTWs meet the General Limits for effluent discharge.
- Episodic overflows from sewage pump stations and surcharging manholes result in overflows that pass either directly into watercourses or enter them via the stormwater system.
- Runoff from informal settlements and housing areas with high levels of backyard dwelling and/or where there is poor attention paid to maintenance of existing infrastructure result in permanent, generally low volume but highly contaminated waste streams passing out of informal settlements and into the City's watercourses.
- Accumulations of large amounts of solid waste and illegal dumping of waste that characterise many areas of the City's open spaces, roadways and pavements. Much of this waste enters watercourses, where it may contribute harmful pollutants to aquatic ecosystems (e.g. cans containing oil and other waste; old nappies and other organic waste) or block stormwater drains and channels. When solid waste is disposed of into the sewer system, it can block sewers and clog pumps at sewage pump stations. This issue stems largely from inadequate solid waste collection, compared with the volume of waste generated.

There are many other activities and land uses that contribute to cumulative water quality



degradation in the City. The above are considered by far the most significant, and unless they can be addressed or their impacts mitigated, there is little likelihood that the City will be able to effect meaningful and measurable improvement in water quality in most of its managed sub-catchments.

## **E6 RECOMMENDATIONS**

The Technical Report includes detailed recommendations for implementation by the City and, in some cases by its residents, to improve water quality in its rivers, estuaries and other waterbodies.

Upfront it is however stressed that until the pervasive issues of pollution from WWTWs and informal settlements can be addressed, it is unlikely that there will be a significant turn-around in water quality in many areas.

Key recommendations, outlined in full in the report, focus on measures to:

- Reduce the impacts of point source pollution on aquatic ecosystems, with different measures suggested to reduce pollution from:
  - major WWTWs, through improved maintenance as well as prioritized upgrades and also with attention to incentivise reduced use of phosphorus-containing products in Cape Town's catchments;
  - informal settlements and suburbs with high levels of backyard settlements, including on- or off-site package plant treatment or strategic low flow diversions to sewers and WWTWs;
  - overflows from pump station failure;
- Reduce the passage of solid waste into stormwater systems and watercourses through improved collection frequency and effort as well as through measures such as actively encouraging (through Policy) waste recovery and repurposing (e.g. the use of "green building aggregates");
- Amend stormwater, sewerage reticulation and urban waste management structures to align management boundaries with City catchments;
- Fast-track implementation of PASAPs and TAPs;
- Actively conserve existing sub-catchments or parts of sub-catchments in relatively good condition (Silvermine, Lourens, (upper) Hout Bay Catchments as well as parts of the Sand and Lower Salt (Liesbeek) sub-catchments);
- Conserve remnant floodplains and their wetlands (especially Kuils, lower Eerste, Diep and Hout Bay);
- Prioritise LUW programme implementation;
- Implement a number of (specified) changes to the City's water quality monitoring programme in terms of sampling sites and water quality variables;
- Use water quality monitoring data to trigger pollution control interventions;
- Include monitoring of flow data in water quality monitoring to allow calculation of loading and inform management interventions;
- Allocate catchment data to C3 sewage spill reporting datasets.

In addition to the above, specific recommendations have been provided to improve inland water quality reporting going forward. One of the key recommendations made, in order to simplify water quality reporting, is that the City reports on Inland Water Quality using its Water Quality Indices, developed in 2013 for such purposes. The Indices output a single rating per water sample (A-F), which is based on the concentrations and condition thresholds of the full range of variables considered individually in the current Inland Water Quality Report.

Note that many of the above measures were included in previous reports. Some of these have already been implemented in part or in planning by the City, but remain important interventions that will together help to bring about an improvement in Cape Town's inland water quality.

## City of Cape Town

Inland Water Quality Report covering rivers and major vleis  
with a focus on the period October 2022 to September 2024 (2023 and 2024 Reporting Periods)

### ACRONYMS

|                |                                                                             |
|----------------|-----------------------------------------------------------------------------|
| BMB            | Biodiversity Management Branch                                              |
| CBD            | Central Business District                                                   |
| CCPOA          | Century City Property Owners' Association                                   |
| City           | City of Cape Town Metropolitan Municipality                                 |
| CFF            | C40 Cities Finance Facility                                                 |
| cfu            | Colony forming units                                                        |
| Chl-a          | Chlorophyll-a                                                               |
| COD            | Chemical Oxygen Demand                                                      |
| CSRM           | Catchment, Stormwater and River Management (Branch of City)                 |
| CWQC           | City Water Quality Categories                                               |
| DEA            | Department of Environmental Affairs                                         |
| DEADP          | (Western Cape) Department of Environmental Affairs and Development Planning |
| DO             | Dissolved oxygen                                                            |
| DWAF           | Department of Water Affairs and Forestry (now DWS)                          |
| DWS            | Department of Water and Sanitation                                          |
| EFZ            | Estuarine Functional Zone                                                   |
| <i>E. coli</i> | <i>Escherichia coli</i>                                                     |
| EC             | Electrical conductivity                                                     |
| FLR            | Friends of the Liesbeek River                                               |
| FBNR           | False Bay Nature Reserve                                                    |
| FOZR           | Friends of Zeekoevlei and Rondevlei                                         |
| GI             | Green Infrastructure                                                        |
| GN             | Government Notice                                                           |
| HBRCF          | Hout Bay River Catchment Forum                                              |
| IUA            | Integrated Unit of Analysis                                                 |
| LDC            | Liz Day Consulting (Pty) Ltd                                                |
| LUW            | Liveable Urban Waterways (programme)                                        |
| mamsl          | metres above mean sea level                                                 |
| MAC            | Milnerton Aquatic Club                                                      |
| MCC            | Milnerton Canoe Club                                                        |
| M'Plain        | Mitchell's Plain                                                            |
| MMP            | Maintenance and Management Programme                                        |
| MPP            | Mayoral Priority Programme                                                  |
| mS/m           | milli-Siemens per metre (unit of measurement for conductivity)              |
| NbS            | Nature-based Solution                                                       |
| NH3            | Abbreviation used in this report for free ammonia (NH <sub>3</sub> )        |

## City of Cape Town

Inland Water Quality Report covering rivers and major vleis  
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|                    |                                                                                                                   |
|--------------------|-------------------------------------------------------------------------------------------------------------------|
| NH <sub>4</sub> -N | Abbreviation used in this report for nitrogen in total ammonia (NH <sub>3</sub> + NH <sub>4</sub> <sup>+</sup> )N |
| NO <sub>3</sub> -N | Abbreviation used in this report for nitrogen in nitrate salts                                                    |
| PASAPs             | Pollution Abatement Strategy and Action Plan                                                                      |
| PES                | Present Ecological State                                                                                          |
| pH                 | Potential of hydrogen (a measure of how acidic or basic a substance is)                                           |
| PM                 | Project Manager                                                                                                   |
| PO <sub>4</sub> -P | Abbreviation used in this report for phosphorus in orthophosphate                                                 |
| PPP                | Public- Private Partnership                                                                                       |
| RQOs               | Resource Quality Objectives                                                                                       |
| SABS               | South African Bureau of Standards                                                                                 |
| SIWQP              | Sanitation and Inland Water Quality                                                                               |
| SLPass             | Sir Lowry's Pass                                                                                                  |
| SSB                | Scientific Services Branch (of the City)                                                                          |
| SUDS               | Sustainable Urban Drainage Systems                                                                                |
| TAPs               | Transversal Action Plans                                                                                          |
| TECs               | Target Ecological Category                                                                                        |
| TIN                | Total inorganic nitrogen                                                                                          |
| ToR                | Terms of Reference                                                                                                |
| Tot P              | Total phosphorus                                                                                                  |
| TSS                | Total suspended solids                                                                                            |
| UNESCO             | United Nations Educational, Scientific and Cultural Organisation                                                  |
| W&SD               | Water and Sanitation Department (City)                                                                            |
| WHO                | World Health Organisation                                                                                         |
| WQIP               | Water Quality Improvement Programme                                                                               |
| WQMR               | Water Quality Management Region                                                                                   |
| WTP                | Water Treatment Plant                                                                                             |
| WWTW               | Waste Water Treatment Works                                                                                       |

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## 1 PREFACE AND INTRODUCTION

### 1.1 Background

The City of Cape Town ("the City") is responsible for the management of numerous rivers and wetlands, including open water vlei systems, estuaries and coastal lakes, within its municipal boundaries. These are referred to together as 'inland waters', in line with the South African classification system for aquatic ecosystems (Ollis et al. 2013).

The City has monitored the quality of water in these water bodies since the early 1980s, and its water quality database includes data from both long-term, routine monitoring points and those generated from *ad hoc* or project-specific monitoring.

Regular reporting on the results of water quality sampling is required in order to inform both City managers and other interested parties / members of the public about the state of Cape Town's watercourses. The City's Catchment, Stormwater and River Management Branch (CSRM) thus provides ongoing internal reporting on inland water quality to various City branches and departments and has, since April 2022, made its water quality data publicly available, via its water quality data portal<sup>1</sup>. In November 2024, the Inland Water Quality Dashboard was also launched. This is a user-friendly platform to view and monitor the quality of the City of Cape Town's inland water bodies<sup>2</sup>.

In addition to the above, independent assessments and overviews of all water quality data collected for the City's routine monitoring sites is undertaken on an annual basis. The first such report was compiled in 2020 (Day et al 2020) and assessed data back to 1982, with an emphasis on the previous five years. Since then, Inland Water Quality Reports have been produced for the 2020/2021 Reporting Periods (Day et al 2023) and the 2022/2023 Reporting Periods (Day et al 2024).

The present report covers the 2023/2024 Reporting Periods, and has been compiled by Liz Day Consulting ("LDC"), who was subcontracted by Lukhozi Consulting Engineers ("Lukhozi"), through its term tender (Contract 194C/2020/21-CSRM) with the City. The report assesses the 2023/2024 data in the context of the medium-term trajectory of water quality over the past five years (i.e. from October 2019 to end of September 2024).

### 1.2 Scope of Works

The City's Scope of Works for this project stipulated that the appointed consultants should compile a report on the water quality of Cape Town's waterways that:

- Follows the same format as previous Inland Water Quality Reports;
- Utilises the same thresholds for interpretation of water quality data that were used in the 2022/2023 Inland Water Quality Report (Day et al 2024);
- Analyses water quality data for a five-year period up until end of September 2024, with a particular focus on the two-year period between October 2022 and September 2024;
- Is scientifically defensible in its analyses and data interpretation and presentation;
- Uses language that is readily accessible by a wide-ranging and largely non-technical / non-scientific audience;
- Includes reporting on progress made in key City programmes that have a bearing on water quality in inland waters;
- Includes all data, analyses and graphics in spreadsheet format for subsequent use by the

---

<sup>1</sup> <https://odp-cctegis.opendata.arcgis.com/datasets/cctegis::routine-inland-water-quality-monitoring/explore?location=-34.072562%2c18.691468%2c9.43>

<sup>2</sup> <https://www.arcgis.com/apps/dashboards/9f857f26b59d4aa3abf13ba4a7787d8b>

City;

- Is accompanied by a Summary Document for easier consumption by a non-technical audience.

### 1.3 Project Team

Lukhozi is a consulting engineering company, which has sub-contracted the present project to Liz Day Consulting (LDC). LDC is a private consulting company, specialising in river and wetland assessment, management and rehabilitation.

The current project included the following team members:

- Lukhozi team:
  - Mr James Lochner
  - Mr Casey Beveridge
  - Ms Natalie Ritsch
- LDC team:
  - Dr Liz Day (LDC): project manager and water quality consultant
  - Mr Dean Ollis (Inland Waters Consultancy): water quality consultant
  - Mr Tom Smyth (Infinity Environmental): R analyses
  - Mr Jeremy Rose (Infinity Environmental)
  - Mr Ian Wilson (Spatial Mapping Solutions), providing GIS input and producing all GIS-based maps.

For the purposes of this report, reference to LDC includes acknowledgement of the full team of consultants listed above.

### 1.4 Client team

Input into this report was also guided by the City's team from the Catchment Stormwater and River Management (CSRM) Branch, comprising:

- Ms Nicole Garcia
- Mr Fahad Aziz
- Mr Richard Nell.

In addition, all four of the City's Stormwater Regional Managers and their teams made themselves available for detailed discussions, with particular input from:

- Mr Ben De Wet and team (Central Region)
- Mr Johann Terblanche and team (Northern Region)
- Mr Gehardt Muller and team (Eastern Region) and
- Mr Luqmaan Abdullah and team (Southern Region).

### 1.5 Audience

This report is intended to be accessible to a wide range of audiences, including people with both technical and non-technical / non-scientific backgrounds. Nevertheless, the data need to be presented in a scientifically defensible and rigorous manner, which means that some parts of the report are more technical than others. It is hoped that any difficulty in understanding this material, or limited time to go through it all in detail, is addressed in the summary sections at the end of each chapter; in the concluding sections; in the Executive Summary; and in the non-technical Summary Report that is being produced as an accompaniment to this technical report.

### 1.6 Types of aquatic systems included

This report considers water quality data for Cape Town's inland and estuarine water quality monitoring sites, as well as for a number of coastal stormwater outlets. It does not include data for



any marine sites and includes only a few examples of artificial stormwater detention or attenuation ponds, where these provide useful indications of water quality issues in key catchments. The report also excludes water quality data from *ad hoc* or once-off sites, for which only a few data points exist, as well as data generated as part of investigations into specific water quality issues in localised parts of the City (e.g. following particular pollution events). New sampling points established by the City for which less than one year of data are available have also been excluded from this report.

## 1.7 Limitations

The following limitations should be borne in mind when reading this report:

- Large amounts of water quality data are available in the City's database. Of necessity, this project needs to summarise these data to draw out significant patterns and highlight particular areas of interest. The report thus focuses on a few key variables only, and does not consider data relating to every one of the water quality variables monitored by the City;
- Conversely, not all variables of concern are necessarily included in the City's monitoring programme and are not therefore covered in this report. Heavy metals, for example, are not routinely analysed by the City, largely for budgetary reasons. Jackson et al. (2009), however, noted significant concentrations of various heavy metals in the Diep and Eerste River estuaries and Gammon and Clark (2022) found some heavy metal accumulations at concentrations of concern in fish tissue. On the basis of these studies, other catchments might well be subject to similar issues;
- Although the City routinely collects phytoplankton samples for enumeration and identification of algal species, these data were not included in this assessment;
- This report does not provide a synopsis of the ambient water quality in Cape Town's rivers, canals, and open water bodies, because the analyses presented here are based exclusively on the sampling sites of particular concern that are routinely monitored by the City's Scientific Services Branch (SSB) – aquatic systems that are not affected by pollution issues have, to date, generally not been monitored;
- No responsibility is taken by LDC for the accuracy of water quality data, which have all been derived from samples collected and analysed at the City's SSB, in Athlone;
- LDC distances itself from the implications of any future decisions taken to access any water bodies for recreational purposes, on the basis of the data and assessments outlined here. These all refer to the past condition of these water bodies, and no predictions around future water quality or risk to human health should be drawn from this report.

## 1.8 Report structure

This report has been structured as follows:

- **Section 1:** Preface and general introduction;
- **Section 2:** Background information on water quality, an introduction to the City's managed river catchments and stormwater regions, and a brief summary of the main findings and recommendations of the previous Inland Water Quality Report;
- **Section 3:** Introduction to the City's routine water quality monitoring programme and datasets; description of the water quality variables considered in this report; the water quality thresholds used to determine water quality classes and to set targets; an outline of data analysis and presentation approaches used in this report;
- **Section 4:** Consideration of rainfall data from sites within the City, to illustrate rainfall seasonality and patterns in annual rainfall that might have some bearing on water quality in Cape Town's watercourses;
- **Section 5:** Presentation of the assessment of long-term and current water quality data for river, stormwater and standing water sites across City, presented at a sub-catchment level, and

discussed in terms of each of the key variables selected. This section includes compliance-type graphs and summary boxplots for all of the key variables included;

- **Section 6:** Presentation of water quality data pertaining to the condition of the key recreational vleis in the City, with regard to water quality risks to human health. This section focuses on variables with a direct bearing on human health during recreational activities, hence: *E. coli*, enterococci, and microcystin toxin data;
- **Section 7:** An overview of the key programmes established by the City in an effort to address water quality issues in particular;
- **Section 8:** A summary of water quality conditions and concerns in the City's seven priority catchments, including comment on measures undertaken in each to try to address these;
- **Section 9:** Summary of key issues, with recommendations and conclusions;
- **Appendices:** These include a list of sites for which data have been accessed for this report; a brief review of the information used to define water quality thresholds of acceptability; detailed data tables, showing summary annual data for each of the key variables selected, for each site, for each year between October 2021 and September 2023; and the full statistical boxplots for variables presented in **Section 5**. Readers with a particular interest in water quality at a particular site can access more detailed site specific information in these tables.

## 1.9 Acknowledgements

Useful comments and feedback and ongoing input into the project were provided by the following officials from the City's CSRM Branch: Water and Sanitation Department; Water and Waste Directorate:

- Ms Nicole Garcia
- Mr Richard Nell
- Mr Fahad Aziz
- Stormwater Planning Region managers and their teams:
  - Mr Luqmaan Abdullah
  - Mr Ben De Wet
  - Mr Johann Terblanche and
  - Mr Gehardt Muller.

The Scientific Services Branch is thanked for providing the datasets, and for comments regarding the collection and analysis of water quality samples, as well as for useful discussions regarding *Escherichia coli* data reporting and analyses.

The Century City Property Owners' Association (CCPOA) is also thanked for making their rainfall data available for this study.

## 2 WATER QUALITY IN AN URBAN CONTEXT

### 2.1 Cape Town's watercourses

Extensive natural watercourses as well as artificial stormwater channels, canals, pipelines and detention ponds occur in Cape Town's urban areas, and together form part of Cape Town's stormwater system, which is managed by the City. These include:

- 16 630 km of pipes and culverts<sup>3</sup>
- 890 detention ponds
- 236 stormwater treatment wetlands
- 1 880 km of natural rivers and streams<sup>4</sup>
- Around 567 km of lined and unlined open channels and canals
- 4 164 'natural and semi natural' wetlands, including 'vleis' and estuaries<sup>5</sup>.

### 2.2 Water course classification

The City's watercourses range from rivers, through to wetlands and coastal lakes, to estuaries, as well as artificial or highly modified dams and vleis. Natural water quality can vary widely between these different systems. Thus when assessing water quality data, it is important to understand which watercourses are being assessed.

In South Africa, a classification system has been developed, to allow different aquatic ecosystems to be distinguished from each other (see Ollis et al 2013). This system is a hierarchical one, which distinguishes first between marine, estuarine and inland systems, and then further categorises inland systems, in terms of different types of rivers and wetlands. The present report deals only with **inland** and **estuarine** ecosystems. These are discussed and illustrated briefly below.

#### 2.2.1 Inland systems

There are three broad types of inland systems, namely:

- **Rivers**, which are flowing water systems, where water is concentrated in distinct channels. Five river types can be identified within Cape Town's water bodies:
  - **Mountain stream** reaches flowing off steep mountain gradients, and tending to occur on the outskirts of Cape Town and to lie outside of the urban edge – many of these are perennial systems, fed by extensive aquifers;
  - **Upper (or cobble) foothill** reaches, which occur on steep mountain foothills and which, where they pass through Cape Town's boundaries, tend to run mainly through farms, smallholdings or low-density residential areas and nature reserves;
  - **Lower (or gravel) foothills** which, with a few exceptions, run through highly developed

#### Box 2.1

##### What is a watercourse ?

The National Water Act (Act 36 of 1998) defines a 'watercourse' as -

- (a) a river or spring;
- (b) a natural channel in which water flows regularly or intermittently;
- (c) a wetland, lake or dam into which, or from which, water flows; and
- (d) any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The 'extent of a watercourse' (i.e. that area that is considered in the legislation) is further defined in Government Notice (GN) 4167 of 2023 as the area within the 1:100 year floodline of the watercourse, or the delineated riparian area, whichever is the larger.

The City also considers the river floodplain as the area below the 1:100 year floodline – this has relevance to the application of its policy for development in flood-prone areas, which requires new developments to be set back from rivers and their floodplains and its stormwater quality policy, which regulates the treatment of runoff from new developments, into watercourses.

<sup>3</sup> Data from <http://www.capetown.gov.za/family%20and%20home/transport-and-vehicles/road-safety/our-stormwater-system>

<sup>4</sup> Data kindly supplied by Ms Kristin Botes, City of Cape Town

<sup>5</sup> Data from City's wetland layer



urban areas, including residential suburbs, commercial and industrial zones – these tend to be highly impacted by urban land-use;

- River reaches classified in the City's database as 'transitional', but which are more accurately classified in terms of Ollis et al (2013) as **valley-bottom wetlands**, and which dominate the naturally seasonal flat, low-lying Cape Flats area – most of these have been channelised, and have lost all or most of their wetland characteristics; and
- **Lowland rivers**, which meander across broad floodplains and generally pass into the estuarine zone of the river. These systems have been highly impacted by urban land-use (e.g. they have been canalized or channelised to reduce their floodplain extent) and many floodplains have been developed over.

**Table 2.1**  
**Examples of river types in Cape Town.**



**Mountain stream (upper Silvermine River)**  
(Photo: D. Ollis)



**Wetland transitional stream through Noordhoek wetlands area**



**Cobble foothills**  
**(Silvermine River)**



**Gravel foothills**  
**Liesbeek River (Lower Salt sub-catchment)**





**Valley-bottom wetland / 'wetland transitional' stream  
Channelised and partially diverted Keysers River**



**Lowland River  
(Kuils River)**



**Remnant floodplain wetlands on the Eerste River**



**Flooded floodplain wetlands  
(Eerste River – September 2024)  
(Photo: T. Smyth)**



- **Open water bodies**, which are permanently inundated water bodies where standing water is the main habitat – open water bodies with water greater than 2 m in depth are also called lake (or limnetic) systems;
- **Wetlands**, which are characterised by permanently, seasonally or temporarily saturated soils, sometimes covered with shallow water and vegetated with plants that are adapted to life in saturated soils or standing water.

Of the above inland systems, **this report considers only rivers, artificial stormwater channels and canals** that are comparable to ‘rivers’ in their various forms; and the main ‘**open water**’ bodies (dams, lakes and vleis) that are routinely monitored by the City. The latter include both natural and artificial water bodies (e.g. stormwater detention ponds).

In addition, the City monitors a number of piped stormwater outlets into marine areas – these are included with the river (i.e. flowing water) systems for the purposes of this report.

### 2.2.2 Estuaries

Before urbanisation, Cape Town’s rivers all ultimately passed into the sea via estuaries or coastal lagoons. There are 10 estuaries within the City’s boundaries, namely the Diep River (Milnerton Lagoon), Hout Bay, Wildevoelvlei, Bokramspruit, Schusters, Silvermine, Zandvlei, Eerste, Lourens and Sir Lowry’s Pass estuaries. The Sout and Salt systems would also have formed estuaries / coastal lagoons under natural conditions, but these have long lost all natural estuarine function as a result of upstream changes including canalisation up to the seashore.

Today, most of Cape Town’s estuaries have been highly modified, their river outlets having been converted into concrete canals (e.g. the Salt and Sir Lowry’s Pass Rivers), and with none of the salt flux and tidal exchange necessary to meet the criteria for an estuary. At the time of this report, Zandvlei was the only remaining system that, despite significant levels of impact, retained real estuarine functionality (see **Section 6**). The Eerste River Estuary has been severely impacted by large volumes of low salinity wastewater discharges; the Diep River Estuary (Milnerton Lagoon) has been heavily polluted by ongoing inflows of treated and untreated sewage, including from the Potsdam WWTW (Rose et al

#### Box 2.2

##### Open water bodies

Rietvlei, Zeekoevlei, Princess Vlei, Little Princessvlei, Langvlei and Wildevoelvlei are all lake-like open water bodies. Of these, Rietvlei and Zeekoevlei have both been artificially modified to provide near-permanent standing water for recreational purposes, and water levels in Princess Vlei are also managed by an artificial weir.



**View of Princess Vlei**  
(Photo: FOZR)

#### Box 2.3

##### What is an estuary ?

Estuaries are legally defined as ‘a body of surface water— (a) that is permanently or periodically open to the sea; (b) in which a rise and fall of the water level as a result of the tides is measurable at spring tides when the body of surface water is open to the sea; or (c) in respect of which the salinity is higher than fresh water as a result of the influence of the sea, and where there is a salinity gradient between the tidal reach and the mouth of the body of surface water’ (definition from The National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008 (as amended 2015))).

Many of Cape Town’s natural estuaries no longer meet the above criteria.



**Photo: Eerste River estuary, impacted by high levels of water quality contamination**

2023 and Day et al 2024a); and the Lourens River and Silvermine River estuaries have also been impacted by urban development and (in the case of the former) significant upstream abstraction.

Other naturally seasonal coastal lakes, which opened periodically to the sea during particularly wet periods (e.g. Rondevlei and Zeekoevlei) have today been connected to the sea via artificial channels and canals (Brown and Magoba 2009). These channelled outlets do not, however, have any estuarine function.

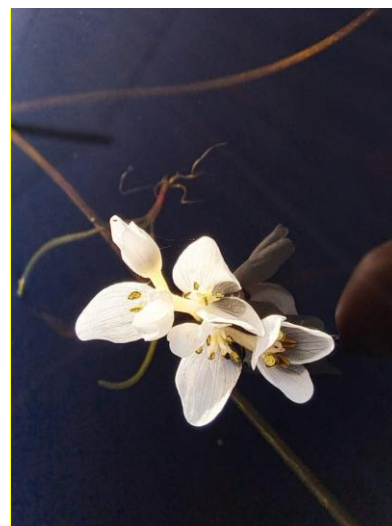
In this report, Milnerton Lagoon (downstream of Otto Du Plessis Drive) and Zandvlei have been treated as functional estuaries. The other estuaries are either not routinely monitored at their outlets or their outlets are too altered to be expected to have any estuarine characteristics.

## 2.3 The ecological importance of urban watercourses

From an ecological perspective, urban watercourses can act as corridors of relatively natural habitat through increasingly sterile urban landscapes and, in Cape Town's case, they also connect mountainous habitats with the coast. They also provide aquatic habitat and, in some areas, are of great biodiversity importance. The City lies in the heart of the Cape Fynbos Biome, and some of its aquatic ecosystems, support species of plants and/or animals that occur in a restricted area and nowhere else in the world.



**The African (or Cape) Clawless Otter (*Aonyx capensis*) is the second largest otter species with a global (IUCN) and regional listing of Near Threatened. It occurs in many of Cape Town's river corridors and wetlands, as well as along coastal areas, generally where there is also access to freshwater streams or seeps into the ocean. It feeds mainly on crabs, highlighting the importance of maintaining rivers with water quality and physical habitat that can support freshwater crabs, although otters will also feed on other fauna including fish. Robust riverine corridors that provide safe shelter for otters and other fauna are important in otherwise sterile urban areas.** (Photo: D. Gibbs)



***Aponogeton angustifolius* (Cape pondweed) is a Western Cape endemic wetland plant species that occurs in watercourses that dry out in summer. It is threatened by habitat loss, with many seasonal wetlands within urban areas in particular being infilled or changed to permanently wetted systems as a result of urban drainage** (Photo: T. Stock)

## 2.4 Urban watercourses and waste

Urban watercourses can play important roles in a city, and their overarching condition can have significant indirect impacts on issues such as human health, property value, security, amenity opportunities, flood risk, and maintenance and management costs such as litter and sediment removal. For example, while properties in proximity to well-managed watercourses in good condition may benefit from enhanced property value, those in proximity to watercourses that are in poor condition, subject to litter, odour or aquatic plant invasion (including algal growth in standing water

bodies), are likely to experience a decline in property value (de Wit et al. 2009).

Among the most profound issues affecting water quality in Cape Town, as well as in many other urban centers, is the impact of solid waste and treated and untreated sewage and so-called “grey water” (i.e. waste water from domestic uses such as washing, cooking and bathing).

Treated and untreated sewage waste that enters Cape Town's watercourses are particularly problematic from a water quality perspective, as outlined below.

Under ideal conditions, domestic and industrial waste is conveyed to waste water treatment works (WWTWs), where it is treated to an acceptable standard and then either released back into the environment (usually into rivers or the sea); re-used in industry or for irrigation; or, in some areas, treated further for human consumption, sometimes by way of aquifer recharge. In practice, however, the management and treatment of human waste is often fraught with problems, particularly in developing countries. Key issues relevant to waste management in Cape Town are:

- Informal settlements and back-yard dwellings with inadequate or no sanitation, resulting in sewage waste as well as grey water being discharged into roads or directly into stormwater systems – high densities of human populations in both informal settlements and backyard dwellings make this a major water quality (and human health) issue;
- Informal settlements in marginal land considered unsuitable for housing – such land is often in low-lying areas, in or near to seasonally inundated wetlands. The disposal of waste from residents is thus often directly into these areas, resulting in rapid pollution and degradation of sometimes important seasonal wetlands;
- Repeated sewer leaks and overflows from aging infrastructure in dense urban areas – these are often older areas, where infrastructure is now failing;
- Overflows from sewers as a result of sewage pump failure, sometimes caused by power outages due to ‘load-shedding’ or the illegal dumping of foreign objects into the sewage system;
- Poorly treated effluent discharged from WWTWs into rivers, contributing to significant enrichment and often low levels of oxygen and elevated ammonia, affecting river habitat quality and downstream systems such as vleis and other wetlands. Without dilution by the receiving waterbody, even effluent that is treated to comply with legal standards (e.g. General Effluent Limits, as specified by the National Department of Water and Sanitation (DWS)), is likely to contain high levels of nutrients, as well as ammonia, and could also lead to poorly oxygenated waters as a result of high levels of organic decomposition – this is a particularly serious issue in naturally seasonal watercourses, where in summer, all of the flow can sometimes comprise treated (or untreated) waste water, with no dilution;
- Illegal connections in industrial or residential areas, allowing waste that should be discharged into sewers to be passed instead into the stormwater systems – a common source of pollution in many more affluent residential areas is the passage of water back-washed from swimming pools into streets or the stormwater system, where it can result in the formation of persistent toxins (e.g. chloramines);
- Poor levels of solid waste collection and high levels of illegal waste dumping, resulting in the accumulation of waste along roads and open spaces, from where plastics and organic waste (e.g. from used nappies, offal and other waste sources) can wash into the stormwater system.





**Litter accumulating in watercourses in Cape Town (Big Lotus River), from where it is washed into important wetlands (in this case Zeekoevlei, a Ramsar wetland)**



**Accumulated raw sewage in the Theo Marais channel, Diep River catchment, following months of sewage overflows from the Koeberg sewage pump station**



**Solid waste and raw sewage threaten human health and downstream wetlands in the Masiphumelele informal settlement**



**Polluted point-source inflows of sewage and grey water from unserviced settlements in the Big Lotus River catchment**

## **2.5 City catchments**

Cape Town's numerous watercourses drain 21 major catchment areas, shown in **Figure 2.1**.

It should be noted that the City Bowl and adjacent Sea Point and Camps Bay areas do not have any remaining natural rivers. Both natural and artificial drainage is diverted into underground systems, which can nevertheless affect coastal water quality if polluted. These catchments are reflected in this report in data for coastal stormwater outlets only, although it is noted that new sampling points were established in the upper reaches of some of these systems in late 2024, and that these data will inform future Inland Water Quality reporting (see Section 3.7).

By contrast, the Mitchell's Plain catchment, shown in **Figure 2.1**, would not have included any natural rivers prior to urbanisation. Rainwater falling in this part of the Cape Flats probably infiltrated through the sand or formed shallow, largely isolated wetlands. Today, however, the area is highly urbanised, and runoff from the hardened surfaces is collected in large artificial detention ponds and conveyed to the sea through stormwater pipes and drains.

Other catchments (Atlantis, Steenbras, Llandudno, Chapmans Peak and Muizenberg catchments,



as well as a number of small catchments, lumped in this and previous Inland Water Quality Reports into the so-called "South Peninsula" catchment area) do not include monitoring points with data to inform the current monitoring period and are thus not color-coded in **Figure 2.1** or referenced further in this report. New monitoring points have however been established *inter alia* by the City in the Atlantis and South Peninsula catchments, and these data should inform future reporting on water quality in these areas.

Three catchments are significantly larger than others, namely the Diep, Eerste and Salt catchments. For the purposes of this report, these catchments have been further divided into sub-catchments (the Diep and Mosselbank; the Kuils and Eerste; Elsieskraal and the Lower Salt Sub-catchments), as shown in **Figure 2.1**. It should be noted however that a large proportion of the Diep, Mosselbank and Eerste River Sub-catchments in fact lie outside of the City's boundary.

## **2.6 Priority catchment areas**

Seven priority catchment areas have been identified by the City for focused interventions intended to improve river and wetland ecosystem function and, through this, bring about an improvement in water quality. The priority sub-catchments are:

- The Lower Diep River (upstream of Milnerton Lagoon)
- The Soet River
- The Lower Salt River
- The Kuils / Eerste Rivers
- The Hout Bay River
- The Big and Little Lotus Rivers (within the Zeekoe catchment)
- The Sand catchment (upstream of Zandvlei).

The above priority catchments also form the focus of three major City programmes, namely the City's Water Quality Improvement Programme (WQIP); the Liveable Urban Waterways (LUW) Programme and the Mayor's Priority Programme (MPP) on Sanitation and Inland Water Quality.

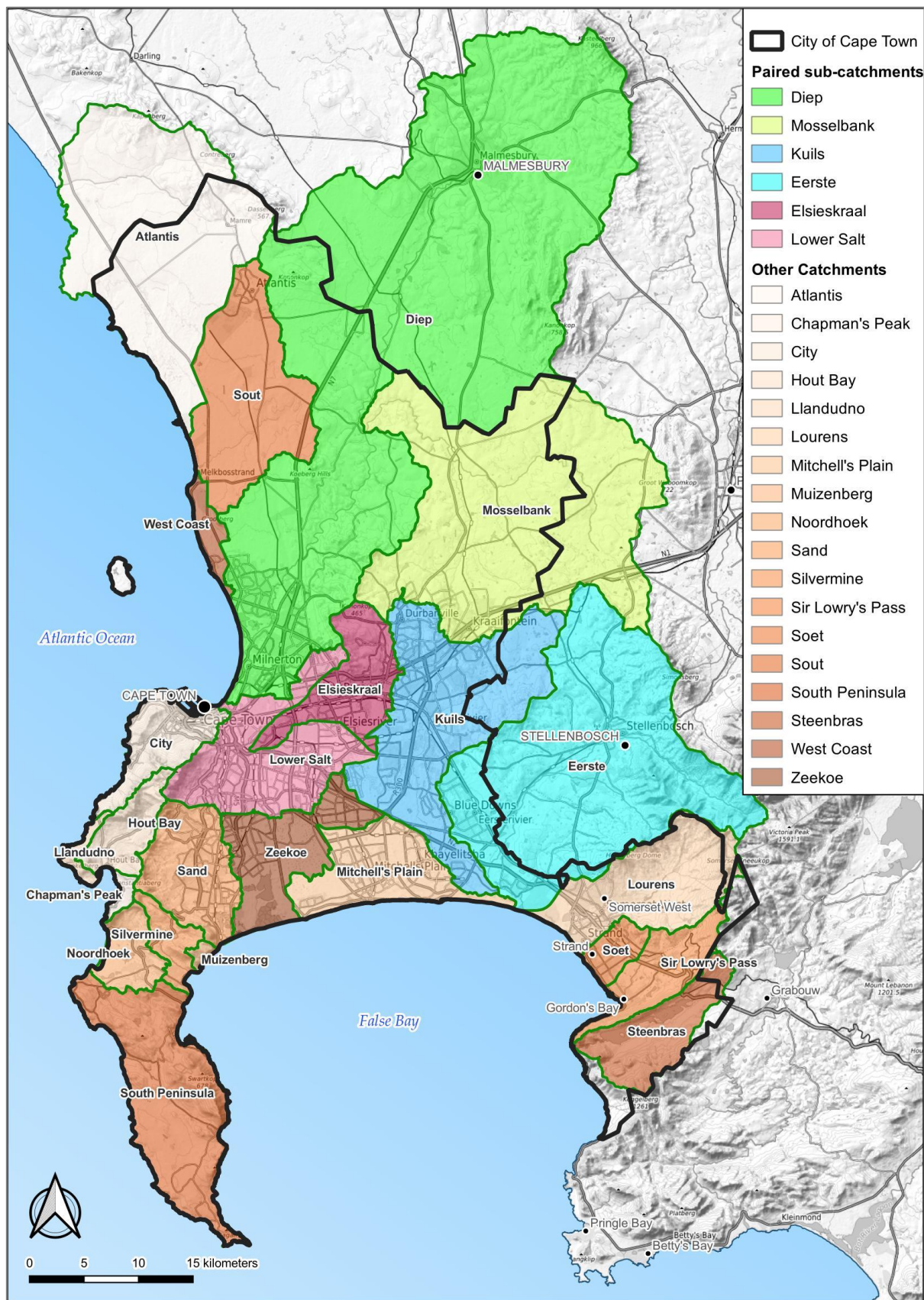
Progress in these three programmes, with particular regard to interventions aimed at improving water quality within the priority sub-catchment areas, is reported on in **Section 7**, and the condition and trajectory of water quality in each of the priority sub-catchments is considered in **Section 8**.

## **2.7 Stormwater management regions**

While Cape Town's rivers and other watercourses lie within catchments, defined by topography and separated by watersheds, the City manages them through so-called Stormwater Planning Regions. There are four such regions, comprising a Northern, Southern, Eastern, Central and Western region (see **Figure 2.2**). Each region has a separate manager, responsible for stormwater management across the whole region.

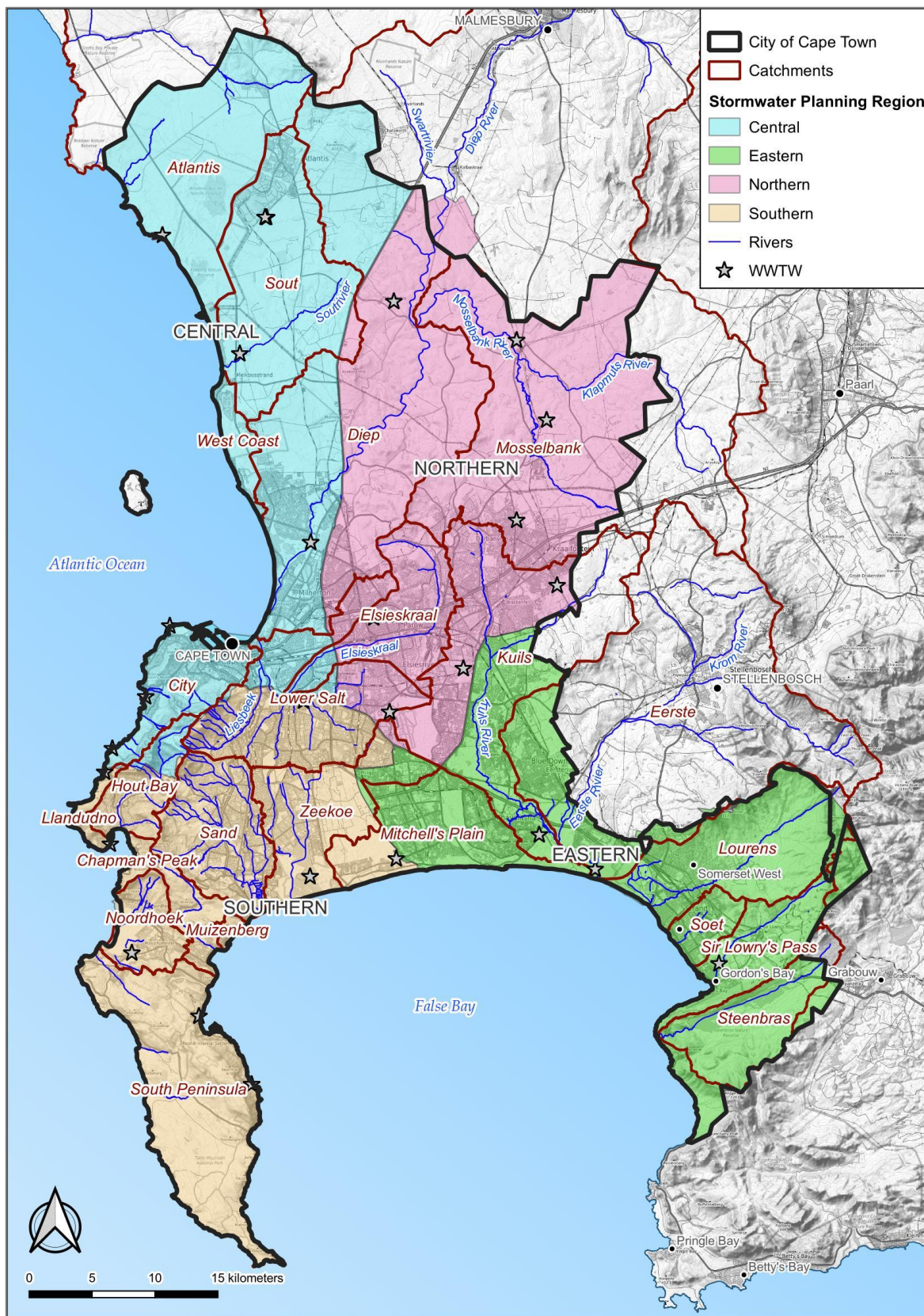
The delineations of the regions do not however account of the 17 major river sub-catchments, but were based historically on transport routes. This means that all of the regions cut across multiple catchments, and that different sections of a river and its tributaries are, in some cases, assigned to two or even three different managers. This system inhibits effective management of stormwater and its associated water quality issues from a catchment perspective.

**City of Cape Town**  
Inland Water Quality Report covering rivers and major vleis  
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**Figure 2.1**  
Cape Town's major catchments and watercourses (note that the larger catchments (Eerste, Salt and Diep) have been sub-divided into sub-catchments)





**Figure 2.2**  
 Relationship between the City's stormwater planning regions and Cape Town's river catchments.

## **2.8 Key findings and recommendations of the previous (2022/2023) Inland Water Quality Report**

The previous Inland Water Quality Report (Day et al. 2024) concluded with the following broad findings and recommendations:

- From an ecological perspective, the most problematic and pervasive water quality issue almost throughout the City's monitored rivers and other watercourses was orthophosphate enrichment, with its knock-on effects of increased plant-productivity, increased risk of blue-green algal blooms (and associated microcystin toxicity events), increased waterbody maintenance costs (reed and alien vegetation removal costs) and assumed associated accumulation of organic sludges in many open water bodies including vleis;
- Key pollution sources were identified as:
  - Inflows of treated effluent from WWTWs (in many cases not compliant with licensing conditions);
  - Episodic overflows from sewage pumpstations and surcharging manholes, due mainly to electrical failures and pump tripping, followed by load-shedding shut-downs and then supply faults and blockages
  - Runoff of raw sewage and grey water from informal settlements;
  - Dumping and associated accumulations of large volumes of solid waste alongside and within watercourses;
- Key recommendations from the report focused on the following:
  - Addressing pollution from major WWTWs, with the following priorities:
    - Major capital investment in upgrading WWTWs, prioritizing those discharging into the Kuils, Eerste, Mosselbank, and Diep Rivers;
    - A focus on reducing final effluent orthophosphate concentrations, to reduce ecological and economic costs;
    - Improving the speed of access to basic equipment for emergency management of WWTWs;
    - Inclusion of final WWTW effluent water quality and discharge volumes from all WWTWs in the CSRM water quality dashboard (or similar, publicly accessible dashboard);
  - Addressing pollution from informal settlements and suburbs with high levels of backyard settlement, through the following measures:
    - Improving access to adequate sewerage and stormwater services as a matter of urgency;
    - Attention to diversions of polluted dry-weather flows to WWTWs via existing or new sewers;
    - Addressing the rapid and uncontrolled expansion of informal settlements and their associated need for servicing;
  - Addressing sewage overflows from pump station failure by:
    - Ensuring availability of crucial spare parts, pro-active maintenance, and strategic upgrading of pump stations;



- Including upstream sediment and solid waste traps, additional bunding, and dual grid systems in pump station upgrades;
  - Reducing the passage of solid waste into stormwater systems and watercourses by:
    - Upscaling solid waste collection in Cape Town, and in solid waste hotspots in particular;
    - Innovative approaches like the "Swap shop" should be considered for broader implementation 10.
    - Engagement with City's Waste Services Department is essential 11.
  - Making changes in stormwater and sewerage reticulation management structures by:
    - Aligning management areas and responsibilities with hydrological catchments;
  - Fast-tracking the implementation of existing PASAPs and TAPs by:
    - Compilation and implementation of additional PASAPs for other key pollution hotspots;
  - Changing targets for interpreting sewage contamination in water quality data, with a recommended target of 100% Acceptable samples;
  - Conservation of existing sub-catchments in relatively good condition by:
    - Safeguarding sub-catchments in good condition;
    - Urgently addressing sources of periodic pollutant inflows;
  - Conservation of remnant floodplains and their wetlands through:
    - Safeguarding floodplain wetlands along the Diep, Kuils and Eerste Rivers in particular;
  - Prioritisation of implementation of the LUW Programme including re-evaluation of the cut in LUW programme budget;
- Changes to the City's current Water Quality Monitoring Programme, including:
    - Adding additional water quality monitoring sites and providing for ambient water quality monitoring rather than focusing on pollution hotspots;
    - Adding chloramine and COD testing in rivers downstream of existing WWTW outlets;
    - Inclusion of periodic heavy metal testing of water quality samples, particularly in priority catchments;
    - Inclusion of Enterococci testing in water samples for recreational water bodies (in-line with WHO recommendations);
    - Analysis of orthophosphate concentrations to lower detection levels than 0.1 mg P/L and inclusion of total phosphorus analyses;
    - Occasional analysis of water samples for Contaminants of Emerging Concern

(CEC);

- Standardisation of reporting on *E. coli* data so that data can be statistically analysed;
  - Focus on data-based pollution tracking in problem catchments, to identify key point-source inflows;
  - Inclusion of flow monitoring, to allow assessment of pollution loading and, based on this, the identification of key interventions to address major pollution sources;
  - Tracking of pollution abatement interventions;
  - Consideration of updating of the City's Water Quality Indices for more user-friendly inland water quality reporting;
  - Inclusion of additional monitoring sites to allow for better ambient water quality reporting within the City's watercourses;
- A roll-out of measures that the City's residents should implement, in playing their role in reducing pollution of Cape Town's watercourses.

## **2.9 Measures undertaken by CSRM in addressing the above issues**

Since the release of the 2022/2023 Inland Water Quality report, the CSRM have, amongst other measures:

- Launched the Inland Water Quality Dashboard, which allows the public rapid and visually easy access to inland water quality data on a site by site basis<sup>6</sup>;
- Increased the number of sampling sites across the city, to include sites on less-polluted but hitherto unmonitored systems as well as additional sites needed for more effective pollution tracking;
- Developed and are in the process of finalizing refined Pollution Abatement Strategy and Action Plans (PASAPs) and Transversal Action Plans (TAPs) that aim to assign (and reach agreement on) clear outcomes-driven responsibility for specific interventions in priority catchments by different line departments and officials;
- Engaged with the City's Scientific Services Branch (SSB) regarding laboratory analyses of *E. coli* that will allow more effective use of data in reporting and pollution tracking;
- Re-funded the LUW programme, to allow for the implementation of existing approved projects, mainly in the Sand catchment but including in the Lower Salt sub-catchment;

Section 7 provides more information regarding the planned or actual roll-out of these and other interventions of relevance to the above recommendations, in terms of the MPP.

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<sup>6</sup> <https://www.arcgis.com/apps/dashboards/9f857f26b59d4aa3abf13ba4a7787d8b>

## 3 APPROACHES TO WATER QUALITY MONITORING, DATA ANALYSIS AND INTERPRETATION<sup>7</sup>

### 3.1 What is water quality?

The term 'water quality' refers to the combined effects of the physical, chemical, and biological attributes of a sample of water on a particular user. It is a measure of the condition of water, relative to the requirements of one or more species, or to any human need or purpose – that is, its 'fitness for use'.

Water quality is usually interpreted with regard to standards or guidelines, developed around the specific effects of different aspects of water quality on a particular user group or purpose. Guidelines may focus on water quality criteria for human drinking water; aquaculture; industrial use; domestic animal drinking water; irrigation water; recreational use of water (e.g. swimming or watersports); and guidelines as to the effects of different concentrations of different water quality variables on aquatic plants and animals.

### 3.2 Who measures and interprets water quality?

Water quality data are only as good as the *in situ* measurements, sample collection and laboratory analytical processes that produce them. Rigorous attention to quality control through all of these processes must underpin any water quality monitoring and reporting programme.

Since assessing water quality from a human health and/or ecological perspective requires data representing a range of physical, chemical, and biological attributes, people with expertise in the fields of freshwater ecology, water chemistry and microbiology should ideally be tasked with interpreting the data.

### 3.3 Why monitor water quality in urban watercourses?

Water quality monitoring, if carefully structured and rigorously carried out, can provide valuable insights into the long-term trajectory of water quality in water bodies, including rivers and lakes/vleis. This is important for informing decisions about the risks that exposure to water may pose to different user groups (for example, which of our watercourses are generally fit for recreational uses such as swimming, rowing, sailing, or canoeing?). It also provides information about the ecological health of these systems and, where long-term data are available, can provide an indication of the trajectory of different ecosystems – that is, whether their condition is improving or deteriorating over time. Such information can and should be used to inform planning around the need for engineering or other interventions to address deterioration in any watercourses. It can also be used to assist CSRM regional managers in strategic planning around where to focus efforts to achieve maximum returns and where key pollution hotspots are.

Water quality data can also 'red flag' sudden onsets of pollution (caused, for example, by sewage overflows or illegal discharges); inform pollution-tracking efforts along watercourses; and provide evidence for compliance with licensing or permit conditions.

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<sup>7</sup> While most of this report has been updated entirely to reflect new thinking, data and interpretation since the 2022/2023 report of Day et al. (2024), this section has been edited only where necessary, to reflect minor changes, but essentially the assessment and reporting methodologies outlined here remain (as a specific requirement of the Terms of Reference for this contract) as per those of the 2024 approach.

### 3.4 The City's Inland Water Quality Monitoring Programme

The City's water quality database goes back to the late 1970s for at least some monitoring points along its main rivers and wetlands/vleis. The 2020 Inland Water Quality Report (Day et al 2020) analysed and discussed the full historical record of water quality data included in this extensive database.

The present report deals only with data generated from water quality monitoring over the past five years (October 2020 to September 2024). The monitoring points are located in main rivers and stormwater outflows into watercourses, as well as key wetlands, dams, detention ponds and stormwater outflows into the marine environment.

The City differentiates between water quality data from its routine sampling programme, reflecting data from samples collected from the same monitoring points on a regular, long-term basis; *ad hoc* samples, collected to inform specific once-off or short-term questions around pollution type, magnitude or sources in particular watercourses; and project-specific data, collected as part of specific programmes such as for pollution tracking or to inform stormwater master planning.

The present report considers only data from **routine** water quality sampling sites.

A range of chemical, algal and bacterial constituents are measured from water samples collected at these sites, and the data are interpreted and reported on by the City's Catchment, Stormwater and River Management (CSRM)

Branch.

#### Box 3.1

##### Public access to water quality data

Water quality data from the City's Inland Water Quality Database can be downloaded from its publicly assessable data portal [<https://odp-CCTegis.opendata.arcgis.com/documents/inland-water-quality/about>]. These data include most but not all of the monitored water quality variables (e.g. not total phosphorus) from routine inland and estuary monitoring points, from 2017 onwards. They are updated on a monthly basis.

#### Box 3.2

##### Limitations of water quality data

Water quality data show only what the quality of water was like at the time of sampling and at the specific location where the sample was collected. It cannot be used to infer future water quality (for example whether a waterbody is fit for swimming a day or even an hour after sampling, or to show what it was like immediately before sampling. 'Plugs' of pollution, for example, may be missed, or accidentally targeted by the timing of sampling. Furthermore, where watercourses are seriously contaminated, point-source pollution streams may be difficult to identify, because of the high level of general contamination.

It also only provides information about the constituents that were actually measured – there may also be other kinds of pollutants in the water. For example, the City's routine water quality monitoring does not include analyses of heavy metals, hydrocarbons, or contaminants of emerging concern (CECs). CSIR (2025) for example analysed coastal waters around Cape Town and found that the greatest number of pharmaceutical compounds in sea water were associated with sites that are directly influenced by discharges from wastewater treatment works.

Note that the present report reflects only water chemistry and microbiological data, and not algal data, other than microcystin toxin data.

### 3.5 Objectives of the City's water quality monitoring programme

To date, the City's water quality monitoring programme has been designed to monitor changes in watercourses where water quality is likely to be a cause for concern. Many of the monitoring points are therefore downstream of WWTW effluent discharge points, and in river reaches in catchments where runoff is likely to be contaminated. Some sampling points are located in watercourses that are used for religious rituals (e.g. baptisms) and/or recreational purposes (e.g. sailing, rowing and kayaking). Water quality data for such systems are thus used to provide information as to the fitness for use of these systems.

An important outcome of this approach is that, rather than being a structured programme that generates an overall understanding of the condition of all of Cape Town's watercourses, the data



collected by the City to date have focused on problem areas, and provide information about long-term trends and trajectories of water quality in these systems.

This means that water quality data over-emphasize problem areas, and do not provide an overarching view of water quality in the City's rivers and wetlands as a whole.

### 3.6 Amendments to the monitoring programme - inclusion of additional sites

In order to address, in part, the above issue of pollution-focused monitoring, and following an extensive review of existing routine water quality sampling points and consultation with the City's SSB, regional stormwater management and BMB officials, the City's inland water quality monitoring programme was extended to include an additional 65 monitoring points.

The new monitoring points were selected variously to:

- Include more holistic representation of water quality across the City's watercourses (i.e. ambient water quality monitoring), whereas the existing programme has traditionally been skewed towards pollution hotspot areas, selected to track and mitigate pollution;
- Complement planned river flow measurements at selected sites, thus allowing for the calculation of pollution loads;
- Provide additional data in some watercourses to allow better pollution tracking and identification of point-source inflows.

**Box 3-3**  
**Ambient water quality**  
'Ambient water quality' refers to the quality of water in natural watercourses, as opposed to treated or piped water quality. The term is used to describe the state or condition of systems, derived from holistic monitoring of whole systems.

Collection and analysis of samples from the new monitoring sites was introduced in a phased manner, starting in August 2024, with all sites included by October 2024.

Sample points for which six months of data are available are included in the City's open data portal and can be viewed on the inland water quality dashboard. These data will be reported on in the next (2024/2024) annual Inland Water Quality Report.

The new monitoring points and their respective catchments are listed in **Table A2** in Appendix A, and their locations illustrated in **Figure A1** of the same appendix.

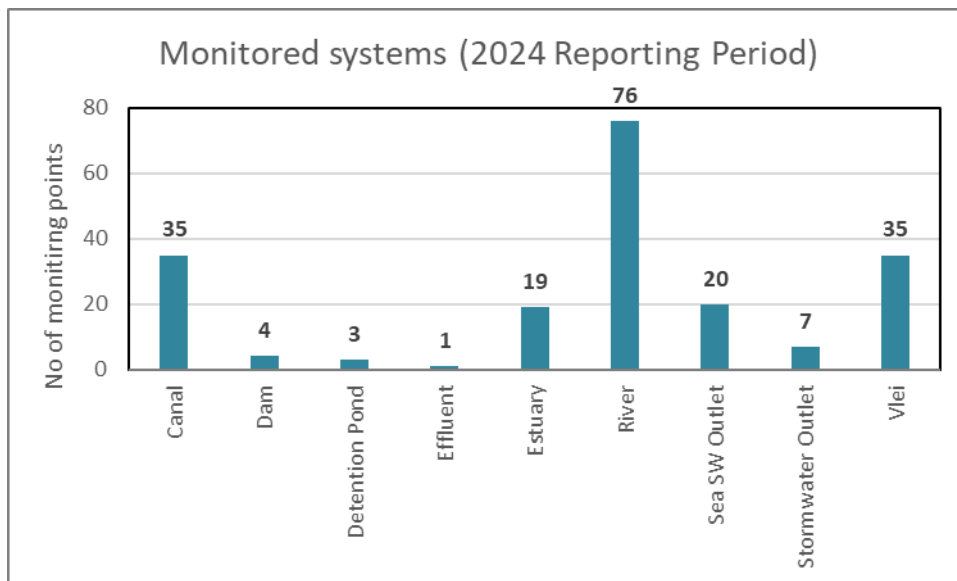
### 3.7 Sampling sites included in the current analyses

The current Annual Report does not include data for the additional 65 points discussed above, but includes only those for which at least one year of monitoring data were available, as of 30 September 2024. These comprise a total of 182 sites, including sites in rivers, major vleis, estuaries (Zandvlei and Milnerton Lagoon), stormwater outlets into vleis and rivers, canals (mainly canalised natural rivers), detention ponds, dams, stormwater outlets into the sea and one effluent site, located in the cut-off drain from the Cape Flats WWTW maturation ponds, leading to the Zeekoe channel. Of these, the majority of sites are located in rivers, canals, vleis, estuaries and stormwater outlets into the sea (see **Figure 3.1**).

**Figure 3.2** summarises the number of sites per catchment, as in the 2024 reporting period, while **Figure 3.3** shows the actual site locations spatially. These data show that the largest number of routine monitoring points are located in the Sand Catchment (35); followed by the Diep (26); the Lower Salt (18) and the Zeekoe (17) catchments.

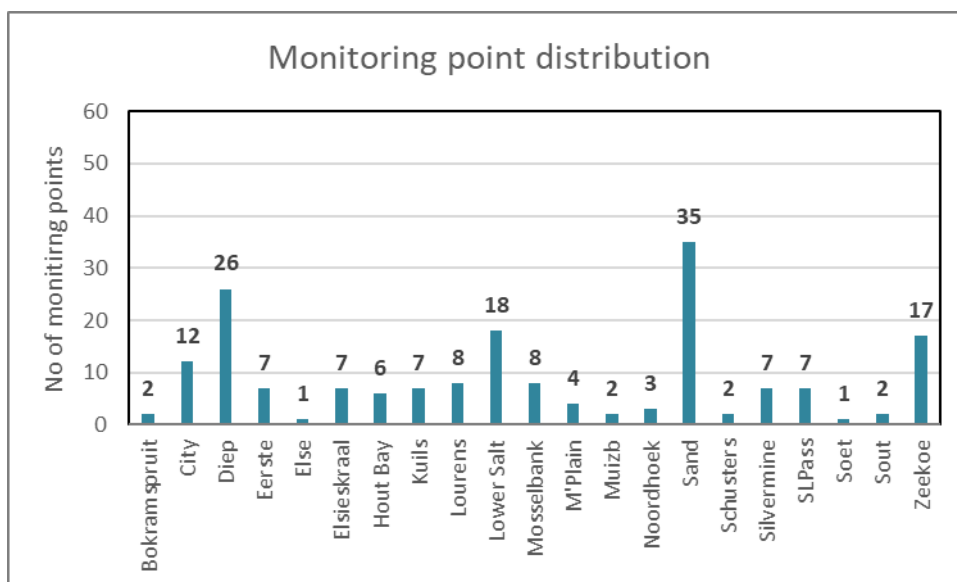
All sites are sampled at least monthly, with samples being analysed for basic water chemistry variables and microbiology (*E. coli*). In addition, recreational vleis (Rietvlei, Milnerton Lagoon, Zeekoevlei, Princessvlei and Zandvlei) are sampled roughly twice monthly for *E. coli*.

Listings of the actual locations of each monitoring point in each sub-catchment and their sampling frequency over the past five years are provided in **Appendix A**.



**Figure 3.1**

Summary of types and numbers of sample points for which data have been included in the present report.

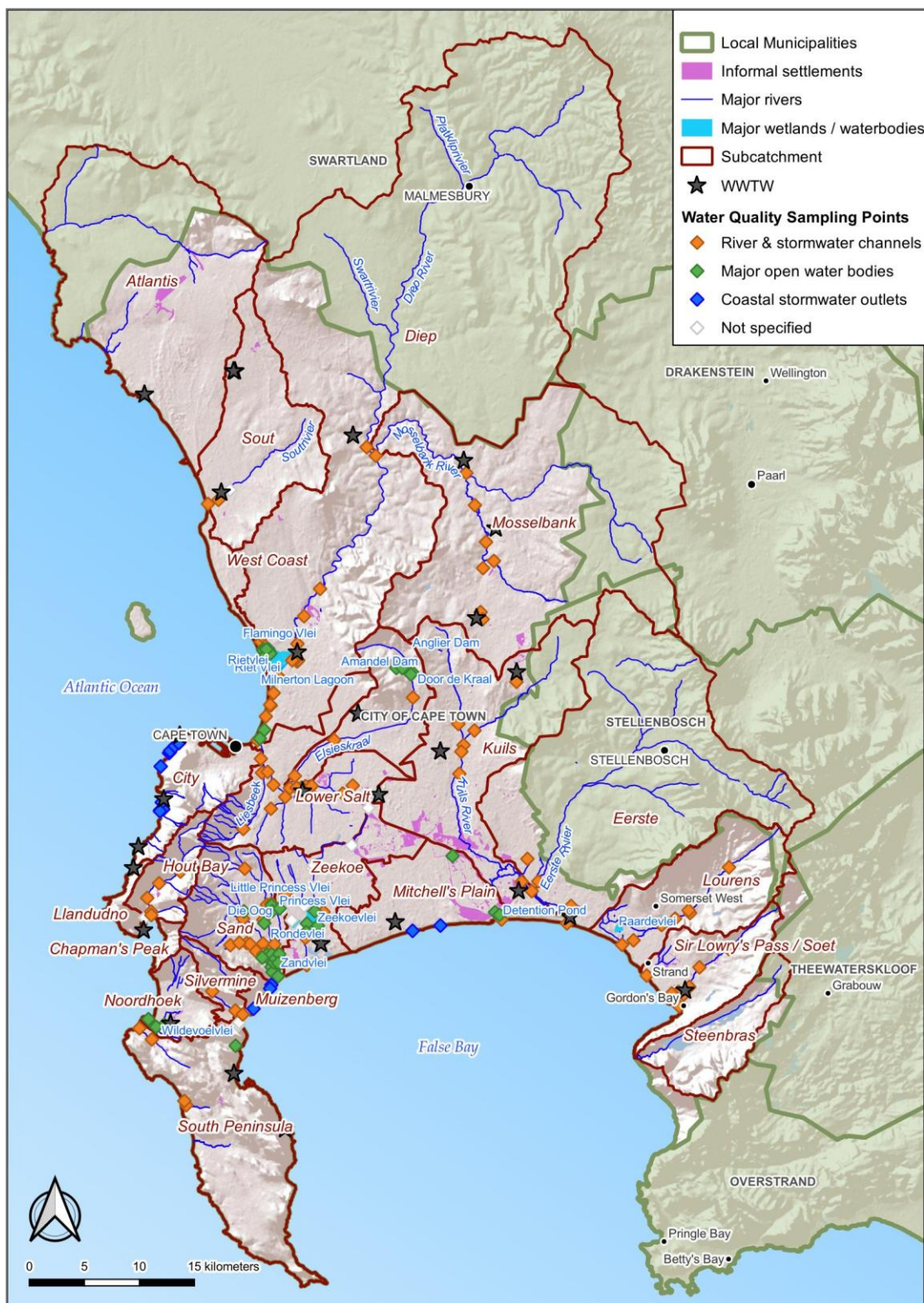


**Figure 3.2**

Summary of numbers of sites in each sub-catchment for which data have been included in this report.

## City of Cape Town

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**Figure 3.3**  
City sub-catchments, showing water quality sampling point locations on river and stormwater channels and canals; standing water systems (vleis and dams); and coastal stormwater pipeline outlets.

### 3.8 Context in the Berg Resource Quality Objectives study

Cape Town lies in the Department of Water and Sanitation (DWS)'s Breede-Olifants Water Management Area (WMA), which includes the Berg River catchment. Although not part of the actual catchment of the Berg River, Cape Town's river catchments are included in the Berg Catchment Resource Quality Objectives, which were gazetted by the DWS in November 2020 (Government Notice GN 1179 of November 2020). This notice outlines the proposed Water Resource Classification and Resource Quality Objectives (RQOs) for Priority (water) Resource Units in the Berg Catchment, along with a number of smaller catchments within the Cape Town Metropolitan Area, on the Cape Peninsula and along the West Coast.

The following Priority Resource Units fall within the City's boundaries:

- Two river nodes in the Diep River, as well as the Diep River Estuary and Rietvlei;
- Two river nodes in the Peninsula, and Wildevoelvlei as an estuary node;
- One river node in the Cape Flats; and Zandvlei as an estuary node;
- Two river nodes in the Eerste River catchment, and the Eerste River estuary;
- Three river nodes in the Sir Lowry's Pass / Lourens River catchment areas, the Lourens River Estuary, the Steenbras Reservoir, and the Upper Steenbras Dam.

The resource classification and associated determination of RQOs are intended to inform management of water resources in the greater Berg catchment. The gazetted RQOs were based on meeting defined Target Ecological Categories (TECs) for each Integrated Unit of Analysis (IUA) (usually particular river reaches or specified estuaries). The TECs comprised hierarchical categories A to F, for the following components:

- Water quantity (flow regime/hydroperiod)
- Water quality
- Aquatic habitat and
- Aquatic biota.

The water quality categories used in the present Inland Water Quality Reports are generally compatible with those of the Berg RQOs, although there are some differences in the classification of estuaries between the two (see **Box 3.4** above), and orthophosphate and free ammonia ranges have been amended in this report, to reflect more accurate ecological thresholds than those included in the RQOs (these issues are unpacked in more detail in **Section 3.7**).

With regard to the vlei systems that have been delineated as estuaries in the Berg RQO study, previous inland reports (Day et al 2023 and 2024) showed that Estuarine RQO thresholds for salinity far exceed the range of Electrical Conductivity (EC) values typically measured in Rietvlei, Wildevoelvlei, Zeekoevlei and Rondevlei, indicating that none of these inland water systems are influenced by saline intrusion from a connection to the sea. As none of these systems are influenced by tidal fluctuations either, they are not true estuaries, rendering evaluation against the Gazetted Estuarine RQOs for salinity a meaningless exercise because the specified objectives are not relevant. On this basis it was recommended that the only vlei systems in the City that should be evaluated against the Gazetted Estuarine RQOs for salinity and other estuarine variables, as part of the ongoing

#### Box 3.4

##### RQOs and Estuaries

The Berg Water Resource Classification system assigned Resource Quality Objectives to river and estuary systems in the Berg Water Management Area, including those in Cape Town. It is important to note that this study defined estuaries as all areas below 5 m above mean sea level (mamsl). This area in fact relates to the legislated Estuarine Functional Zone (EFZ). It is based on Listing Notice 3 of Government Notice (GN) 324 of 2017, which defines an EFZ as *'the area in and around an estuary which includes the open water area, estuarine habitat (such as sand and mudflats, rock and plant communities) and the surrounding floodplain area, as defined by the area below the 5 m topographical contour (referenced from the indicative mean sea level)'*.

Under this definition, many non-estuarine watercourses such as Langvlei, Rondevlei and Zeekoevlei have been classified as estuarine, and assigned estuarine rather than Inland standing water RQOs.



monitoring of water quality, are Milnerton Lagoon (excluding Rietvlei) and Zandvlei because these are the only currently functional estuarine systems.

Following on from this recommendation, only the results for these two systems are reported on in terms of compliance with the Estuarine RQOs for salinity in the current report (see Section 5.7).

Note that the Water Resource Classification as presented in the gazette relates only to rivers and estuaries, with the classification of wetlands and the associated setting of wetland RQOs not yet having been finalised.

### 3.9 Water quality variables considered in this report

Although the City analyses a wide range of water quality variables, only those considered the most important general indicators of urban aquatic ecosystem health and human health risk are assessed in the Inland Water Quality Report, as determined in Day et al. (2020). The following variables have been included (abbreviations used to refer to them in this report are shown in brackets – note that, with the exception of un-ionised ammonia (NH<sub>3</sub>) these abbreviations are not intended to be in scientific notation):

- Major nutrients
  - Phosphorus in orthophosphates (PO<sub>4</sub>-P)
  - Phosphorus in total phosphorus (Tot-P)
  - Total Inorganic Nitrogen (TIN)
- Un-ionised (or 'free') ammonia (NH<sub>3</sub>)
- Dissolved oxygen (DO)
- *Escherichia coli* bacteria (*E. coli*)
- Microcystin concentrations
- Chlorophyll-a (Chl-a)
- pH as an indicator of ammonia toxicity risk; and
- Electrical conductivity (EC) as a measure of salinity, specifically for estuarine systems for which the Berg RQO study Estuarine RQOs are relevant (see Section 3.8).

Note that total phosphorus has not however been analysed by the SSB since December 2022.

### 3.10 Water quality thresholds to guide data interpretation

#### 3.10.1 Water quality thresholds to interpret ecosystem condition

**Tables 3.1** and **3.2** outline the ranges in concentrations of key water quality variables considered in this report, with regard to their implications for **ecosystem condition**. The criteria used to derive these (currently nationally acceptable) thresholds are outlined in **Appendix B** along with the link between these categories and the various terminologies used in different DWS reporting (e.g. DWS (2008) A-F categories and DWAF (2011) Ideal – Unacceptable descriptors).

The ranges and thresholds distinguish between **flowing water systems** (rivers, channels, canals, stormwater outlets and Milnerton Lagoon, considered a flowing rather than a standing water system) and **open water systems** (dams, vleis, detention ponds and coastal lakes). The rationale behind these thresholds is also outlined in **Appendix B**, after Day et al. (2020).

Note that the thresholds shown in the tables include changes made in the 2023/2024 report (Day et al 2024) with regard to free ammonia (NH<sub>3</sub>) ranges and thresholds, and the preferred use of total phosphorus as a measure of phosphorus enrichment in standing water bodies, rather than orthophosphate, as follows:

- **Free ammonia** ranges were amended to reflect more accurate ecological thresholds than those included in the RQOs. Specifically, the Present Ecological State (PES) Category A and B ("GOOD") and Category C ("Fair") thresholds (all "Acceptable") were decreased from ≤ 0.044 mg/L to ≤ 0.007 mg/L and from 0.072 mg/L to ≤ 0.015 mg/L, respectively. This change is in line with the DWAF (1996) guidelines for target and chronic toxicity thresholds, respectively.

Since DWAF (2008) also references DWAF (1996) as the source of toxicity thresholds, it was assumed that the values used in DWAF (2008) for Categories A-D (rating classes 0-3) were entered erroneously;

- <sup>8</sup>**Total phosphorus** concentrations were used to measure standing water phosphorus enrichment, using the values provided by DWAF (2002) and reiterated in the DWAF (2011) guidelines for lakes and dams. Whereas the 2020 RQOs for dams in the Berg catchment use the same orthophosphate phosphorus thresholds for dams and rivers, the use of total phosphorus concentrations is a more useful measure for standing water systems such as vleis, lakes and dams (Cooke et al 2005).

Although the use of total phosphorus is included in the threshold table for standing water bodies, it is noted that the City's SSB has not in fact analysed total phosphorus in any of its samples since December 2022 (Memo from SSB to Ms N. Garcia, 16 April 2024) to date.

### **3.10.2 Changes in water quality thresholds for aquatic ecosystem assessments – this report**

In addition to the changes with regard to free ammonia and total phosphorus rating thresholds and their applications described above, an additional change was introduced into the current report, to include additional thresholds in dissolved oxygen (DO) concentrations. These new thresholds ("Poor (high)" and "Unacceptable (high)") consider the fact that, while low DO concentrations are clearly negative and have well-defined thresholds associated with different water quality categories (e.g. DWAF 2008), highly elevated DO concentrations can also be problematic in aquatic ecosystems and moreover indicate hypertrophic conditions.

Elevated DO in aquatic ecosystems can derive from turbulence (e.g. downstream of waterfalls, dam outlets and fast-flowing rivers) but may also develop in the near-surface waters of standing water systems as a result of high levels of photosynthesis, driven by elevated orthophosphate availability and often associated with blue-green algal productivity. Thus high DO concentrations do not necessarily reflect healthy aquatic ecosystems, and the associated super-saturation of water ("hyperoxia") can, in some cases, result in mortalities to fish and aquatic invertebrates, with significant mortalities noted (in salmon fry populations) where oxygen saturation is maintained above thresholds of 115 – 120 % for sustained periods (e.g. Geist et al 2013).

These additional thresholds for hyperoxic conditions were thus included in this report, allowing additional flagging of hypertrophic aquatic ecosystems.

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<sup>8</sup> Total Phosphorus (TP) is a measure of all the forms of phosphorus, dissolved or particulate, that are found in a sample. By contrast, orthophosphate phosphorus is a measure of the soluble, inorganic) portion of total phosphorus. This form is the biologically available component that is taken up by plants.

## City of Cape Town

Inland Water Quality Report covering rivers and major vleis  
with a focus on the period October 2022 to September 2024 (2023 and 2024 Reporting Periods)

**Table 3.1**

Rating ranges for variables considered in this assessment of water quality in Cape Town's rivers.

See Appendix B for derivation of threshold values.

Note: PO<sub>4</sub>-P= orthophosphate phosphorus; TIN=Total inorganic Nitrogen; DO=Dissolved oxygen; N:P= ratio of TIN:PO<sub>4</sub>-P; NH<sub>3</sub> = un-ionised ammonia. Note also that the terms 'PO<sub>4</sub>-P', 'TIN' are abbreviations and are not the full chemical notation for these variables.

| City Water Quality Categories (CWQC) | Interpretation of CWQC | PO <sub>4</sub> -P<br>Mg P/l     | TIN<br>Mg N/l                                                              | DO<br>mg/l              | N:P   | NH <sub>3</sub><br>mg/l           |
|--------------------------------------|------------------------|----------------------------------|----------------------------------------------------------------------------|-------------------------|-------|-----------------------------------|
| GOOD                                 | TARGET                 | ≤ 0.015<br>(oligotrophic)        | ≤ 0.70<br>(oligotrophic - mesotrophic)                                     | >7                      | >25   | ≤ 0.007                           |
| FAIR                                 |                        | > 0.015 - 0.025<br>(mesotrophic) | >0.70-1.00<br>(mesotrophic)                                                | >6-7                    |       | > 0.007 -0.015                    |
| POOR                                 | POOR                   | > 0.025- 0.125<br>(eutrophic)    | >1.00 -4.00<br>(mesotrophic - eutrophic)                                   | >4 -6<br>OR<br>>12 - 15 | 10-25 | > 0.015-0.1<br>(chronic toxicity) |
| UNACCEPTABLE                         | UNACCEPTABLE           | > 0.125<br>(hypertrophic)        | > 4.00<br>(eutrophic - concentrations > 10mg/L classified as hypertrophic) | ≤ 4<br>OR<br>>15        | < 10  | > 0.1<br>(acute toxicity)         |

**Table 3.2**

Rating ranges for variables considered in this assessment of water quality in Cape Town's vleis and dams.

See Appendix B for derivation of threshold values.

Note: TP= total phosphorus; TIN=Total inorganic Nitrogen; DO=Dissolved oxygen; N:P= ratio of TIN:PO<sub>4</sub>P; NH<sub>3</sub> = un-ionised ammonia; CHL-A= Chlorophyll-a. Note also that the terms 'PO<sub>4</sub>-P', 'TIN' etc are abbreviations and are not the full chemical notation for these variables.

| City Water Quality Categories (CWQC) | Interpretation of CWQC | TOTAL PHOSPHORUS<br>mg P/l       | TIN<br>mg N/l | DO<br>mg/l              | N:P   | NH <sub>3</sub><br>mg/l            | RUNNING MEAN ANNUAL CHL-A<br>µg/l |
|--------------------------------------|------------------------|----------------------------------|---------------|-------------------------|-------|------------------------------------|-----------------------------------|
| GOOD                                 | TARGET                 | ≤ 0.015<br>(oligotrophic)        | ≤ 0.7         | > 7                     | >25   | ≤ 0.007                            | ≤ 5                               |
| FAIR                                 |                        | > 0.015 – 0.047<br>(mesotrophic) | >0.7 -1       | >6-7                    |       | > 0.007 - 0.015                    | >5 - 10                           |
| POOR                                 | POOR                   | >0.047 - 0.130<br>(eutrophic)    | >1.0-4.0      | >4 -6<br>OR<br>>12 - 15 | 10-25 | > 0.015- 0.1<br>(chronic toxicity) | > 20 - 30                         |
| UNACCEPTABLE                         | UNACCEPTABLE           | >0.130<br>(hypertrophic)         | > 4           | ≤ 4<br>OR<br>>15        | <10   | > 0.1<br>(acute toxicity)          | > 30                              |

### 3.10.3 Thresholds for interpreting water quality risks to human health

**Tables 3.3** and **3.4** present the thresholds used to determine risks to human health on the basis of monitoring of two key variables, namely *Escherichia coli* bacteria (an indicator of exposure to raw sewage and other fecal sources from warm-blooded animals (i.e. birds and mammals)) and microcystin toxins, which can be associated with cyanobacteria (also called blue-green algae).

Concentrations of all of these are evaluated with respect to the level of risk they pose to people undertaking 'intermediate contact' recreational activities, such as canoeing, kayaking, fishing, sailing, rowing, kite-boarding and wind-surfing.

Although people undertaking such activities are likely to come into contact with and possibly ingest some water, they are less at risk than people undertaking 'full-contact' recreational activities (e.g. swimming).

#### Box 3.5

##### Interpreting human health guidelines

WHO (2021) guidelines for management of water quality in recreational water bodies stress important points, namely that most generic guideline values are derived from studies involving healthy adult recreational water users. They may not apply to children, the elderly or people who are immunocompromised, who may have lower immunity and might require a greater degree of protection. In addition, risks are also likely to be greater in areas with higher carriage rates or prevalence of diseases that could be transmitted through recreational water contact.

These warnings are particularly relevant to many low-income and particularly informal settlement areas in Cape Town, where people's immune systems may be compromised by chronic exposure to pathogens and poor nutrition and limited access to basic health structures.

**Note that the City does not manage any of its water bodies with the objective of their being fit for full contact recreation. This is not considered a realistic target under the present circumstances.**

The criteria used to derive these thresholds are outlined in **Appendix B**.

It must also be noted that, whereas the City previously (see Day et al 2023) also monitored Enterococci bacteria in vlei water samples, these analyses have been wholly discontinued since December 2023 and were only sporadically collected post February 2022 from a few sites, despite recommendations for their continuance and expansion of monitoring sites made in Day et al (2023 and 2024).

**Table 3.3**

**Approach to the interpretation of microbial data (fecal coliforms including *Escherichia coli*).**

**See Appendix B for derivation of threshold values.**

**Note the inclusion of Full Contact AND Intermediate Contact thresholds, as well as the expansion of the UNACCEPTABLE range, to show different scales of pollution. This expanded scale was not used in the present report, as a result of issues of reporting on ">" values, as discussed in Section 3.8.10.**

| Interpretation                                                 | Inland systems<br><sup>1</sup> Fecal Coliform Count (including <i>E. coli</i> ) <sup>1</sup> |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| TARGET FOR MAXIMUM ACCEPTABLE RISK FOR FULL CONTACT RECREATION | ≤ 400 <sup>2</sup> cfu/100 ml                                                                |
| ACCEPTABLE RISK INTERMEDIATE CONTACT                           | 1 001 – 2 500 cfu/100 ml                                                                     |
| TOLERABLE RISK - INTERMEDIATE CONTACT                          | > 2 500 – 4 000 cfu/100 ml                                                                   |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT– LEVEL 1              | > 4 000 – 10 000 cfu/100 ml                                                                  |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT– LEVEL 2              | > 10 001 - 100 000 cfu/100 ml                                                                |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT– LEVEL 3              | > 100 000 cfu/100 ml                                                                         |

<sup>1</sup> DWAF (1996) uses fecal coliform bacteria to provide target ranges and risk thresholds for intermediate recreational use.

That report acknowledges that *Escherichia coli* bacteria are a preferred indicator of fecal pollution, but notes that many smaller laboratories do not have facilities for these analyses. The report further notes that *E. coli* may however comprise up to 97% of coliform bacteria in human faeces. The City's SSB analyses its water samples for *E. coli* bacteria. This means that the thresholds are slightly higher than had they been set for *E. coli* only.



<sup>2</sup> The concentrations of bacteria in water is usually expressed as numbers of colony-forming units (cfu) per 100 ml, which is a measure of the number of viable cells in a particular sample, where a colony represents an aggregate of cells derived from a single progenitor cell

**Table 3.4**

**Water quality grades and corresponding threshold concentrations for microcystin toxins for inland waters adopted for this project.**

Guideline levels are based on those published by the WHO (2003). Note that WHO (2021) provides an updated GV Recreation (GVRECREATION) Threshold of 24 µg/L for microcystins, below which recreational water use should be within acceptable risk limits. This suggests that the Medium Risk values in the table below are slightly conservative (i.e. samples >20<24 will be categorised as Medium Risk rather than Acceptable). See Appendix B for derivation of threshold values.

| Interpretation              | Microcystin concentration |
|-----------------------------|---------------------------|
| TARGET (ACCEPTABLE)         | ≤ 20 µg/L                 |
| MEDIUM RISK (UNACCEPTABLE)  | >20- 30 µg/L              |
| HIGH RISK (UNACCEPTABLE)    | >30-40 µg/L               |
| EXTREME RISK (UNACCEPTABLE) | >40 µg/L                  |

### 3.11 Data analysis

This section outlines how some of the more problematic or contextually complex aspects of the water quality dataset are dealt with in this report.

#### 3.11.1 Dealing with seasonal variability

The concentrations of a number of water quality variables measured in rivers, vleis and other wetlands undergo significant seasonal variability, largely related to differences in rainfall and temperature between the wet and dry seasons. An attempt has thus been made to take seasonal variability into account in the annual water quality assessments, by assigning one of two seasons to the data, as follows:

- Winter (typically the 'wet season' in Cape Town) = April to September
- Summer (typically the 'dry season' in Cape Town) = October to March.

The assignment of different months to these seasons was based on the four seasons assigned by Dallas *et al.* (1998) in the development of regional guidelines for water quality assessment in South Africa, with the 'winter' referred to here, starting mid-way through the Dallas *et al.* autumn season (i.e. April) and 'summer' starting mid-way through the Dallas *et al.* spring season.

Each sampling record in the dataset was pre-assigned to one of the two above-mentioned seasons before conducting the data analyses. The dataset used in the report concludes on 30 September 2024 (end of the wet season).

#### 3.11.2 Spatial groupings of data

Sites within the water quality dataset were classified into sub-catchments and catchments, as per the areas identified in **Figure 3.3**. The sub-catchments used as the basis for data analysis are as listed below, noting that while most comprise whole river catchments (e.g. Hout Bay River), in some cases, the main (larger) catchments have been split into different sub-catchments (e.g. Mosselbank and (lower) Diep sub-catchments of the Diep River).

Note that whereas previous reports lumped data from small, adjacent catchments in the South Peninsula, comprising the Else, Bokramspruit and Schusters rivers, these data have been assessed separately in this report, although catchment delineations have not yet been carried out for these areas, and they are shown together spatially, as the South Peninsula catchment area (see **Figure 3.3**).

The groupings for catchments and sub-catchments that have been used to present water quality data in this report are as follows:

- Cape Town City Bowl
- Diep
  - Mosselbank
  - Lower Diep
- Eerste
  - Kuils
  - Eerste (from the Kuils River confluence to the estuary)
- Salt
  - Elsieskraal
  - Lower Salt
- Hout Bay
- Lourens
- Mitchell's Plain (M'Plain)
- Noordhoek
- Sand
- Silvermine
- Sir Lowrys Pass (SLPass)
- Soet
- Sout
- South Peninsula
  - Bokramspruit
  - Else
  - Schusters
- Zeekoe.

Note that, of these systems, the Mitchell's Plain sub-catchment does not include any natural river systems, but generates large volumes of runoff from hardened urban areas. Two stormwater attenuation pond sample sites have been used to represent water quality in this sub-catchment, runoff from which is also represented in a number of coastal sample sites, which include stormwater outlets onto the beaches of False Bay.

It should also be noted that not every catchment in Cape Town is represented in the monitoring programme. Some catchments that are not considered problematic from a water quality perspective, or which do not have significant river systems (e.g. the Atlantis Sub-catchment), or where natural rivers have been almost entirely piped into the stormwater system (e.g. City Bowl rivers) are not represented in data produced in the current report, other than with data from their coastal stormwater outfall sites. This issue has however been addressed by CSRM, as outlined in Section 3.6.

### **3.11.3 Calculated water quality variables**

The following additional water quality variables were obtained for analysis in this report, by calculation from existing data:

- Total Inorganic Nitrogen (TIN) – through addition of NH<sub>4</sub>-N and (NO<sub>3</sub>+NO<sub>2</sub>)-N
- NH<sub>4</sub>:TIN – the ratio of NH<sub>4</sub>-N:TIN
- TIN: PO<sub>4</sub>P – data presented as a ratio of TIN to PO<sub>4</sub>-P
- PO<sub>4</sub>-P:Total phosphorus (PO<sub>4</sub>-P:TotP), expressed as a ratio (note that in some cases this ratio exceeded 1, suggesting analytical error / inaccuracy, and in such cases the data were excluded).

### **3.11.4 Changes in annual reporting cycles in this report**

Previous Inland water quality reports (Day et al 2020 and Day et al 2023) based water quality reporting on annual cycles between April of one year through to March of the following year. These cycles covered ecosystem cycles between autumn and late summer.

With effect from the 2022/2023 report of Day et al. (2024), the annual reporting cycle has been changed to reflect so-called **hydrological periods**, extending from 1 October of one year to end of September of the following year. This change has been instituted to allow for timeous reporting on water quality in any annual cycle, before the end of the City's financial year in June. The new cycle aligns well with the summer / winter seasons already incorporated into data assessments (see Section 3.11.1) and is thus not considered problematic from the perspective of scientific rigour in reporting.

### 3.11.5 Reporting cycle nomenclature

The annual reporting period used in this report comprises the period from 1 October to 30 September in any given cycle and is given the YEAR identity of the **end** of the period. Data for the period 1 October 2023 to 30 September 2024 are accordingly referred to as the **2024** dataset. These annual cycles are different to those referenced in previous Inland water quality reports, as outlined in Section 3.11.4.

### 3.11.6 Time series considered in this report

The Scope of Works for the present report required a focus on water quality data for the **2023 and 2024 reporting periods** (1 October 2022 to 30 September 2024).

In order to be able to report meaningfully on at least short- to medium-term water quality trajectories, data for the (new) 2023 and 2024 reporting periods are, however, assessed in the light of data over a five-year period. **Thus, the report includes data from 1 October 2019 through until 30 September 2024.**

Note however that water quality for stormwater outlets into the sea have only recently been included among Inland Water Quality sampling points. In the present report, only data for the 2024 reporting period have been included. Going forwards, the full historical database for these sites should be incorporated.

### 3.11.7 Treatment of unreliable *E. coli* data

Between April 2021 and January 2022, the City's Scientific Services Branch (SSB) reported *E. coli* data that appeared out of sync with observed conditions in many water bodies, and led to the closure of Rietvlei, Zeekoevlei and Zandvlei, over various periods. Following testing of replicate water samples at independent laboratories, it was noted that there was a serious discrepancy in results, with *E. coli* concentrations being over-reported in SSB data. This was confirmed in independent testing carried out in both Rietvlei and Zeekoevlei.

An investigation into the SSB processes was carried out by SABS in May 2022. This investigation concluded that the Hicrome MTEC agar that SSB had started using in April 2021 was problematic, in that it allowed the growth of both *E. coli* and another fecal coliform bacteria, *Klebsiella pneumoniae*, which has a similar colony form. This made differentiation of the two difficult, leading to inaccurate reporting (Memorandum from SSB to CSRM, 7 February 2023).

As a result of the above findings, the SSB has switched analytical methods, and now uses the Colilert system for *E. coli* analysis.

Given these issues, the *E. coli* data for the period **April 2021 to at least May 2022** were not previously used in Inland Water Quality reporting (Day 2020, 2023 and 2024).

During the present reporting period, however, long-term *E. coli* reporting data were assessed for the period October 2019 to September 2024. These data are plotted in **Figure 3.4**, with data reported as ">" or "<" specified values plotted at those values, and colour-coded.

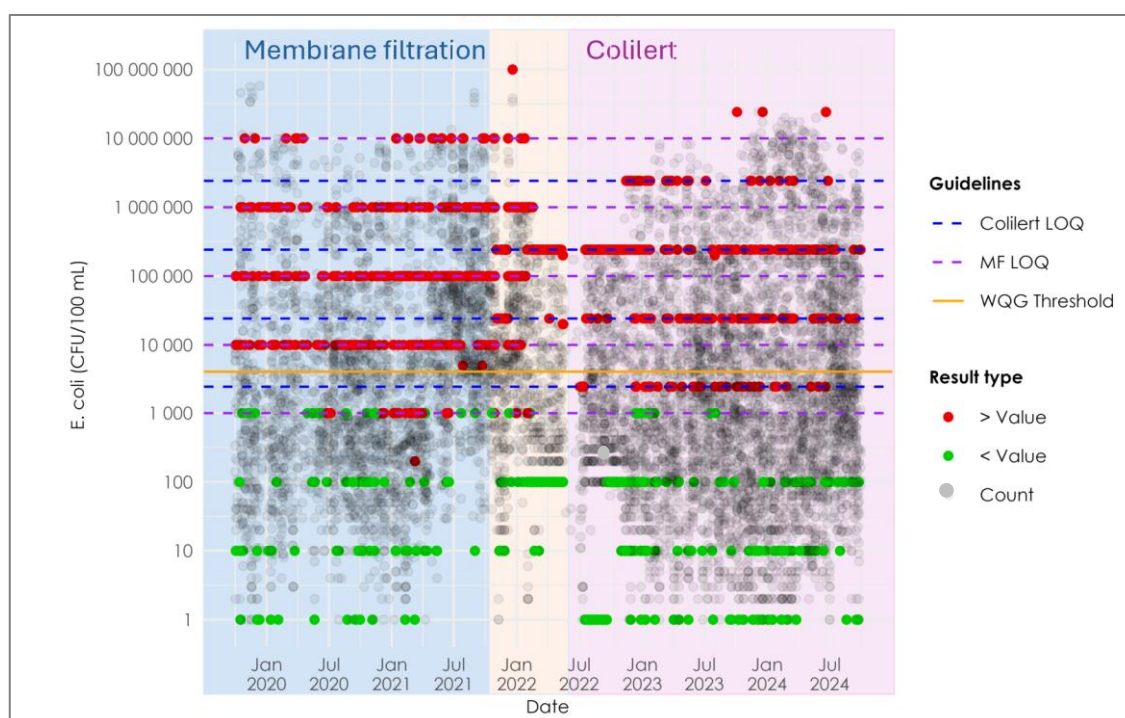
This figure suggests however that the period during which *E. coli* data may have been unreliable spans a longer period – potentially until October 2022 – the dataset shown in **Figure 3.4** shows markedly anomalous values over this period. In discussions with CSRM and SSB as part of the present report, the following timelines were confirmed:

- Data derived from use of the Hicrome MTEC agar between April 2021 and May 2022 deemed

unreliable;

- SSB commenced using the Colilert system from February 2022, but were accredited only in March 2023;
- As a result of various analytical problems and issues with sample dilution, during early take-on of the Colilert technology, sample analyses were outsourced to a (freshwater) accredited laboratory, also using the Colilert system, between June and end of September 2022;
- In October 2022, the SSB continued with use of the Colilert system, and data from then on are from SSB analyses;
- In March 2023, the SSB was accredited for Colilert analyses.

Based on the above and with reference to the data shown in **Figure 3.4**, it is recommended that in fact *E. coli* in the City's inland water quality database should be discarded between the periods April 2021 and end of September 2022. In effect, this means that reporting periods 2021 and 2022 should be excluded from analyses in the Inland Water Quality Report.



**Figure 3.4**

**Plots of *Escherichia coli* data from the City's inland water quality database, showing variability in data with changes in analytical approaches (membrane filtration versus Colilert systems) and inconsistent data between at least April 2021 and September 2022**

Furthermore, it is noted with concern that comparative analyses conducted by the CSRM, using split sampling of 75 different water samples, collected from a wide range of watercourses, showed that 78.1 % of the 73 usable results obtained from the Colilert system (SSB analyses) and from the Membrane Filtration (MF) system used by an independent (freshwater accredited) laboratory had a <sup>9</sup>Relative Percent Difference (RPD) > 20%, suggesting that these results could not be regarded as acceptable duplicate measurements (CSRM 2024). In fact, 65.7% of all split samples had RPDs > 50% and 27.4% of samples had RPDs > 100%. The Colilert data were generally, but not always, higher than the MF data. The report concluded that the high variation could be explained by different distances from site to the two laboratories as well as by the use of different analytical techniques. MF is described as an "older technique" and the IDEXX Colilert Most Probable Number (MPN) method as

<sup>9</sup> Relative Percent Difference is a statistical measure used to quantify the difference between two values relative to their average



a “more modern approach, renowned for its accuracy and sensitivity in detecting *E. coli*”.

The present report finds itself at odds with this interpretation. Luyt et al (2012), in a review of microbial analyses in South Africa, noted that Colilert®18 is prone to both false positive and false negative results, derived from the Colilert medium composition as a function of the temperature and the type of the water resource sampled. The paper notes that these can be significant and may cast doubt on the reliability of measured concentrations of *E. coli* using this method. The interpretation of results using statistical tables (as opposed to the actual counts used in MF) also makes them prone to a wide spread of *E. coli* concentrations, with the result that *E. coli* concentrations measured by the Colilert system can be up to one order of magnitude higher than the results obtained from membrane filtration determinations.

The IDEXX Colilert MPN method is however approved by the International Organisation for Standardisation (ISO) (ISO 9308-2:2012) for *E. coli* monitoring in bathing waters. Buckalew et al (2006) found that counts obtained by Colilert compared equally to those obtained by MF across all samples and dates during a three year study in Virginia, USA, and Pichel et al (2023) note that Colilert-18® has been validated and/or compared to MF using several media, showing equivalent results.

In terms of reporting on *E. coli* data in this report, the changes in analytical approaches and the significant differences between the SSB's Colilert and the independent laboratory's MF methodologies mean, further, that it is difficult to use data over the present five year monitoring period usefully, with major changes in technology that have not included detailed comparative assessments of differences between the two.

The great discrepancy in results presented in the CSRM (2024) report suggests that this issue requires serious and urgent attention. At the time of this report, it is understood that the City has contracted independent sampling and comparative assessments of *E. coli* from river samples, using a laboratory that also uses the Colilert system. **While this approach is supported, it is reiterated that close-out on this issue can only be obtained through the use of multiple accredited laboratories for split sample testing using both MF and Colilert technologies**

### 3.11.8 Treatment of data below detection limits

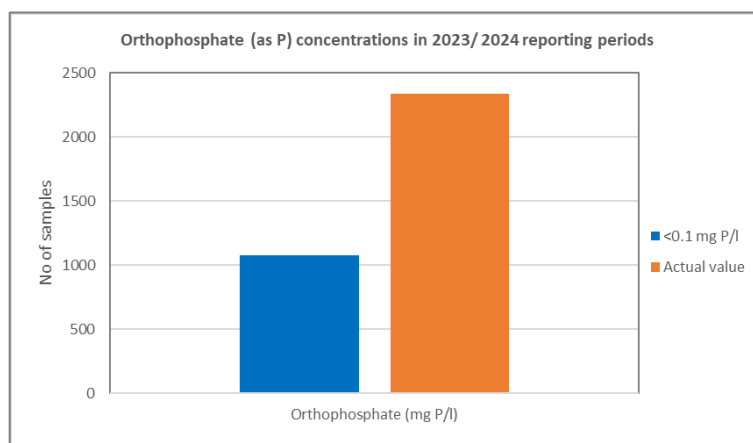
Reporting on the results of laboratory analyses of water samples for different variables are subject to the limits of detection and limits of quantification of different analytical techniques. These data are reported as “< x”, where x=the limit of detection and/or quantification. By convention, such data are analysed in water quality reporting as 0.5 x the reported limit – thus a value reported as <0.5 would be reflected in the dataset as 0.25.

This issue has however created problems in the present reporting cycle, with regard to orthophosphate data. Up until December 2022, SSB's limits of detection were reported as < 0.01 mg P/l for this variable. With effect from this date, however, the analytical equipment used by SSB for these analyses ceased functioning, and the laboratory now uses Flow Injection Analysis Colorimetry equipment with a Limit of Quantification (LOQ) of > 0.1 mg P/L. **This is an order of magnitude increase in the detectable concentrations of phosphorus.** If the 50% reporting rule is used, and the data are analysed as 0.05 mg P/L, they will at best lie within the “Poor” range for rivers / flowing systems.

Since there are no total phosphorus data available since December 2022 either, the level of phosphorus enrichment of vleis and other “standing” water bodies can also only be assessed using orthophosphate concentrations, and the default minimum “Poor” label is thus attached to these samples as well.

This has implications for tracking the trajectory of concentrations of this critical nutrient in the City's water bodies, as high detection limits / limits of quantification may mask improvements in some systems, and will not indicate significant deterioration in others.

Analysis of data for the 2023 / 2024 reporting period showed that **46%** of orthophosphate data (1076 out of 2340 data points) were reported as < 0.1 mg P/l (see **Figure 3.5**). These samples are all automatically classified as in the “Poor” category (**Tables 3.1 and 3.2**), and the limits of quantification do not allow for any samples to be classified as in the Target range.



**Figure 3.5**

**Orthophosphate data for monitoring points in the 2023 and 2024 reporting periods, showing number of samples analysed as “<0.1 mg P/l”.**

This has significant implications for the monitoring of water quality trajectory for this important nutrient, assessed in previous reports as the most significant water quality variable driving inland aquatic ecosystem degradation in Cape Town’s water bodies (Day et al 2020, 2023 and 2024).

This is an important issue that must be addressed by the SSB.

### **3.11.9 Treatment of data reported as greater than specified limits**

Another data issue that arose in both the present (2023/2024) reporting and previous reporting periods is that regarding the reporting of *E. coli* data by SSB. The data include a number of samples that, for reasons of under-dilution cannot be assigned actual numbers of *E. coli* colony forming units, but which are rather reported as ‘>x’ (where x= the level of resolution that has been attained by the laboratory for that sample).

While this method of reporting is normal laboratory practice, over the 2020 reporting period for which *E. coli* data are assumed to be reliable, as well as the 2023 reporting period, there was a marked increase in the reporting of samples as ‘>’ values that were either still below the Unacceptable threshold for this variable, or above the lower threshold, but within relatively low concentrations for known highly polluted scenarios. For example, reporting at >24 196 cfus for samples in a system where *E. coli* counts frequently exceed 1 000 000 cfus does not allow for pollution tracking or for detection of areas where pollution appears to be greater and closer to source. Such practices also make meaningful statistics difficult.

The City’s SSB has noted that its laboratory routinely conducts dilutions of up to 10<sup>4</sup> of water samples. Where such dilution is insufficient to result in an absolute value, the laboratory reports it as “>x”. A limitation on the laboratory’s ability to run further dilutions on such samples is that laboratory best practice for *E. coli* analyses requires the analysis of water samples within 6 hours of sample collection (comment from Ms Millicent Julius, SSB, City), and greater than 24 hours would have elapsed since sample collection if analyses were to be repeated.

During discussions with SSB and CSRM in the present project, it was suggested that these issues could be dealt with by formalizing an analysis protocol that requires standard dilution of all river samples to by 10<sup>-2</sup> and 10<sup>-4</sup>. This would allow analysis of *E. coli* concentrations between 100 and 24 196 000.

Recreational vleis are currently analysed to dilutions of 10<sup>-1</sup>, 10<sup>-2</sup> and 10<sup>-4</sup>.

For the above reasons, *E. coli* data were analysed in this report only in terms of Compliance-type reporting of the percentage of samples falling within different categories of acceptability, and were not analysed statistically with regard to their geometric mean or other statistical measures, other than in reporting on year-on-year trajectories for this variable in priority catchments (see Section 8).

In addition:

- Data reported as ">" any number below the Unacceptable threshold were automatically rated as Unacceptable;
- Similarly, (less frequent) reporting as "<" any number within the Unacceptable range was also rated Unacceptable. This is a risk-averse strategy to deal with data uncertainty and could result in some over-estimation of Unacceptable data;
- Data reported as ">" any value between Unacceptable Risk 1 and Unacceptable Risk 2 thresholds (**Table 3.3**) were automatically reported as Unacceptable Risk 2;
- Data reported as ">" any value between Unacceptable Risk 2 and Unacceptable Risk 3 thresholds (**Table 3.3**) were automatically reported as Unacceptable Risk 3;
- Data reported as ">" any value above Unacceptable Risk 3 thresholds (**Table 3.3**) were automatically reported as that number, and accorded low confidence. This means that Geometric mean data included in maps in Section 8 for Priority Catchments may well underestimate actual *E. coli* contamination levels, as these were often well above Level 3 threshold concentrations of 100 000.

### **3.11.10 Data categorisation**

- Seasons were allocated as described in **Section 3.11.1**;
- Catchments (and some sub-catchments, for larger catchments) were used as the unit of analysis, as already described;
- Sites were analysed separately according to watercourse type (i.e. standing water (vleis, dams, detention ponds) and flowing water (rivers, canals, stormwater channels and coastal stormwater outlets);
- Functional estuaries<sup>10</sup> were classified as to whether they were standing water or flowing systems – water quality data for the Diep River Estuary / Milnerton lagoon were classified as from a flowing water system, while Zandvlei was classified as a standing water system. Note that these classifications applied only to water quality variables such as DO, PO<sub>4</sub>-P, TIN and N:P ratios, the interpretation of which did not differ between estuarine and freshwater systems. *E. coli* assessments did, however, distinguish between estuaries and other aquatic ecosystems, since different standards are applicable to estuarine and freshwater systems.

### **3.11.11 Missing total phosphorus data**

No analyses of total phosphorus were carried out by the SSB with effect from December 2022, as a result of equipment failure. The SSB's analytical equipment requires replacement, and at the time of writing of this report, such replacement had not yet taken place.

### **3.11.12 Analysis of data for the current reporting period**

For the purposes of this report, the 'current' reporting period is defined as the last two years of the monitoring record – that is, October 2022 to September 2024 - and the data from this period have been treated as follows:

- In order to provide broad summaries of 'performance' (that is, the proportion of data for each selected key variable from monitoring points across each sub-catchment over any specified reporting period), compliance-type graphs were created, plotting the percentage of data falling into each of the Target, Poor and Unacceptable categories listed in **Tables 3.1-3.3** for ecological variables, *E. coli* and microcystin toxicity. In this regard:
  - Boxplots were developed for all of the selected data, and presented for discussion,

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<sup>10</sup> Note that the DWS (2018) classification of all areas below the 5 mamsl contour line as estuarine was not considered in this assessment, and only systems known to comply with the legal definition of an estuary (see **Section 2.2.2**) were assessed using Estuarine rather than Inland thresholds for *E. coli*

comparing the current (2023 and 2024) datasets (separately) with data from the previous three years (20120 – 2022 reporting periods) – these data are presented relative to the interpretation categories for aquatic ecosystem and human health (*E. coli*) shown in **Tables 3.1 – 3.3**;

- Median annual data per site per variable are also presented in table form (**Appendix C**), with data colour-coded for ease of reference as to its water quality category (note that geometric mean data were provided for *E. coli* and arithmetic mean data were provided for Chlorophyll-*a* and other variables);
- Truncated summary boxplot data are presented in **Section 5** for ease of reference – the full boxplot datasets, including outliers, are presented in **Appendix D**.

**Box 3.6** provides an explanation of the interpretation of boxplots as a guide to readers unfamiliar with this form of data presentation.

### Box 3.6

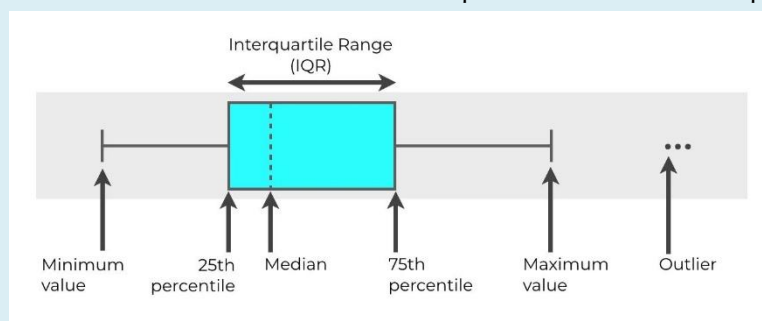
#### Explanation of boxplots, also known as box-and-whisker plots

A boxplot, or box-and-whisker diagram, is a standardised type of graph for visually depicting the central tendency and variability of a dataset, as well as the distribution (or skewness) of the data and the presence of outliers. It does this by dividing the range of a dataset into quarters, or quartiles, with each quartile containing 25% of the data points. There are thus the same number of data points in each quartile. A boxplot typically consists of three parts: a box (usually split into two portions), a set of lines perpendicular to the box (‘whiskers’) and point markers beyond the whiskers depicting outliers, as shown in the diagram below. Sometimes, the full range of a dataset is shown as part of the whiskers, in which case there will be no outliers.

The box represents the range of values from the first/lower quartile ( $Q_1 = 25^{\text{th}}$  percentile) of a dataset to the third/upper quartile ( $Q_3 = 75^{\text{th}}$  percentile), with the middle value in the dataset ( $Q_2 = \text{median or } 50^{\text{th}}$  percentile) indicated by a line dividing the box into two quartiles. The box thus shows the range of values within which the central half (50%) of the data points of a dataset fall, extending from  $Q_1$  to  $Q_3$  and known as the Inter-quartile Range (IQR).

The whiskers of a boxplot extend outwards from ends of the box, which represent the lower and upper quartiles ( $Q_1$  and  $Q_3$ , respectively), to the minimum and maximum values of the dataset. For a boxplot, the minimum and maximum values are typically derived from the IQR (i.e.,  $Q_3 - Q_1$ ) to set a boundary beyond which any observations would be considered outliers. The maximum is taken as the largest observed value of a dataset that falls within 1.5 times the IQR added to  $Q_3$ , while the minimum is taken as the smallest observed value falling within 1.5 times the IQR subtracted from  $Q_1$ . The whiskers either simply terminate at the minimum and maximum values or short lines are drawn perpendicular to the whiskers at these points (as in the diagram below). It is important to remember that, even though 1.5 times the IQR is the same for both sides of the box, the whisker lengths are often unequal because the whiskers must end at an observed data point. In some cases, the minimum (and boundary of the lower whisker) is simply taken as the smallest observed value of the data set, and the maximum (boundary of the upper whisker) as the largest observed value of the data set.

All data points outside the boundary of the whiskers (i.e., less than the derived minimum or greater than the derived maximum values) are considered to be outliers. Outliers are plotted as individual data points on the boxplot.





### 3.11.13 *Assessment of the current state of water quality in terms of human health risks at major recreational sites*

For the assessment of the current state of Cape Town's inland water quality, the last five reporting years of available data (2020 – 2024 Reporting Periods) were used, and the same seasonal cycles and year nomenclature were used as presented in **Sections 3.11.1 and 3.11.5**.

Data focused on Cape Town's main recreational vleis / water bodies, namely:

- Princess Vlei
- Zeekoevlei
- Rietvlei
- Milnerton Lagoon
- Zandvlei.

Although inclusion of a section of the lower Kuils River from which the Khayelitsha Canoe Club operates, has been proposed in previous reports (Day 2020, 2023 and 2024), there are no sample points that adequately reflect water quality in this area and investigations by CSRM during the present reporting cycle indicated that security issues for SSB staff collecting samples in this area were of great concern and that the canoe club is also currently not active, largely as a result of excessive growth of (alien) water hyacinth in the river and its wetlands, prohibiting canoe activities. The club has now switched to recycling and the manufacture of biochar from water hyacinth (pers. comm. from Mr Siyanda Sopangisa to Liz Day, May 2025).

Assessment of human health risk at each waterbody entailed an analysis of the percentage of samples that exceeded the target value for safe intermediate contact recreation in terms of *E. coli*, and microcystin concentrations (see **Sections 3.10** for an explanation of the relevant criteria).

*E. coli* data for the 2021 and 2022 reporting periods were not used, given issues around the reliability of these data (see **Section 3.11.7**).

### 3.11.14 *Assessment of the trajectory of water quality in priority sub-catchments*

- Median annual and seasonal data were calculated separately for the two current reporting years (2023 and 2024) and compared against the combined year sets for the 2019 to 2022 reporting periods for all key variables, except chlorophyll-*a* and *E. coli* data. Arithmetic mean data were calculated for the former, while geometric mean data were calculated for *E. coli* data, using the Hazen Method as recommended by WHO (2021), and interpreted as per **Table 3.3**;
- Data showing changes in annual and seasonal data per variable between the 2023 data and 2024 datasets were plotted on GIS maps, with a map produced per Priority sub-catchment;
  - The maps were produced for the water quality variables believed to be most indicative of catchment quality – PO4-P; NH3; DO and *E. coli*;
  - The mapped data were colour-coded per site for each variable considered, using the thresholds for Target to Unacceptable, as shown in **Tables 3.1-3.3**;
  - In order to provide an indication of trajectory of change, data points were also coded to indicate improvement, degradation, or no real change. Significant 'change' was determined as **an increase or decrease of 25% or more, compared to the previous**
  - *Escherichia coli* data shown in the maps are presented as geometric means, rather than median values, this being the more appropriate way of treating these data (see **Box 3.7**) – but note that current reporting of *E. coli* data as ">" various values means that geometric means are not statistically accurate and may either over-estimate or under-estimate actual *E. coli* concentrations;
  - Total phosphorus data were also not available for either the 2023 or 2024 reporting periods.

**Box 3.7**

**Geometric versus arithmetic means**

The Geometric Mean (GM) is a type of average, which is often used as a measure of central tendency for bacteria concentrations and other datasets with a large range of variability. While the arithmetic mean finds the average by summing the values and dividing by the number of observations, the GM finds the average by multiplying and then taking a root of the product. The GM is mathematically defined as the **n<sup>th</sup> root of the product of n numbers**, with the following formula:

$$\sqrt[n]{X_1 X_2 \dots X_n}$$

GM =

Where:

X = the values of a variable; and

n = the number of values in the dataset.

What this formula means is that the values are multiplied by one another, and then the n<sup>th</sup> root is calculated, where n is the number of values in the dataset. This is the same as taking the average of the logarithmic values of a dataset and converting this back to a base 10 number, which implies that the geometric mean (sometimes referred to as the log mean) is really a log-transformation of a dataset.

The GM tends to dampen the effect of very high or low values to a greater degree than the arithmetic mean. It is always less than the arithmetic mean, except where all the values of the dataset are the same, in which case the two means are equal.

If the variable of interest has a log-normal distribution, the GM is the same as the median for that dataset (Vogel 2020), although random differences can be expected in practice, depending on the number of samples and the sampling frequency (DWAF 1996). It is important to be aware that **the GM is extremely sensitive to both the underlying distribution of a dataset and its skewness, as well as differences in sample size** (Vogel 2020). This measure should thus be used with caution when comparing datasets that have significantly different sample sizes.

## 4 RAINFALL PATTERNS IN CAPE TOWN

### 4.1 Rationale for assessing rainfall

Rainfall data are included to provide background understanding of rainfall patterns in different catchments of the City, both over the current reporting period and to get context over a longer-term period (e.g. whether it was a drought year). Tight correlations of rainfall events with individual sample point data is not, however, possible because sample collection is not (and is not intended to) align with rainfall events.

### 4.2 Approach

Daily rainfall data were provided by the CSRM for 38 rain-gauging stations across Cape Town, spanning the period October 2019 to September 2024 (i.e. Reporting Periods 2020 through to 2024). Unfortunately, the dataset provided had numerous 'no data' entries for most of the stations during the relevant reporting periods. In the end, the rainfall analyses completed for the current project involved the use of rainfall data from only nine official City rain-gauging stations with no missing data (or only one 'no data' entry during a period when no or very little rainfall was recorded at other rain-gauging stations). The nine stations that were selected are spread across seven of the City's catchments (see list in **Table 4.1** and map in **Figure 4.1**).

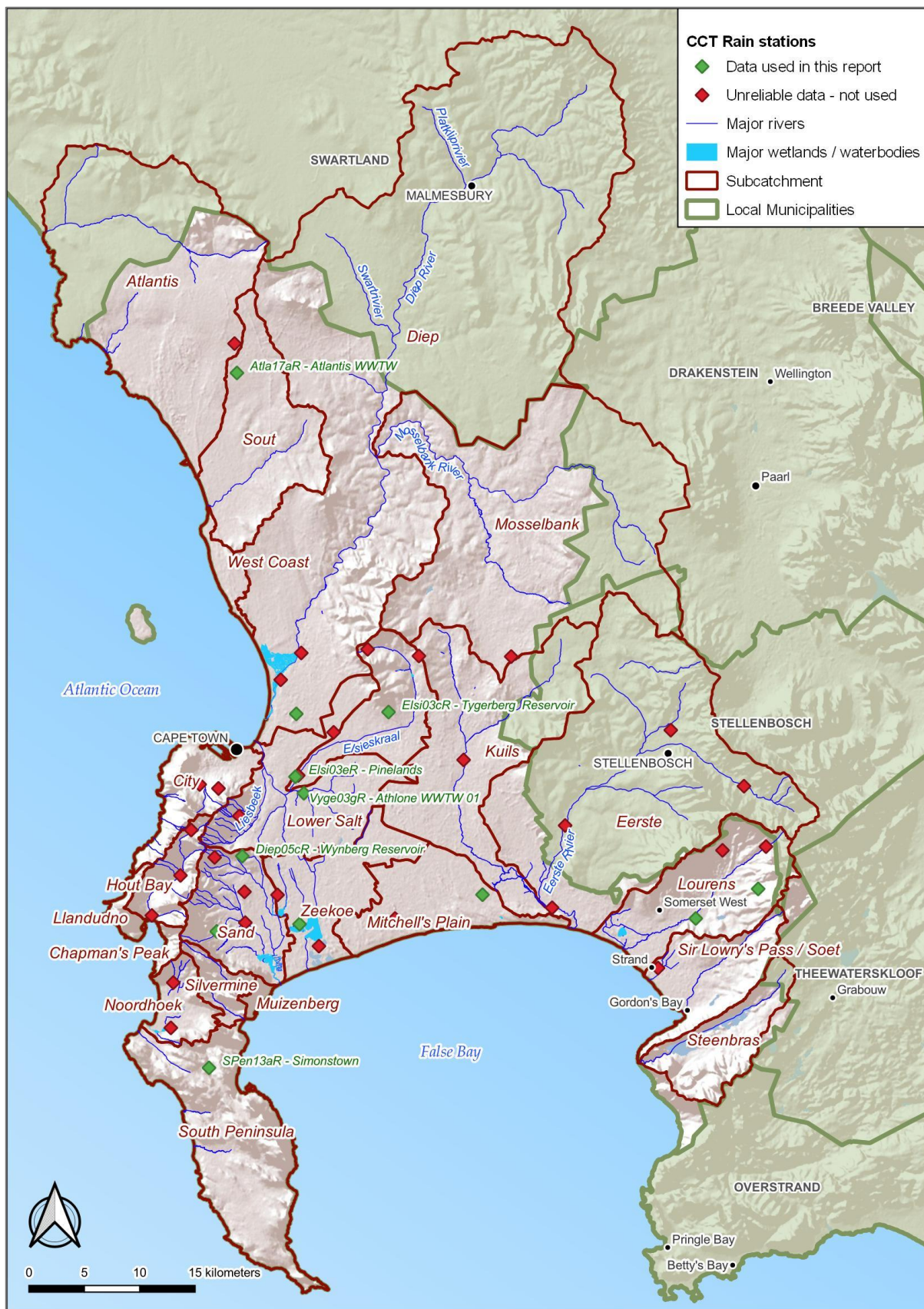
Additional monthly rainfall data for the five-year period of analysis (Reporting Periods 2020 through to 2024) were obtained for a rain-gauging station at the Rondevlei section of False Bay Nature Reserve (in the Zeekoe catchment). To gain a better understanding of the rainfall patterns in the study area during the time period of analysis in relation to longer term trends, a reliable long-term dataset for a rain-gauging station at Intaka Island (Century City, located within the Diep catchment) was also obtained. For the current study, 20 years of rainfall data were extracted from this additional dataset for the period October 2004 to September 2024.

**Table 4.1**  
**List of rain-gauging stations used in the rainfall analyses, indicating which catchment and sub-catchment each station is located within [official CSRM rain station codes in bold].**

| Rain station    | Description                            | Catchment       | Sub-catchment |
|-----------------|----------------------------------------|-----------------|---------------|
| <b>ATLA17AR</b> | Atlantis WWTW                          | Sout            | [n/a]         |
| INTAKA          | Intaka Island, Century City            | Diep            | Diep          |
| <b>ELSI03BR</b> | Dagbreek Reservoir                     | Salt            | Elsieskraal   |
| <b>ELSI03CR</b> | Tygerberg Reservoir                    |                 | Lower Salt    |
| <b>VYGE03GR</b> | Athlone WWTW                           |                 |               |
| <b>DIEP05CR</b> | Wynberg Reservoir                      | Sand            | [n/a]         |
| <b>KEYS05FR</b> | Tokai Forest                           |                 |               |
| RONDEVLEI       | Rondevlei Section of FB Nature Reserve | Zeekoe          | [n/a]         |
| <b>KHAY01RS</b> | Khayelitsha Roads Depot                | M-Plain         | [n/a]         |
| <b>SPEN13AR</b> | Brooklyn WTP, Red Hill, Simonstown     | South Peninsula | [n/a]         |
| <b>LOUR06DR</b> | Vergelegen Farm, Somerset West         | Lourens         | [n/a]         |

[Note that data from stations ELSI03CR & LOUR06BRS were included in the previous report (Day et al 2024) but could not be used for the current reporting period due to unreliable data. Conversely, station ELSI03BR could not be used in the previous analysis but was included on this occasion because there were reliable data for the 2020-2024 reporting period].





**Figure 4.1**  
 Map of rain-gauging stations that were used for the rainfall analyses, in relation to sub-catchments



For the rainfall analyses, monthly rainfall totals were derived from daily rainfall figures, except for the Rondevlei and Intaka rain stations, for which monthly rainfall totals were provided. The monthly totals were grouped into 'hydrological years' or 'reporting periods (October to September)', as opposed to calendar years, and into 'summer' (October to March) and 'winter' (April to September) seasons using the seasonal categorisation explained previously (see **Section 3.11.1**). Rain-gauging stations were grouped into catchments/sub-catchments for some of the analyses.

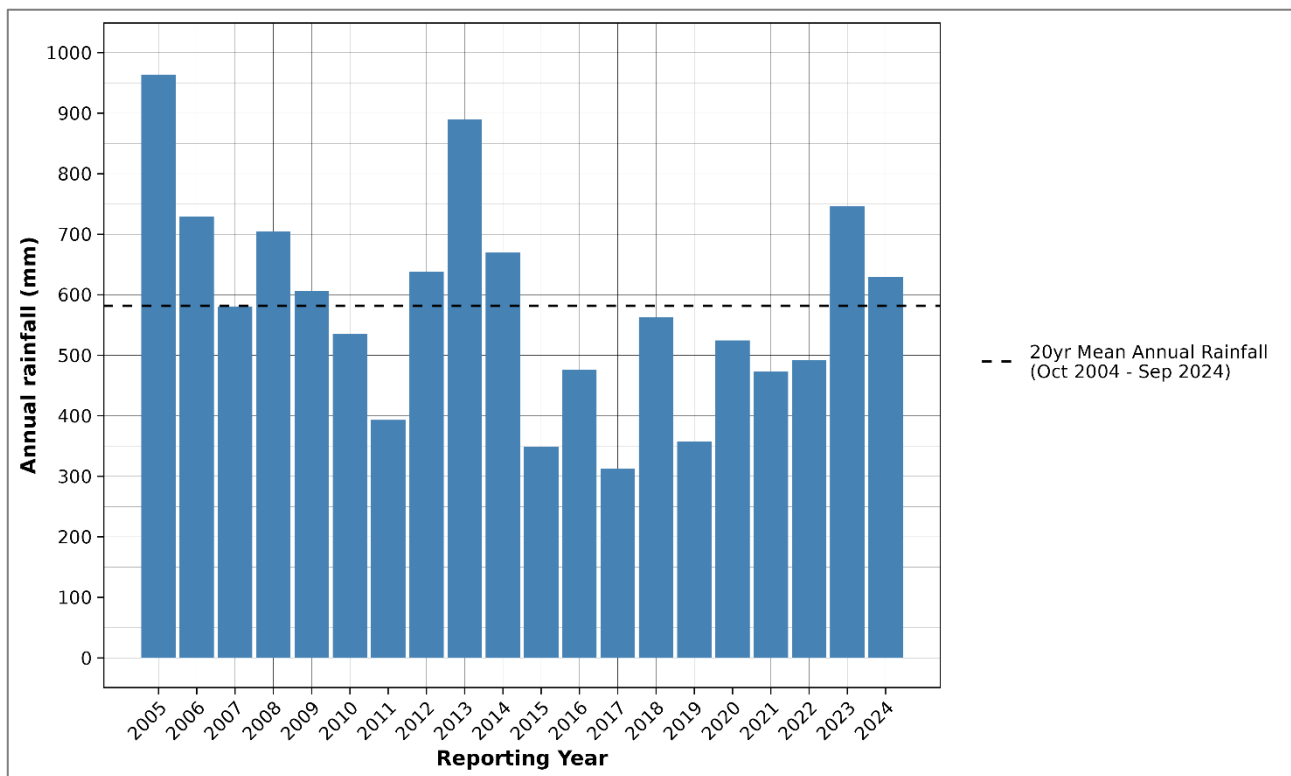
The following rainfall data summaries were produced from the two rainfall datasets:

- Intaka Island gauging station (long-term dataset):
  - Total annual rainfall for each year, compared against the mean annual rainfall over the October 2004 – September 2024 period; and
  - Total seasonal rainfall per reporting year, compared against the mean annual rainfall values over the summer and winter seasons for the 20-year period;
- City gauging stations:
  - Monthly rainfall at each of the 9 CSRM stations for the October 2019 – September 2024 reporting period, plotted together with maximum daily rainfall per month [the Rondevlei gauging station was excluded from this plot because daily rainfall data weren't available];
  - Total annual rainfall at each station (including Rondevlei) for each reporting year (2020-2024), grouped by sub-catchment, compared against the mean annual rainfall at Intaka Island over the 20-year period;
  - Mean annual rainfall (and standard deviation) across all gauging stations (including Rondevlei) per reporting year for the five-year reporting period (2020-2024), compared against the 20-year mean annual rainfall at Intaka Island; and
  - Total seasonal rainfall per reporting year at each of the 10 stations (including Rondevlei) for the five-year reporting period, compared against the 20-year mean winter rainfall at Intaka Island.

The rainfall patterns are discussed separately, below, for the 20-year period preceding the end of the current reporting period (i.e., September 2024), based on the Intaka Island dataset (**Section 4.3**), and for the five-year period up to the end of the current reporting period, based on the City's rain-gauge data (**Section 4.4**). The long-term average, derived from the 20-year Intaka Island dataset, is shown as a point of comparison in some of the analyses for the recent five-year period.

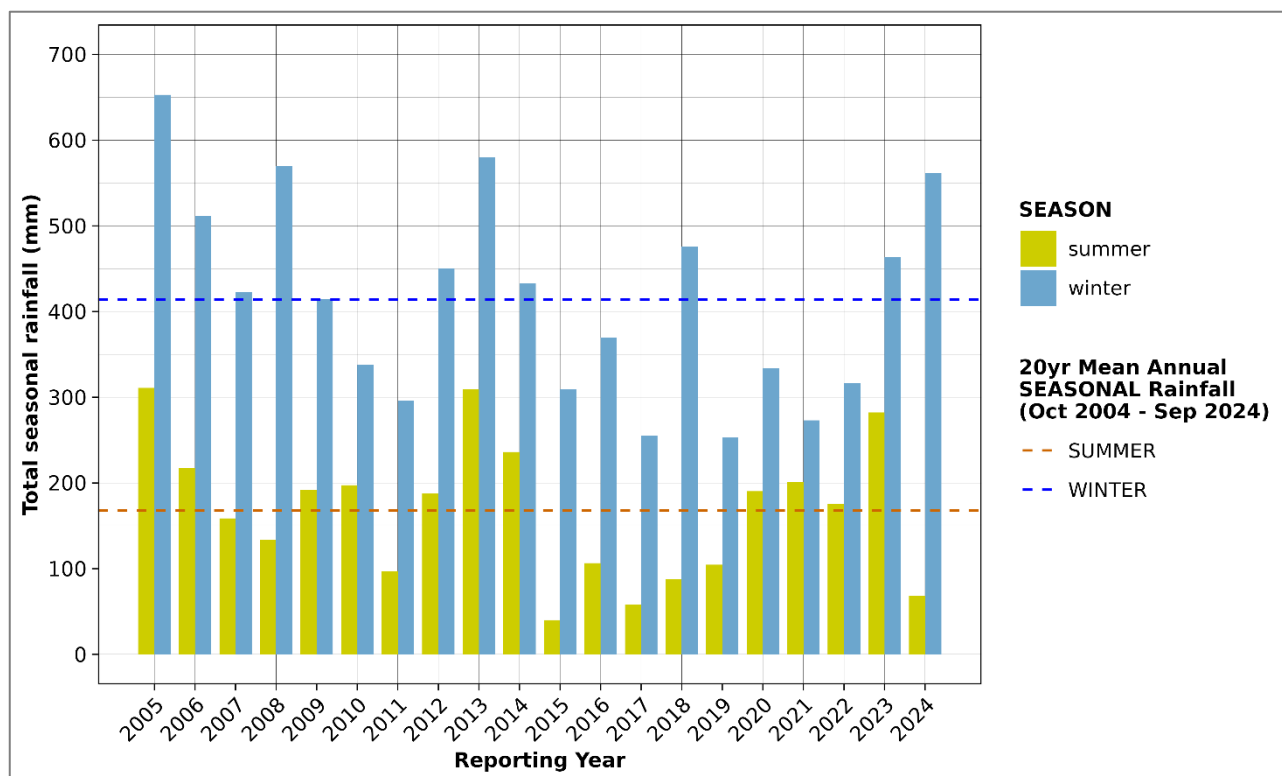
### 4.3 Intaka Island 20-year dataset

The mean annual rainfall at Intaka Island over the 20-year period of analysis (Oct 2004 – Sep 2024) was 581.755 mm (see **Figure 4.2**). The recent dry years of 2015, 2017 and 2019, with less  $\leq$  350 mm per annum, are clearly visible on the bar graph. Going back further, the previous dry period (with  $<$  400 mm of annual rainfall), was a much shorter spell in the 2011 reporting period. The annual rainfall recorded at Intaka Island in the 2021 and 2022 reporting periods was still significantly below the 20-year average, at  $<$  500 mm per annum, while for the 2023 reporting period the annual rainfall (almost 750 mm) was well above the long-term average. Previous wet periods in the last 20 years (with  $>$ 700 mm of rain per annum) were observed in the Intaka Island rainfall records for the 2005-2006, 2008 and 2013 reporting periods. The annual rainfall recorded at Intaka Island during the main focal year for the current report (i.e. the 2024 reporting period), at 630 mm, was slightly higher than the long-term average.



**Figure 4.2**  
**Total annual rainfall at Intaka island for the 20-year period Oct 2004 – Sep 2024, showing the mean annual rainfall over this period.**

Interrogation of the total rainfall per season for each year over the last 20 years at Intaka Island (see **Figure 4.3**) shows that the total winter rainfall during the 2020-2022 reporting periods, at less than 350 mm per season, was somewhat less than the long-term (20-year) winter average of 414 mm. During the 2023 and especially 2024 reporting periods, the **winter rainfall** total was above the seasonal average at >450 mm and >550 mm, respectively. Prior to this, above-average winter rainfall was recorded during the last 20 years at Intaka Island in the 2004-2006, 2008 and 2012-2014 reporting periods. Total **summer rainfall** was well below-average during the 2015-2019 reporting periods, increasing to average levels (~180 mm per summer) in the 2020-2022 reporting periods and rising significantly above the long-term summer average in the 2023 reporting period (when close to 300 mm of rainfall was recorded at Intaka Island over the summer months of October 2022 to March 2023). In the 2024 reporting period, total summer rainfall (at <75 mm) dropped back down to a similarly low, below-average level to those recorded during the 2015-2019 reporting periods.



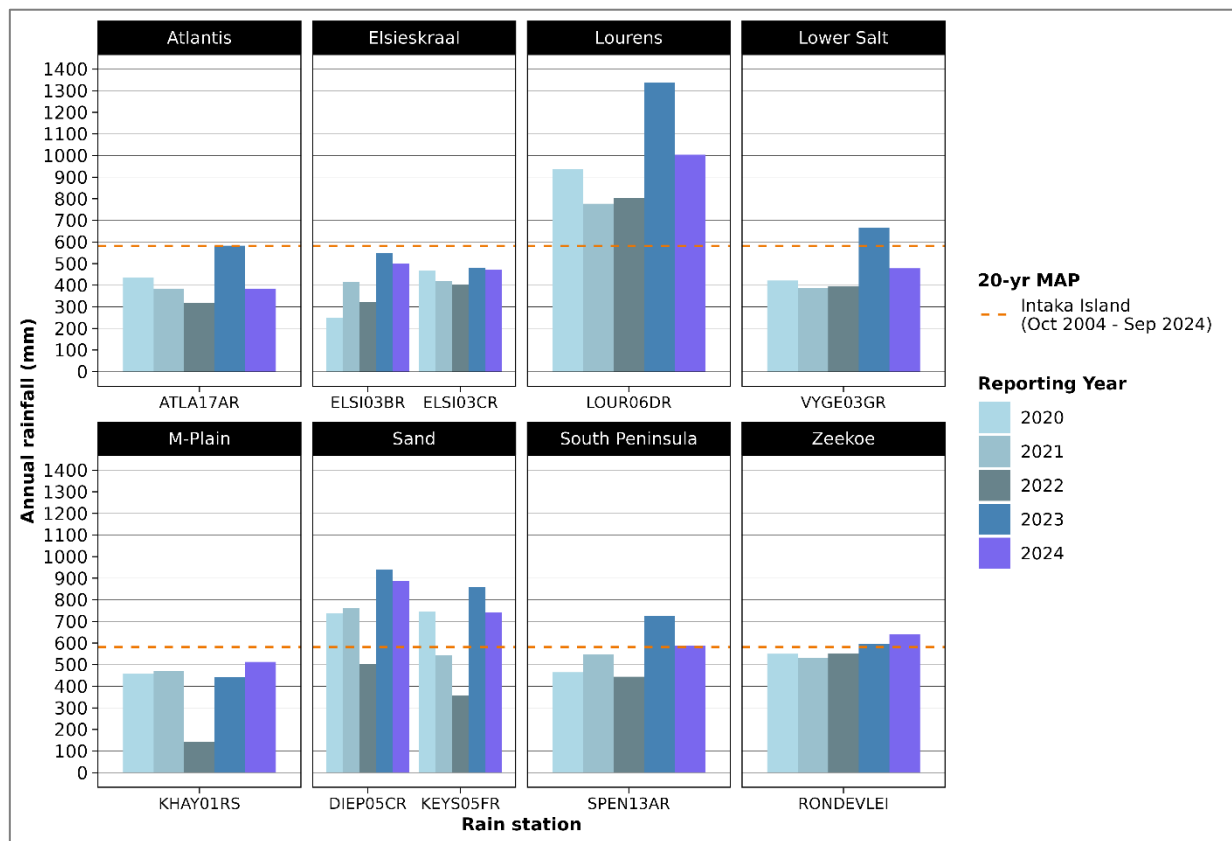
**Figure 4.3**

Total summer and winter rainfall at Intaka Island for each reporting year between 2005 and 2024, in relation to mean annual summer and winter rainfall for the full 20-year period.

#### 4.4 Five-year period (Oct 2019- Sep 2024) at the City's rain-gauging stations

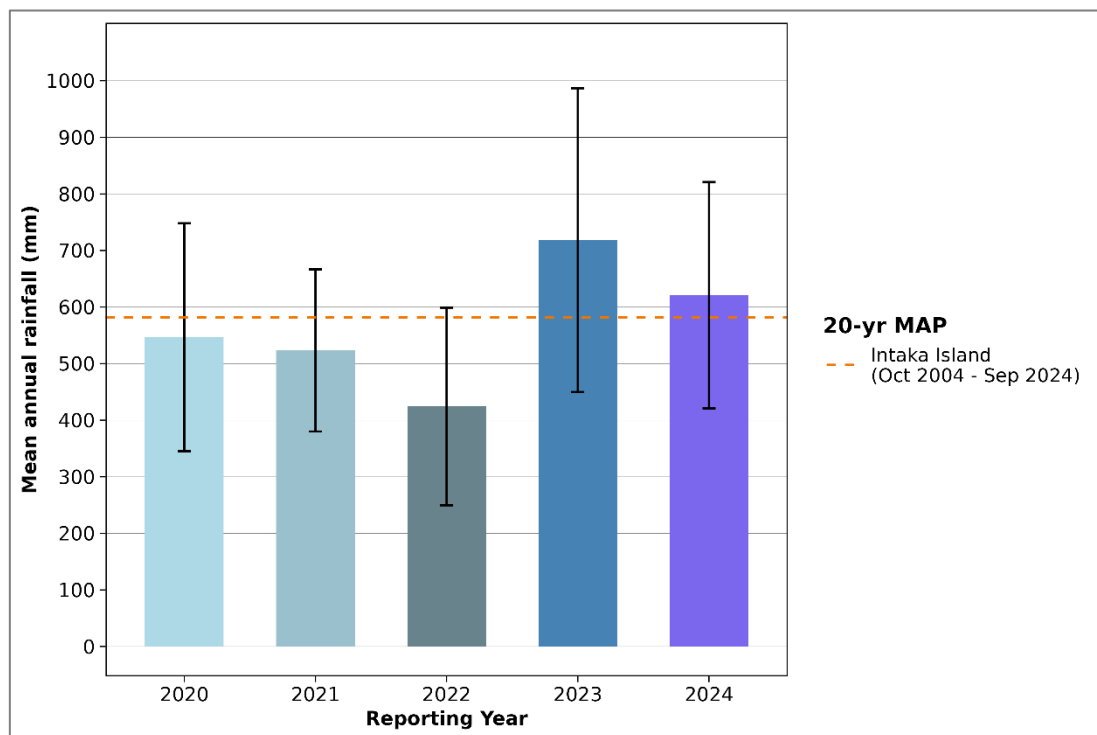
The graph of total annual rainfall at the City's rain-gauging stations for the 2020-2024 period (**Figure 4.4**) shows that there was a significant amount of variability between gauging stations across Cape Town in each year, with the highest cumulative rainfall for each year typically being recorded at rain station LOUR06DR (in the upper reaches of the Lourens catchment) and, to slightly less degree, at stations DIEP05AR and KEYS05FR (in the Sand catchment). At most of the rain stations across the City, significantly more rain was recorded for Reporting Period 2023 compared with the other years, with the only exceptions being rain stations ELSI03CR, KHAY01RS and RONDEVLEI (where the total rainfall in Reporting Period 2023 was not significantly higher than the other years in the period of analysis). This pattern is also shown very clearly in the graph of mean annual rainfall (and standard deviation) per year across all gauging stations (**Figure 4.5**), confirming that the 2023 reporting period was a particularly wet year across all parts of Cape Town. The mean annual rainfall across all gauging stations was marginally higher than the long-term average in the 2024 reporting period, and the total annual rainfall at most stations was generally the next-highest after Reporting Year 2023, or similar, over the 5-year period of analysis (an exception was ATLA17AR in the relatively dry Atlantis catchment, where the total annual rainfall in the 2024 reporting period was marginally less than that in the 2020 reporting period and similar to that in 2021).

For the 2020 to 2022 reporting periods, but especially 2022, the mean annual rainfall across all City rainfall stations included in the analysis was below the long-term (20-year) MAP of just under 600 mm derived from the Intaka Island dataset.



**Figure 4.4**

Total annual rainfall (Reporting Years 2020-2024) at each of the City's rain-gauging stations that were selected for the rainfall analyses, grouped by sub-catchment, showing the long-term (20-year) map at Intaka Island.



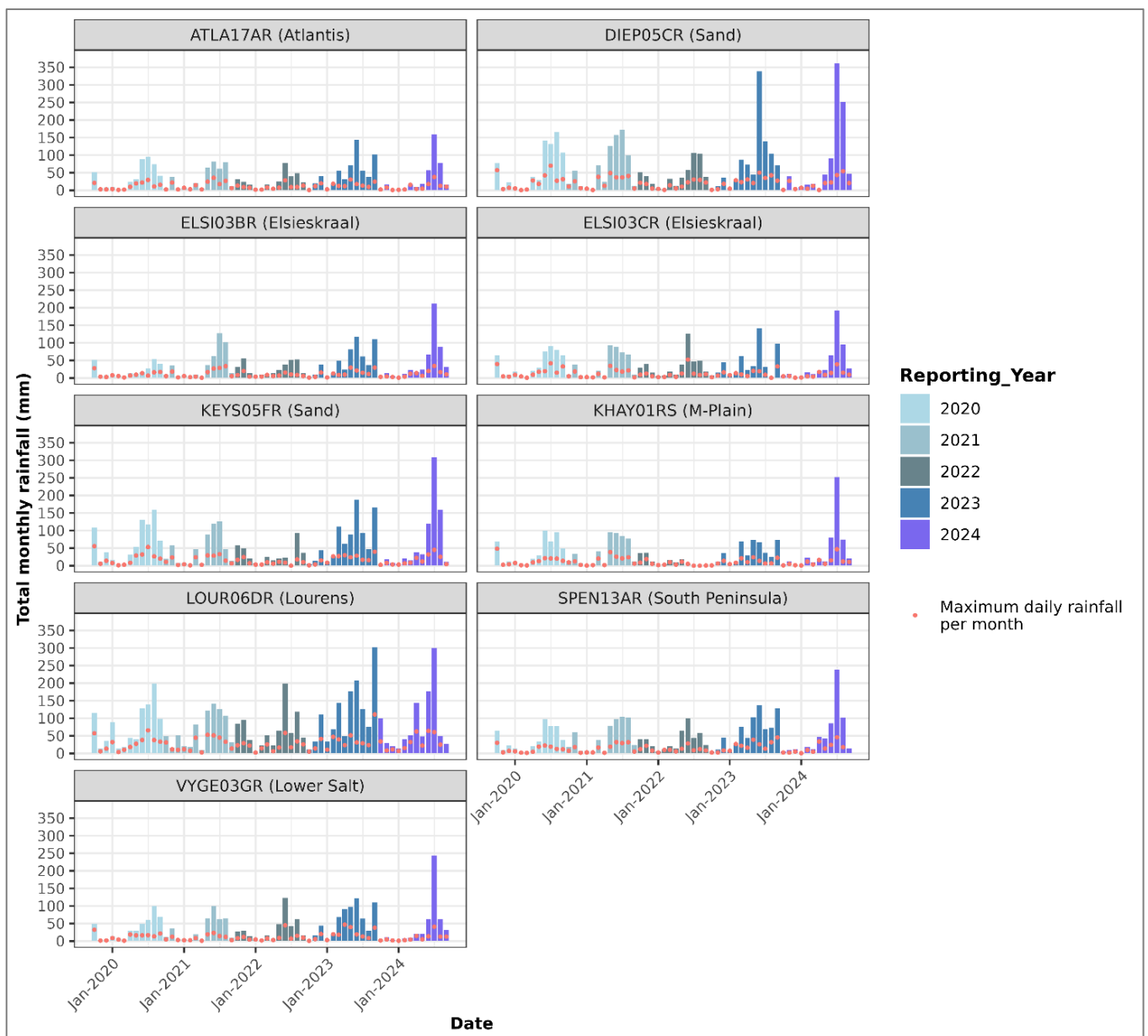
**Figure 4.5**

Mean annual rainfall (and standard deviation) per year across all of the City's rain-gauging stations that were selected for the rainfall analyses (Reporting Years 2020-2024).



The similar pattern of **month-to-month fluctuations in rainfall**, typically peaking in the winter months of June to August/September, is evident in the bar graphs of total monthly rainfall at the selected City-operated rain-gauging stations over the October 2019 to September 2024 period (see **Figure 4.6**). These graphs show that particularly high rainfall was recorded at most gauging stations in June and September 2023, and again in July 2024, with daily rainfall maxima of 50 mm or more (indicative of flood events) having been recorded at many stations during these months. Especially high rainfall was recorded at DIEP05CR in June 2023 and July 2024 (close to 350 mm) and at KEYS05FR in July 2024 (close to 300 mm), both in the Sand catchment.

Approximately 300 mm of rainfall was also recorded at LOUR06DR (in the upper Lourens catchment) in September 2023 and July 2024, with a particularly high daily maximum of 110 mm recorded at this station on 24/09/2023, and daily maxima of 64 mm and 60.8 mm recorded in June and July 2024, respectively.

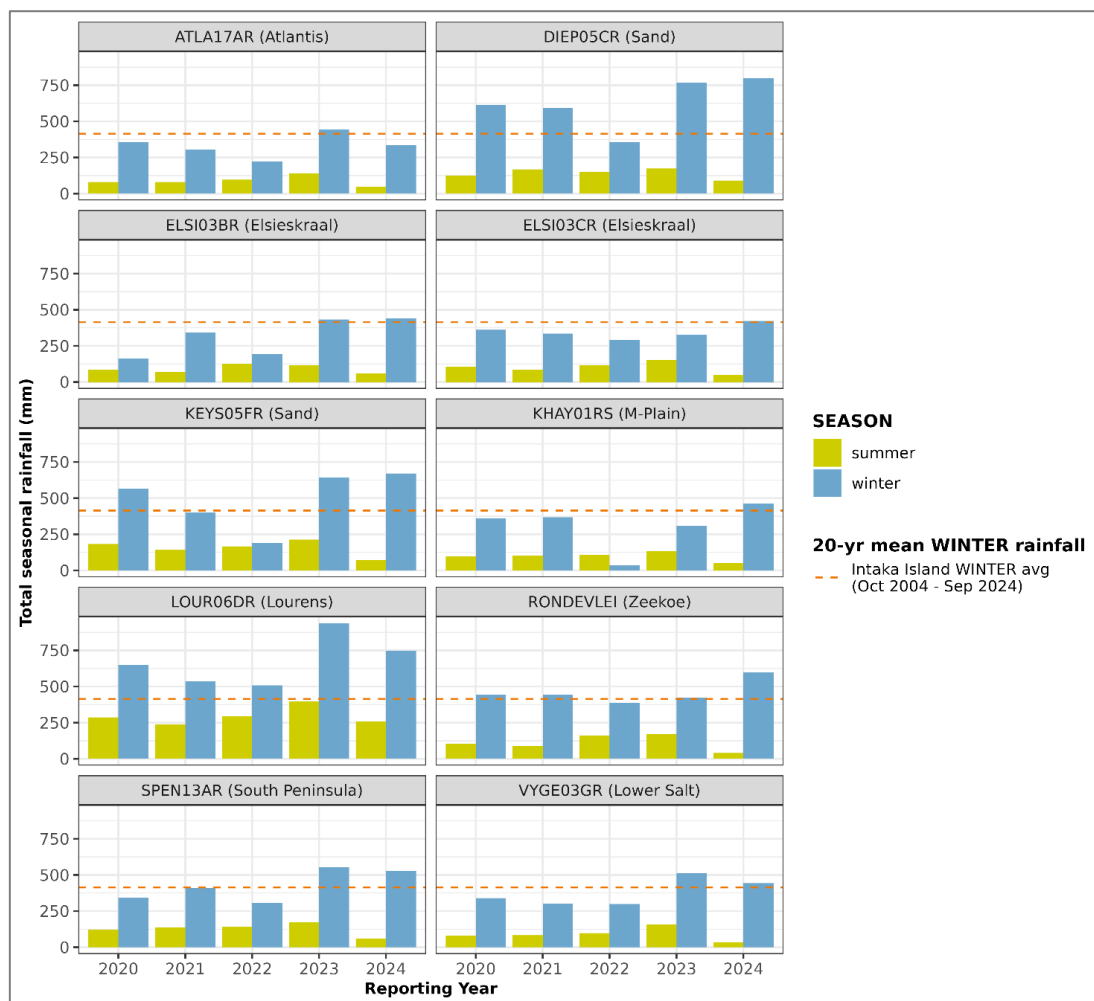


**Figure 4.6**

**Total monthly rainfall (bars) and maximum daily rainfall per month (red dots) at each of the City's rain-gauging stations that were selected for the rainfall analyses (reporting years 2020-2024), indicating the sub-catchment (in brackets behind the station name).**

The analysis of **total rainfall per season per reporting period at each of the selected City rain-gauging stations**, for the five-year period from October 2020 to September 2024 (**Figure 4.7**), shows that summer rainfall was significantly lower than winter rainfall at all stations, as was the case for the Intaka Island 20-year dataset (**Figure 4.3**). This confirms that the seasons, as classified for the current project, very clearly reflect a 'dry season' (summer) and a 'wet season' (winter) and can thus be used to aid interpretation of the results of the water quality data analyses.

The graphs of total rainfall by season for the selected City gauging stations (see **Figure 4.7**) also show that the cumulative winter rainfall at most stations was similar in the 2023 and 2024 reporting periods. Furthermore, winter rainfall in the 2023 and 2024 reporting periods was generally greater than that of the other 3 years in the period of analysis, and above the long-term (20-year) mean winter rainfall of 414 mm recorded at Intaka Island. Exceptions to this were gauging stations ELSI03CR (in the Elsieskraal sub-catchment), KHAY01RS (in the M-Plain catchment) and RONDEVLEI (in the Zeekoe catchment) for the 2023 and 2024 reporting periods, and ATLA17AR (in the Atlantis catchment) for the 2024 reporting period. Total summer rainfall was generally significantly lower than total winter rainfall at most of the selected rain gauging stations during most of the reporting periods. Exceptions to this pattern were recorded at KEYS05FR and KHAY01RS in the 2022 reporting period, when total summer rainfall was similar to or even greater than total winter rainfall. At most of the gauging stations, the total summer rainfall in the 2024 reporting period (<100 mm, with the exception of station LOUR06DR) was significantly lower than that of the four preceding reporting periods considered in this analysis.



**Figure 4.7**  
**Total rainfall per season at the City's rain-gauging stations for each reporting year from 2020 to 2024, compared with the 20-year mean winter rainfall figure derived from the Intaka Island dataset.**

## 5 CURRENT STATE AND TRAJECTORIES OF CHANGE IN WATER QUALITY IN CAPE TOWN'S MAJOR WATERCOURSES

### 5.1 *Escherichia coli* bacterial counts as an indicator of sewage contamination

#### 5.1.1 Relevance

*Escherichia coli* measurements are used primarily as an indicator of human health risk, particularly for drinking or recreational use of a waterbody. Consideration of this parameter is, therefore, of most relevance to Cape Town's established recreational vlei systems, where a range of watersports and/or other water-based activities are known to take place (i.e. Zandvlei, Zeekoevlei, Rietvlei, Milnerton Lagoon and Princess Vlei). These systems are discussed in more detail in Section 6.

The current section has however been included in this report to evaluate the potential fitness for (recreational) use of a broader array of rivers and vlei systems within Cape Town – not necessarily all major / established recreational water bodies. The data referenced here also highlight point-source pollution into watercourses, where elevated *E. coli* is an indicator of contamination from untreated sewage, either from overflows from manholes or sewage pump stations, or from inflows from poorly serviced backyard or informal settlements with inadequate access to sewer networks.

#### Box 5.1

***Escherichia coli*** (abbreviated *E. coli*) is a species of fecal coliform bacteria that is commonly found in the lower intestine of warm-blooded organisms (birds and mammals) and usually accounts for the majority of bacteria found in the faeces of these animals. Most *E. coli* strains are harmless, but some can cause serious gut and other infections in humans. Their presence in the water is used as an 'indicator' of fecal contamination of avian or mammalian origin, and therefore are indicative of other pathogens that may be present in faeces.

#### 5.1.2 Risk levels

The recreational risk ratings applied in the current assessment include *E. coli* thresholds for intermediate contact use (e.g. canoeing, sailing, paddling), as explained in Section 3.10.3 (see **Table 3.3**). Ranges are provided for 'Target' (acceptable risk), 'Poor' (tolerable risk) and 'Unacceptable' (high risk), with the latter including an additional two levels of 'Unacceptable', to aid in the identification of areas where there is extreme exceedance of the high-risk threshold for *E. coli*.

Reliable *E. coli* data were however not available for large parts of the 2021 and 2022 reporting periods (see Section 3.8.8), and these reporting periods have thus been omitted from this report.

#### 5.1.3 Sources of sewage contamination

Sources of sewage contamination in Cape Town's sub-catchments include:

- Periodic sewer blockages and manhole overflows that enter the stormwater system and thus pass into watercourses (Section 5.2 illustrates that blockages result variously from poor solid waste management (due to multiple factors), overflows as a result of stormwater ingress, vandalism, aging infrastructure (reflecting a history of poor maintenance effort), and increasing sewage volumes generated from rapidly expanding informal and backyard settlements;
- Overflows from sewage pump stations (or from low-lying manholes downstream of pump stations) as a result of blockages, pump station failure and from load-shedding power outages – unless diverted back into the sewerage system by pumping or other means, such waste finds its way into the stormwater system and thence into the City's watercourses (**Photo 5.1.1**);
- Contaminated stormwater runoff from poorly serviced informal settlements, where sewage is disposed of into canals and stormwater drains for want of alternative disposal options or because access to options to dispose of waste to sewers is unsafe (e.g. at night) or unhygienic (because of a build-up of solid waste and/or fecal waste) (**Photos 5.1.2 and 5.1.4**);



- Runoff from urban areas with high levels of homeless people without alternative waste disposal options;
- Illegal connections of sewers into stormwater systems;
- Old sewer designs allowing direct overflows into stormwater systems;
- Inputs from wildlife (baboons and birds);
- Input from livestock (e.g. feedlots in agricultural areas in and draining into rivers or other watercourses);
- Runoff from pavements, parks etc. accessed by domestic animals (e.g. dogs) – this is however likely to be a relatively minor input in most areas.

Major likely sources of sewage into the stormwater system are assessed in more detail in Section 5.2.



**Photo 5.1.1**  
**Homeless people washing and collecting water from the polluted Elseieskraal River, Bellville CBD**



**Photo 5.1.2**  
**Informal settlements in Langa overhang the Jakkalsvlei River (Lower Salt Sub-catchment) and discharge night soil and other waste into the river**



**Photo 5.1.3**  
**Sewage overflows into the Theo Marais channel, leading to the Milnerton Lagoon (Diep River Sub-catchment) as a result of prolonged failure of the Koeberg Pump Station**



**Photo 5.1.4**  
**Outflows of raw sewage enter the Big Lotus River, Zeekoe Catchment, from the Sweet Home and other informal settlements**



#### 5.1.4 Assessment of available *E. coli* data

**Figures 5.1.1** and **5.1.2** present the results of analyses of samples from routine water quality monitoring points in rivers/ stormwater channels and standing water systems (vleis / detention ponds etc.) respectively. The data are compared over the 2020 and 2023-2024 reporting periods only (see Sections 3.11.7). Data from the 2021 and 2022 reporting period have been excluded, as a result of unreliable laboratory analyses over this time, as discussed in Section 3.11.7.

It is noted moreover that the SSB changed its analytical methods between the 2020 and 2023 datasets, from membrane filtration to the Colilert® system, further complicating interpretation of trends in data over time (see discussion in Section 3.11.7).

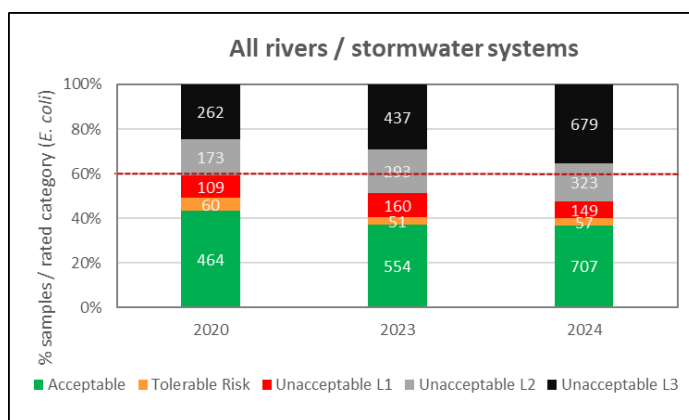
Bearing the above issues in mind, the following implications can be drawn from the data:

- For **rivers / flowing water systems**:
  - The summary data in **Figure 5.1.1** show a marked increase in both the frequency and the magnitude of sewage contamination of Cape Town's rivers between 2020 and the 2023 and 2024 reporting periods, with 2024 showing a similar proportion of sites falling within the "Unacceptable" range compared with 2023 (60 %) but with a higher proportion of these showing an increased magnitude of exceedance of the Unacceptable threshold (52% at Level 2 Unacceptable or higher versus 39% in 2023)
  - Data in **Figure 5.1.2** allow comparison of performance of different catchments over the 2024 reporting period, while **Figure 5.1.3** allows comparison of performance between the 2020, 2023 and 2024 reporting periods. These data allow the following interpretation:.
    - The best performing catchments comprised (in order) the Schusters, Sout, Muizenberg (sea outfalls), Lourens and Silvermine Catchments, with the Schusters and Sout Catchments having < 20% of samples within the Unacceptable range for *E. coli*. This statement must however be tempered for the Sout Catchment – the sampling site lies downstream of the Melkbosstrand WWTW, and disinfection of treated effluent takes place at the WWTW – thus while *E. coli* concentrations were low, other variables indicative of sewage inflows still pertain to this system (see subsequent sections of this report);
    - Of the above, the frequency of samples with *E. coli* at Unacceptable levels and their magnitude (as shown by Unacceptable Levels 1-3) decreased in the Schusters and Sout Catchments in the 2024 reporting period compared with both the 2023 and the 2020 reporting periods (**Figure 5.1.3**);
    - **Figure 5.1.3** shows moreover that sewage inflows appear to have increased in both frequency and magnitude in the Lourens Catchment and in magnitude in the Silvermine Catchment between the 2020, 2023 and 2024 reporting periods – **these are serious red flags, as both of these catchments have hitherto been reflected in Inland Water Quality Reports as the best performing catchments with relatively good overall water quality.** Drawing on site-level data (see Appendix C):
      - In the Lourens Catchment, while the upper reaches were unimpacted by sewage inflows, downstream of the Morgenster Sewage Pump station, substantial deterioration in water quality occurred in the last reporting period, with 18% of samples at LOU02 being in the Unacceptable range versus none in previous reporting periods. Further deterioration occurred with distance downstream, with the two worst-performing sites being the closely abutting LOU08 and LOU03, near the Main Road crossing, both with >40% of samples in the Unacceptable range. These do not lie close to major pump stations and it is assumed that there are problematic sewer lines in their catchment areas. This should be investigated. Data for sites LOU04 and LOU05 (at the estuary) all reflect increases in the frequency

and magnitude of sewage inflows;

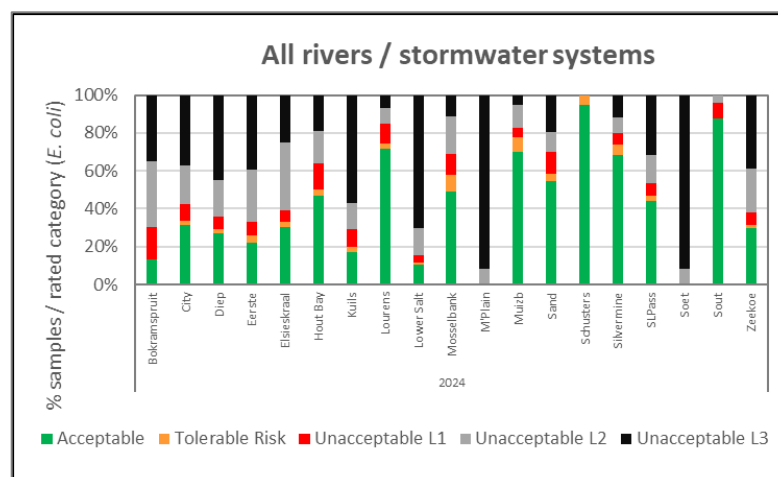
- In the Silvermine Catchment, the deterioration in catchment-scale performance reflects an increase in the magnitude of *E. coli* samples (see **Figure C1** in Appendix 3) at the downstream site (SIL06), indicating a real deterioration in river condition in the downstream reaches.
- The worst performing catchments in the 2024 reporting period comprised (in order) the Soet, Mitchell's Plain (sea outfall), Lower Salt, Bokramspruit, Kuils, Eerste and Diep Catchments –of these, **no samples in the entire monitoring year in both the Soet and the Mitchell's Plain catchments were ever better than Level 2 Unacceptability**, indicating permanent, high levels of sewage inflows into these systems;
  - Data in **Figure 5.1.3** suggest however that there was a very slight improvement in the frequency and magnitude of *E. coli* pollution in the Lower Salt sub-catchment in 2024, compared with 2023;
  - By contrast, the data suggest deterioration in all of the other catchments listed above, between the 2023 and 2024 reporting periods, albeit with slight improvement in the magnitude of sewage pollution in the Mitchell's Plain catchment, compared with 2020 data;
  - In the case of the Diep Sub-catchment, the increase in the frequency and magnitude of sewage contamination in the 2024 reporting period is attributed to major pump station failures in the catchment, including the Koeberg pump station, as well as increasing inflows from informal settlements east and south of the Potsdam WWTW, including the Jo Slovo settlement, as well as (at least in the wet season), flows from the Doornbach and Dunoon settlements upstream of the Potsdam WWTW;
- After the Diep Sub-catchment, the next worst-performing catchments comprised (in order) the Zeekoe, Elsieskraal, Sir Lowry's Pass and Hout Bay Catchments. Of these, the Elsieskraal is least impacted by informal settlements but does include enclaves of homeless people, living on streets and along watercourses and contributing to watercourse degradation, along with a high frequency of sewage overflows into the river (Day and Uys 2024). The Sir Lowry's Pass and Hout Bay catchments include both lesser contaminated upstream reaches and highly polluted downstream reaches, affected by inflows from extensive informal settlements and backyard dwellers; the Zeekoe catchment is characterized by high levels of inflow from informal and backyard settlements (Day et al 2022);
  - The data shown in **Figure 5.1.3** suggest that, between the 2023 and 2024 reporting periods, there was:
    - An improvement in sewage contamination in the Hout Bay River at a Catchment level. However, closer assessment of data at a site level (see Appendix C) showed that:
      - The hitherto generally unimpacted upper reaches of the river (DR04 and DR06) were both subject to infrequent sewage inflows of a high magnitude (Level 2 Unacceptable) in the 2024 reporting period;
      - The catchment-level improvement in water quality was mainly attributable to a marked improvement in water quality at DR02, downstream of Victoria Road, possibly reflecting the impacts of low-flow stormwater diversions to sewer in the adjacent catchment and dilution and die-off of upstream pollution sources from the upper catchment;

- While DR01 and DR05 (at the estuary) remained highly contaminated and in the Unacceptable Range for over 90% of the time in the 2024 reporting period, the magnitude of contamination reduced (less Level 3 Unacceptable), compared with the previous reporting periods.
  - These may also reflect the result of improved catchment policing and managed low-flow diversions to sewer and maintenance of these (see Section 7);
- A reduction in the frequency and magnitude of sewage contamination in the Elsieskraal Sub-catchment, albeit still at higher levels when compared to 2020 data;
- A marked increase in the frequency and magnitude of sewage contamination in the Sir Lowry's Pass Catchment, attributed mainly to sewage inflows from informal settlements and backyard dwellings in Sir Lowry's Pass Village, as well as to manhole overflows throughout the catchment, but probably primarily in the areas between the T2 and the upper reaches of Sir Lowry's Pass Village (see Section 5.2 for discussion);
- Continued deterioration in the Zeekoe catchment, with data showing an increase in both the frequency and magnitude of sewage inflows into the Zeekoe catchment rivers – these derive primarily from burgeoning informal settlements as well as from sewage pump station failures and manhole overflows (Day et al 2022 and pers. obs.);
- The Mosselbank and Sand catchments are ranked next (in decreasing order of sewage contamination) in the 2024 reporting period, with the former reflecting presumed inflows from informal settlements in the upper catchment as well as possible influences of livestock in downstream agricultural areas of the catchment;
  - Data for the Sand catchment (**Figure 5.1.3**) show some improvement in the frequency of sewage impacts in the catchment over the 2024 reporting period compared with 2023. However, the magnitude of reported impacts increased, suggesting periodic major inflows of raw sewage, assumed to be associated with pump station failure (see Section 8 for further discussion).



**Figure 5.1.1**

Summary data showing percentage of samples across all City sample sites in rivers, stormwater channels and other flowing systems, in rated *E. coli* categories (as per Table 3.4) for reporting periods 2020, 2023 and 2024. Number of samples indicated in figure.



**Figure 5.1.2**

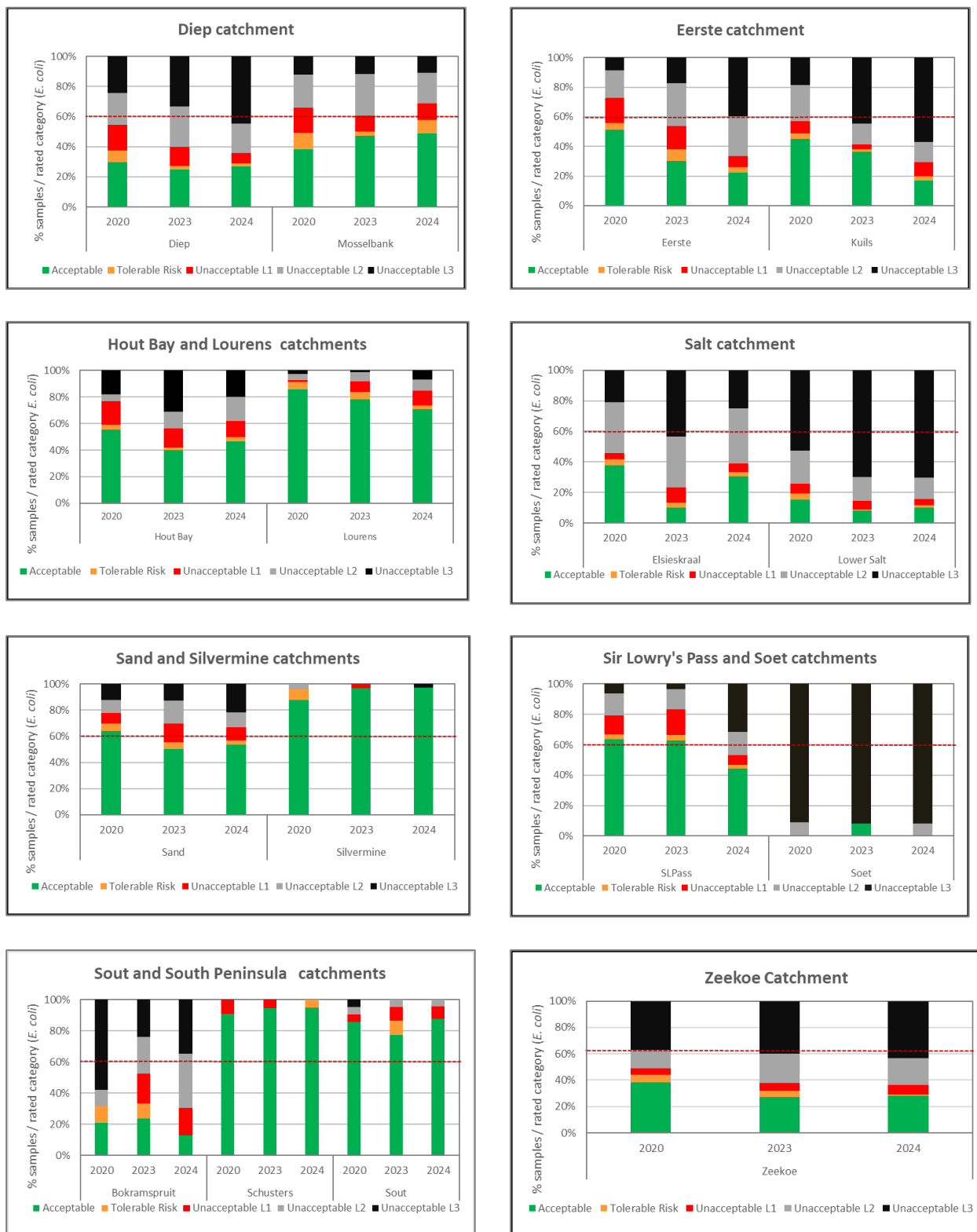
**Data showing percentage of samples per catchment in rivers, stormwater channels, stormwater outflows into the sea and other flowing systems, in rated *E. coli* categories (as per Table 3.4).**

With regard to the above, it must be noted that the summary data reported on in this section generally assessed data from multiple sites across catchments. A high proportion of samples rated Unacceptable might represent both a high frequency of sewage contamination throughout the catchment, or simply inflows from a few point-source areas, reflecting in a limited number of downstream sites. The Hout Bay River is an example of this scenario. Spatial variation of water quality within sub-catchments is however explored in more detail in the maps presented per priority sub-catchment in Section 8, while **Figure 5.1.3a** and **Figure 5.1.3b** respectively separate out river / channel samples in catchments from seawater outlets from these catchments.

- For **stormwater outlets into the sea**:
  - The only sites that had no measured *E. coli* in the 2024 reporting period were LOU13 (Lourens Catchment) and CN33 (Bakoven, City Bowl Catchment);
  - All of the other sites draining from the City Bowl included high frequencies of highly contaminated flows (Level 3 Unacceptable) and only sites CN17B, CN24 and CN 27 ≤ 50% of their samples rated Unacceptable while the remaining sites all had between 65% and 90% of their samples rated Unacceptable, reflecting inflows of water contaminated with sewage, both from periodic pump station or manhole overflows or from wash-off from enclaves of informal settlements that increased in parts of the City Bowl since the 2020 Covid pandemic.
  - Elsewhere in the city:
    - Stormwater runoff from the Mitchell's Plain catchment was most contaminated, with the outlet from the Khayeltisha detention ponds off Baden Powell Drive and immediately downslope of the Monwabisi pump station having samples that were never better than Unacceptable Level 2. These conditions were nearly matched by runoff at site CS23 in the same catchment;
    - All of the other catchments, with the already noted exception of the Lourens River, showed periodic episodes of highly polluted outflows, that would contribute to the pollution of coastal waters, and reflected, variously, catchments that were generally "dirty" with high levels of informality that contribute ongoing waste streams into stormwater systems, as well as catchments affected by episodic events of varying magnitude that are also conveyed into the coastal waters.

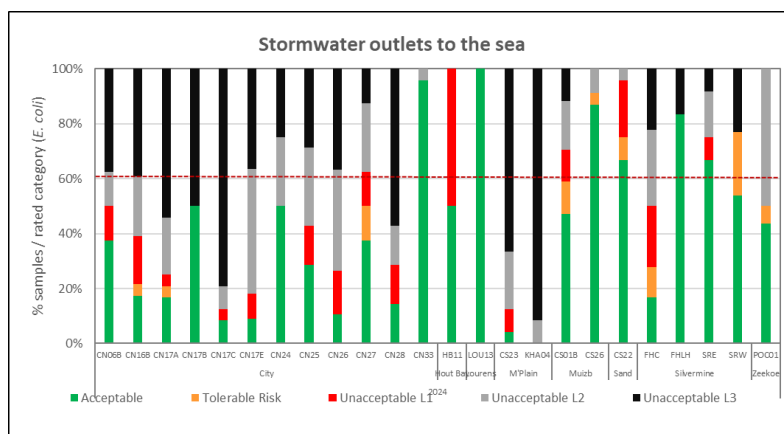


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**Figure 5.1.3a**

Percentage of *Escherichia coli* samples falling within each rated category for this variable, per catchment. Thresholds for rated categories as defined in Table 3.4. Data for river / 'flowing' water monitoring points in each sub-catchment. Sub-catchments as shown in Figure 2.1. Dotted red line indicates City's '60% Target' for *E. coli*. Graphs arranged alphabetically by catchment.



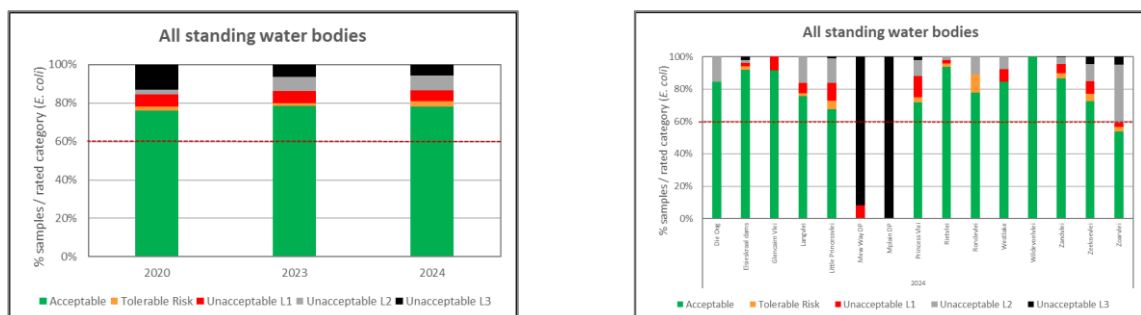
**Figure 5.1.3b**

**Percentage of *Escherichia coli* samples falling within each rated category for this variable, per catchment. Thresholds for rated categories as defined in Table 3.4. Data for coastal stormwater outlets only. Catchments as shown in Figure 2.1. Dotted red line indicates City's '60% Target' for *E. coli*. Note that only data for the 2024 reporting period are included in this report.**

- **Standing water systems (vleis, dams, detention ponds)** typically have lower *E. coli* concentrations and perform better in terms of compliance data than do the rivers feeding into them. This is evidenced by much of the data shown in **Figure 5.1.4**, compared with **Figure 5.1.1**. The reason for this is that larger water bodies in particular often offer dilution opportunities relative to the inflowing pollution load, and retention time in these systems with exposure to sunlight also results in *E. coli* die-off. The data shown in **Figure 5.1.4** show that 20 % of water samples from standing water bodies was rated as Unacceptable over the 2024 reporting period. These data are similar to those for the 2023 reporting period, with similar levels of magnitude of pollution also shown in Levels 1 to 3 of Unacceptable. The data do however show some improvement over the 2020 dataset, when far higher numbers of sample in the Unacceptable Category 3 were recorded in assessed waterbodies.
  - Data in **Figure 5.1.5** allow comparison of different individual monitored waterbodies catchments over the 2024 reporting period, while **Figure 5.1.6** allows comparison of performance between the 2020, 2023 and 2024 reporting periods. These data allow the following interpretation:
    - The worst performing systems were the Mew Way and Mitchell's Plain detention ponds, from which all samples were in the Unacceptable category, and generally at Level 3 indicating serious levels of contamination with raw sewage. A slight improvement in the Mew Way pond was shown between the 2023 and 2024 reporting periods – however, the data remained Unacceptable. Comparison with similar data for 2020 indicate that this is a long-term impact, reported on previously in Day et al (2020, 2023 and 2024). The ponds are located in areas with high levels of informal settlements and/or backyard dwellings;
    - Although performing much better than the above two detention ponds, Zoarvlei data also show that this wetland was subject to frequent high-magnitude pollution, resulting in 42% of samples lying above the Unacceptable threshold and mostly at Level 2. **Figure 5.1.6** shows that both the frequency and magnitude of sewage pollution in this waterbody have increased since 2020, with samples in the 2024 reporting period performing worse than those of the previous year;
    - The remaining open waterbodies were subject to much lower frequency and magnitude of sewage inflows, with over 60% of samples lying within the Acceptable / Target range in the 2024 reporting period;
    - Of these, Wildevoelvlei, interestingly, was the best-performing waterbody, with all samples in the Acceptable range, suggesting high levels of compliance with

regard to disinfection at the Wildevoelvlei WWTW and sufficient time for *E. coli* die-back downstream of the informal settlements abutting upstream wetlands in Masiphumelele;

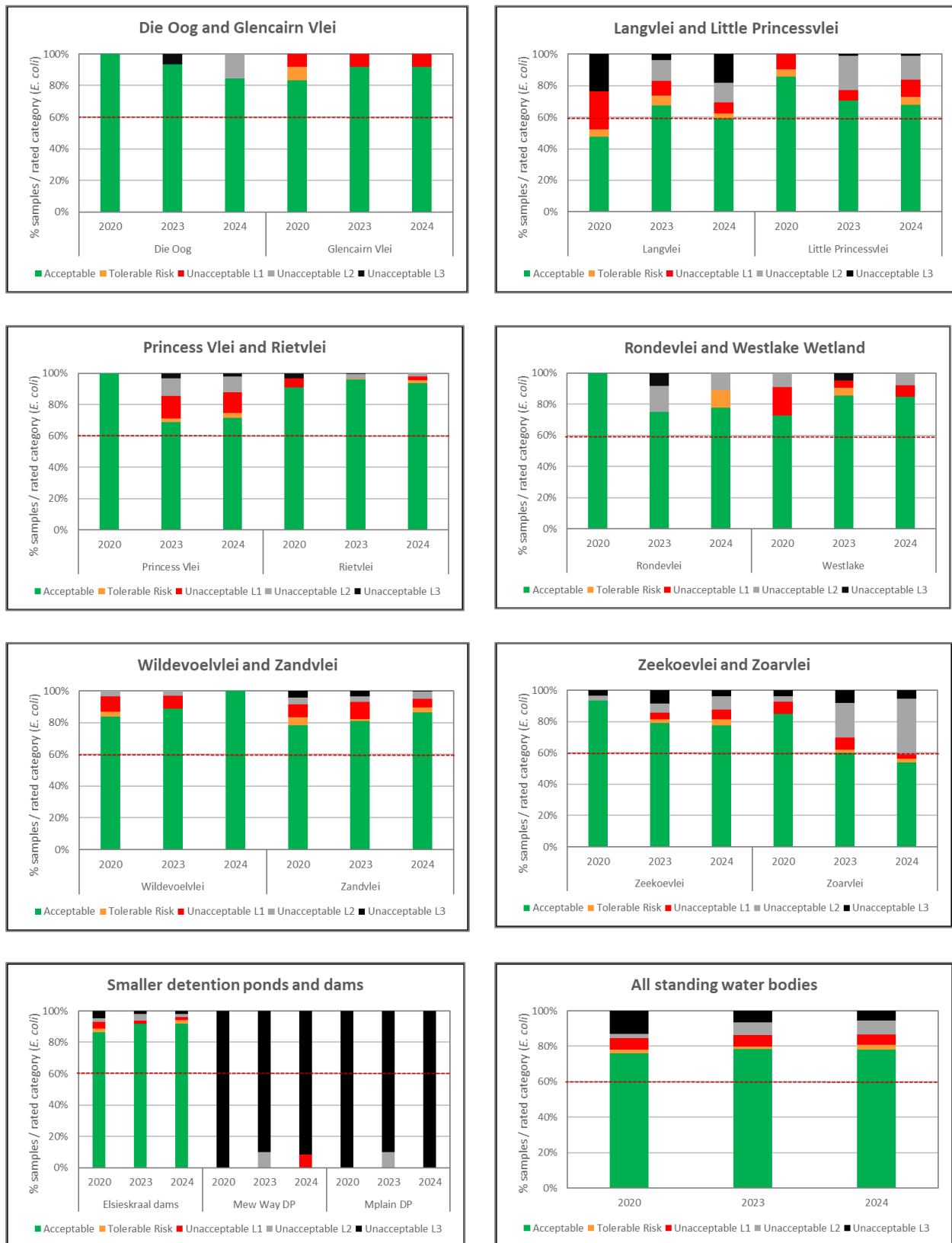
- Glencairn Vlei, Rietvlei, Zandvlei, Westlake, Die Oog and the dams in the upper Elsiekraal Sub-catchment were also relatively well-performing (all above 80% Target), although all were affected at least at times by inflows of raw sewage that ranged from very high severity (Unacceptable Levels 1 to 3) suggesting sustained, high levels of sewage inflows at times, to more moderate (or abated) pollution reflected in "Poor" ratings. Of these:
  - The frequency of measured major sewage inflows into Zandvlei decreased in the 2024 reporting period, resulting in fewer samples being in the "Unacceptable" range, and no measured incidents resulting in Pollution Level 3, although 5% of samples were in the Level 2 range, indicating that the catchment remains vulnerable to such impacts;
  - The severity of measured sewage pollution in Rietvlei decreased over the 2024 reporting period decreased, although there was little change in frequency;
  - There was little change in the severity or frequency of measured pollution events in the Elsiekraal Dams and Glencairn Vlei;
  - The frequency of severe *E. coli* pollution decreased in Rondevlei compared with 2023, although both 2023 and 2024 data showed a major deterioration compared with 2020 data;
  - Westlake wetlands remained impacted on occasion by severe inflows of raw sewage, assumed to stem mainly from pump station overflows;
  - Die Oog was subject to more frequent and severe inflows of raw sewage over the 2024 reporting periods than in 2023, and it too showed a significant deterioration since the 2020 reporting period;
- Zeekoevlei, Langvlei and Zoarvlei all showed between 60 and 80% compliance, although the frequency of sewage pollution events increased in all three systems in the 2024 reporting period, with frequent reporting of samples at Unacceptable Levels 2 and 3. While Zeekoevlei and Langvlei data showed a marked decline since the 2020 reporting period, some improvement in the frequency if not the severity of sewage pollution is evident in the data;
- Princess Vlei and Little Princessvlei both remained subject to periodic inflows of sewage including severe inflows (Levels 1 to 3) and both showed a clear increase in the frequency and magnitude of sewage inflows since 2020.



**Figure 5.1.4**

**Summary data showing percentage of samples across all City sample sites in standing water bodies (vleis, lakes, detention ponds etc.) in rated *E. coli* categories (as per Table 3.4) for reporting periods 2020, 2023 and 2024, for all catchments (LHS), and by catchment (2024 reporting period only) (RHS)**

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**Figure 5.1.6**  
Percentage of *Escherichia coli* samples falling within each rated category for this variable. Thresholds for rated categories as defined in Table 3.4. Data for sample points in standing water bodies / vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing water bodies'). Dotted red line indicates City's '60% Target' for *E. coli*. Graphs arranged alphabetically.



In considering the above data, it must however be stressed that *E. coli* data are used in the City's monitoring programme as indicators of sewage contamination. Even if these bacteria are killed by UV light or chlorine (at some WWTWs), the nutrients, associated decomposing organic waste, and various pathogens also often found in sewage would still remain within the affected water bodies. Thus even where *E. coli* counts are low, these contaminants would still be expected to result in short- to long-term impacts on the fitness for use of the system for both human use and aquatic ecosystems.

### 5.1.5 City's *E. coli* targets

In the case of *E. coli* data, the City has set itself a 'target' that at least 60% of samples in any catchment should meet the defined Acceptable thresholds of  $\leq$  cfu /100 ml (as per **Table 3.3**). *Escherichia coli* compliance graphs thus also show this 60% threshold as a dotted line across the data. The rationale for this "target" has been questioned in previous reports, particularly as, in practice, many waterbody users engaging in intermediate recreation (considered safer than full contact recreational use) are in fact already exposed to a greater degree of risk than what is implied by 'intermediate' recreational exposure. Sailing, rowing, kayaking, and kite-surfing, for example, are all popular sports engaged in within Cape Town's inland recreational water bodies. These all expose participants to full immersion at times in the water bodies.

The data described in the previous section indicate that, in the City's monitored rivers and stormwater channels, the 60% target was achieved in only four catchments in the 2024 reporting period (Schusters, Lourens, Silvermine and Sout Catchments), with the Silvermine and Sout Catchments both showing deterioration compared with the 2023 and 2020 reporting periods, even when the additional stormwater sites in the Silvermine Catchment are excluded from analysis.

The standing waterbodies performed better, for reasons already discussed, and all lay above the 60% compliance level, with the exception of the highly contaminated Mew Way and Mitchell's Plain detention ponds and Zoarvlei.

### 5.1.6 Enterococci data

The 2020, 2023 and 2024 Inland Water Quality reports have all recommended that intestinal enterococci should be monitored in inland water bodies, based on recommendations in WHO (2003) and WHO (2021), as well as with regard to uncertainty at times as to the accuracy of *E. coli* data from the SSB (see Section 3.11.7). Enterococci data, collected on a regular, long-term basis would provide an additional measure of sewage pollution, against which the trends displayed by *E. coli* data could be compared.

Although enterococci data were included in data used in the 2023 inland water quality report, such monitoring was discontinued, on the basis that most of the City's historical microbiological data base includes *E. coli* and not enterococci data as well as because of the costs of attaining laboratory certification for these analyses and the costs of duplication of both datasets over an extended period. Intestinal enterococci data

It is again recommended that enterococci analyses should be included for at least recreational water bodies, both so that the City keeps up with global standards and to provide an alternative dataset with which to assess the magnitude and associated human health risks of sewage pollution into water bodies access to enterococci data would have assisted, *inter alia*, with the comparison and interpretation of different results from the Colilert versus Membrane Filtration analytical methodologies discussed in Section 3.11.7;

### 5.1.7 Key take-away points

Sewage contamination in Cape Town's sub-catchments arises from multiple sources, including sewer blockages and manhole overflows caused by *inter alia* aging sewer infrastructure, pump station failures (exacerbated by load-shedding); contaminated runoff from poorly serviced informal settlements and backyard dwellings; as well as illegal and/or outdated sewer-to-stormwater connections.

Data for the 2024 reporting period show a marked increase in both the frequency and the magnitude

of sewage contamination in Cape Town's rivers between 2020 and the 2023 and 2024 reporting periods, with 2024 showing a similar proportion of sites falling within the "Unacceptable" range compared with 2023 (60 %) but with a higher proportion of these showing an increased magnitude of exceedance of the Unacceptable threshold (52% at Level 2 Unacceptable or higher in 2024 versus 39% in 2023).

The best performing catchments comprised (in order) the Schusters, Sout, Lourens and Silvermine Catchments, with the Schusters and Sout Catchments having < 20% of samples within the Unacceptable range for *E. coli*. However, sewage inflows appear to have increased in both frequency and magnitude in the Lourens Catchment in particular, as well as in magnitude in the Silvermine Catchment, between the 2020, 2023 and 2024 reporting periods. **These are serious red flags, as both of these catchments have hitherto been reflected in Inland Water Quality Reports as the best performing catchments with generally good overall water quality.**

The worst performing catchments in the 2024 reporting period comprised (in order) the Soet, Mitchell's Plain (sea outfall), Lower Salt, Bokramspruit, Kuils, Eerste and Diep Catchments -of these, **no samples in the entire monitoring year in either the Soet or the Mitchell's Plain Catchments were ever better than Level 2 Unacceptability**, indicating permanent, high levels of sewage inflows into these systems.

After the Diep Sub-catchment, the next worst-performing catchments comprised (in order) the Zeekoe, Elsieskraal, Sir Lowry's Pass and Hout Bay Catchments. Of these, the Elsieskraal is least impacted by informal settlements is characterized by enclaves of homeless people, living on streets and along watercourses and contributing to watercourse degradation, along with a high frequency of sewage overflows into the river. The Sir Lowry's Pass and Hout Bay catchments include both lesser (but increasingly) contaminated upstream reaches and highly polluted downstream reaches, affected by inflows from extensive informal settlements and backyard dwellers; the Zeekoe catchment is characterised by high levels of inflow from informal and backyard settlements.

Data for the Sand catchment showed some reduction in the frequency of sewage impacts over the 2024 reporting period. However, the magnitude of reported impacts increased, suggesting periodic major inflows of raw sewage, assumed to be associated with pump station failure.

Overall, of the 18 catchments / sub-catchments assessed, the 2024 reporting period showed a reduction in the frequency and/or magnitude of measured *E. coli* contamination in only 5 catchments, namely the Mosselbank, Hout Bay, Elsieskraal, and Schusters catchments. All of the remaining catchments showed further degradation, often off an already low base, and the City's 60% Acceptable target was achieved in only four catchments in the 2024 reporting period (Schusters, Lourens, Silvermine and Sout Catchments), with the last three of these still showing deterioration compared with the 2023 and 2020 reporting periods.

With regard to the routinely monitored standing-water systems in the City, and with the exception of Zoarvlei and the highly contaminated Mew Way and Mitchell's Plain detention ponds, these waterbodies generally showed relatively low levels of sewage pollution as measured by *E. coli* counts, with > 60% of samples in all systems lying within the Acceptable range for *E. coli* during the 2024 reporting period. Slight reductions in the frequency and/or magnitude of measured sewage contamination were, moreover, noted for the 2024 reporting period, in all but Die Oog, Langvlei, Westlake wetlands, Zoarvlei and the Mitchell's Plain detention ponds. The data do however indicate that all systems were subject to periodic pollution incidents, when they were exposed to raw sewage flows. These affected the fitness of these systems for recreational activities, at least at times.

Moreover, the city-wide inflows of raw sewage into all catchments and standing waterbodies at times contributed to nutrient enrichment of these systems, with knock-on impacts of blue-green algal blooms and associated occasional microcystin toxicity in some recreational waterbodies, as well as excessive growths of reeds and alien vegetation (e.g. water hyacinth) and actual or potential ecosystem collapse in some systems (e.g. Milnerton lagoon).

Assessment of *E. coli* data was however hampered by missing data (due to compromised or potentially compromised laboratory analyses) and inadequate dilutions. Adjustments to routine assessment protocols have thus been recommended. In addition, as per the City's 2020, 2023 and

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2024 Inland Water Quality reports, it is again recommended that enterococci analyses should be included for at least recreational water bodies, both so that the City keeps up with global standards and to provide an alternative dataset with which to assess the magnitude and associated human health risks of sewage pollution into water bodies.

## 5.2 Other indicators of sewage contamination

### 5.2.1 Inflows of treated effluent from Cape Town's (inland) WWTWs

#### 5.2.1.1 Background

The City has 25 WWTWs, 16 of which pass effluent into inland aquatic ecosystems and are therefore considered in this report. These 16 WWTWs treat approximately 508 ML/day, and this is discharged into a number of different aquatic ecosystems. Nine of the City's WWTW plants discharge directly to the marine or coastal environment. Cape Town's marine outfalls contribute approximately 5% of the total amount of waste water produced in Cape Town, with 95% of Cape Town's waste water discharging first into inland aquatic ecosystems, which lead to the sea via rivers and/or estuaries. Of these, the Cape Flats and Macassar WWTWs discharge into estuaries in close proximity to the mouths of these systems.

The quality and the quantity of effluent that is discharged from these WWTWs is regulated, at least theoretically, by a Water Use License issued by the national department of Water and Sanitation or the Breede-Olifants Catchment Management Agency in terms of the National Water Act. Auditing of WWTW compliance is currently undertaken through the Green Drop Certification programmes, as well as through direct monitoring and reporting programmes stipulated in the conditions included in the various individual WWTW licenses.

In general, effluent quality from the City's WWTWs is required to comply as a minimum with the DWS's General Effluent Limits, as listed in **Table 5.2.1** (taken from Government Notice No. 169 of 2013). Since the main focus of this report is on inland water quality and not on WWTW compliance, only those water quality variables that are most relevant to the receiving environments (rivers, vleis, dams, estuaries and wetlands) are considered here, and this section is not intended to be an audit on WWTW compliance.

The data presented here also need to be considered in the context of impacts on receiving watercourses. Even WWTW effluent discharges that are fully compliant with General Limits for effluents may exert major impacts on aquatic ecosystems, where the volume of effluent discharged exceeds or dominates the volume of natural flows in the river or wetland at any time.

#### Box 5.2

##### Upgraded Zandvliet WWTW

Zandvliet WWTW has recently been upgraded, with its capacity increased from 72 to 90 million litres of effluent per day. The upgraded plant includes membrane treatment technology, which treats effluent to very high water quality standards.

<https://www.capetown.gov.za/Media-and-news/Cape%20Town%20completes%20R2bn%20upgrade%20of%20Zandvliet%20Waste%20Water%20Treatment%20Works>





**Table 5.2.1**  
**General and special effluent limits as applicable to discharges from WWTWs into water resources in South Africa (Government Notice 169 of 2013: Revision of General Authorisations in terms of Section 39 of the National Water Act (Act 36 of 1998))**

| SUBSTANCE/PARAMETER                                 | GENERAL LIMIT                                 | SPECIAL LIMIT                                                      |
|-----------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------|
| Faecal Coliforms (per 100 ml)                       | 1000                                          | 0                                                                  |
| Chemical Oxygen Demand (mg/l)                       | 75 (i)                                        | 30(i)                                                              |
| pH                                                  | 5,5-9,5                                       | 5,5-7,5                                                            |
| Ammonia (ionised and un-ionised) as Nitrogen (mg/l) | 6                                             | 2                                                                  |
| Nitrate/Nitrite as Nitrogen (mg/l)                  | 15                                            | 1,5                                                                |
| Chlorine as Free Chlorine (mg/l)                    | 0,25                                          | 0                                                                  |
| Suspended Solids (mg/l)                             | 25                                            | 10                                                                 |
| Electrical Conductivity (mS/m)                      | 70 mS/m above intake to a maximum of 150 mS/m | 50 mS/m above background receiving water, to a maximum of 100 mS/m |
| Ortho-Phosphate as phosphorous (mg/l)               | 10                                            | 1 (median) and 2,5 (maximum)                                       |
| Fluoride (mg/l)                                     | 1                                             | 1                                                                  |
| Soap, oil or grease (mg/l)                          | 2,5                                           | 0                                                                  |

| SUBSTANCE/PARAMETER              | GENERAL LIMIT | SPECIAL LIMIT |
|----------------------------------|---------------|---------------|
| Dissolved Arsenic (mg/l)         | 0,02          | 0,01          |
| Dissolved Cadmium (mg/l)         | 0,005         | 0,001         |
| Dissolved Chromium (VI) (mg/l)   | 0,05          | 0,02          |
| Dissolved Copper (mg/l)          | 0,01          | 0,002         |
| Dissolved Cyanide (mg/l)         | 0,02          | 0,01          |
| Dissolved Iron (mg/l)            | 0,3           | 0,3           |
| Dissolved Lead (mg/l)            | 0,01          | 0,006         |
| Dissolved Manganese (mg/l)       | 0,1           | 0,1           |
| Mercury and its compounds (mg/l) | 0,005         | 0,001         |
| Dissolved Selenium (mg/l)        | 0,02          | 0,02          |
| Dissolved Zinc (mg/l)            | 0,1           | 0,04          |
| Boron (mg/l)                     | 1             | 0,5           |

### 5.2.1.2 Locations of inland WWTWs

**Figure 5.2.1** shows the locations of the City's WWTWs, located in the following sub-catchments:

- Eerste Sub-catchment:
  - Zandvliet WWTW
  - Macassar WWTW
- Kuils Sub-catchment:
  - Scottsdene WWTW
  - Bellville WWTW
- Mosselbank Sub-catchment:
  - Klipheuwel WWTW
  - Kraaifontein WWTW
  - Fisantekraal WWTW
- Lower Diep Sub-catchment:
  - Potsdam WWTW
- Sout Sub-catchment:
  - Melkbosstrand WWTW
  - Wesfleur Industrial WWTW

- Wesfleur Domestic WWTW
- Lower Salt Sub-catchment
  - Athlone WWTW (<sup>11</sup>note that sludge from this WWTW is at times piped to the Cape Flats WWTW, in the Zeekoe Sub-catchment)
  - Borchard's Quarry WWTW
- South Peninsula Sub-catchments
  - Wildevoelvlei WWTW
- Zeekoe-Sub-catchment:
  - Cape Flats WWTW
- Sir Lowry's Pass Sub-catchment:
  - Gordon's Bay WWTW

Of the above, final effluent (FE) data and daily effluent flows (for days on which water quality samples were collected) were provided by the City. Median daily effluent flows were calculated from these data as a coarse means of comparing effluent volumes between WWTWs. These are summarised in **Figure 5.2.2**.

Daily effluent loading was calculated from daily effluent flow data, and presented as time series graphs for each variable considered here, along with FE water quality data. Although data were provided to the LDC consultant team for multiple water quality variables, only key ones were considered in this report, namely *E. coli*, COD, total ammoniacal nitrogen (NH<sub>4</sub>-N) and orthophosphate phosphorus (PO<sub>4</sub>-P).

**Figures 5.6.3 to 5.6.6** show summary and time series data for water quality concentrations and loading for *E. coli*, COD, total ammoniacal nitrogen (NH<sub>4</sub>-N) and orthophosphates (PO<sub>4</sub>-P), over the 2023 and 2024 reporting periods. FE quality data are shown in relation to General Limits for the relevant variables plotted.

#### **5.2.1.3 WWTW effluent quantity**

Median daily effluent flow data summarised in **Figure 5.2.2** illustrate that:

- The largest treated effluent volumes passing into the City's inland watercourses and accounting for some 59.2 % of total effluent came from (in order)
  - Cape Flats WWTW
  - Athlone WWTW
  - Zandvliet WWTW
- Potsdam, Bellville, Borchard's Quarry and Macassar WWTWs accounted for a further estimated 30 % of total effluent;
- The remaining 10% of treated effluent came from eight smaller WWTWs, shown in the figure, all contributing relatively low effluent volumes into watercourses – the impact of final effluent on these watercourses is however determined by the quality of the effluent and the sensitivity and size (relative to effluent volume and pollutant loading) of the watercourse.
- While overall median daily flow was 10 ML less than the previous reporting years, both Athlone and Potsdam increased daily discharge by approximately 8.5 % each. As the 3<sup>rd</sup> and 4<sup>th</sup> largest inland WWTW that are already performing very poorly, this is magnitude of year-on-year increase is likely to have negative environmental impacts.

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<sup>11</sup> Comment from Mr L. Abdullah (CSRM) to Liz Day

## City of Cape Town

Inland Water Quality Report covering rivers and major vleis  
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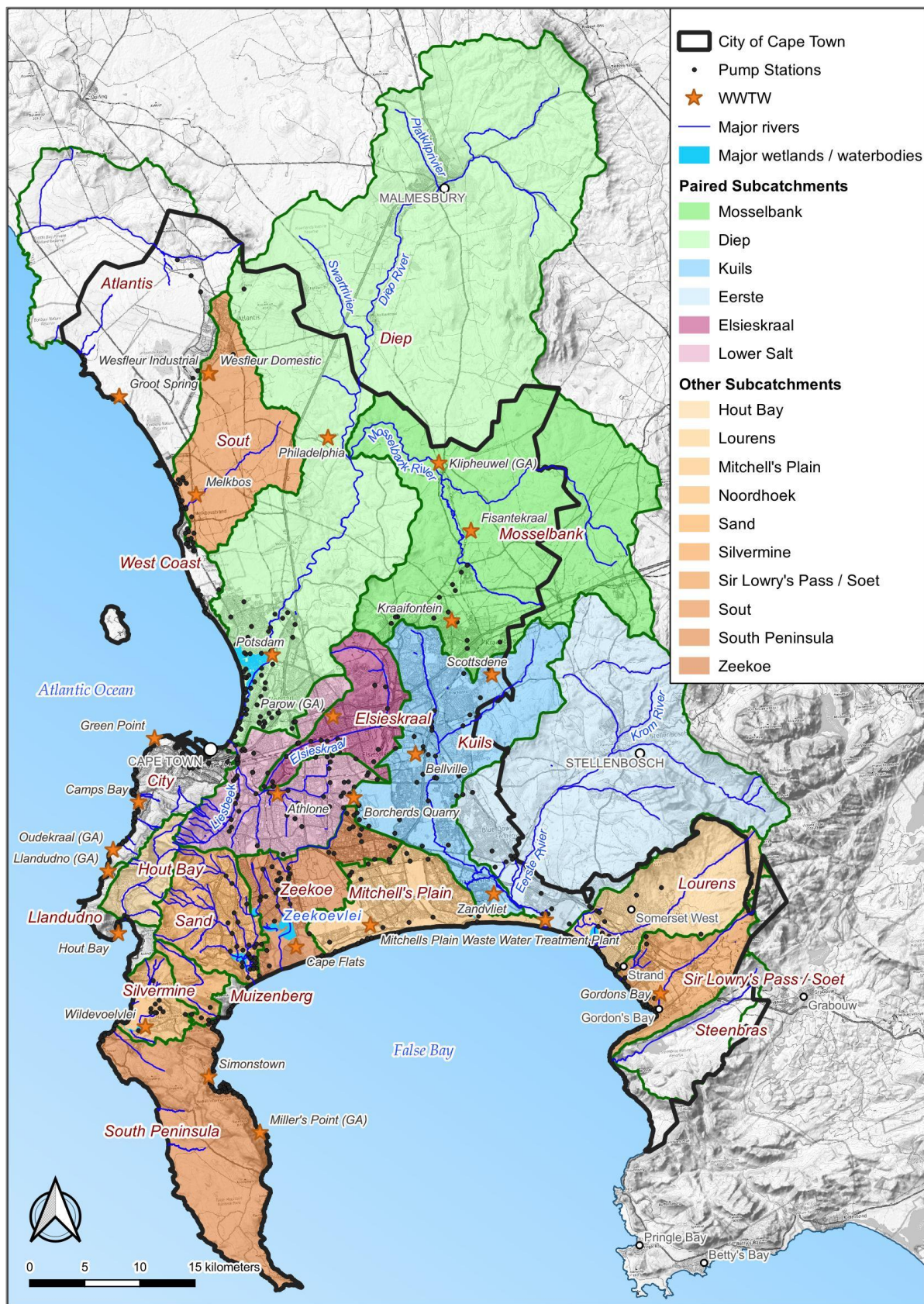
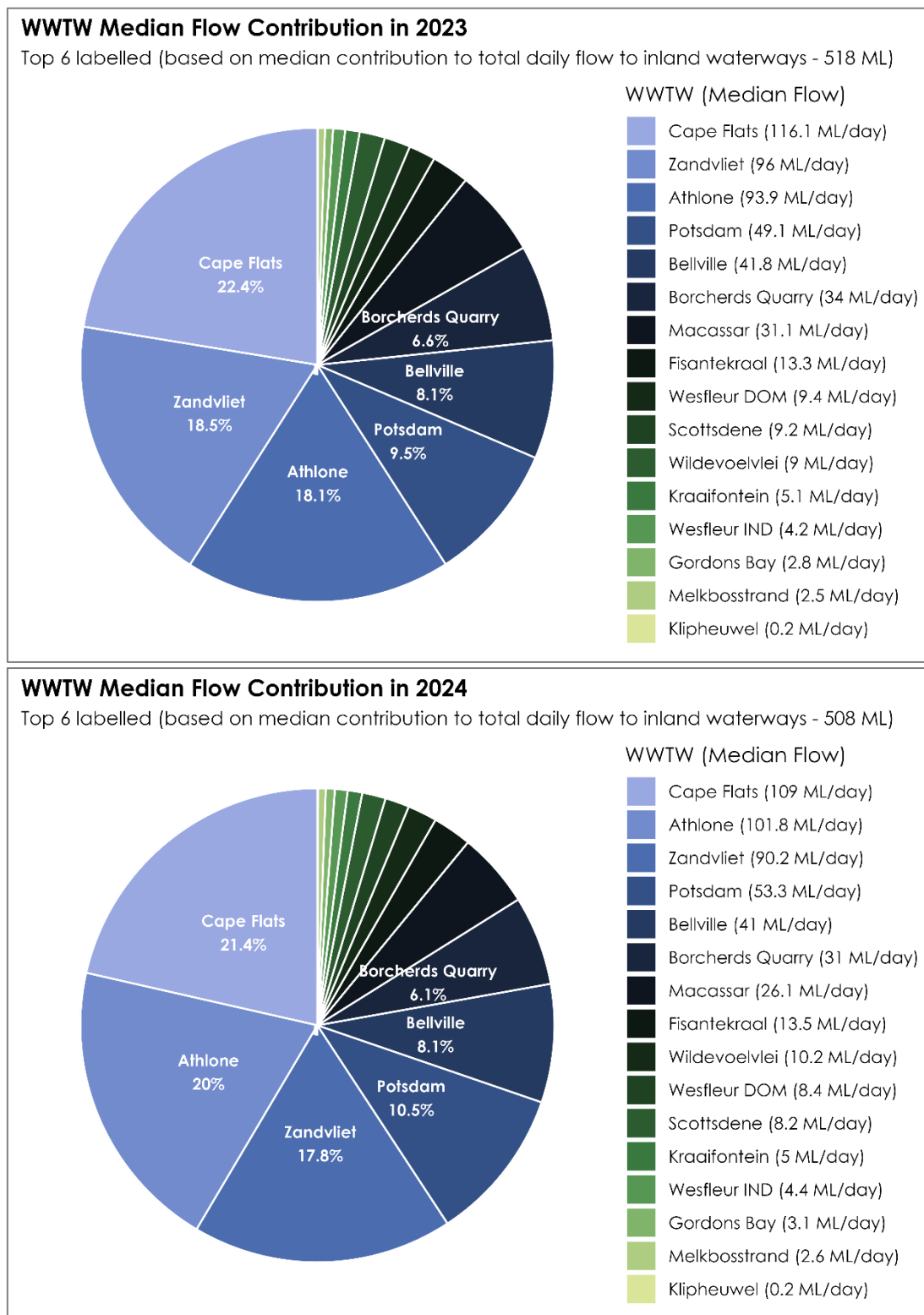


Figure 5.2.1

Map showing the locations of the City of Cape Town's WWTWs and sewage pump stations, in the context of different sub-catchments and their rivers and major wetlands.





**Figure 5.2.2**  
**Comparison of median daily final effluent flows from the City's inland WWTWs (2023 and 2024 reporting periods).**



#### 5.2.1.4 Effluent quality and loading

Over the 2023 and 2024 reporting periods:

- **Escherichia coli** data (**Figure 5.2.3**) for final effluent suggest that:
  - Only six of the City's WWTWs generally produced effluent that had been treated to levels where *E. coli* had been effectively removed, to (generally) below the general limit of 1000 cfu/100 ml for this variable. These comprised the Zandvliet, Potsdam, Gordon's Bay, Melkbosstrand, Wesfleur Domestic, Wesfleur Industrial, and Wildevoëllei WWTWs. Significant improvements in this variable were noted at the Zandvliet (upgraded 2023), Wildevoëllei, and Kraaifontein WWTWs;
  - At larger WWTWs where compliance with *E.coli* thresholds is routinely achieved only by chlorine disinfection (such as at Potsdam WWTW, where UV disinfection has been inactive for more than two years), it is anticipated that additional unintended water quality impacts are occurring due to the production in ammonia-rich water of chloramines, which are conservative (i.e. long-lasting), highly toxic chemicals that impact on downstream aquatic organisms;
  - Of the remaining WWTWs, all producing effluent with *E. coli* at concentrations often if not usually beyond the general limit, those where median concentrations were highest were Athlone (deteriorated since 2023), Cape Flats, Klipheuwel and Macassar, followed by Scottsdale (improved since 2023);
  - Data for the poorly performing WWTWs listed above showed interquartile ranges for *E. coli* from these WWTWs to be orders of magnitude greater than general limits, and well within the range of Unacceptable risk for intermediate recreation – Athlone and the Cape Flats WWTW notably not achieving compliant results at any time during the year;
  - Watercourses affected by such conditions are the Black and Salt Rivers (Athlone), the Zeekoe canal (downstream of Zeekoevlei), the Mosselbank (and downstream Diep) Rivers, and the Kuils River (affected by inflows from Bellville and Scottsdale WWTWs);
  - Compliance-type data shown in **Figure 5.2.4** further highlight poor performance by most WWTWs over the 2024 reporting period, showing that:
    - Only the Zandvliet, Kraaifontein, Wesfleur Domestic and Fisantekraal WWTWs achieved 90% compliance or better for *E. coli* samples;
    - The Wesfleur Industrial and the Gordons Bay works achieved >80% compliance;
    - Melkbosstrand, Potsdam and Wildevoëllei WWTWs achieved between 60 and 80% compliance;
    - The remaining WWTWs achieved extremely poor levels of FE compliance, with the Cape Flats plant being the worst performing (0% compliance); followed by Athlone (<1%); Klipheuwel and Macassar (<25%); Bellville (<35%), Scottsdale (<45%); and Borchard's Quarry (<55%).

- Final effluent **COD data (Figure 5.2.6 and Figure 5.2.7)** suggest that:
  - The Melkbosstrand, Wesfleur (Domestic), Fisantekraal, Kraaifontein, Gordons Bay and Zandvliet WWTW median COD concentrations lay below the general limits for COD in both reporting periods;
  - WWTWs with median concentrations lying at or just above general limits comprised the Wesfleur Industrial, Borchers Quarry, Bellville, Scottsdale and Wildevoelvlei WWTWs;
  - WWTWs where both median concentrations and the interquartile ranges of COD concentrations exceeded general limits by a marked degree comprised the Athlone, Potsdam, Cape Flats, Macassar, and Klipheuwel WWTWs;
  - Marked deterioration in median effluent quality was observable at the Klipheuwel, Macassar, and Gordon's Bay WWTWs between the 2023 and 2024 reporting periods, while slight improvements were noted for the Zandvliet, Kraaifontein, Wildevoelvlei, and Potsdam WWTWs over the same period;
  - Of the above worst-performing WWTWs, loading was greatest from the Athlone WWTW (into the Black River – Lower Salt Sub-catchment), followed by Potsdam and Cape Flats WWTWs (Diep and Zeekoe Sub-catchments respectively). These WWTWs are likely to have substantial impacts on downstream aquatic ecosystems and are the primary reasons underpinning the exceptionally poor water quality in the lower Black / Salt River and the Milnerton Lagoon;
  - WWTWs that produced effluent that lay closer to general limits, but was produced in large volumes also contributed (at least at times) high COD loadings into riverine systems. The most marked of these WWTWs comprised Borchers Quarry, Macassar and Bellville WWTWs.
- **Total ammoniacal nitrogen** data for WWTW final effluent (**Figure 5.2.7**) paint a slightly different picture to COD performance and show that:
  - The only WWTWs that generally produced effluent within (below) general limits were the Zandvliet, Borchers Quarry, Wesfleur Domestic, Fisantekraal, and Kraaifontein WWTWs, and loading of total ammonia into the receiving watercourses for these systems (Donkergat River in the Sout sub-catchment and the Mosselbank sub-catchment respectively) was also relatively low;
  - By far the worst performing WWTW in terms of median and interquartile ranges for total ammoniacal nitrogen in the 2024 reporting period was Macassar (median concentrations > 30 times the general limit, and showing an even greater deterioration since the 2023 reporting period), followed by Athlone, Klipheuwel, Potsdam, Bellville, and Cape Flats, WWTWs, all of which had median NH<sub>4</sub>-N concentrations above 20 mg N/L (> 10 times the general limit);
  - The Scottsdale WWTW also exceeded general limits, but by lower multiples while the Melkbosstrand and Wesfleur Industrial WWTWs produced effluent with total ammoniacal nitrogen usually relatively close to general limits;

**Box 5.7**

**Chemical Oxygen Demand (COD)**

COD is a measure of the oxygen needed to oxidise the organic matter present in a quantity of water (that is, for decomposition). When COD is high, it can indicate low available oxygen for aquatic organisms such as fish and may correlate with high (potentially toxic) total ammonia and indicators of anaerobic conditions such as hydrogen sulphide gases.

- The Zandvliet, Borchards Quarry, and Wildevoelvlei WWTWs showed demonstrable improvements relative to 2023;

- Of the above, loading calculations show that the greatest loads of ammoniacal nitrogen in the 2023 reporting period at least were produced by the Cape Flats WWTW, followed by Athlone, Macassar, and Potsdam;

- Marked improvements (median in 2024 fell below the interquartile range for 2023) in ammoniacal nitrogen concentrations were evident in data for the Zandvliet, Wildevoelvlei, Borchards Quarry and Gordons Bay WWTWs between the 2023 and 2024 reporting periods, although these WWTWs still produced effluent many times greater than acute toxicity thresholds for aquatic ecosystems (as per DWAF 1996);

- WWTWs where function deteriorated markedly over this time comprised Macassar, Athlone, and Bellville;

- Bellville, Borchard's Quarry, and Scottsdale all produced marked but lower loads throughout the year.

- Final effluent **orthophosphate phosphorus (PO<sub>4</sub>-P)** data (**Figure 5.2.8**) suggest that:

- WWTWs all met general limits all or nearly all the time over the 2023 and 2024 reporting periods – however, the general limit for this variable is very high from an ecological perspective – 10mg P/L. This is nearly an order of magnitude greater than the hypertrophic ("Unacceptable") thresholds for this variable of 0.125 and 0.130 mg P/L in rivers and standing water systems respectively, and where WWTW final effluent comprises nearly the total flow in river systems (as is the case during the summer months) this is therefore potentially still a major contributor to excess nutrient loading in these systems;

- The highest loads into downstream systems affected the Zeekoe canal (by far the largest loads, usually > 500 kg/ day from the Cape Flats WWTW), followed by the Lower Salt (>200 kg per day from the Athlone and Borchards Quarry WWTWs, the Eerste (>50 kg per day from the Macassar, Bellville, and Zandvliet WWTWs) and the lower Diep (> 50 kg per day from the Potsdam WWTW).

#### **Box 5.8**

##### **Total ammoniacal nitrogen (NH<sub>4</sub>-N)**

The General Limit for total ammoniacal nitrogen is 2 mg/L (see Table 5.6.1). At an assumed pH of 8 and temperature of 20C, this would translate into free ammonia (NH<sub>3</sub>) at a concentration of 0.076 mg/L – this is 5 times the chronic toxicity threshold for ammonia in aquatic ecosystems and just under the threshold of 0.01 mg/L for acute toxicity. Thus even WWTWs producing effluent at the general limit pose severe ecological risk to downstream aquatic ecosystems, especially in summer when effluent constitutes all or most of the effluent in naturally seasonal rivers.

#### **5.2.1.5 Comments**

The data presented in this section highlight the varying levels of function of WWTWs over the 2023 and 2024 reporting periods, and the variation in efficiency of different WWTWs in treating different chemical variables.

*Escherichia coli* data showed that only six of the City's WWTWs consistently produced effluent within general limits for *E. coli*, with most of the other WWTWs producing effluent with *E. coli* counts several orders of magnitude higher, and highlighting the risks posed by such effluent to downstream water users in contact with the water. Even where *E. coli* compliance is achieved by disinfection, this may be at the cost of other impacts of excessive chlorination on downstream ecosystems.

COD data present probably the most useful single variable for highlighting the magnitude of downstream chemical risk to aquatic ecosystems. These data indicate that the most poorly performing WWTWs in this regard feed into the following river aquatic ecosystems:

- Eerste River estuary (Macassar WWTW);

- Black River and Salt River canal (Athlone and Borchard's Quarry WWTWs);
- Diep River estuary and Milnerton Lagoon (Potsdam WWTW);
- Zeekoe canal (Cape Flats WWTW); and
- Mosselbank River (and lower Diep River) (Klipheuwel WWTW) – note however that the effluent volume from this system was relatively low, so downstream loading was not marked).

Of the above, the impacts of the Potsdam and Macassar WWTWs on the downstream systems are considered most significant, as these WWTWs directly impact on what were largely functional estuarine habitats. In the case of Potsdam this has been shown to have contributed largely to the collapse of this estuary and its once-important nursery for juvenile fish (Rose et al 2023).

Although the Cape Flats, Athlone and Borchard's Quarry WWTWs essentially now feed into canalised artefacts of urban drainage, these systems nevertheless play important roles in Cape Town's urban society and poor effluent quality both actively detracts from the value of the areas through which they pass, and has significant ecological costs – for example, the potential for estuarine fish to migrate up the Zeekoe Canal into the False Bay Nature Reserve – a Ramsar wetland of international importance – is compromised by large volumes of effluent outflows, often of very poor quality. Similarly, the Black River accumulates organic sludges from upstream inflows of *inter alia* treated effluent, with CODs well above the capacity of this system to effect aerobic decomposition.

Improved performance in some WWTWs was apparent in both loading and effluent quality data, in particular at the Zandvliet WWTW following its major upgrade in 2023.

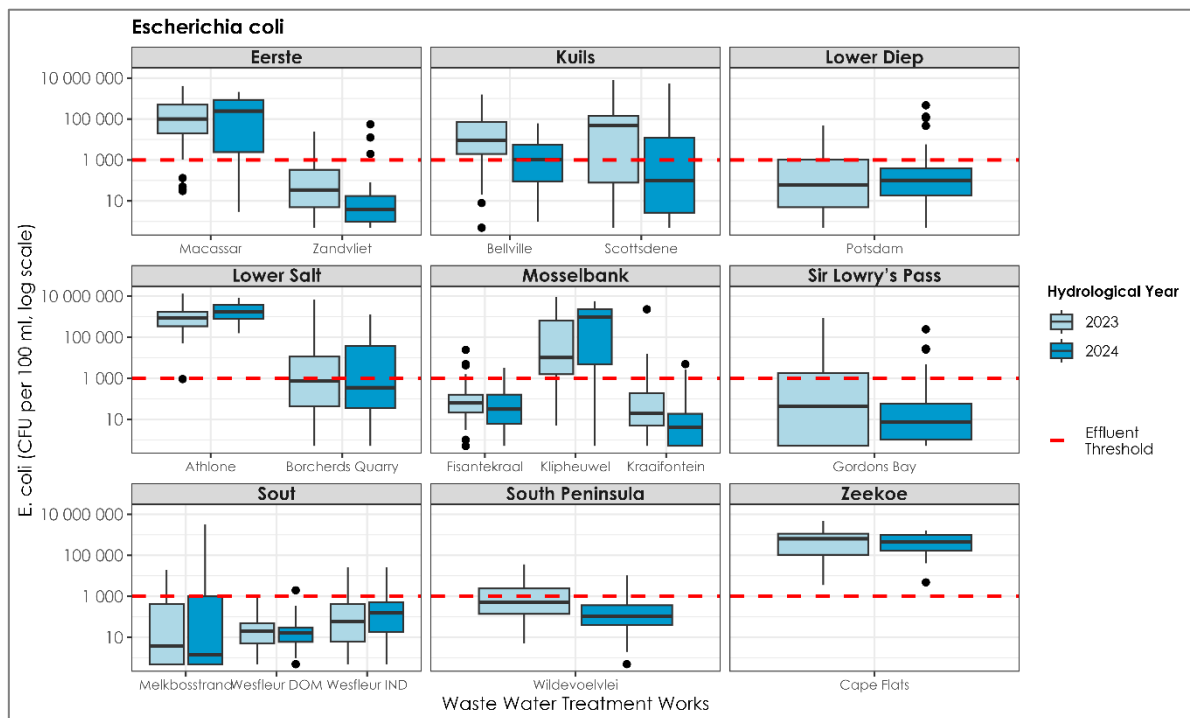
Finally, it is noted that high concentrations of phosphorus in effluent from all WWTWs were apparent in final effluent data, despite compliance with regulated general limits.

#### **5.2.1.6 Recommendations**

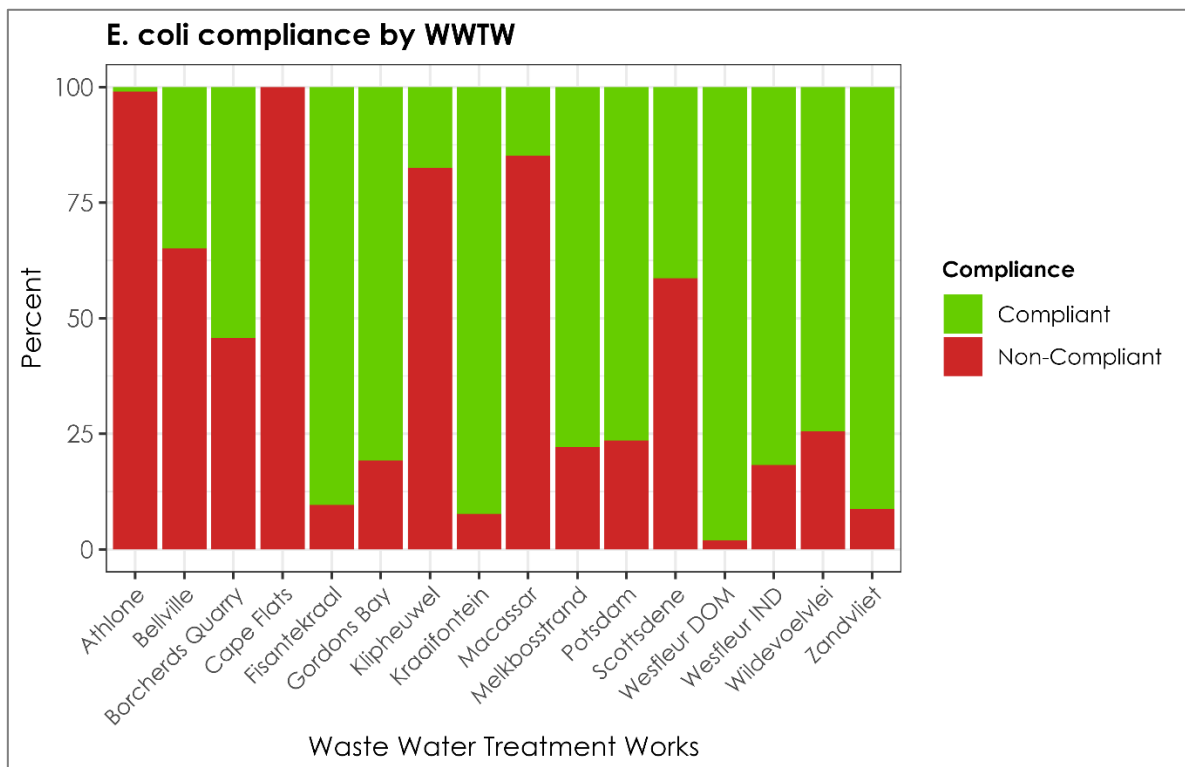
It is recommended that measures to further reduce final effluent concentrations should be prioritised by the City for WWTWs that discharge into rivers that feed into important vleis, coastal lakes or estuaries, and contribute to algal and other plant blooms; and an increase in organic sludges from algal growth. A substantial effort to decrease treated effluent phosphorus concentrations to eutrophic levels or below should reduce both the ecological (and knock-on recreational and economic) costs of degraded aquatic ecosystems in urban areas, but also result in reduced management costs, in terms of clearing of invasive aquatic vegetation such as water hyacinth as well as reeds and the need for river and vlei dredging.

It is understood that the City is investigating the upgrade and other requirements of existing WWTWs across the City (see Section 7). It is recommended that prioritisation of such interventions take cognizance of the importance, sensitivity and restorability of receiving watercourses when determining which WWTWs to focus on for upgrades. WWTWs discharging into the Kuils, Eerste, Mosselbank and Diep Rivers in particular should be prioritized, as these river systems retain elements of natural aquatic ecosystem function and include important downstream estuaries and floodplain wetlands. This recommendation is not intended to imply that polluted discharges into other systems do not also result in major ecological and human health consequences. The recommendation is rather about prioritisation of effort.

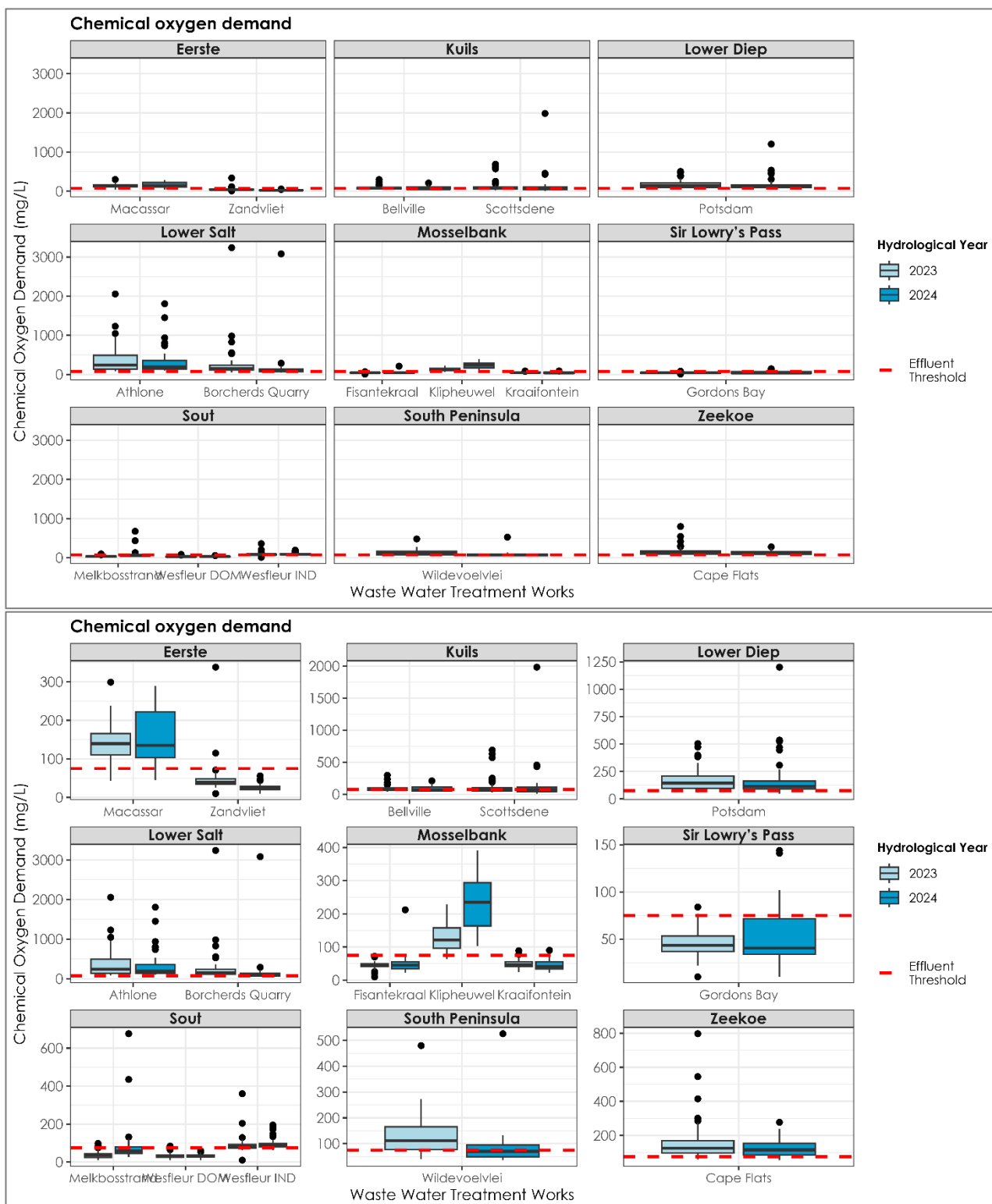




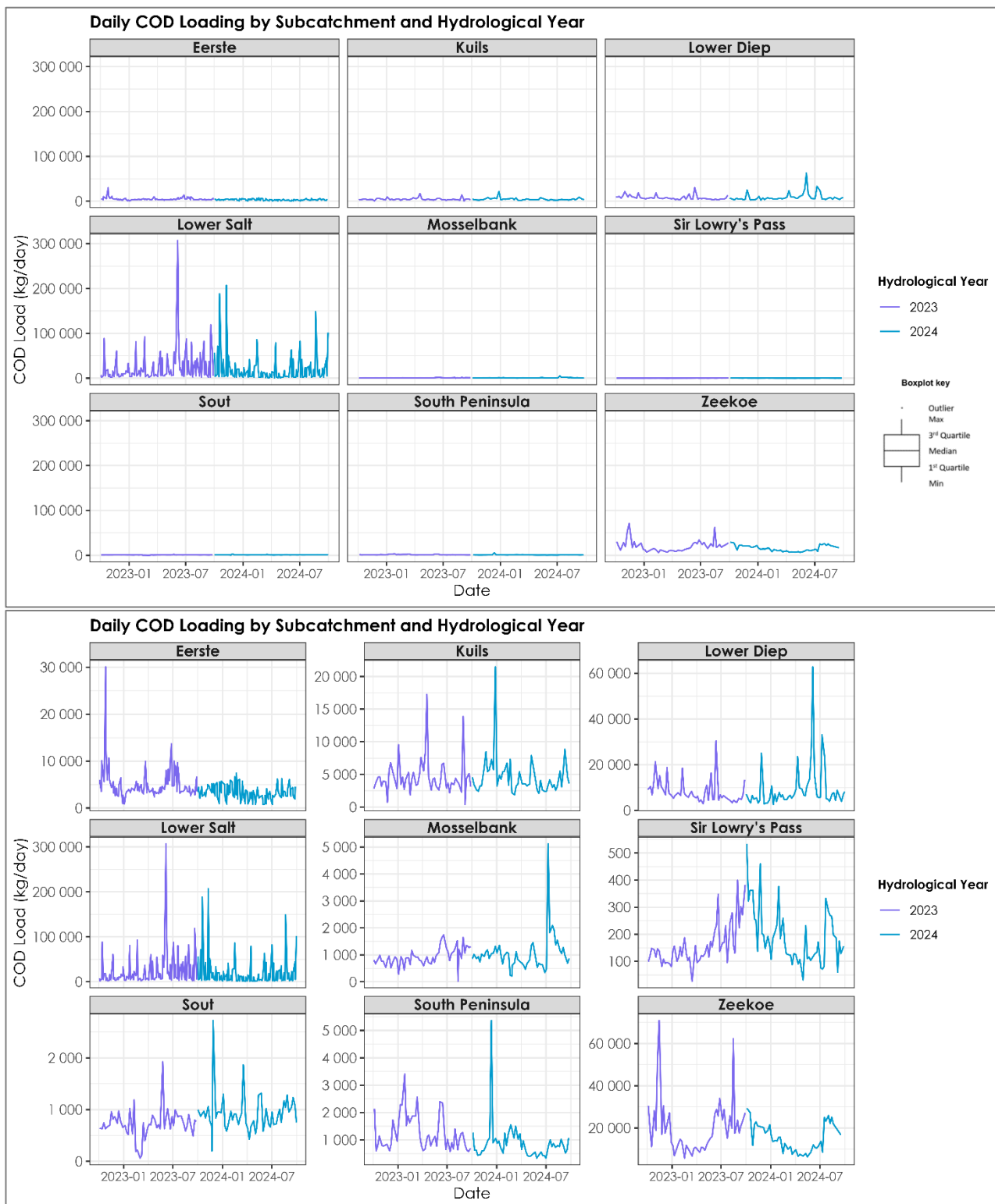
**Figure 5.2.3**  
Median *Escherichia coli* concentrations and loading in effluent from WWTWs in Cape Town. Note difference in y-axis between graphs.



**Figure 5.2.4**  
Proportion of *Escherichia coli* samples from each WWTW falling within or above General Effluent Limits (combined 2023 and 2024 reporting period)

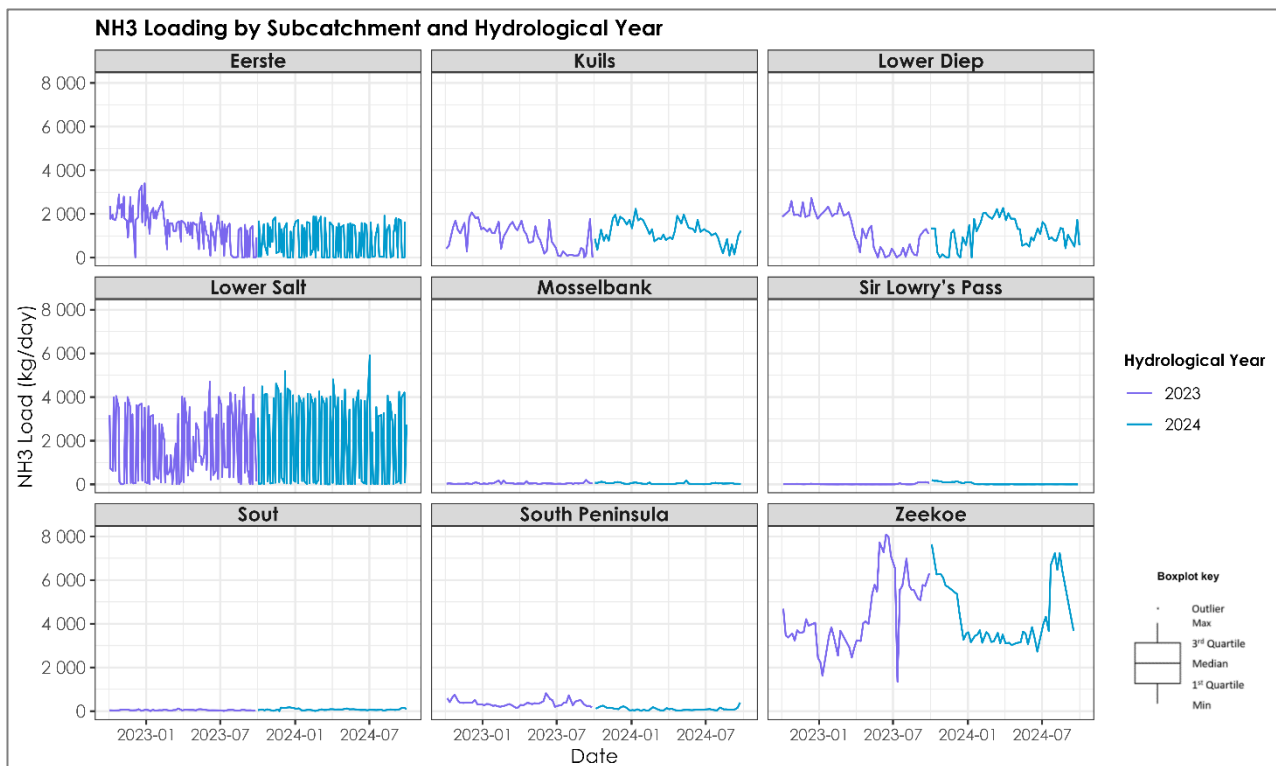
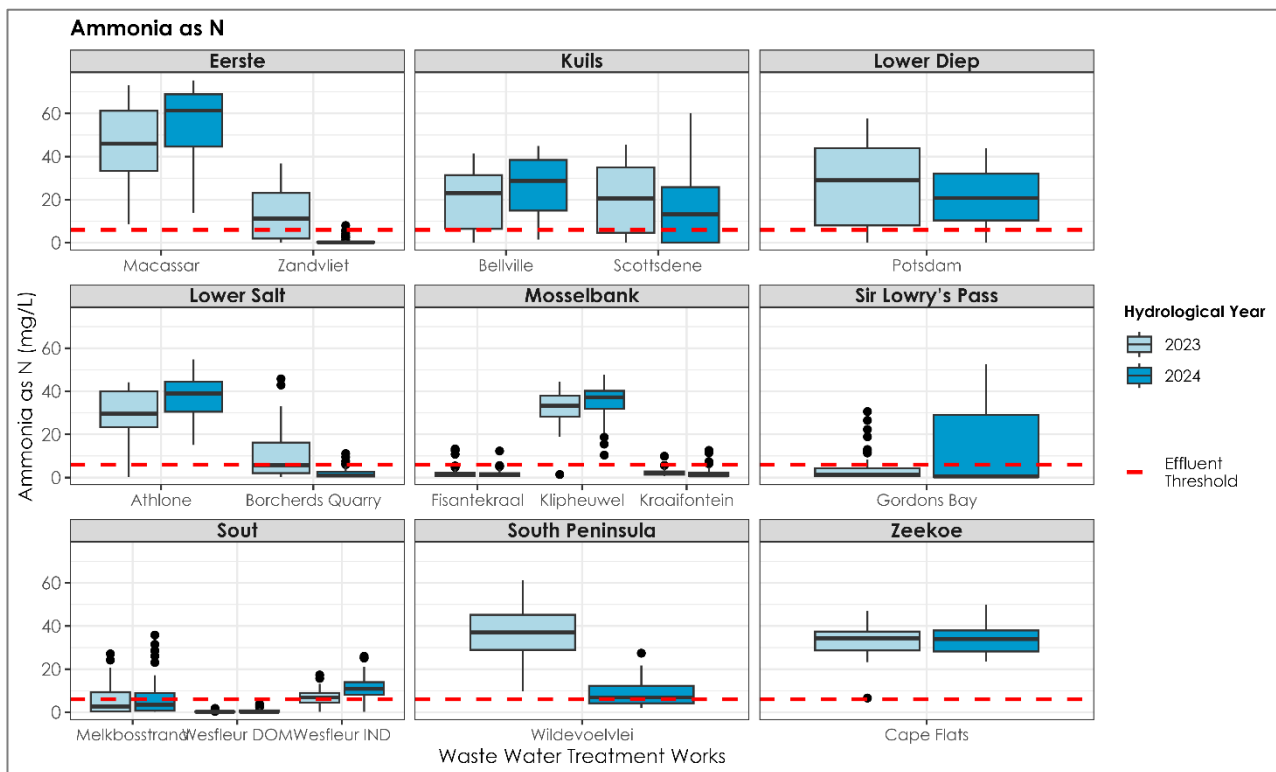


**Figure 5.2.5**  
**Median Chemical Oxygen Demand (COD) loading of effluent from WWTWs in Cape Town**



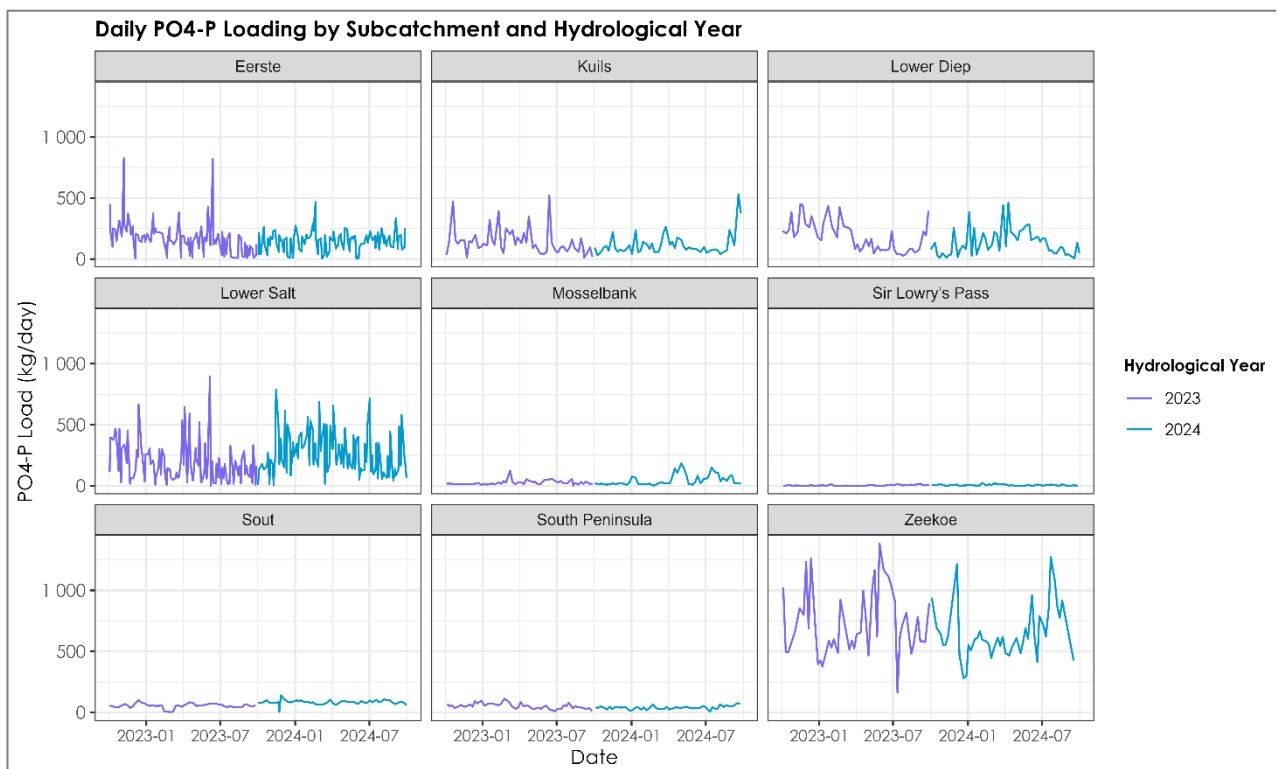
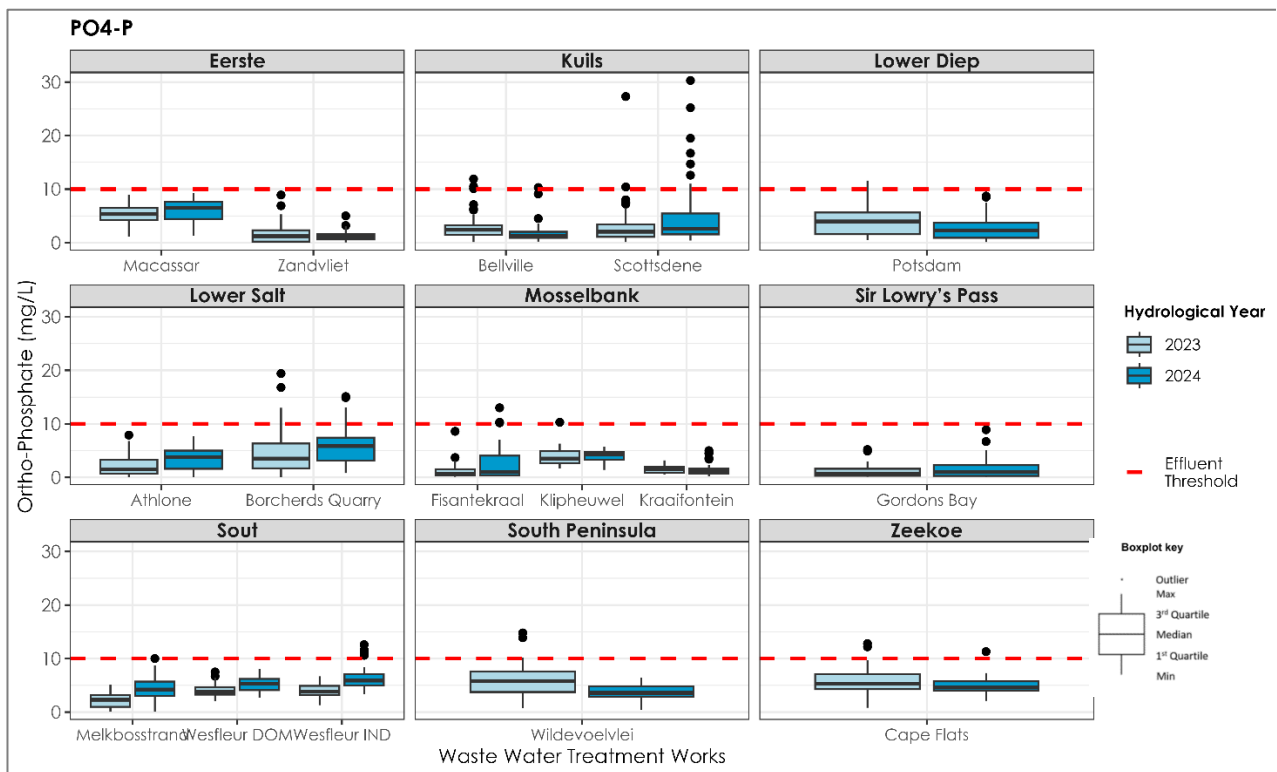
**Figure 5.2.6**  
**Median Chemical Oxygen Demand (COD) loading of effluent from WWTWs in Cape Town**

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**Figure 5.2.7**  
**Median total ammonia concentrations (NH<sub>3</sub>-N) and loading in effluent from WWTWs in Cape Town**





**Figure 5.2.8**  
**Median orthophosphate phosphorus (PO4-P) concentrations and loading in effluent from WWTWs in Cape Town**

### 5.2.2 Overview

Apart from bacterial count data, the water quality impacts of sewage pollution on Cape Town's watercourses include nutrient enrichment (particularly by phosphorus nutrients); elevation of ammonia, potentially to toxic levels; and lowering of dissolved oxygen concentrations. All of these effects contribute to aquatic ecosystem degradation, and some to excessive algal and other plant growth.

Inflows of both treated and raw sewage into the City's watercourses are one of the main sources of phosphorus nutrients into these systems, and also contribute to high ammonia concentrations and conditions of low dissolved oxygen - in some instances, anoxic conditions. This is because raw sewage includes organic material and high ammoniacal concentrations, the decomposition of all of which has a high oxygen demand. Inadequately treated sewage can also have a high biological and chemical oxygen demand, resulting in water bodies with low dissolved oxygen for fish and other gilled fauna, and resulting also in the generation of toxic byproducts of anaerobic decomposition, including methane, ammonia and hydrogen sulphide.

Although informal settlements, as well as any areas with unserviced back-yard settlements, contribute permanent streams of raw sewage into watercourses, usually by way of formal or informal stormwater systems, by far the greatest loading of sewage-associated pollutants into the City's watercourses, as a result of the much greater volumes involved, are assumed to stem from the formal sewage reticulation and treatment systems (WWTWs).

The frequency of overflows from the former and the quality of effluent from the latter are explored in this section, in relation to water quality impacts in different sub-catchments within the City.

#### 5.2.3 Pump station failures and associated overflows into stormwater systems

A major but episodic rather than perennial source of raw sewage into the City's catchments is from the sewer system, with overflows occurring from blocked or malfunctional pump stations; sewer manholes (because of sewer or pump station blockages); or as a result of sewer pipeline collapse /failure.

This section attempts to gauge the magnitude of these issues, and to identify which sub-catchments are most vulnerable, using City records of both pump station failures and the public reporting of sewage manhole overflow incidents (C3 reporting). Sewage spill data are further categorised by the City in terms of the magnitude and/or significance of impact of each spill incident, as shown in **Table 5.2.2**.

The collation and inclusion of matching spatial data in these records reflect an important and relatively new effort by the City to track pollution-related incidents, their locations and causes.

At the time of this writing, data for pump station overflow events were available up until January 2025. In order to maintain consistency with the inland water quality report reporting periods, only data for the 2023 and 2024 reporting periods were included in this report.

##### 5.2.3.1 Pump station breakdowns (associated with sewage overflows)

Over the 2023 and 2024 reporting period, a total of **875 pump station failures** were recorded. 309 spills occurred in the 2023 period and 566 in the 2024 hydrological year. Over both reporting years, there were a total of three catastrophic, 31 major, and 116 moderate pump station failures. There were a further 316 spills deemed insignificant, and 370 which were considered minor (Figure 5.2.9). Of the three catastrophic spill events, two were in the Diep catchment - Koeberg Road and Table View East pump stations. Both spills occurred in the 2024 reporting year, and lasted more than 24 hours.

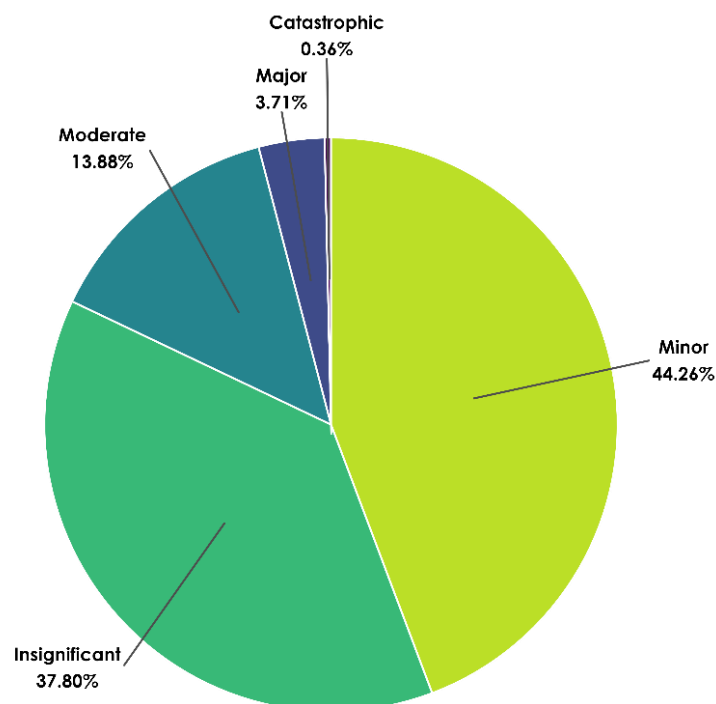
The only other catastrophic failure was at the Dalebrook pump station in February 2023, and it was resolved within less than 24 hours. This failure ran directly into the sea without impacting inland waterways.

Further breaking down this pump station failure data reveals which sub-catchments are most impacted (Figure 5.2.10):

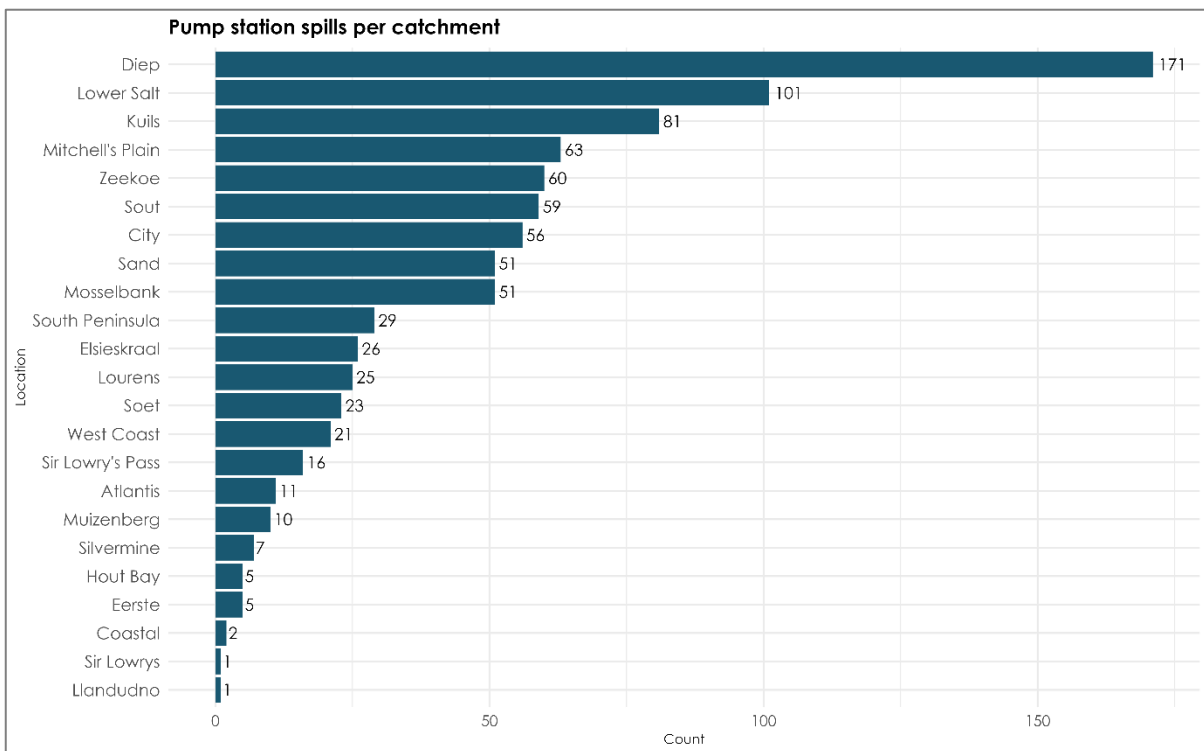
- The Diep sub-catchment was by far the most impacted by pump station failures, accounting for 19.6% of all failures in the two-year period;
- The Lower Salt and Kuils sub-catchments were also subjected to notably higher levels of pump stations failures than other catchments (11.5 % and 9.3 % respectively);
- The top five most affected sub-catchments accounted for 54% of all pump station failures in 2023-2024 (Mitchells Plain and Zeekoe in 4<sup>th</sup> and 5<sup>th</sup> respectively);
- The Silvermine, Muizenberg, Hout Bay, Eerste, Sir Lowry's Pass and Llandudno Catchments each accounted for less than 1% of pump station failures.

The disproportionate number of pump station failures in the Diep sub-catchment is further demonstrated in Figure 5.2.11. It shows that the two worst performing pump stations in the city over the 2023 to 2024 reporting periods were both in the Diep, and four of the top 10 pump stations with the most recorded spills were also in the Diep sub-catchment. Koeberg Road pump station accounted for more than twice the number of spills of any other pump station in the city. Given the volume of flows handled at this pump station, this is of particular concern for the Diep River Estuary (see section 7.2 for further discussions on this pump station and the Diep sub-catchment).

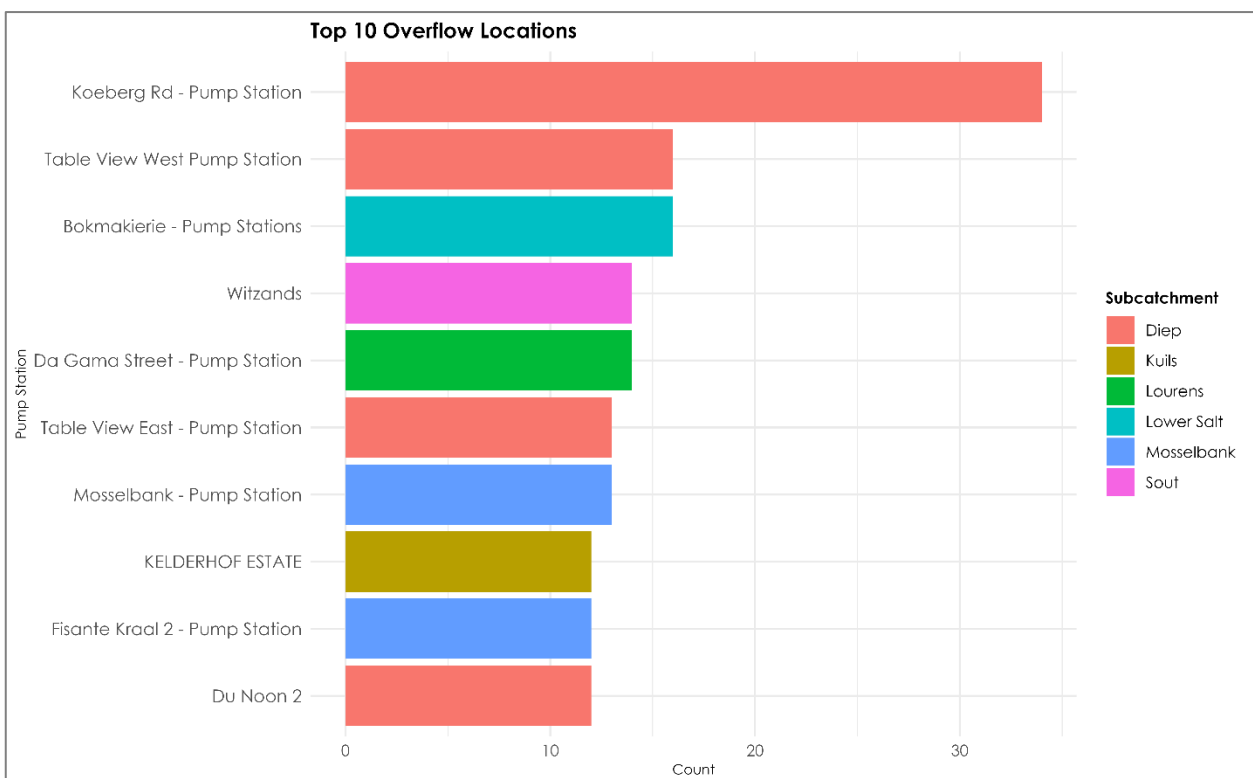
Interestingly, no pump stations from the Zeekoe and Mitchells Plain sub-catchments appeared on the worst performing pump stations plot, implying that a wider array of pump stations, each with fewer spills, caused these two sub-catchments to have notably high total pump station failure counts.



**Figure 5.2.9**  
**Occurrence rates of different spill magnitudes (as recorded by the City) during the 2023 and 2024 reporting periods. Data sourced from the City 2025 Director's Report.**



**Figure 5.2.10**  
Number of pump station spills in each sub-catchment during the 2023 and 2024 reporting periods. Data sourced from the City's 2025 Director's Report.



**Figure 5.2.11**  
10 pump stations with the greatest number of spills between 2023 and 2024 reporting periods, with pump stations coloured by sub-catchment. Data sourced from the City 2025 Director's Report.



### 5.2.3.2 Pump station breakdown - causes

**Figure 5.2.12** summarises the main causes of pump station failure over the 2023 and 2024 reporting period. These data illustrate:

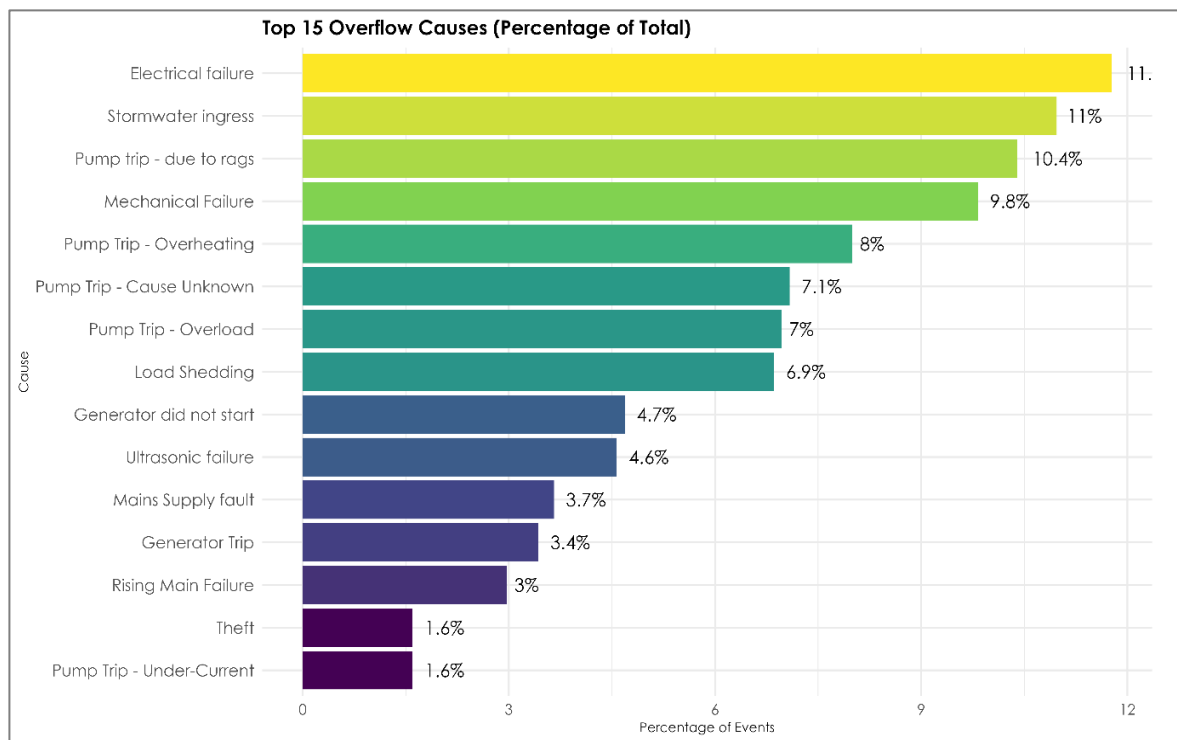
- The most common causes of pump station failure over the reporting period across the city were electrical failure (11.8 %) and stormwater ingress (11 %);
- Pump tripping due to rags (10.4 %), general mechanical failure (9.8 %), and pump tripping due to overheating (8 %) were the next three highest causes. These top five categories account for over 50% of failures across the City;
  - Rags and other foreign objects contributed to over 10% of all failures across the City – a figure that could be drastically reduced through education and improved solid waste management, particularly in impoverished and under-serviced areas.
- Load shedding, pump tripping (overload), and pump tripping (unknown cause) each accounted for roughly 7 % of pump station breakdowns;
- Theft only accounted for 1.6 % of failures.
- The top 15 causes accounted for 94.5% of spills over the past two reporting years. Many other causes accounted for the remaining 5-6% of spills.
- Only 3 out of 875 incidents during the 2024 reporting year were described as having “unknown” causes (< 0.5%).

When compared to the previous IWQ Report (Day et al., 2024), surface-level results suggest a significant increase in pump station failures across the City – rising from 338 failures in 2022 to 566 in 2024. However, it is important to note this kind of reporting and data collection has only been introduced in the past five years. As a result, data completeness and accuracy are improving every year, likely inflating the apparent annual difference in recorded incidents. While this dataset provides valuable insights into pump station failures within a given year, caution should be exercised when making year-on-year comparisons. Accordingly, this report focuses only on the most recent two years of available data, and analyses them in combination, avoiding fine-scale comparisons between report years.

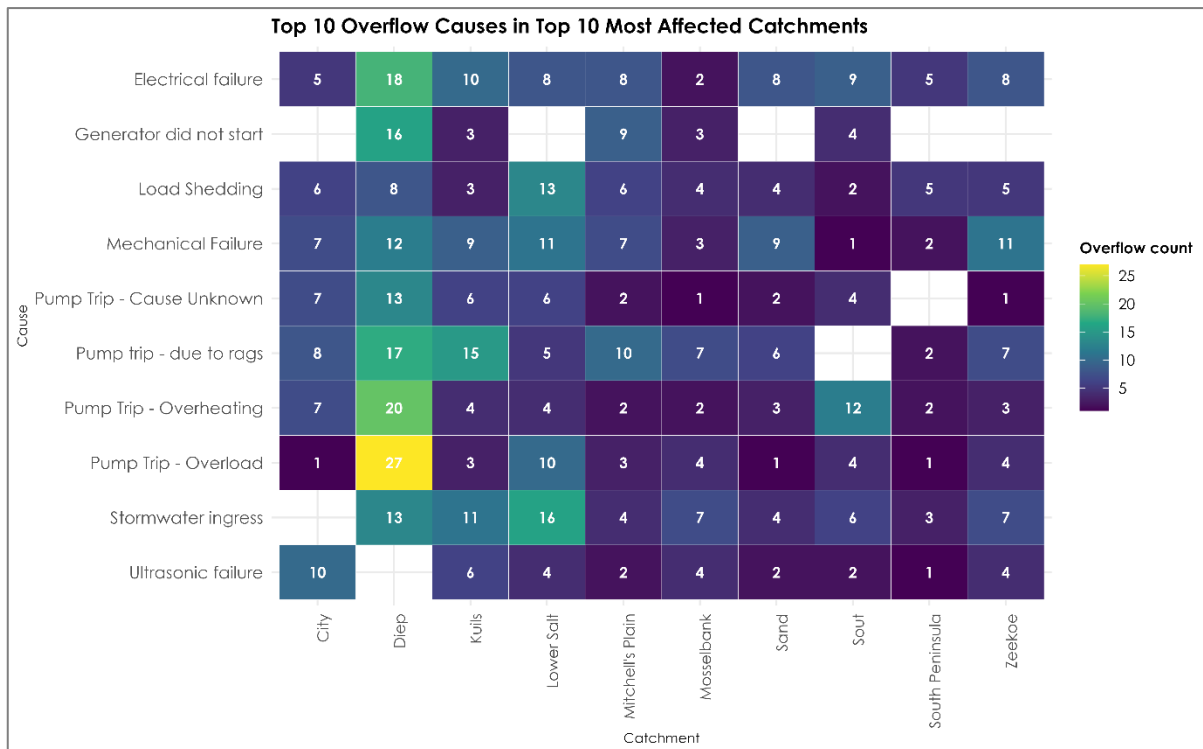
Further data on pump station failures can be ascertained by investigating the association between sub-catchments, spill causes, and impact level rating (or magnitude). **Figure 5.2.13**, **Figure 5.2.14** and **Figure 5.2.15** (map) show that:

- The Diep is heavily impacted by pump overloads, overheating, electrical failure, and clogging by rags. It is affected by pump overloads more than any other catchment
  - Frequent pump overloads are likely as a result of the failure of infrastructure to keep up with urban growth in this sub-catchment.
- The Lower Salt was most impacted by stormwater ingress, load shedding, and mechanical failure. This is one of the last catchments to still be heavily impacted by loadshedding;
  - Special effort should be made to increase the capacity of pump stations in this sub-catchment to cope with load shedding.
- The Kuils was most heavily impacted by rags, stormwater ingress, and electrical failure, in that order of significance;
- Kuils, Mitchells Plain, and Diep sub-catchments were all significantly affected by rags causing pump station failures – focus should be placed on solid waste management and removal from sewers in these catchments;
- Mechanical and electrical failure, stormwater ingress, and rags contribute consistently to pump station failures across all 10 of these sub-catchments;

- Electrical failure, mechanical failure, and PLC failure each caused one catastrophic failure;
- Electrical failure and rags caused the most major spills across the City;
- Stormwater ingress, mechanical failure, electrical failure, and pump overloads were the most common causes of moderate spills;
- Minor and insignificant spills had a wide range of causes;
  - Stormwater ingress was caused the most insignificant failures;
  - Rags caused the most minor failures.
- Overall, these data show that mechanical and electrical failures are widespread issues affecting pumpstations in all catchments;
- Loadshedding appears to be less of an issue during the most recent reporting period – although it still caused many spills, they were almost all minor or insignificant; and
- The more critical failures were often caused by rare occurrences, such as PLC failures and theft.

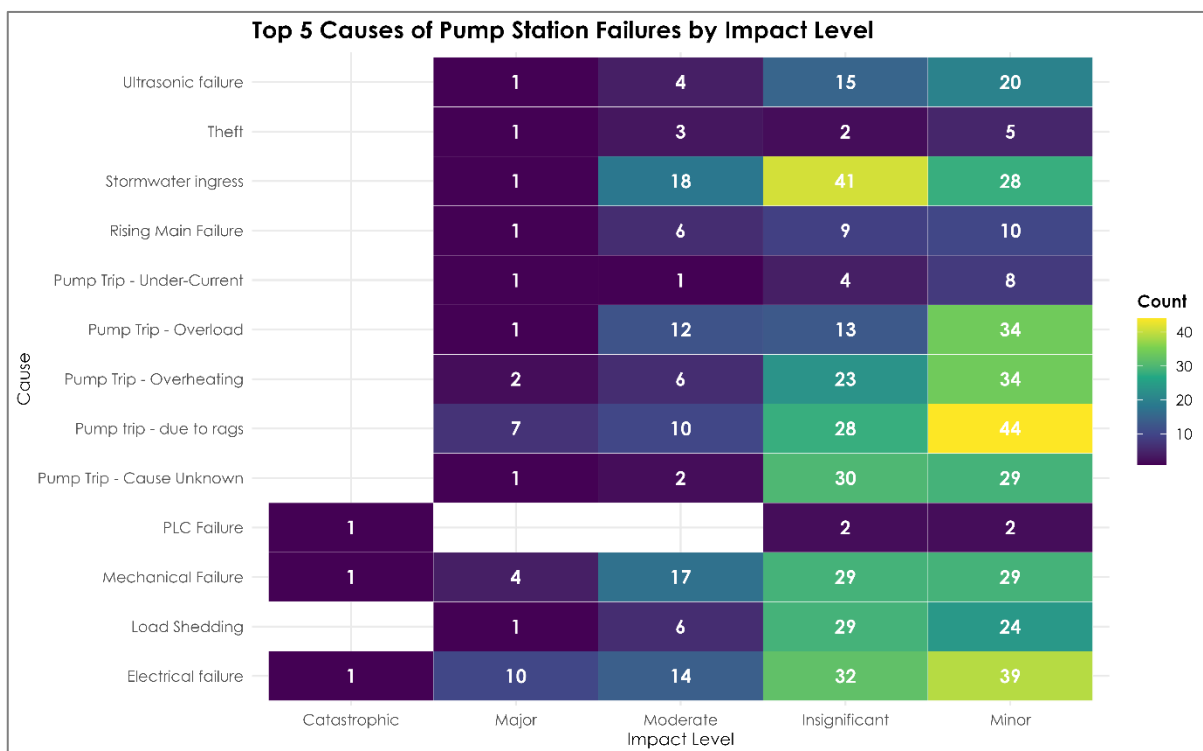


**Figure 5.2.12**  
**Contribution of different causes to sewage pump station overflows (2023 and 2024 reporting period). Data sourced from the City 2025 Director's Report. The top 15 causes accounted for 94.5% of spills over the past two reporting years.**



**Figure 5.2.13**

Graph showing the top 10 causes of pump station overflows across the 10 most affected sub-catchments.



**Figure 5.2.14**

Graph showing the top causes of each level of pump station failure across the City.

**Table 5.2.2**  
**Classification of Sewage Pollution Incidents. Classification supplied by the City.**

| Level | Classification                                                                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | <b>Minor</b><br>(No reporting)                                                                               | The overflow <b>is/will be contained and not drain</b> to a local sensitive environment* and/or <ul style="list-style-type: none"> <li>Where the overflow reaches waters, the volume of sewage likely to enter the waterway may be insignificantly small with regard to the volume and flow of receiving waters or,</li> <li>Where the overflow reaches land, it is contained in an area where public exposure is minimal given the maximum response time**.</li> </ul>     |
| 2     | <b>Moderate</b><br>(Responsible Person to report internally Alarm report and EIR)                            | The overflow <b>may not be contained and/or could drain</b> to a local sensitive environment* and/or <ul style="list-style-type: none"> <li>Where the overflow reaches waters, the volume of sewage likely to enter the water way is insignificant with regard to the volume and flow of receiving waters, or</li> <li>Where the overflow reaches land or watercourse, it may travel to an area where public exposure is low within the maximum response time**.</li> </ul> |
| 3     | <b>Major</b><br>(Responsible Person to report internally & externally – alarm report and 14 days EIR)        | The overflow <b>is uncontrollable and likely to drain</b> to a local sensitive environment* and/or <ul style="list-style-type: none"> <li>Where the overflow reaches waters, the volume of sewage likely to enter the waterway is high with regard to the volume and flow of the receiving waters, or</li> <li>Where the overflow reaches land or watercourse, the public exposure risk will be high given the maximum response time**.</li> </ul>                          |
| 4     | <b>Catastrophic</b><br>(Responsible Person to report internally & externally – alarm report and 14 days EIR) | The overflow <b>drains to</b> a local sensitive environment* and <ul style="list-style-type: none"> <li>Where the overflow discharges to waters, the volume of sewage entering the water is very high with regard to the volume and flow of receiving waters, or</li> <li>Where the overflow discharges to land or watercourse, the public exposure risk is very high given the maximum response time**.</li> </ul>                                                         |

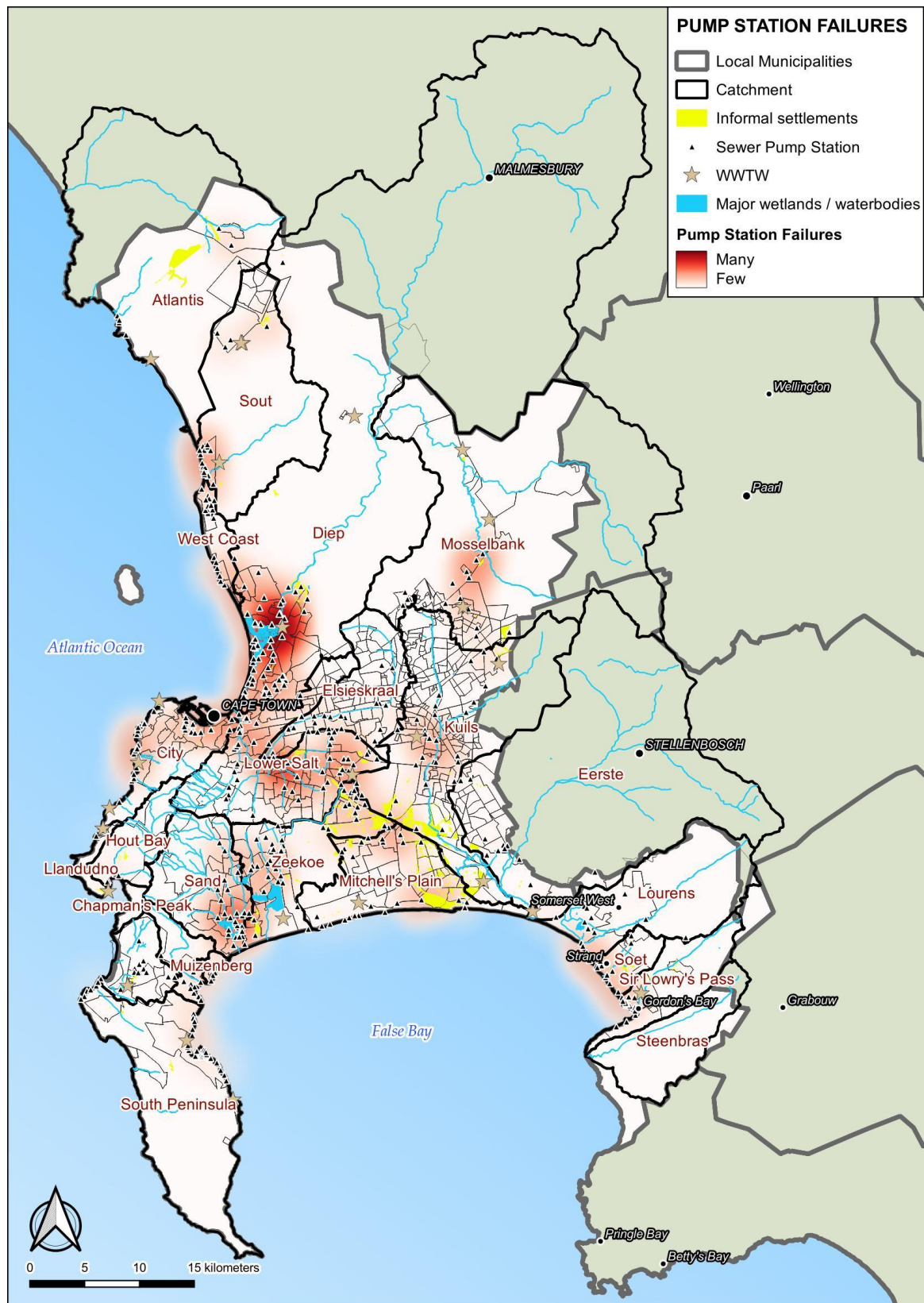
\*A sensitive environment includes:

- A drinking water catchment or domestic groundwater source, or
- Protected water bodies, ecological communities or conservation areas as defined by Local Government, National Conservation Authorities, or
- Waterways used for recreation (non-contact), or
- A recreational area or other area with high public exposure or associated health risk

\*\*Maximum response time should be based on the length of time taken for the relevant official to detect the overflow or for the overflow to be reported, and the time taken for the relevant official to attend to the site and secure against public contact.

\*\*\*Overflow = raw untreated overflow

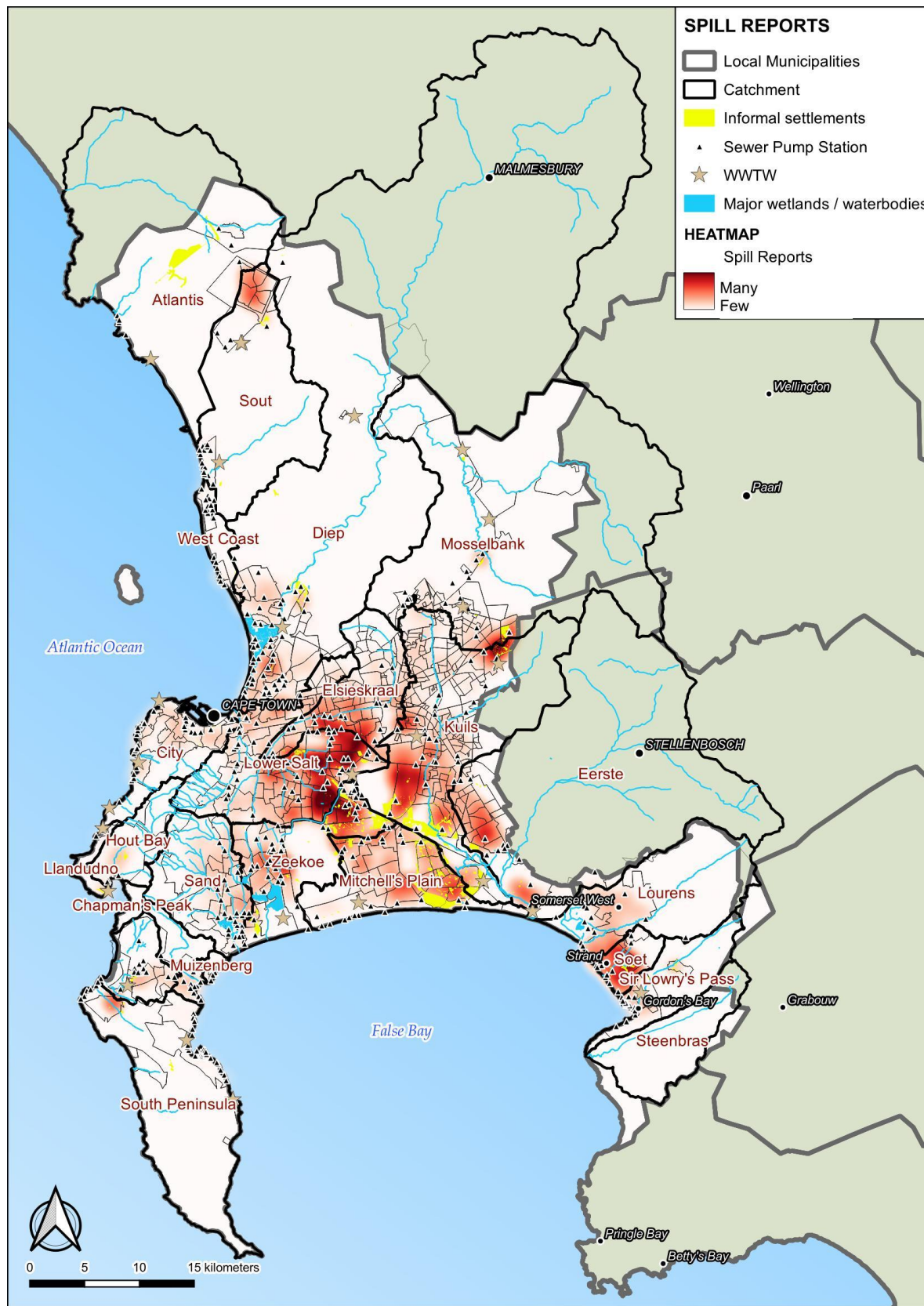




Figure

### 5.2.15

'Heat map' showing the number of pump station failures in Cape Town over the 2024 reporting period (1 October 2023 to 30 September 2024). Data not coded as to significance of overflow event.



**Figure 5.2.16**  
**'Heat map' showing the number of C3 complaints filed for sewage spills in Cape Town over the 2024 reporting periods (1 October 2023 to 30 September 2024)**



#### 5.2.4 Reported sewage overflows from manholes

Another measure of sewage spill frequency in Cape Town is provided by records of reporting on sewage spills by members of the public. This is done online using the City's C3 reporting forms. **Figure 5.2.16** provides a coarse spatial overview of the distribution of C3 data for the period. The data are presented as a 'heat map', which shows the intensity of C3 reporting for sewage spills in different areas of Cape Town. Repeated reporting of single incidents were deleted from the dataset.

These data indicate that, over the 2024 reporting period:

- The hotspots for sewage overflows, based on reported incidents, lay in the Lower Salt, Zeekoe, and Elsieskraal Sub-catchments.
  - Lower Salt - Bonteheuwel, Ruytewacht, Kewtown and Manenberg areas;
  - Zeekoe - Manenberg, Crossroads / Gugulethu, and along the Parklands and Grassy Park areas;
  - Elsieskraal – Goodwood and Epping areas, along both edges of the Elsieskraalrivier.
- Other significantly affected catchments or sub-catchments included:
  - The Diep River – low levels of reporting across most of the sub-catchment
  - Soet River
  - Mitchell's Plain (particularly in the Westridge, Eastridge, Tafelsig and Beacon Valley areas)
  - The Kuils River, particularly in the Delft and Bardale areas,
  - The Eerste River in the Faure and Macassar areas
  - The Sout – northern corner of the catchment near the recent developments
  - South Peninsula – northern corner near the ocean view area

Of the above, areas with the most intense levels of sewage overflows are those with high levels of informal settlement and/or backyard dwellings. These same sub-catchments are characterised by an accumulation of solid waste that is likely to contribute to the frequency of sewer blockage, along with an increased likelihood of vandalism of sewers and pump stations as a result of a range of socio-economic conditions.

A caveat to the data presented in **Figure 5.2.16** is however that the original data source does not indicate volumes of sewage spilled or overflowing, or the time over which the spill occurred before being addressed. In addition, the data reflect only areas in which sewage spills were reported – in some areas, residents might be more vigilant in reporting problems than in others, and some reports might also reflect relatively short-lived incidents versus major spills.



**Photograph 5.2.1. Spill from the surcharging Koeberg Pump Station**

### **5.2.5 General comments**

WWTW effluent of varying quality, often not complying with general effluent limits, and in general, far in excess of the nutrient and other pollutant loads that receiving water bodies can accept without impact; sewage overflows from pump stations, largely as a result of electrical and mechanical problems, exacerbated by issues of foreign material that is not collected in debris screens; and overflowing sewers, as a result of pump station blockages, sewer blockages and sewer collapse all contributed to the ongoing, serious pollution of Cape Town's watercourses over the current reporting period (2023 and 2024 reporting periods).

Important comments and recommendations raised by consideration of the above include the following:

- Measures to further reduce final effluent concentrations should be seriously considered by the City for WWTWs that discharge into rivers that feed into important vleis, coastal lakes or estuaries; contribute to algal and other plant blooms; and an increase in organic sludges from algal growth;
- A substantial effort to decrease treated effluent orthophosphate concentrations to eutrophic levels or below should be undertaken. This would reduce both the ecological (and knock-on recreational and economic) costs of degraded aquatic ecosystems in urban areas, but also result in reduced management costs, in terms of clearing of invasive aquatic vegetation such as water hyacinth as well as reeds and the need for river and vlei dredging;
- Pump station overflows were, on the basis of data from City, linked primarily to electrical failure and stormwater ingress, as well as blockages from rags and other foreign objects, and mechanical failure. This suggests that increased pump station maintenance and management is required across most of the City's sub-catchments;
- The ongoing passage of foreign material into pump stations is clearly an issue of concern – the City's plans to include sediment and solid waste traps upstream of pump stations in the future, where space allows, should address this issue to some extent. However, the passage of solid waste into the wet wells of pump stations during screen cleaning is clearly a risk inherent in many pump stations at present, and could be rectified through measures such as double screens, even in systems where there is not space for sediment and solid waste trapping upstream;
- Manhole overflows are due to both pump station blockages and sewer blockages or collapses – measures such as proactive sewer cleaning and re-lining as necessary may assist in reducing these events. It is however clear that a dramatically improved approach to solid waste management is required at a city-wide scale, to reduce knock-on impacts on sewerage systems and watercourse condition.

## 5.3 Major nutrients (phosphorus and nitrogen)

### 5.3.1 Role of nutrients

All ecosystems require nutrients to support growth. In aquatic ecosystems, the major nutrients are phosphorus and nitrogen, which occur in various forms. These two nutrients play a particularly important role in determining the rate of plant growth, and so are sometimes referred to as 'growth-limiting' nutrients. In freshwater ecosystems, phosphorus is the main growth limiting nutrient, as some plants can access sufficient nitrogen from the air for growth. Other nutrients are also important for healthy growth, and these include sulphur, magnesium, potassium, calcium, iron, and many others, often required only in very small amounts.

**This section deals only with phosphorus and nitrogen nutrients**, which play a major role in determining aquatic ecosystem condition.

### 5.3.2 Forms of phosphorus and nitrogen in aquatic ecosystems

Both phosphorus and nitrogen occur in various forms in aquatic ecosystems, some of which are available for uptake by plants.

**Phosphorus**, for example, occurs in both inorganic and organic forms, and may be present in water as particulate or dissolved species. Phosphate species ( $\text{H}_2\text{PO}_4^-$  and  $\text{HPO}_4^{2-}$ ) are the only forms of soluble inorganic phosphorus that can be utilised directly by plants (DWAF 1996a). In this report they are referred to generally as orthophosphate, and with regard to data that reflect the concentration of phosphorus in orthophosphate only, as the abbreviation "PO<sub>4</sub>-P".

Total phosphorus (Tot-P) is a measure of all the chemical species of phosphorus present in the water column. It includes dissolved forms, insoluble particulate forms and phosphorus already incorporated into phytoplankton or other fine particulate organic material (Malan and Day 2005). Total phosphorus is useful for understanding the nutrient (or trophic) status of aquatic ecosystems because it represents all the phosphorus potentially available for incorporation into active biomass.

Phosphorus is reactive under oxidizing conditions, forming relatively insoluble compounds with cations (e.g.  $\text{Al}^{3+}$  (aluminium),  $\text{Fe}^{3+}/\text{Fe}^{2+}$  (iron)), which precipitate out of the water, into bottom sediments. By contrast, low-oxygen conditions may cause the release of phosphorus back into the water column (DWAF 1996a).

In aquatic ecosystems, **nitrogen** occurs both as organic nitrogen and as inorganic nitrogen, in the form of nitrate ( $\text{NO}_3^-$ ) and nitrite ( $\text{NO}_2^-$ ) ions, as well as total ammonia, comprising ionised ( $\text{NH}_4^+$ ) and un-ionised ( $\text{NH}_3$ ) forms. Un-ionised (or 'free') ammonia can be toxic to some aquatic organisms, even at very low concentrations (DWAF 1996a and DWAF 2008). This aspect is discussed in **Section 5.4**.

### 5.3.3 The effects of nutrient enrichment on aquatic ecosystems

In inland aquatic ecosystems, high concentrations of nutrients, and orthophosphate in particular, promote rapid plant growth. This growth may be in the form of rooted plants such as reeds and sedges in shallow areas of watercourses, vleis and lakes; floating or rooted plants in the water column or on the water surface; or algae, suspended in the water column, floating on the water surface as scums or algal mats, or attached to the surfaces of rocks or other substrate, as filamentous algae.

Rooted plants such as pondweed play important roles in aquatic ecosystems, as they take up nutrients and store them in plant tissues as well as oxygenating the water column through photosynthesis. Such plants do, however, rely on light penetration for photosynthesis to take place. In deep waters, or where aquatic weeds or algae inhibit light penetration, they may not have access to sufficient light. Under such conditions, with high orthophosphate concentrations providing an abundance of nutrients, there may be a shift in plant type, with phytoplankton and/or floating aquatic macrophyte plants dominating the system instead. Blue-green algae (or cyanobacteria) often prevail in these circumstances, in part because they are also able to access nitrogen from the air, in response to high orthophosphate availability.



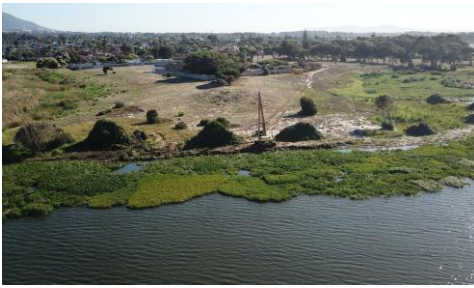
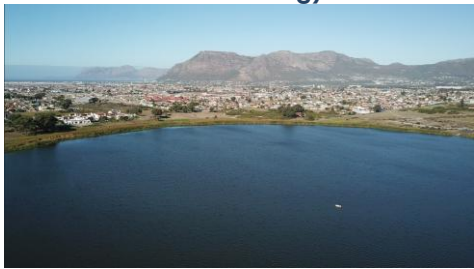


Photo 5.3.1

**Build-up of invasive water hyacinth in Princess Vlei as well as other water bodies requires ongoing efforts – this water body was cleared in 2024 by combined efforts, with the Princess Vlei forum funding manual removal of the weed, and CSRm collecting stacked piles of plant material for composting at its various facilities (see below, following alien clearing).**



(Photos: FOZR)

As algal cells die off and fall to the lake or vlei floor, they start to decompose. Decomposition requires oxygen – and if abundant nutrients have promoted **eutrophic to hypertrophic** conditions (see Section 5.1.4), then the oxygen demands of decomposition may be very high. This is often particularly the case in summer, when warm temperatures promote decomposition and algal growth, and when dissolved oxygen concentrations are in any case lower, because of temperature.

Under such conditions, or when there are additional inflows of organic enrichment (e.g. raw sewage), oxygen demand may well exceed oxygen supply, resulting in anoxic or low-oxygen conditions, which may result in sudden fish die-off and the deaths of other aquatic organisms that depend on the availability of dissolved oxygen in the water column.

In the Western Cape, floating non-algal aquatic plants are all alien to this area, and likely to proliferate under conditions of elevated nutrients. The most problematic floating plant species include water hyacinth (*Pontaderia crassipes*), duck weed (*Lemna gibba*) and water hornwort (*Ceratophyllum demersum*). These can create serious management problems. Water hyacinth in particular blocks channels and open water bodies, leading to flooding and affecting their suitability for recreational uses such as sailing, rowing, and kayaking. Control of water hyacinth in the Western Cape is primarily by physical removal, which is a costly, ongoing exercise.

### 5.3.4 Categorising nutrient levels as trophic states

The nutrient (or 'trophic') status of freshwater ecosystems allows them to be broadly classified into one of four trophic categories - oligotrophic, mesotrophic, eutrophic, and hypertrophic – respectively associated with low, moderate, high and extremely high levels of nutrients (mainly phosphorus and nitrogen nutrients) (see **Box 5.3.1**).

In standing water bodies such as vleis or lakes, these conditions can translate into the following broad habitat types, where:

- **Oligotrophic** water bodies typically have clear waters and a rocky or sandy shoreline. Both planktonic and rooted plant growth are sparse;
- **Mesotrophic** water bodies represent intermediate trophic states between oligotrophic and eutrophic, and often share characteristics between the other two;
- **Eutrophic** water bodies are typically shallow with a soft, silty bottom. Rooted plant growth is abundant along the shores and out into the lake, and algal blooms are not unusual. Water clarity is usually poor. If deep enough to thermally stratify, the bottom waters are often devoid of or low in dissolved oxygen concentrations;
- **Hypertrophic** water bodies may have similar habitat types to eutrophic systems, but bottom-level anoxia is more common and the systems are prone to blooms of blue-green as well as green algae. During the day, shallow warm waters may also at times be hyperoxic, as a result of very high rates of photosynthesis by algae.

**Appendix B** presents the range of nitrogen and phosphorus concentrations associated with different trophic states in South African freshwater ecosystems. These are also indicated in **Tables 3.1** and **3.2**,

in relation to the threshold ranges used in this report.

### 5.3.5 Sources of nutrients

The main sources of nutrients into Cape Town's watercourses are as follows:

- Inputs of treated sewage effluent from any of the City's 16 WWTWs that discharge treated effluent into inland watercourses or estuaries. These discharges do not always meet licensing conditions (see Section 5.2), and even if they do so, the volumes of effluent discharged, compared to the volumes of river water, mean that they still give rise to significant nutrient enrichment downstream. This is particularly likely in summer, when treated effluent makes up the entire run-of-river flow in some naturally seasonal systems (e.g. the Black, Kuils and Mosselbank Rivers and Milnerton Lagoon) – see Section 5.5 for discussion of WWTW outflows;
- Overflows from sewage pump stations and/or low-lying sewer manholes into the stormwater system as a result of load-shedding or sewer line blockage – see Section 5.5 for data and more detailed discussion around these issues;
- Runoff from catchment areas with high levels of backyard or informal settlements, subject to poor levels of sewage and stormwater servicing and often large populations;
- Illegal discharges of nutrient-enriched water into the stormwater system in industrial and commercial areas (e.g. fertiliser factories; car washes; markets; informal butcheries and meat markets);
- Runoff from fertilised gardens and parks;
- Runoff from agricultural areas (e.g. Philippi Horticultural Area);
- Runoff, irrigation seepage or direct discharges from so-called sewage package plants used to treat sewage effluent on a small scale (usually on private developments);
- Recycling of decomposing sediments from bottom waters in lakes and dams, as a result of low-oxygen conditions that cause re-activation of phosphorus; and also, as a result of stirring up sediments from wind- or boat-induced wave action.

#### Box 5.3.1

##### Nutrients under natural conditions

Under natural (or 'reference') conditions, prior to human-induced change, the upper reaches of Cape Town's rivers would have been naturally low in nutrients, especially those that passed through catchments dominated by ancient, well-leached (and thus nutrient-poor) Table Mountain Sandstones. With distance downstream, even natural rivers tend to accumulate low levels of nutrients, as they are exposed to larger areas of the catchment and its runoff.

By contrast, even under pre-development conditions, wetlands would probably have been more nutrient enriched than rivers – particularly those wetlands that were not linked to channeled outflows, and thus accumulated plant material over time. Shallow, seasonally inundated wetlands used as feeding areas by birds could become highly nutrient-enriched over time, supporting rich 'soups' of invertebrates.

Today, most if not all of the aquatic ecosystems in the City have been severely impacted by the receipt of additional nutrients, particularly phosphorus.

### 5.3.6 Phosphorus enrichment of Cape Town's watercourses

In this report, **orthophosphate** (PO<sub>4</sub>-P) data are assessed for both rivers and standing water systems. This is a change in reporting, in order to adapt to the lack of total phosphorus data since December 2022. Orthophosphate thresholds are used for all systems as outlined in **Table 3.1**. This is not ideal – total phosphorus is a better measure with which to assess trophic status in standing waters (Cook et al. 2005) (see Section 3.11.11). Moreover, orthophosphate data themselves are currently analysed with a Limit of Quantification (LOQ) of 0.1 mg/L, and such data are analysed statistically as 0.05 mg P/L.

This high LOQ means that these samples are automatically classed as "Poor" – there are therefore no samples recorded in the Target range for this variable post December 2022, making tracking of improvements or deterioration in phosphorus contamination of the City's water bodies impossible

over this period. **This is a significant limitation**, discussed further in Section 3.11.8.

The above issues notwithstanding, orthophosphate data are presented in this report in the forms of:

- Compliance-type data, showing the percentage of samples in a specified period that met Target conditions for this nutrient, versus the percentage of samples falling within the range for Poor or Unacceptable concentrations. Target concentrations imply mesotrophic to oligotrophic conditions with regards to this nutrient (see **Tables 3.1 and 3.2, Section 5.3.4 and Appendix B**), while Unacceptable concentrations suggest hypertrophic conditions. The following figures are provided:
  - Data for river / stormwater ("flowing" water) samples in each sub-catchment - **Figures 5.3.1** (all flowing systems combined), **5.3.2** (flowing systems separated by catchment, for the 2024 reporting period) and **Figure 5.3.4** (comparison of catchments between 2024, 2023 and the previous three reporting years);
  - Data for vleis, lakes, detention ponds etc. ("standing" water systems) - **Figure 5.3.3** (all standing water systems compared for the 2024 reporting period) and **Figure 5.3.5** (comparison of catchments between 2024, 2023 and the previous three reporting years);
- Boxplots presenting summary statistical data – these are shown as seasonal plots in **Figures 5.3.6 and 5.3.7** for flowing water systems and vleis / dams respectively, and as annual median values (without seasonal distinctions) in **Appendix D (Figures D1.1 and D1.2)**;
- Median annual concentrations of these variables at a catchment scale, for rivers, and for individual vleis /dams, in **Table 5.3.1**;
- Median annual concentrations of these variables at individual monitoring points in each sub-catchment, also presented per catchment, showing trajectories for this and other variables, in **Appendix C**, as well as (for priority catchments), in the maps in **Section 8**, .

The data suggest that:

- For **rivers / flowing water systems**:
  - There was no real change in the proportion of samples rated Unacceptable in the 2023 and 2024 reporting periods (76% and 77% respectively), indicating watercourses throughout Cape Town that were generally hypertrophic and likely to promote excessive plant growth with its associated problems. Comparison with data for the 2020 to 2022 reporting periods in **Figure 5.3.1** indicates that this is a long-term trend, that has not been shifted by any management practices or interventions;
  - At a catchment level, **Figure 5.3.2** shows that the worst performing catchments over the 2024 reporting period were the Mosselbank, Mitchell's Plain(stormwater outflow), Soet, Sout, Eerste and Kuils (95%-100% of samples rated as Unacceptable), followed closely by the Diep, Lower Salt and Zeekoe Catchments. All of these catchments are characterised by high levels of informal settlements in at least some areas; rivers that are exposed to frequent sewage pump station overflows and sewage spills (see Section 5.2); and inflows from poorly performing WWTWs, and with orthophosphate limits for treated effluent already being well above the lower hypertrophic threshold – the Kuils, Black and Mosselbank Rivers in the above catchments are all naturally seasonal rivers in which almost the entire flows in summer are made up of treated sewage, while the Soet, Big Lotus and tributaries of the Black River in the Lower Salt catchment are also naturally seasonal and their summer flows comprise mainly untreated sewage and grey water from informal and backyard settlements. These are all significant sources of phosphorus into these catchments;
  - The data presented in **Figure 5.3.4** suggests moreover that there have been no meaningful improvements in water quality in any of the above catchments, over the three reporting periods referenced in these data;
  - Catchments in which orthophosphate enrichment was clearly problematic (42-70% of

samples in the hypertrophic / Unacceptable range), although less overwhelming than in the above, comprised (in improving order) the Bokramspuit, Elsiekraal, Schusters and Sand catchments. Of these:

- The Elsiekraal Catchment showed some improvement in water quality, with fewer samples in the hypertrophic range in the 2024 reporting period compared with 2023 and the previous 2020-2022 period;
- The Schusters and Bokramspuit Catchments also both showed trends of slightly improving performance, with a smaller proportion of samples being rated as Unacceptable year-on-year (**Figure 5.3.4**);
- The best performing catchments were the Hout Bay, Silvermine and Lourens catchments, all of which had <10% samples in the Unacceptable range, suggesting relatively “clean” catchments:
  - In the case of the Hout Bay Catchment, this is a surprising finding, given the high concentrations of *E. coli* in this catchment (Section 5.1.4) and its exposure to black and grey water runoff from the Imizamo Yethu informal settlement. The 2024 data in fact show a very slight improvement in phosphorus compliance ratings in 2024 compared with previous monitoring data (**Figure 5.3.4**) although median annual data were the same in 2023 and 2024. Total phosphorus data would be useful for this assessment, as orthophosphate data show only biologically available phosphorus, as opposed to phosphorus that is present in solid, organic form that has not yet decomposed;
  - There was little measured year-on-year change in the Lourens Catchment between 2023 and 2024, although increases or decreases in concentrations at the lower end of the spectrum (i.e. in Target to Poor ranges) are not assessable, given limitations of the high orthophosphate LOQ. Samples rated as Unacceptable were limited (2 out of 77 samples);
  - Some deterioration in water quality in the Silvermine Catchment is flagged as a concern, with a (still small) increase in the frequency of Unacceptable ratings in the 2024 reporting period compared with previous years - this correlates with an increased frequency and magnitude of sewage inflows noted in Section 5.1.4, although other sources of orthophosphate in this catchment could include the Clovelly Golf Course, abutting the river in its middle to lower reaches.

**Median data (Table 5.3.1) and seasonal data**, shown as boxplots in **Figure 5.3.7**, provide further insights into patterns of orthophosphate pollution in Cape Town's watercourses. This is in part because such data indicate not only the levels of data compliance with specified targets, but also the magnitude of non-compliance. The data show that:

- High concentrations of orthophosphate characterised all of Cape Town's catchments, with median concentrations lying well above the hypertrophic threshold for this variable in all catchments save the Lourens and Silvermine Catchments;
- These two exceptions were the only catchments where median and at least data up to the 3<sup>rd</sup> quartile (i.e. 75%) lay within the Mesotrophic to Eutrophic ranges, and even these were plagued by periodic spikes in concentration, shown in outlier scatter. These data reflect catchments with generally low levels of urban settlement, little to no informal or backyard settlements, an absence of WWTW inflows, and extensive mountain catchments that receive high quality runoff;
- Median data for the Hout Bay, Lourens, Sand, Schusters and Silvermine Catchments cannot however usefully be compared between years, because with the change (increase) in LOQ for orthophosphate (see Section 3.11.8), median data for these generally least-polluted catchments is reflected as 0.05 mg P/L for multiple samples (recorded as <0.1 mg P/L), meaning that parts of the 2023 and all of the 2024 datasets are skewed in these catchments towards higher values than in previous years with

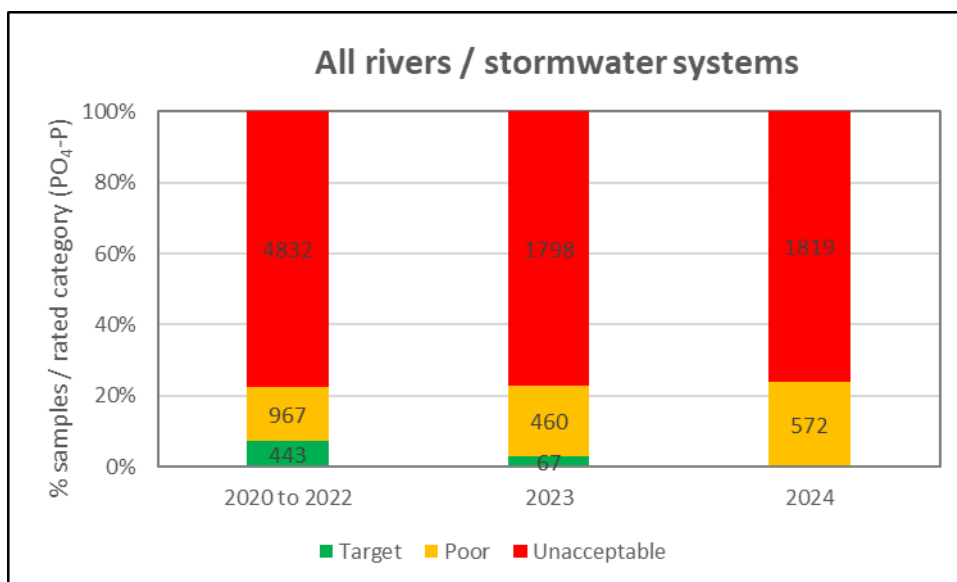


lower LOQs;

- Median orthophosphate concentrations in the Lower Diep, Eerste, Kuils, Lower Salt, Mosselbank, Mitchell's Plain, Soet, Sout and Zeekoe Catchments were consistently many times greater than the Unacceptable threshold for this nutrient, and well over an order of magnitude above concentrations in other, less-polluted catchments;
- Summer concentrations in the Sout Catchment were consistently by far the highest in the City's monitored catchments, with median concentrations of 9.08 and 8.45 mg P/L in the 2023 and 2024 reporting periods, dropping to 3.20 and 4.10 mg/P/L in winter, of the same years, respectively, when catchment-wide dilution is assumed to reduce the high concentrations of orthophosphate entering the lower river from the Melkbosstrand WWTW. These very high summer concentrations are assumed to reflect both perennial inflows from the WWTW, as well as evapo-concentration of nutrients, and inflows from a largely agricultural upstream catchment, with extensive wheat and other crops, assumed to contribute at times nutrients from excess fertilization during spring and summer;
- Median and maximum data were highest in summer across all catchments in data from all three reporting periods assessed (**Figure 3.7**) – this is an expected pattern, reflecting evapo-concentration in rivers, as well as the fact that, in many systems, the only water flowing in the rivers derived from treated or untreated sewage effluent, "grey" water from unserviced households and illegal discharges into the stormwater system. Data shown in **Figures 4.3** and **4.6** reflect moreover that the summer of the 2024 reporting period was drier than that of the previous year, potentially leading to more concentrated pollution flows in Cape Town's rivers over this period;
- The only exceptions to the above were the Bokramspuit (2024), Soet (2024) and Zeekoe (2023) Catchments. In these catchments, all of which have high levels of waste accumulating in drains, drainage channels, on streets, pavements and open spaces, rainfall events outside of major floods may serve simply to wash more pollutants into the rivers, rather than diluting them;
- Although performance data (**Figure 5.3.4**) showed relatively few major changes in catchment performance between reporting periods considered in this report, the high LOQ and very high concentrations of orthophosphate in some catchments respectively mask changes in both least-polluted and most polluted catchments, simply assigning the former to the Poor and the latter to the Unacceptable categories. Data shown in **Figure 5.3.6** and summarized in **Table 5.3.1** as well as Appendix C (**Table C1**) show that:
  - Median orthophosphate concentrations in the Lower Salt, Mosselbank, Soet and Zeekoe Catchments all increased substantially in the 2024 reporting period compared with 2023, increasing by between 33 and 52% of median concentrations that were all already at least an order of magnitude greater than the hypertrophic threshold for this variable, with the exception of the Zeekoe Catchment, at a median concentration 6.4 times that of the hypertrophic threshold (>0.125 mg P/L);
  - The Soet and the Zeekoe Catchments showed still more marked deterioration over time when compared with the 2020-2022 datasets, with median concentrations increasing by 84% and 105 % respectively;
  - On a more positive note, median concentrations decreased in the Sout, Diep and Elsieskraal Catchments, by 20%, 13% and 32% respectively in the 2024 reporting period and (for the Diep and Elsieskraal Catchments only) by 41% and 10% when compared with data from the 2020-2022 reporting period, suggesting some level of improvement in these areas;
- Summary data without seasonal distinctions are presented in **Appendix D (Figure D1.1)**

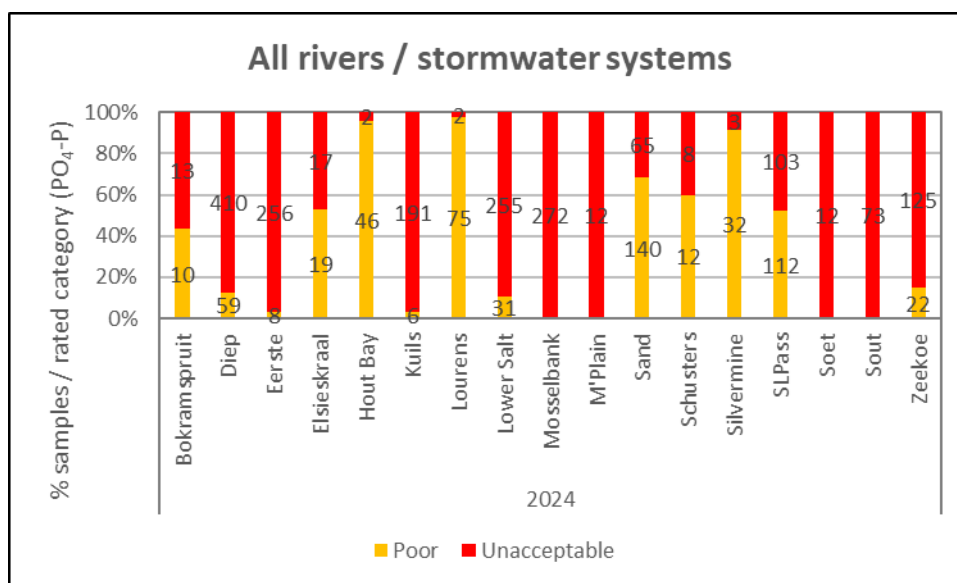
and show a high degree of scatter in orthophosphate concentrations within sub-catchments, pointing to both episodic point-source driven pollution as well as a range of water courses in different condition within the sub-catchments, with some more prone to receipt of severely contaminated water at times than others – the Hout Bay River for example has relatively unenriched water quality in its upper reaches, only deteriorating significantly in its lower reaches, which are impacted primarily by runoff from large informal settlements. These details are unpacked in Section 8, for each of the City's Priority Sub-catchments;

- Overall, orthophosphate data continue to indicate that phosphorus enrichment remains an issue of great concern, affecting most of Cape Town's monitored rivers and other stormwater systems, which over the 2023 and 2024 reporting periods lay generally well within the hypertrophic (Unacceptable) range for this variable.
- Marked increases in orthophosphate concentrations in the Lower Salt, Mosselbank, Soet and Zeekoe Catchments in the 2024 reporting period are all noted with concern, and in the Zeekoe Catchment in particular, the knock-on effect of these on the important Ramsar wetlands downstream (Zeekoevlei and Rondevlei) are particularly vulnerable to the ongoing impacts of eutrophication;
- The costs of orthophosphate enrichment in many of Cape Town's rivers are reflected in the high costs of removal of reeds as well as alien aquatic vegetation such as water hyacinth, which clog watercourses; increase flood risk; and reduce indigenous biodiversity;
- The Silvermine, Lourens, Schusters and Hout Bay Catchments continued to be the best-performing catchments among monitored systems in the City – the degree to which their water quality remains in an Acceptable condition in terms of this variable could not however be assessed with available data, and this issue is flagged as a serious concern that will make long-term monitoring, assessment and responses to possible upward-creeping nutrient enrichment difficult to impossible in these important catchments.



**Figure 5.3.1**

**Summary data showing percentages of samples across all City sample sites in flowing water systems (rivers, canals, stormwater channels and outlets) in rated PO<sub>4</sub>-P categories (as per Table 3.1) for reporting periods 2020-2022, 2023 and 2024. Number of samples indicated in figure.**



**Figure 5.3.2**

Data showing percentages of samples per catchment in rivers, canals and stormwater channels / outlets and other flowing systems, in rated PO<sub>4</sub>-P categories (as per Table 3.1).

- **For standing water systems (vleis, dams, detention ponds)** the available data suggest that:
  - Using compliance type reporting (**Figures 5.3.3 and 5.3.5**):
    - There has been a slight increase in the overall proportion of samples rated as Unacceptable (i.e. in the hypertrophic range) for <sup>12</sup>orthophosphate between the 2024 and 2023 reporting periods, negating the slight improvement between the 2020-2022 and 2023 reporting periods (see summary figure in **Figure 5.3.5**);
    - The degree to which there has been any increase or decrease in concentrations at the more sensitive end of the spectrum, between Target / Acceptable and Poor ratings could not however be determined with available data – this means that improving and deteriorating trends evident in previous year's data can no longer be tracked;
    - The least-enriched waterbodies were likely to be Die Oog (a small wetland in the Sand Catchment), Glencairn Vlei (Else River catchment, South Peninsula) and the Westlake Wetlands (Sand Catchment), none of which had any data at concentrations within the hypertrophic range over this period (**Figure 5.3.3**), and with Die Oog and Westlake Wetlands both showing improvement in enrichment levels compared with 2023 reporting period data (**Figure 5.3.5**). These conditions in the latter two Sand Catchment wetlands as well as Zandvlei itself (see below) potentially reflect the impacts of concerted management efforts at a catchment scale, with a particular focus on reducing the impact of sewage overflows (see Section 8);
    - The Elsiekraal dams (Doordekraal and Angelier Park dams), Little Princessvlei, Princess Vlei and Zandvlei all also had few (< 10%) samples above hypertrophic concentrations in the 2024 reporting period, and showed similar or slight improvements in the proportions of Unacceptable data in the previous reporting periods indicated in **Figure 5.3.5**;
    - Approximately 45% and 35% of data respectively from Rondevlei and Langvlei fell

<sup>12</sup> Readers are again referred to sections 3.8.8 and 3.8.11 for a discussion of data availability and the limitations in the current lack of Tot-P data and high LOQ for PO<sub>4</sub>-P.

within the hypertrophic range for these wetlands in the 2024 reporting period, indicative of systems in which plant growth is likely to be rapid at times – Langvlei data in fact showed some improvement compared with 2023, whereas Rondevlei data showed a trajectory of increasing phosphorus enrichment in water samples;

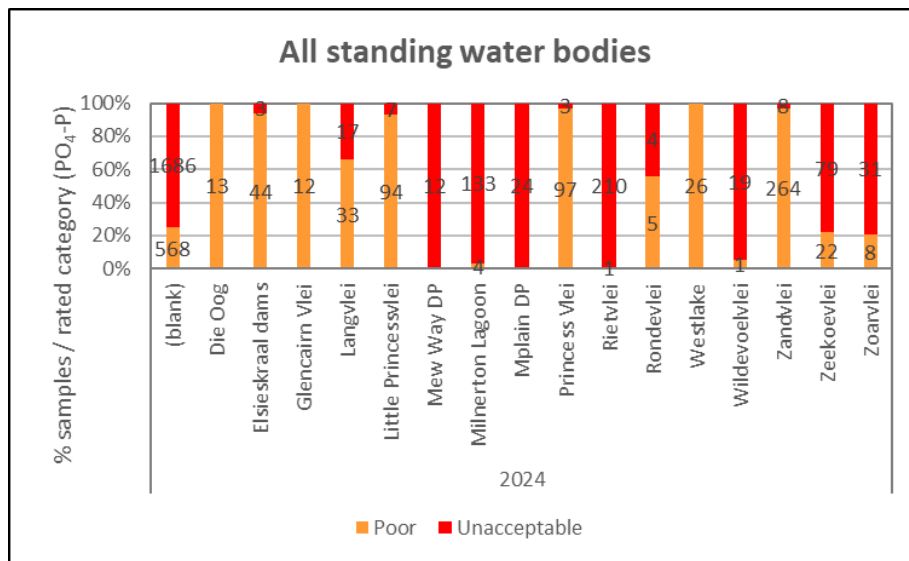
- A marked deterioration in water quality in Rietvlei was noted in the 2024 reporting period, with all samples from this wetland rated as Unacceptable. This is a significant change compared with data for 2023 and the 2020-2022 reporting periods, suggestive of sustained polluted inflows into the system and/or in-wetland turn-over of stored phosphorus in organic sediments. Rose et al (2023) suggested however that this was unlikely (at least then) to be the case, as organic sediments were generally stored in the deepwater sections of the vlei, below levels where they would be exposed to wind turnover. Data presented in Section 5.1.4 did show an increase in the frequency and magnitude of raw sewage inflows into the vlei, albeit still at a frequency < 10%;
- Data for the remaining wetlands (Wildevleivlei, Zeekoevlei, Zoarvlei and the Mitchell's Plain and Mew Way detention ponds) were all well within the hypertrophic range for orthophosphate for all or nearly all of their assessed samples, reflecting waterbodies fed by highly polluted catchments, reflected in the data for "flowing water" already described for the relevant catchments (Figure 5.3.4). Of these waterbodies, Zeekoevlei showed some improvement in orthophosphate concentrations in the 2024 reporting period, with 19% of its samples lying outside of Unacceptable, but remained deeply problematic with regard to orthophosphate enrichment, as evidenced in the recent rapid invasion of the vlei by water hyacinth and the frequency of blue-green algal blooms in the system (see Section 6).
- Seasonal data, shown as boxplots in **Figure 5.3.7**, as well as median data without seasonal distinctions, shown in Appendix D (**Figure D1.2**) provide further insights into patterns of phosphorus pollution in Cape Town's standing water bodies. Again, these graphs are useful because they reflect the magnitude of orthophosphate enrichment, rather than simply showing the extent of non-compliance (or hypertrophic systems). The available data suggest that:
  - By far the highest levels of consistent phosphorus enrichment in standing water bodies over the 2020-2022, 2023 and 2024 reporting periods, based on median data and inter-quartile ranges, were found in Wildevleivlei, followed by the Mew Way and Mitchell's Plain detention ponds, all of which had median orthophosphate concentrations in the range of an order of magnitude (i.e. ten times greater) or more (Wildevleivlei) above the hypertrophic threshold;
  - Zeekoevlei and Zoarvlei, with median concentrations nearly four times greater than the hypertrophic threshold, followed, and although Zeekoevlei showed little change in median orthophosphate concentrations, Zoarvlei's concentrations nearly doubled between the 2023 and 2024 reporting periods (**Table 5.3.1**);
  - Such hypertrophic conditions in all of these systems are likely to be linked to excessive plant growth including blue-green algae, invasive alien plants such as water hyacinth (*Pontaderia crassipes*) and reeds in these systems – this is confirmed in the case of Zeekoevlei in Section 6;
  - By contrast, the smaller waterbodies assessed in **Figure 3.3.7** all showed much lower concentrations of orthophosphate, with the wetlands with the lowest levels of enrichment in the 2023 reporting period comprising Die Oog, the Elsieskraal Dams, Glencairn Vlei, Little Princessvlei, Princess Vlei, the Westlake Wetlands and Zandvlei, albeit potentially still above levels of concern and always (in the 2023 and 2024 reporting periods) in the range likely to be associated with eutrophic conditions, reflecting (unhelpfully) high nutrient availability or high LOQs for this



variable;

- The marked increase in Rietvlei orthophosphate concentrations already discussed with regard to compliance data are also evident in **Figure 5.3.8**, over both summer and winter cycles in the 2024 reporting period;
- Seasonal data shown in **Figure 5.3.8** show that orthophosphate concentrations increased substantially in the Mew Way and Mitchell's Plain detention ponds; Rondevlei, Zeekoevlei and Zoarvlei waterbodies in winter, whereas they tended to decrease in winter (Wildevoevlei) or remain relatively similar in other waterbodies in the 2024 and (generally) previous datasets included in **Figure 5.3.7**. This pattern probably reflects differences in catchment characteristics, with those catchments showing elevated winter concentrations being predominantly "dirty" catchments, with high levels of informal settlements, permanent inflows of raw sewage, and severe dumping of solid waste, often including organic waste, in channels, pavements and other open spaces, from where they wash into the downstream wetlands. Wildevoevlei, by contrast, lies some distance from the informal part of Masiphumelele, and in winter these inflows are assumed to be diluted by groundwater and cleaner inflows across the whole of the Noordhoek wetlands, while WWTW effluent itself is also potentially diluted by stormwater ingresses into sewers;
- The above discussion can be used to inform management decisions about where minor interventions might bring about major ecosystem changes (e.g. associated with decreases in plant and organic sediment management requirements, if a system can move into a lower trophic threshold). Candidate systems for such interventions would potentially thus comprise:
  - Die Oog, the Elsieskraal Dams, Glencairn Vlei, Little Princessvlei, Princess Vlei, the Westlake Wetlands and Zandvlei;and then, more challengingly:
  - Rietvlei, Rondevlei and Langvlei;then (associated with major catchment scale effort):
  - Zoarvlei and Zeekoevlei;and finally, but least likely to achieve measurable change without major catchment and infrastructural interventions:
  - The Mew Way and Michell's Plain detention ponds and Wildevoevlei.
- Overall, orthophosphate data show that all of the City's standing water systems are nutrient-enriched, reflecting inflows from significantly more polluted rivers and stormwater systems, which load standing water bodies with nutrients that accumulate over time, in the water bodies themselves, as well as in bottom sediments and living plant material.

Note that maps showing rated annual median orthophosphate concentrations at all sample points in the priority catchment areas can be accessed in Section 8, while **Table C1** in Appendix C summarises trajectories in PO<sub>4</sub>-P over the full period assessed in this report.



**Figure 5.3.3**

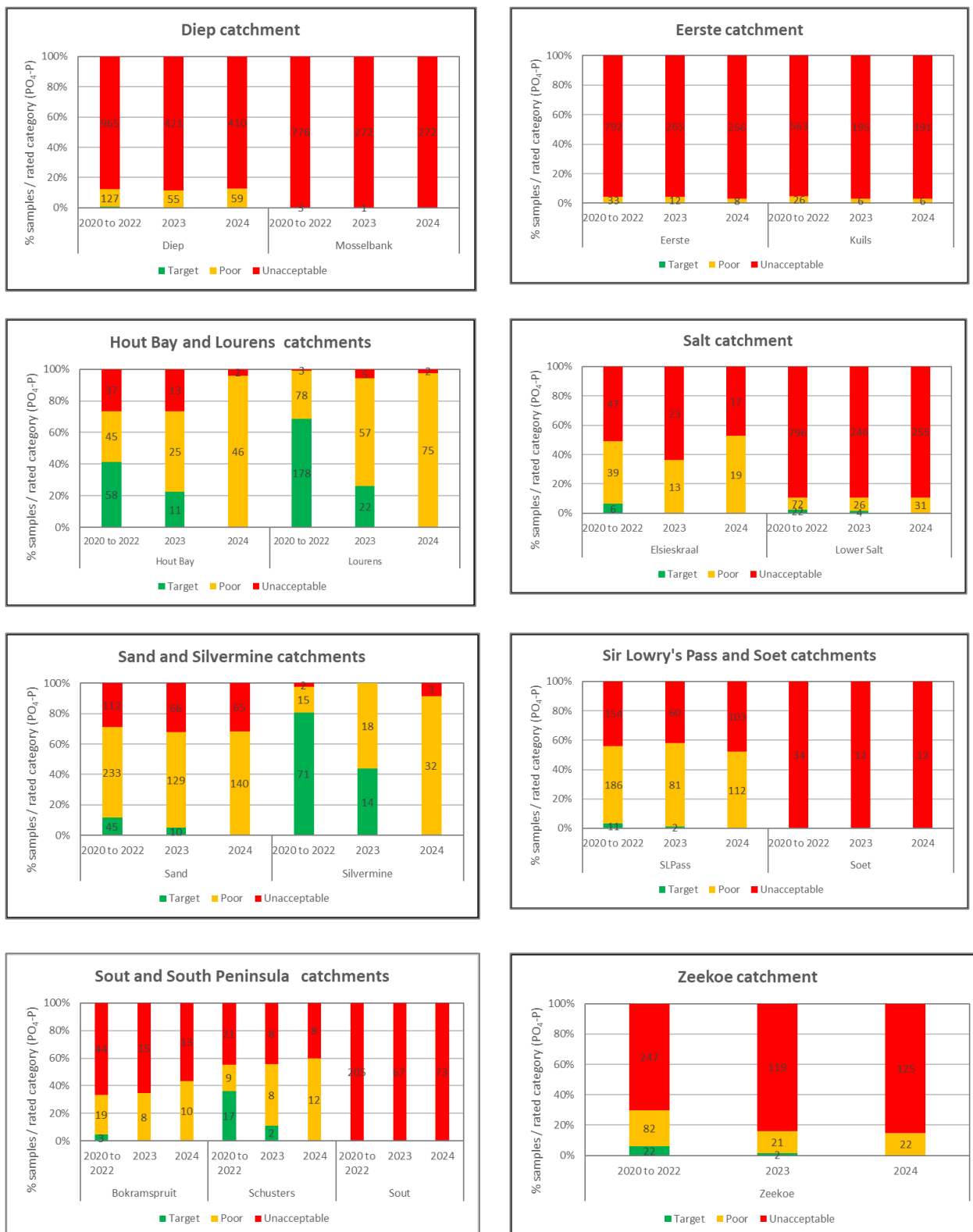
Data showing percentages of samples per catchment in standing water systems (vleis, lakes, dams etc.), in rated PO4-P categories categories (using ratings from Table 3.1 – flowing water systems, in the absence of Tot-P data)

**Table 1.3.1**

**Summary median data (mg/L) for reporting periods 2022 and 2023 –orthophosphate (PO<sub>4</sub>-P) and TIN, with median ratios of NH<sub>4</sub>-N:TIN and TIN:PO<sub>4</sub>-P, showing sub-catchments and vlei names. Note that the method of analysis for PO<sub>4</sub>-P changed in December 2022, with an LOQ of < 0.1, recorded in analysed data as 0.05 mg/L – apparent increases in median PO<sub>4</sub>-P values to 0.05 mg/L in some catchments reflect this change.**

| TYPE           | SUB-CATCHMENT                 | VLEI NAME           | 2023               |       |       |                      | 2024               |       |       |                      |
|----------------|-------------------------------|---------------------|--------------------|-------|-------|----------------------|--------------------|-------|-------|----------------------|
|                |                               |                     | PO <sub>4</sub> -P | N:P   | TIN   | NH <sub>4</sub> :TIN | PO <sub>4</sub> -P | N:P   | TIN   | NH <sub>4</sub> :TIN |
| River dataset  | Bokramspruit                  |                     | 0.17               | 17.69 | 3.23  | 0.67                 | 0.18               | 11.74 | 1.89  | 0.81                 |
|                | Diep (incl. Milnerton lagoon) |                     | 1.49               | 7.36  | 4.12  | 0.65                 | 1.29               | 6.91  | 4.01  | 0.77                 |
|                | Diep                          | Milnerton Lagoon    | 2.97               | 6.33  | 24.14 | 0.99                 | 2.24               | 5.67  | 12.06 | 0.99                 |
|                | Eerste                        |                     | 1.70               | 5.78  | 9.70  | 0.82                 | 1.90               | 6.16  | 12.80 | 0.84                 |
|                | Elsieskraal                   |                     | 0.18               | 10.91 | 2.10  | 0.42                 | 0.12               | 12.12 | 2.01  | 0.36                 |
|                | Hout Bay                      |                     | 0.05               | 6.82  | 0.47  | 0.71                 | 0.05               | 4.65  | 0.23  | 0.61                 |
|                | Kuils                         |                     | 1.60               | 6.34  | 9.38  | 0.60                 | 1.60               | 7.60  | 10.70 | 0.82                 |
|                | Lourens                       |                     | 0.04               | 9.11  | 0.42  | 0.12                 | 0.05               | 8.27  | 0.42  | 0.19                 |
|                | Lower Salt                    |                     | 1.46               | 8.30  | 13.42 | 0.88                 | 2.16               | 7.02  | 12.65 | 0.73                 |
|                | Mosselbank                    |                     | 1.20               | 3.14  | 3.60  | 0.51                 | 1.60               | 3.96  | 4.30  | 0.54                 |
|                | M'Plain                       |                     | 1.19               | 11.42 | 12.02 | 0.98                 | 1.19               | 10.97 | 13.53 | 1.00                 |
|                | Sand                          |                     | 0.06               | 10.67 | 0.90  | 0.27                 | 0.05               | 10.68 | 1.32  | 0.35                 |
|                | Schusters                     |                     | 0.05               | 5.80  | 0.30  | 0.73                 | 0.05               | 5.25  | 0.38  | 0.77                 |
|                | Silvermine                    |                     | 0.03               | 3.18  | 0.09  | 0.48                 | 0.05               | 2.93  | 0.16  | 0.65                 |
|                | SLPass                        |                     | 0.10               | 7.27  | 0.81  | 0.33                 | 0.12               | 11.75 | 1.81  | 0.66                 |
|                | Soet                          |                     | 2.45               | 8.83  | 20.72 | 0.99                 | 3.71               | 8.52  | 31.09 | 1.00                 |
|                | Sout                          |                     | 6.00               | 0.34  | 2.40  | 0.71                 | 4.80               | 0.53  | 2.60  | 0.82                 |
|                | Zeekoe                        |                     | 0.84               | 8.05  | 6.88  | 0.85                 | 1.15               | 9.95  | 9.81  | 0.94                 |
| Standing water | Diep                          | Rietvlei            | 0.06               | 3.40  | 0.16  | 0.49                 | 0.32               | 0.67  | 0.19  | 0.60                 |
|                | Diep                          | Zoarvlei            | 0.23               | 1.99  | 0.44  | 0.65                 | 0.41               | 3.57  | 1.19  | 0.81                 |
|                | Else                          | Glencairn Vlei      | 0.01               | 8.85  | 0.17  | 0.19                 | 0.05               | 1.91  | 0.10  | 0.38                 |
|                | Elsieskraal                   | Elsieskraal dams    | 0.05               | 13.44 | 0.16  | 0.43                 | 0.05               | 3.65  | 0.18  | 0.50                 |
|                | Kuils                         | Mew Way DP          | 1.15               | 10.97 | 12.06 | 0.97                 | 1.55               | 10.05 | 17.20 | 1.00                 |
|                | M'Plain                       | Mplain DP           | 1.00               | 11.20 | 11.53 | 0.94                 | 1.28               | 10.67 | 13.78 | 0.99                 |
|                | Noordhoek                     | Wildevle vlei       | 4.33               | 5.73  | 26.59 | 0.98                 | 3.20               | 2.59  | 6.76  | 0.91                 |
|                | Sand                          | Die Oog             | 0.05               | 6.60  | 0.55  | 0.83                 | 0.05               | 3.25  | 0.16  | 0.76                 |
|                | Sand                          | Langvlei            | 0.13               | 8.79  | 1.06  | 0.48                 | 0.05               | 5.95  | 0.80  | 0.27                 |
|                | Sand                          | Little Princessvlei | 0.05               | 9.89  | 0.45  | 0.49                 | 0.05               | 9.14  | 0.51  | 0.51                 |
|                | Sand                          | Princess Vlei       | 0.02               | 11.00 | 0.11  | 0.34                 | 0.05               | 3.25  | 0.16  | 0.54                 |
|                | Sand                          | Westlake            | 0.06               | 7.00  | 0.41  | 0.51                 | 0.05               | 5.48  | 0.27  | 0.65                 |
|                | Sand                          | Zandvlei            | 0.05               | 3.70  | 0.15  | 0.70                 | 0.05               | 2.44  | 0.12  | 0.68                 |
|                | Zeekoe                        | Rondevlei           | 0.10               | 7.50  | 0.74  | 0.53                 | 0.05               | 3.56  | 0.55  | 0.49                 |
|                | Zeekoe                        | Zeekoevlei          | 0.47               | 2.49  | 0.88  | 0.54                 | 0.46               | 3.29  | 1.71  | 0.58                 |

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with a focus on the period October 2022 to September 2024 (2023 and 2024 Reporting Periods)

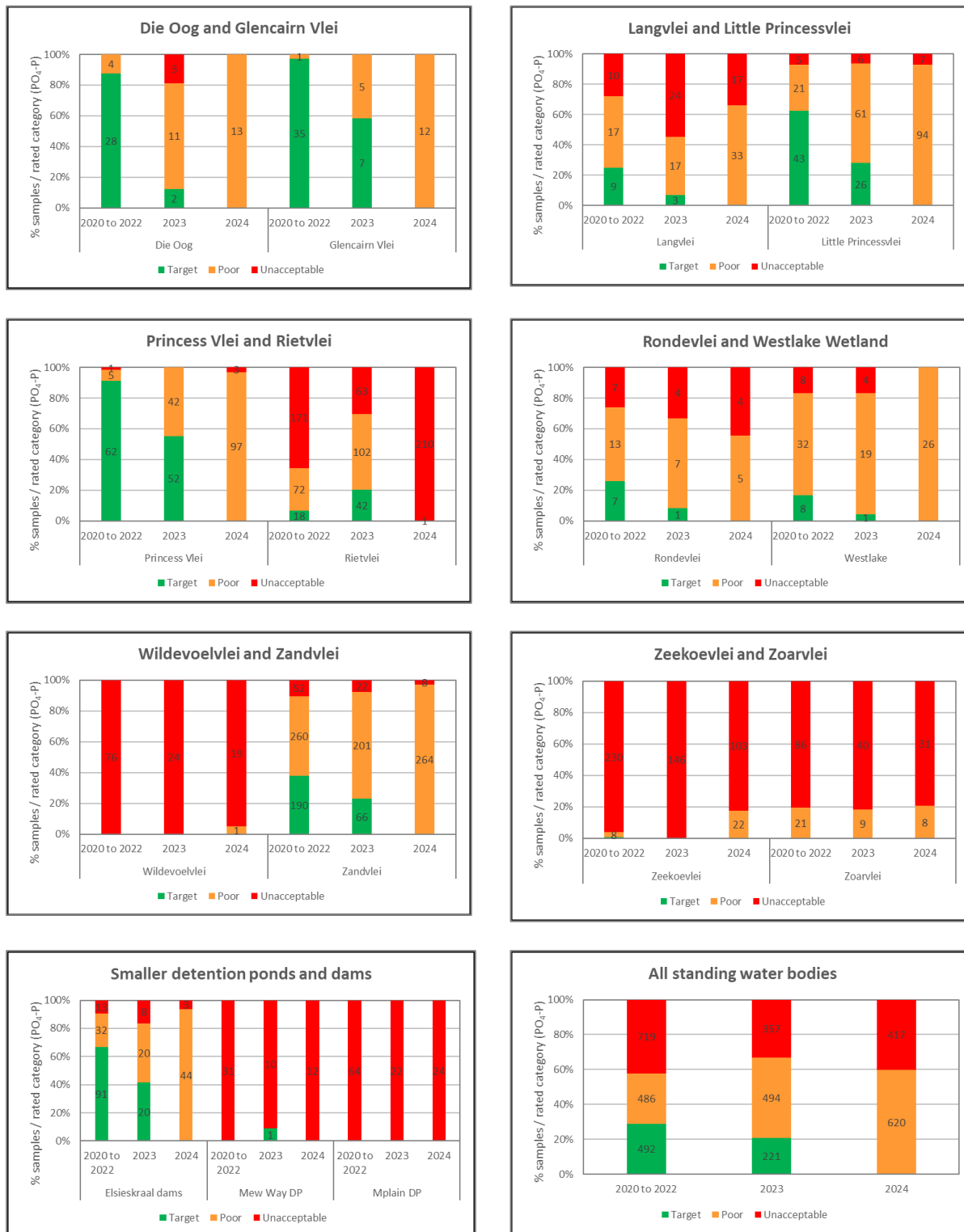


**Figure 5.3.4**

Percentage of orthophosphate (PO<sub>4</sub>-P) samples falling within each rated category for this variable, per sub-catchment, between 2020 and 2022, and 2023 and 2024 reporting periods. Thresholds for rated categories as defined in Table 3.1. Data presented for river / 'flowing' water monitoring points. Sub-catchments as shown in Figure 2.1. Total number of samples considered shown in bars.



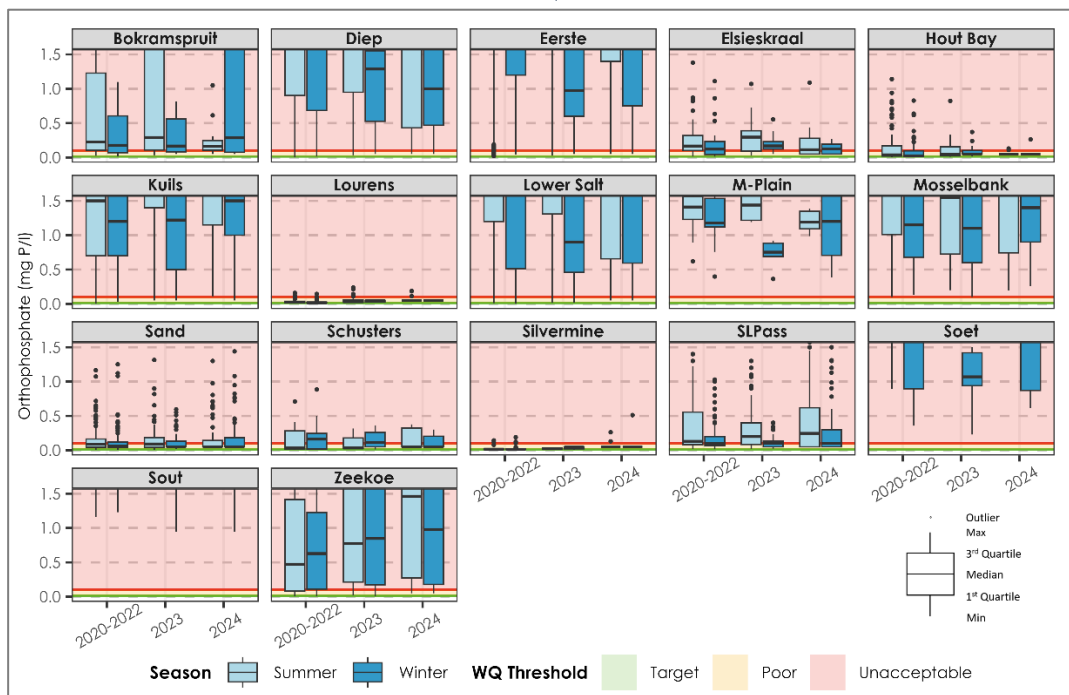
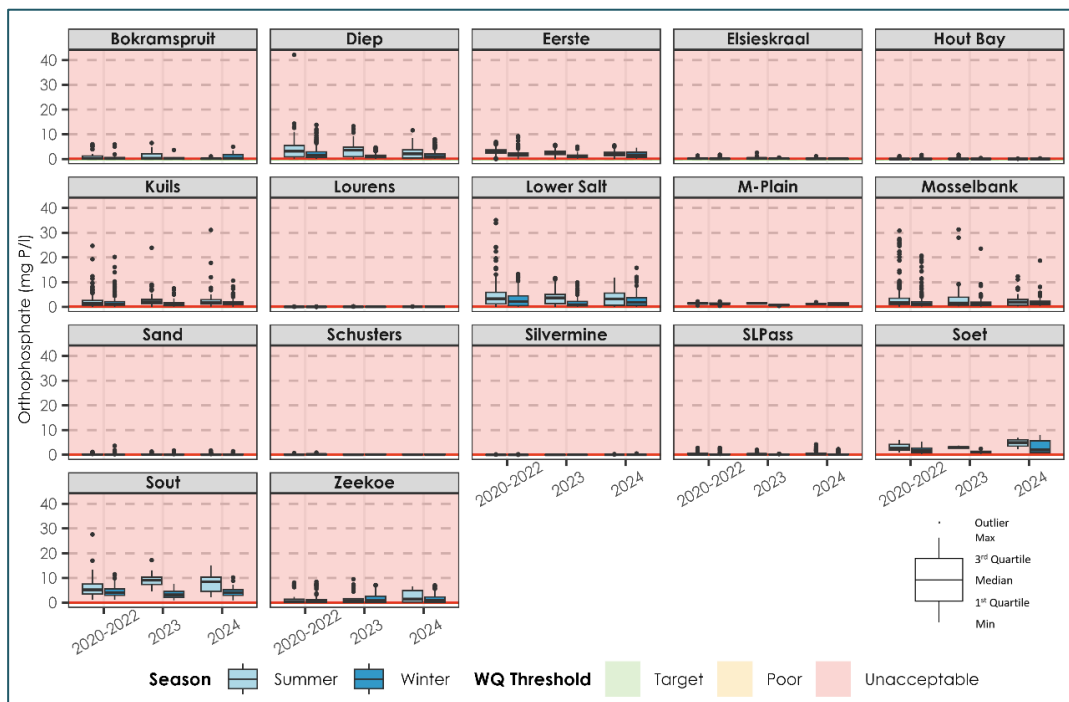
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**Figure 5.3.5**

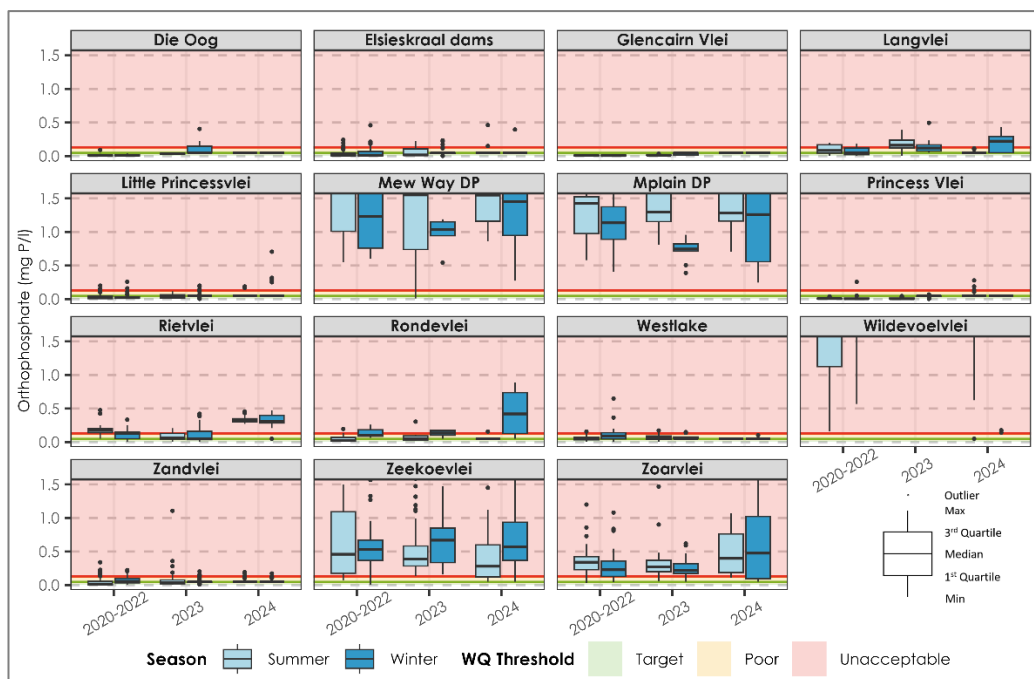
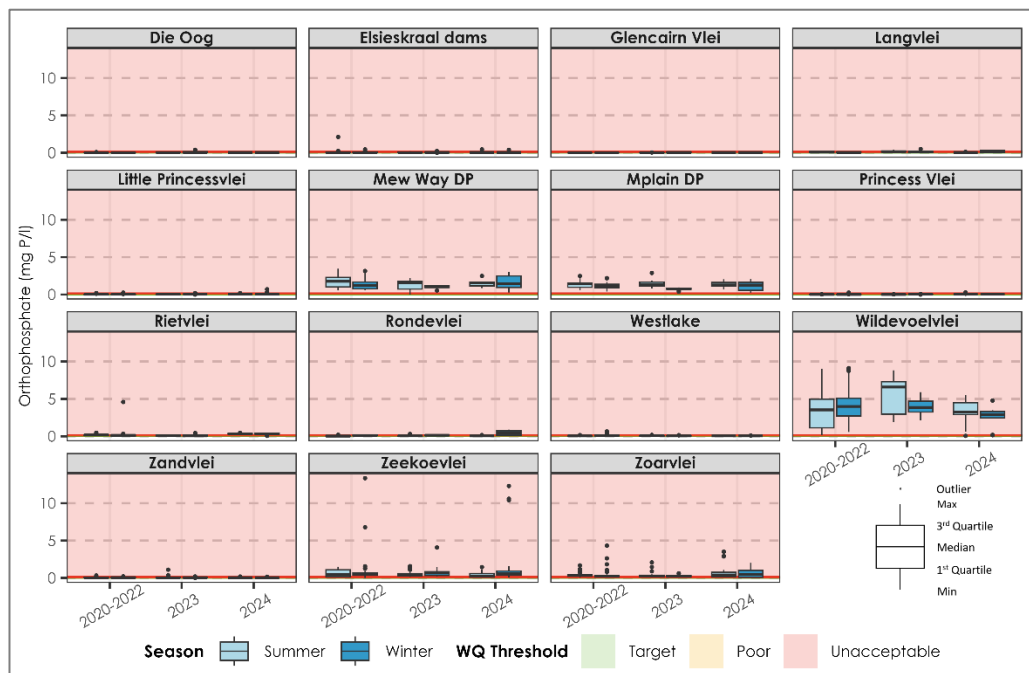
Percentage of orthophosphate (PO<sub>4</sub>-P) samples falling within each rated category for this variable, per monitored standing water system, between 2020 and 2022, and 2023 and 2024 reporting periods. Thresholds for rated categories as defined in Table 3.1 for river systems, given the absence of total phosphorus data for standing water bodies / vleis and detention ponds). Total number of samples considered shown in bars.

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**Figure 5.3.6**

Comparison of orthophosphate (PO<sub>4</sub>-P) data for flowing systems (rivers and stormwater channels) from the 2023 and 2024 reporting periods, with those from the previous three years combined (2020 to 2022). Sub-catchment extent as shown in Figure 2.1. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.1. Bottom figure (arrowed) shows same data at different scale.



**Figure 5.3.7**

Comparison of orthophosphate (PO<sub>4</sub>-P) data for standing water systems from the 2023 and 2024 reporting periods, with those from the previous three years combined (2020 to 2022). Sub-catchment extent as shown in Figure 2.1. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.1, for PO<sub>4</sub>-P and not Tot-P (as in Table 3.2), given the unavailability of total phosphorus data. Bottom figure (arrowed) shows same data at different scale.

### 5.3.7 Nitrogen enrichment in Cape Town's watercourses

As for the previous section, nitrogen enrichment data (reported on as Total Inorganic Nitrogen (TIN)) are presented in this report as both compliance-type data (the proportion of samples in various categories that fall within the Target range for this variable, or are rated as 'Poor' or 'Unacceptable', using the criteria listed in **Tables 3.1 and 3.2**), and as boxplots, which show statistical data for all analysed watercourse groups and categories, allowing consideration of the magnitude of TIN concentrations. These data are again presented separately for flowing water systems (rivers and stormwater channels/ outlets) (**Figures 5.3.8, 5.3.9, 5.3.11 and 5.3.13**), as well as **Figure D1.3 in Appendix D**) and for standing water systems (vleis, dams and detention ponds) **Figures 5.3.10, 5.3.12 and 5.3.14**, as well as **Figure D1.4 in Appendix D**.

- The data show that, as for previously assessed data (i.e. Day et al 2020, Day et al 2023, and Day et al 2024), nitrogen enrichment is generally less problematic in Cape Town's waters than is phosphorus, and TIN data for rivers and stormwater channels, and in particular, standing water bodies (vleis and dams), all showed much higher proportions of samples within the Target range for this variable (**Figures 5.3.8 to 5.3.12**). Nevertheless, the data do indicate that at least in some catchments, nitrogen enrichment was at ecologically problematic levels at times, while other catchments were better performing throughout the year, as is described in the following sections;
- For **rivers / flowing water systems**:
  - Using compliance type reporting (**Figures 5.3.8, 5.3.9 and 5.3.11**), the data showed:
    - Relatively little change in TIN over the 2023 and 2024 reporting periods, compared with the 2020-2022 period, with a slight increase only in the proportion of samples rated Unacceptable in 2024;
    - More specifically, slight improvements were noted between the 2024 reporting period and the 2023 and 2020-2022 periods in the Hout Bay, Bokramspruit, Schusters and Elsieskraal Catchments – the latter showing improvements across the board in its measured water quality variables in 2024;
    - Significant deterioration in the Sir Lowry's Pass Catchment was noted, assumed to correlate with high levels of sewage overflows and informal settlements in the Sir Lowry's Pass Village area, while minor deterioration over time, marked by increasing proportions of samples rated as Unacceptable, were noted in the Eerste and Kuils Catchments. The Sand, Silvermine and Lourens Catchments all showed an increase in samples rated as Poor, rather than Target, albeit with no change in the (low to no) proportion of samples rated as Unacceptable;
    - The best performing catchments with regard to this nutrient in the 2024 reporting period were again the Silvermine, Lourens and Hout Bay Catchments, with no samples rated Unacceptable and over 80% of samples within the Target range – in the case of Hout Bay, the data reflect catchment variability, with the downstream reaches of the Hout Bay River affected by runoff from informal settlements while the upstream river reaches are relatively clean, albeit affected by runoff from horse paddocks, urban agriculture and suburban gardens (see Section 8 for a more detailed spatial discussion of the Hout Bay Catchment);
    - The Bokramspruit, Elsieskraal, Mosselbank, Sand, Schusters and Sout Catchments all showed moderate levels of nitrogen enrichment, with most samples rated as Poor (except in the Mosselbank Catchment, where 55% were rated as Unacceptable in the 2024 reporting period), and all included at least 10% of samples ranked as Acceptable;
    - The only catchments where nitrogen enrichment was consistently at severe problem levels (i.e. > 80% of samples rated Unacceptable) in the 2024 reporting period were the Kuils, Eerste, Mitchell's Plain, Lower Salt and Soet catchments, followed closely by the Zeekoe and Diep Catchments (60-75% Unacceptable)

reflecting high levels of organic waste and raw sewage inflows that dominate watercourses in all of these catchments;

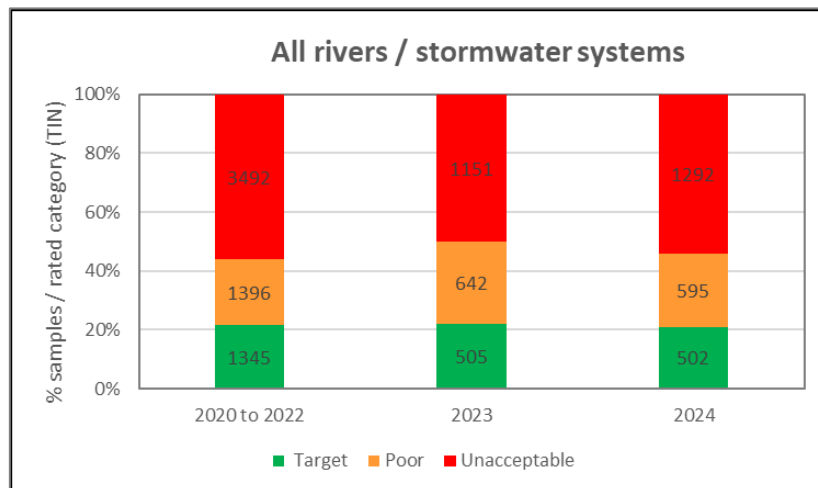
Seasonal data, shown as boxplots in **Figure 5.3.13**, as well as median data without seasonal distinctions, shown in **Table 5.3.1** and Appendix D (**Figure D1.3**) provide further insights into patterns of nitrogen enrichment in Cape Town's flowing water bodies, with known major sources of nitrogen likely to be raw and treated sewage, fertilisers, agricultural waste (livestock) and some industrial processes. The graphs are again useful because they reflect the magnitude of nitrogen enrichment, rather than simply showing the extent of non-compliance (or hypertrophic systems). The available data indicate that:

- Nitrogen was present in Cape Town's waters (measured as TIN) in much higher concentrations than orthophosphate – this is an expected result for this more abundant nutrient;
- The most polluted catchment with regard to nitrogen enrichment was the Soet Catchment, with median TIN in the 2024 reporting period at 31.09 mg N/L and nearly three times the hypertrophic threshold for this nutrient ( $> 10 \text{ mg N /L}$ ), and up by 50% of its 2023 reporting period median;
- Other catchments with high median TIN concentrations, albeit substantially lower than that of the Soet Catchment, comprised the Mitchell's Plain, Lower Salt, Eerste, Kuils and Zeekoe Catchments (median TIN concentrations ranged from 13.53 to 9.81 mg N/L), representative of generally dirty catchments with high levels of organic waste.  $\text{NH}_4\text{:TIN}$  ratios also presented in **Table 5.3.1** show that over 70% of TIN in all of these catchments (and 100% in the case of the Mitchell's Plain system) comprised **ammoniacal nitrogen** rather than oxidized nitrogen (nitrates and nitrites), indicating a system where chemical and biological oxygen demand are likely to be exceedingly high, and oxidation of total ammonia is low compared to its availability. This means that ammonia toxicity is also likely to be a concern in these polluted catchments (DWAF 1996a);
- Catchments where median TIN concentrations were generally rated as Poor rather than Unacceptable, with concentrations  $< 4 \text{ mg N/L}$  (or in the case of the Diep/Mosselbank Catchments, just above) comprised the Mosselbank, Diep, Sout, Elsiekraal, Bokramspuit, Sir Lowry's Pass and Sand Catchments.  $\text{NH}_4\text{:TIN}$  ratios in these catchments were also much lower than in worse-performing catchments, and ranged between 35% (Sand) and 82% (Sout), suggesting that these watercourses have more capacity to deal with the levels of organic and ammoniacal nitrogen enrichment they are exposed to, and that nitrification is more sustainable;
- The catchments least exposed to high levels of nitrogen enrichment comprised (in order of decreasing enrichment) the Lourens, Schusters, Hout Bay and Silvermine Catchments, the median concentrations of all of which were rated as mesotrophic (and within Target). Interestingly, the Hout Bay and Schusters Catchments had  $\text{NH}_4\text{:TIN}$  ratios of 61% and 70% respectively – in the case of the latter, the data probably reflect a naturally wetland-dominated system with slow flows and thus probably inefficient instream nitrification, while in the Hout Bay Catchment, the high loads of organic waste in parts of the catchment and extensive slow-flowing lower river reaches probably also reduce nitrification efficiency relative to load;
- Overall, of the assessed catchments:
  - Median TIN concentrations **decreased** substantially in the 2024 reporting period compared with 2023 in the Bokramspuit and Hout Bay, with the improvement in Hout Bay Catchment water quality also having been reflected in reduced orthophosphate concentrations for this catchment;



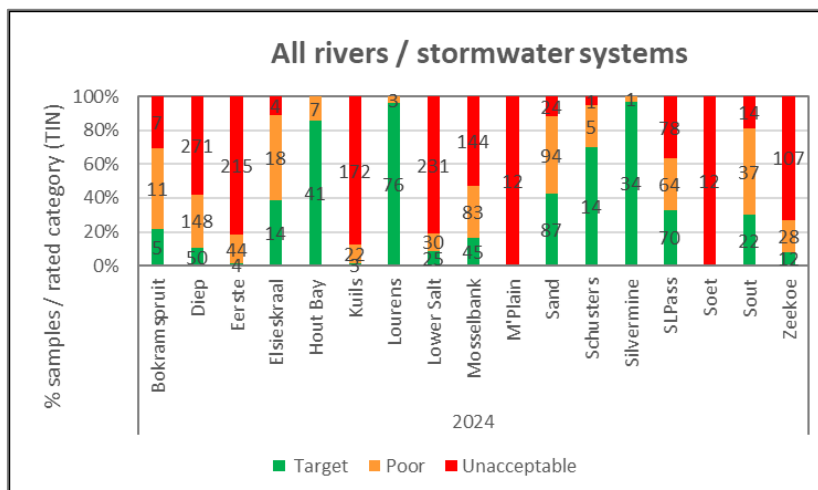
- Median TIN concentrations **increased** substantially in the Eerste, Kuils, Mosselbank, Mitchell's Plain, Sand, Silvermine, Sir Lowry's Pass, Soet and Zeekoe catchments.

The above findings reinforce the message that catchment condition reflects in river water quality, with the least developed catchments having the least impacted water quality while catchments subject to the accumulation of solid waste, treated and untreated sewage inflows and other sources of contaminated stormwater including fertilisers, are characterized by impacted river waters.



**Figure 5.3.8**

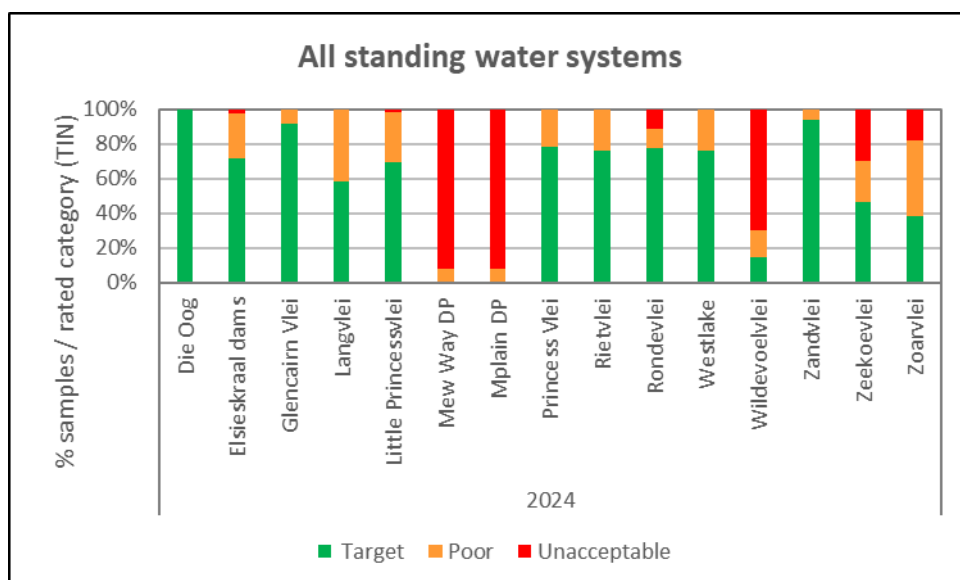
Summary data showing percentage of samples across all City sample sites in flowing systems per catchment (rivers, stormwater channels, stormwater outflows) in rated TIN categories (as per Table 3.1) for reporting periods 2020-2022, 2023 and 2024. Number of samples indicated in figure.



**Figure 5.3.9**

Data showing percentage of samples per catchment in rivers, stormwater channels, stormwater outflows into the sea and other flowing systems, in rated TIN categories categories (as per Table 3.1).

- For **standing water systems (vleis, dams, detention ponds)**:
  - Using compliance type reporting (**Figures 5.3.10 and 5.3.12**), the data showed that:
    - The only waterbodies in which nitrogen enrichment was a significant problem in the 2024 reporting period were the Mew Way and Mitchell's Plain detention ponds in which TIN was in the Unacceptable range in >90% of samples; and Wildevoelvlei (Unacceptable in >70% of samples) in the 2024 reporting period;
    - Data for the Zeekoevlei and Zoarvlei wetlands also showed high levels of nitrogen enrichment, with fewer than 45% of samples from these systems rated as Acceptable – given that Zeekoevlei is a Ramsar wetland site, these data are of great concern;
    - Of the remaining waterbodies, the data suggest that nitrogen enrichment was generally in the Poor to Target range, and not the most significant impact affecting these systems – this is largely because standing water bodies, with their increased detention time and often extensive areas of reedbed and other aquatic vegetation are ideally suited for nitrification and plant-based nitrogen uptake;
  - Seasonal data, shown as boxplots in **Figure 5.3.14**, as well as median data, without seasonal distinctions, shown in **Table 5.3.1** and Appendix D (**Figure D1.4**) provide further insights into patterns of nitrogen enrichment in Cape Town's standing waterbodies. The data indicate that:
    - Wildevoelvlei and the Mew Way and Mitchells Plain detention ponds were by far the most impacted systems with regard to TIN in all of the assessed periods in this report, although **Figure 5.3.14** shows that there was a major reduction in TIN at Wildevoelvlei in the 2024 reporting period (median values reduced from 26.6 mg P/L in 2023 to 6.86 in 2024) – these changes are assumed to relate to improvements in final effluent quality from the Wildevoelvlei WWTW (see Section 5.2);
    - Zeekoevlei and Zoarvlei were the next most enriched of the monitored wetland systems, with elevated median values and interquartile ranges in the Poor range in 2024 (Zoarvlei) and in the 2020-2022, 2023 and 2024 wet seasons (Zeekoevlei);
    - Nitrogen enrichment was generally higher in the winter in most monitored open water bodies, excluding Wildevoelvlei, and is assumed to reflect, as in the case of orthophosphate, surface wash-off of nutrients from often dirty catchments, explaining why these patterns were most evident in the generally dirtier Zeekoevlei and Zoarvlei catchments;
    - **Figure 5.3.15 and Table 5.3.1** highlight the fact that TIN in the Mitchell's Plain and Mew Way detention ponds as well as Wildevoelvlei (summer 2024 reporting period) was primarily in the form of total ammonia rather than oxidized nitrites or nitrates – oxygenation of all of these water bodies would be beneficial in increasing nitrification and thus the oxidation of ammonia to nitrite and nitrate, from where denitrification (transformation of nitrate-nitrogen into nitrogen gas) would be more efficient.



**Figure 5.3.10**  
Data showing percentage of samples per standing water body (vleis, dams and detention ponds) in rated TIN categories (as per Table 3.2)

### 5.3.8 Implications of nitrogen-to-phosphorus ratios

Finally, the ratios of nitrogen (as TIN) to phosphorus (as PO<sub>4</sub>-P) data are presented in **Figure 5.1.10**. These ratios are considered important, because they provide some hint of likely ecosystem responses to different degrees of nutrient enrichment. Aquatic ecosystems that have low N:P ratios (that is, a lot of biologically available phosphorus, compared with nitrogen availability) are more likely to be dominated by plants that are able to extract nitrogen from the air, rather than relying on nitrogen in dissolved compounds in the water. The most common of such plants include cyanophyte (or 'blue-green') algae.

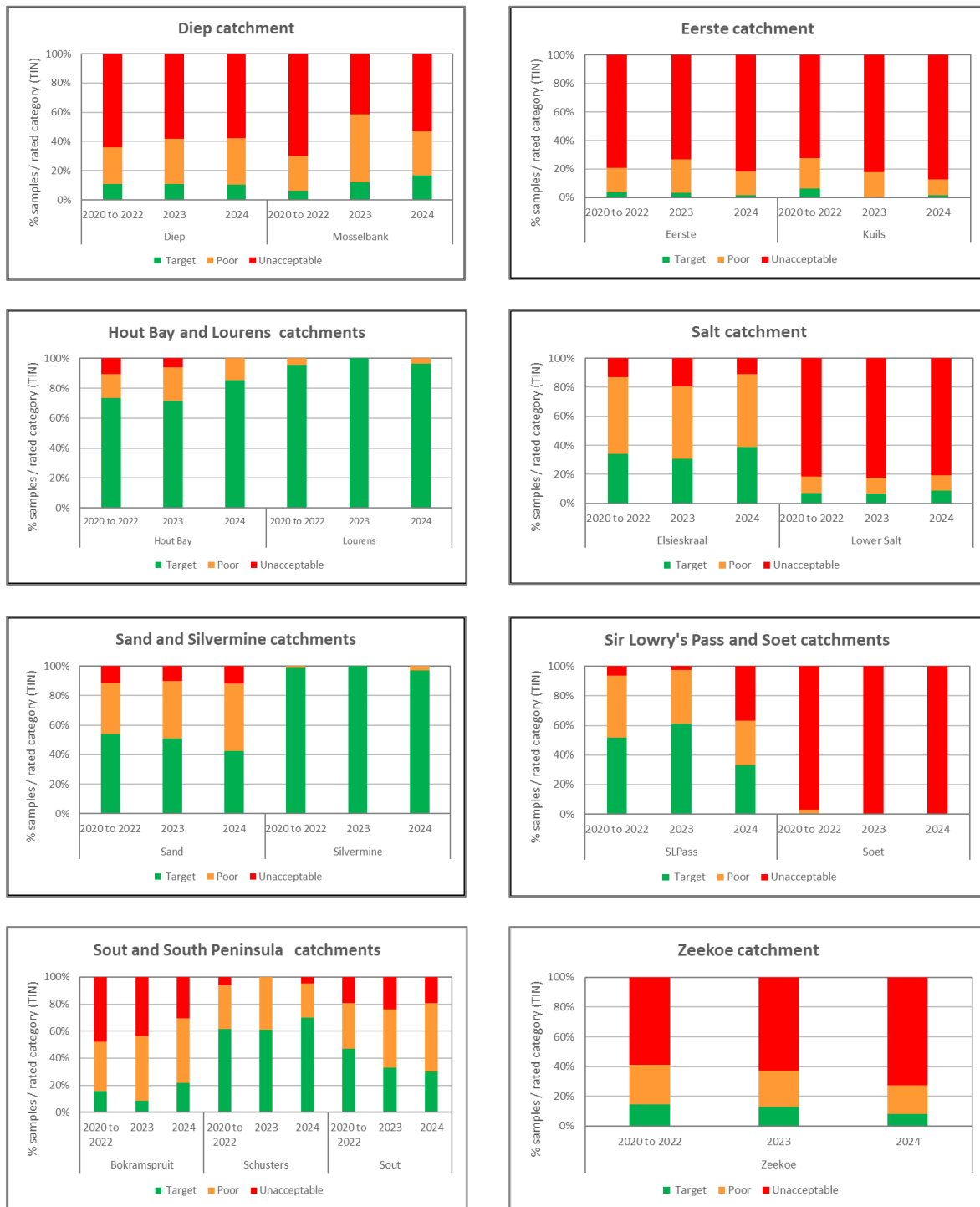
N:P data are presented here only for standing water bodies, where these relationships are more likely to exist than in flowing rivers and stormwater systems, where relatively high flow rates mean that algal growth is often not an issue as a result of low uptake rates in flowing conditions.

The data suggest that:

- Generally, standing water bodies were characterised by low N:P ratios, in the range most likely for these systems to be dominated by blue-green algae rather than rooted plants or other less problematic algal groups;
- In particular, low ratios well below Target values were evident in Wildevoelvlei, the Mew Way and Mitchell's Plain detention ponds, Zeekoevlei, Rondevlei and Zoarvlei (in all three reporting periods shown), suggesting that all of these systems were likely to be affected at least at times by blue-green algal growth. This is discussed further in **Section 6**;

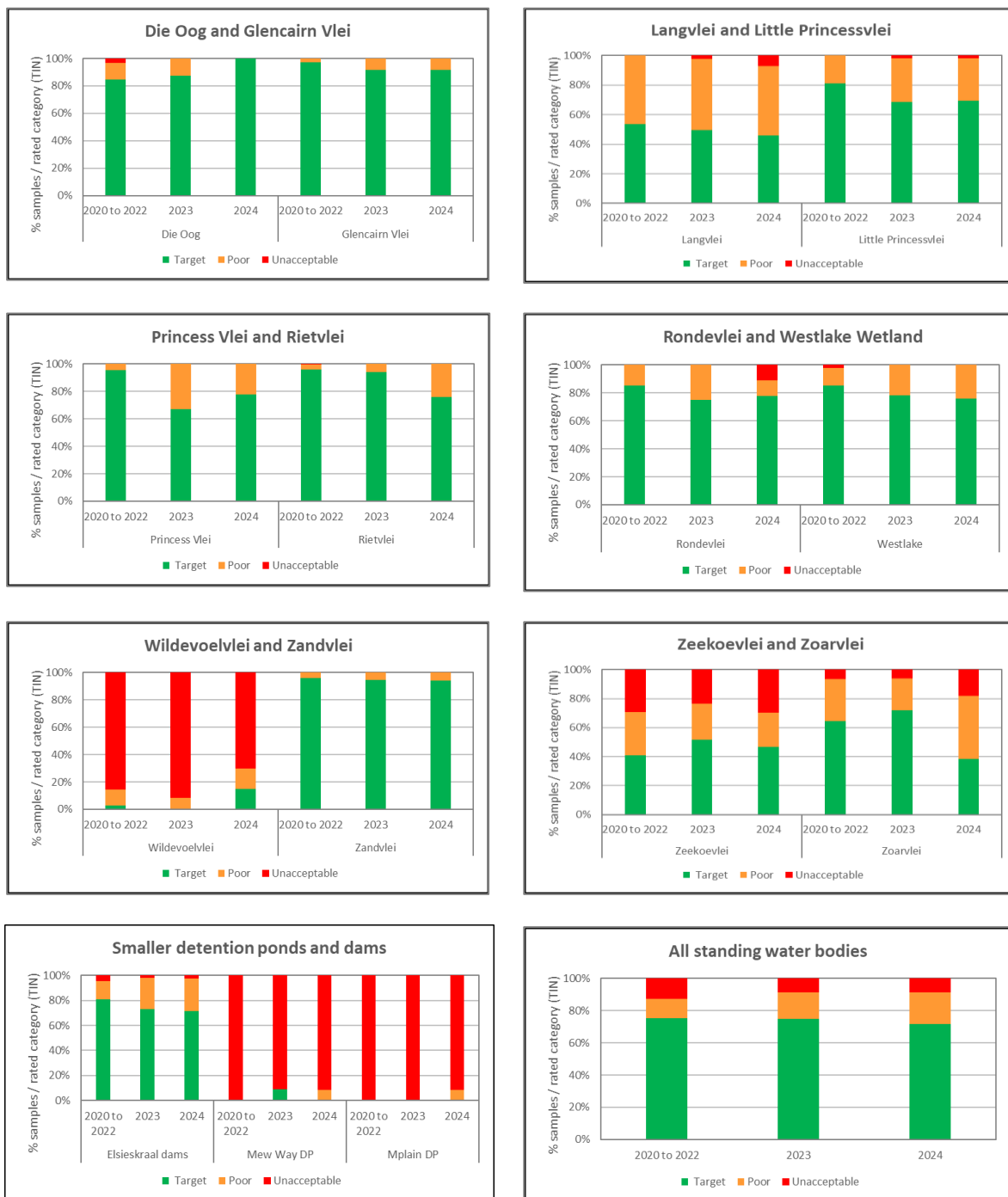
Generally, N:P ratios improved in winter, when orthophosphate usually concentrations reduced as a result of rainfall and groundwater dilution. However, such seasonal changes would be unlikely to drive reduced algal growths, given that lower temperatures and reduced daylight hours would already be factors limiting algal growth in winter.

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**Figure 5.3.11**  
Percentage of Total Inorganic Nitrogen (TIN) samples falling within each rated category for this variable, per sub-catchment. Thresholds for rated categories as defined in Table 3.2. Data for river / 'flowing' water monitoring points in each sub-catchment. Sub-catchments as shown in Figure 2.1.

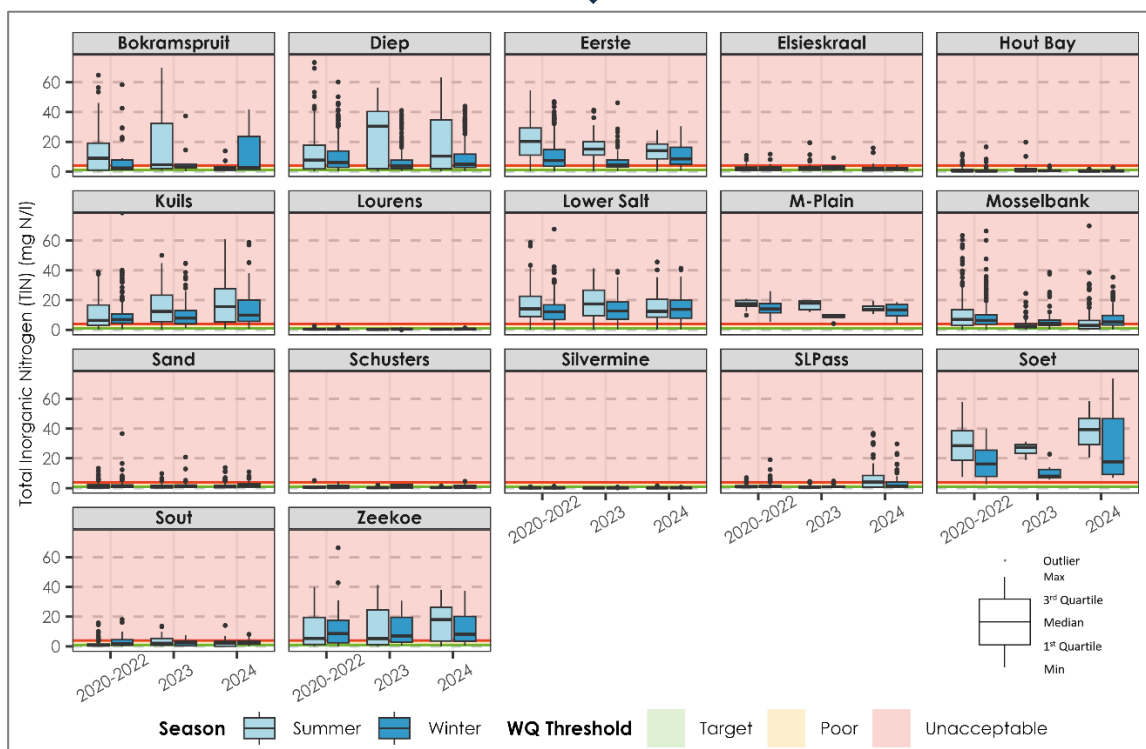
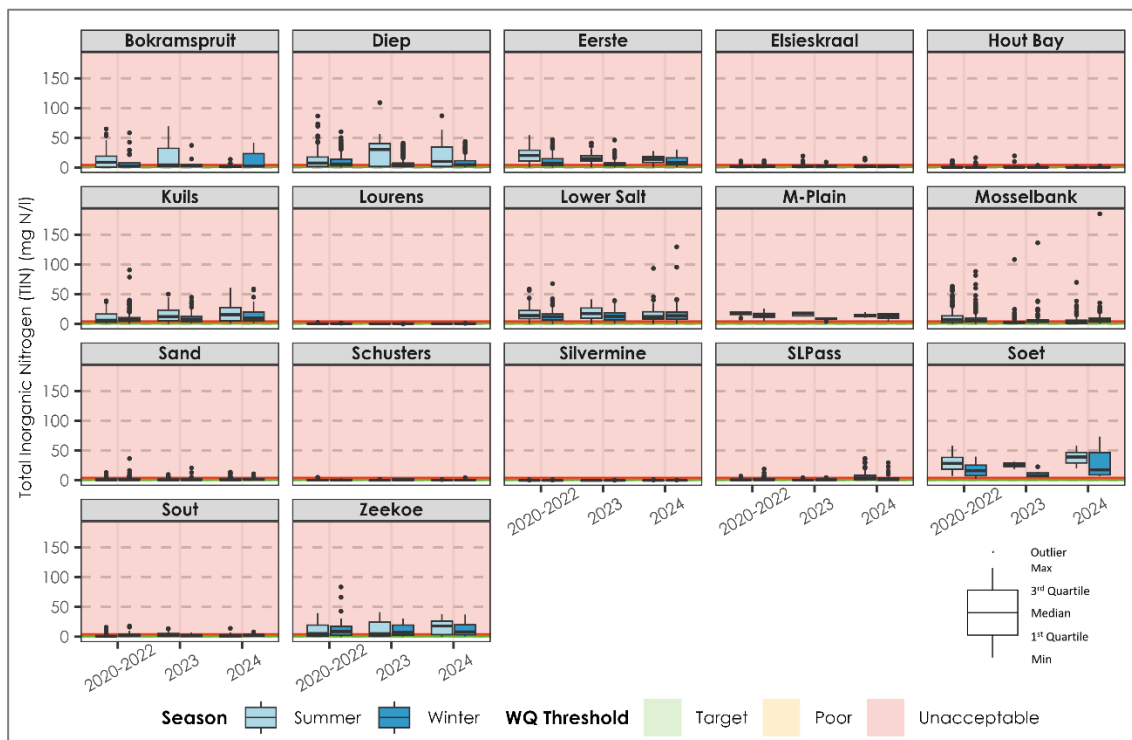
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**Figure 5.3.12**  
Percentage of Total Inorganic Nitrogen (TIN) samples falling within each rated category for this variable, per sub-catchment. Thresholds for rated categories as defined in Table 3.2. Data for standing water systems. All samples considered together in bottom right plot ('All standing water bodies').

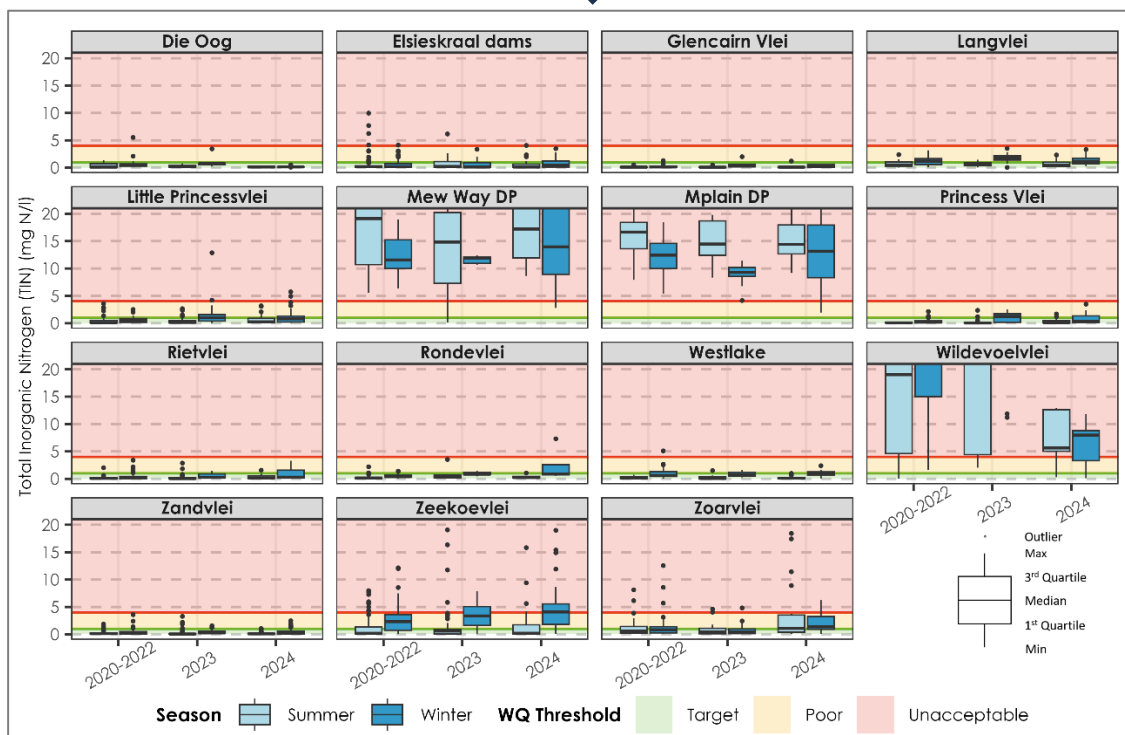
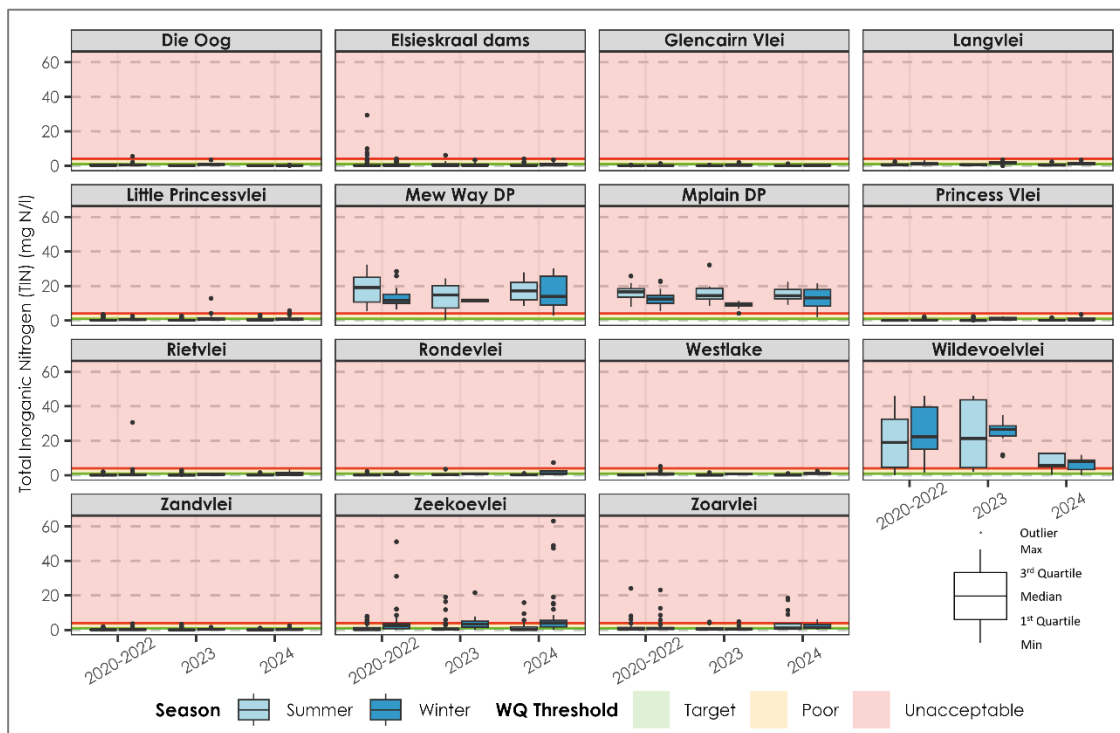


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**Figure 5.3.13**  
Comparison of Total Inorganic Nitrogen (TIN) data for flowing systems (rivers and stormwater channels) from the 2023 and 2024 reporting periods, with those from the previous three years (2020 to 2024) combined. Sub-catchment extent as shown in Figure 2.1. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.1. Bottom figure (arrowed) shows same data at different scale.

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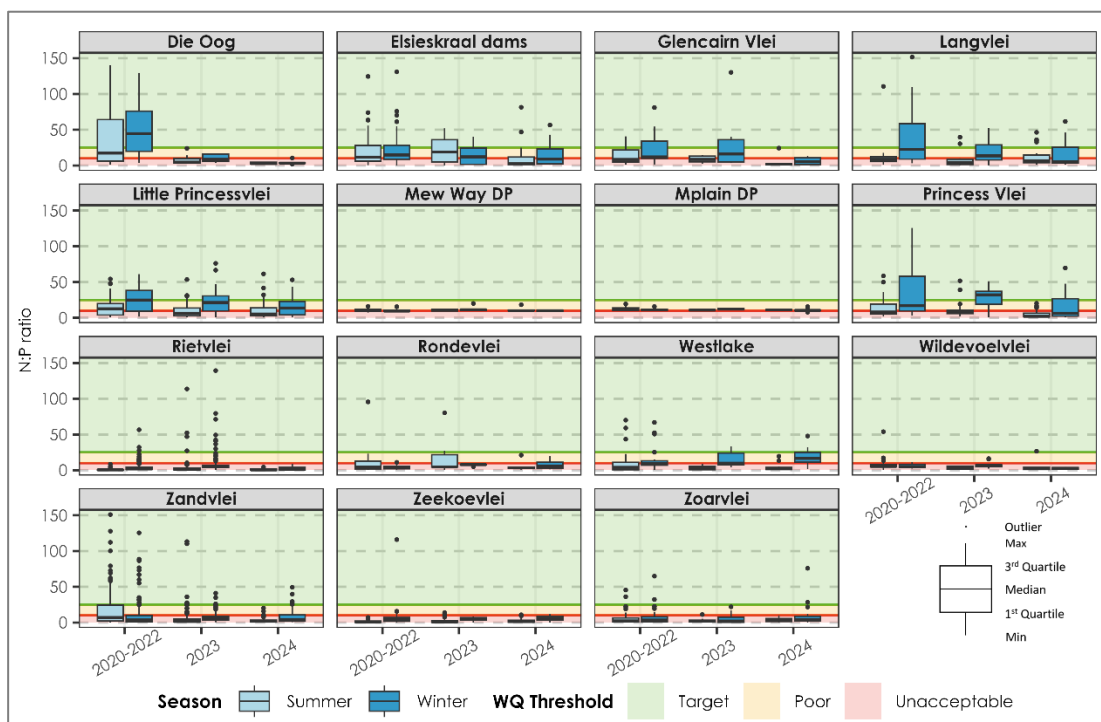


**Figure 5.3.14**

Comparison of Total Inorganic Nitrogen (TIN) data for standing water systems (vleis and dams) from the 2023 and 2024 reporting periods, with those from the previous three years combined (2020 to 2022 reporting periods). Sub-catchment extent as shown in Figure 2.1. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.1. Bottom figure (arrowed) shows same data at different scale.



**Figure 5.3.15**  
Ratio of total ammoniacal nitrogen (NH<sub>4</sub>-N) to Total Inorganic Nitrogen (TIN) data for flowing water systems (top graphs) and standing water systems (vleis and dams) (bottom graphs) from the 2023 and 2024 reporting periods, with those from the previous three years combined (2020 to 2022). Sub-catchment extent as shown in Figure 2.1. Data analysed as summer and winter datasets.



**Figure 5.3.16**

**Comparison of ratios of Total Inorganic Nitrogen (TIN) to orthophosphate phosphorus (PO<sub>4</sub>-P) for standing water systems (vleis, dams and detention ponds) from the 2024 reporting period, with those from 2023 and the previous three years (2020 to 2022) combined. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.2.**

### 5.3.9 Key take-away points from assessment of nutrient data

- As noted in previous Annual Inland Water Quality Reports, **phosphorus enrichment** remains a key concern, affecting the condition of all of Cape Town's watercourses and with no real improvement evidenced in the 2024 reporting period, where 77% of "flowing" (river / stormwater) samples were rated "Unacceptable" (hypertrophic) and median orthophosphate concentrations lay well above the hypertrophic threshold for this variable in all catchments save the Lourens and Silvermine Catchments. Consideration of orthophosphate data provided the following particular insights:
  - The worst-performing **catchments** comprised the Mosselbank, Mitchell's Plain, Soet, Sout, Eerste, Kuils, Diep, Lower Salt and Zeekoe Catchments, all characterised by high levels of informal settlements in at least some areas; rivers that are exposed to frequent sewage pump station overflows and sewage spills; and inflows from poorly performing WWTWs – median orthophosphate concentrations in these catchment were more than an order of magnitude above the lower threshold for Unacceptable ratings;
  - Marked increases in orthophosphate concentrations in the Lower Salt, Mosselbank, Soet and Zeekoe Catchments in the 2024 reporting period compared with previous years have been noted with concern. In the Zeekoe Catchment in particular, the important Ramsar wetlands downstream (Zeekoevlei and Rondevlei) are particularly vulnerable to the ongoing impacts of eutrophication;
  - The best-performing catchments were the Hout Bay, Silvermine and Lourens catchments, all of which had <10% samples in the Unacceptable range - with the exception of Hout Bay, impacted by informal settlements in its lower reaches, these data reflect catchments with generally low levels of urban settlement, little to no informal or backyard settlements, an absence of WWTW inflows, and extensive

mountain catchments that receive high quality runoff. Nevertheless, some deterioration in water quality in the Silvermine Catchment has been flagged as a concern, with a (still small) increase in the frequency of Unacceptable ratings in the 2024 reporting period compared with previous years;

- Summer orthophosphate concentrations were generally the highest, reflecting evapo-concentration in rivers, as well as the fact that, in many systems, the only water flowing in the rivers in summer derived from treated or untreated sewage effluent, "grey" water from unserviced households and illegal discharges;
  - Exceptions to the above were the Bokramspruit (2024), Soet (2024) and Zeekoe (2023) Catchments, where winter concentrations were highest and in which rainfall events outside of major floods may serve simply to wash more pollutants into the rivers, rather than diluting them;
  - Of Cape Town's **standing water systems** (vleis, wetlands and detention ponds), the data showed that they were all highly phosphorus nutrient-enriched, reflecting inflows from significantly more polluted rivers and stormwater systems, which load standing water bodies with nutrients that accumulate over time, in the water bodies themselves, as well as in bottom sediments and living plant material.
  - The overall proportion of samples rated as Unacceptable (i.e. in the hypertrophic range) increased between the 2023 and 2024 reporting periods, with deterioration in the condition of Rietvlei flagged as of particular concern;
  - The costs of the marked orthophosphate enrichment in many of Cape Town's rivers are furthermore reflected in the high costs of removal of reeds as well as alien aquatic vegetation such as water hyacinth, which clog watercourses; increase flood risk; and reduce indigenous biodiversity – the report notes the different scales of intervention required to bring about measurable improvement in the condition of assessed wetlands, noting that in some cases, catchment-scale interventions are required (e.g. Zeekoevlei);
  - The lack of equipment to measure total phosphorus and the SSB's current high Limit of Quantification (LOQ) for orthophosphate, which leads to automatic classification of samples as "Poor," have both been flagged as major concerns that limit the City's ability to track water quality trends accurately, respectively in standing water bodies and particularly in the more sensitive catchments in better condition.
- With regard to **nitrogen enrichment** in Cape Town's watercourses:
    - Nitrogen enrichment, measured as Total Inorganic Nitrogen (TIN), was generally less severe than phosphorus pollution across Cape Town's water systems;
    - Nevertheless, in the 2024 reporting period, 54% of water quality samples from routinely monitored river / stormwater sites were rated Unacceptable with regard to their TIN concentrations (a four percent increase from 2023 data), indicating that, while phosphorus is considered more problematic than nitrogen in driving ecosystems responses to eutrophication nitrogen enrichment is also at levels of concern in many parts of Cape Town's watercourses;
    - Standing water bodies (vleis, dams) showed higher compliance with TIN targets than rivers and stormwater systems, with only 8% of samples rated Unacceptable in the 2024 reporting period;
    - These problem 8% of samples were located primarily in the highly polluted Mitchell's Plain and Mew Way detention ponds, Wildevleivlei, Zeekoevlei, Zoarvlei and Rondevlei, while TIN in the smaller vleis and wetlands was generally in the Poor to



Target range;

- The ratio of TIN that comprises total ammoniacal nitrogen (NH<sub>4</sub>-N) is also an important measure considered in this report. That is because total ammoniacal nitrogen includes a proportion of un-ionised ammonia (NH<sub>3</sub>), which can be toxic to some aquatic biota at relatively low concentrations. Hence its dominance in TIN can reflect problems in ecosystem health (or condition). Generally less-nutrient enriched rivers had lower NH<sub>4</sub>-N;TIN ratios, suggesting that where TIN loads are lower, more efficient nitrification takes place. TIN was mostly in its ammoniacal nitrogen form in the worst-performing vleis / ponds, with associated likely ammonia toxicity at times;
- Most standing water bodies also had low N:P ratios, indicating their susceptibility to blue-green algae blooms, with those most at risk being Wildevleivlei, Zeekoevlei, Zoarvlei, Rondevlei, Zandvlei, Rietvlei and the Mew Way and Mitchell's Plain detention ponds; while vleis such as Little Princessvlei and Princess Vlei were likely to be more resilient;

The above findings highlight how catchment condition reflects in river water quality, with the least developed catchments usually having the least impacted water quality while catchments subject to the accumulation of organic waste, treated and untreated sewage inflows and other sources of contaminated stormwater including fertilisers, are characterized by impacted river waters.

## 5.4 Chlorophyll-a

Chlorophyll-a is a pigment that occurs in green plants and is one of the primary pigments used in photosynthesis. In water quality assessments, it is used as a measure of algal growth, specifically of phytoplankton abundance.

The City monitors chlorophyll-a in many of its standing water systems. This section considers these data from the perspective of its value as an indicator of ecosystem health.

### 5.4.1 Relevance in water quality monitoring

Under conditions of nutrient enrichment, particularly of phosphorus, chlorophyll-a often increases, reflecting an increase in algal growth rates in response to increased nutrients. If nutrient-enriched systems are dominated by macrophytes (that is, more complex plants than single-celled or filamentous algae, such as pondweed or water hyacinth), they are less likely to be dominated by algae or give rise to algal blooms.

The sudden growth and subsequent die-back or simple turnover of phytoplankton blooms can have significant negative ecological impacts, as bloom decomposition may create anoxic conditions that may result in fish deaths. Anoxia also promotes the release of phosphorus from sediments, as well as hydrogen sulphide in the case of estuaries.

Blooms of blue-green algae (also called cyanobacteria or cyanophytes) are usually associated with very high nutrient concentrations. In large concentrations, they form thick, unsightly scums, which may be odorous and at times can produce toxins that cause skin irritations on contact with water, or vomiting, acute gastroenteritis and impaired liver function if ingested (DWAF 2006b). Algal blooms are often associated with super-saturated dissolved oxygen concentrations (>100% saturation) during the day, as a result of oxygen being released through photosynthesis. At night, however, oxygen-demanding respiration by the algae in the absence of sunlight typically leads to very low dissolved oxygen concentrations in the waterbody where such a bloom is present.

Severely elevated chlorophyll-a concentrations, indicative of bloom conditions, have a range of implications for waterbody management. Not only do they contribute to the accumulation of nutrients, organic sludges (requiring periodic dredging) and low-oxygen water in bottom waters, but they can also be associated with odour and aesthetic problems. *Microcystis*, for example, which is the dominant blue-green algal species in some of Cape Town's waterbodies, produces a distinctive foul smell under bloom conditions. The visible presence of green algal scums is also unpleasant, and persistent bloom conditions in waterbodies can affect property value and the suitability of the waterbody for different kinds of recreational uses. This issue is discussed in **Section 6**.

### 5.4.2 Current state and recent trajectory of change

Chlorophyll-a (Chl-a) data for standing waterbodies are presented primarily as compliance-type graphs, showing the proportion of samples from the reporting years under consideration that fall within the Target range, or are rated as 'Poor' or 'Unacceptable' (according to the toxicity criteria listed in **Tables 3.1 and 3.2**). In addition, the data are summarised in the form of boxplots (explained in **Box 3.7**). Seasonal boxplots are shown in this section, while the annual boxplots are provided in **Appendix D**.

#### Box 5.4.1

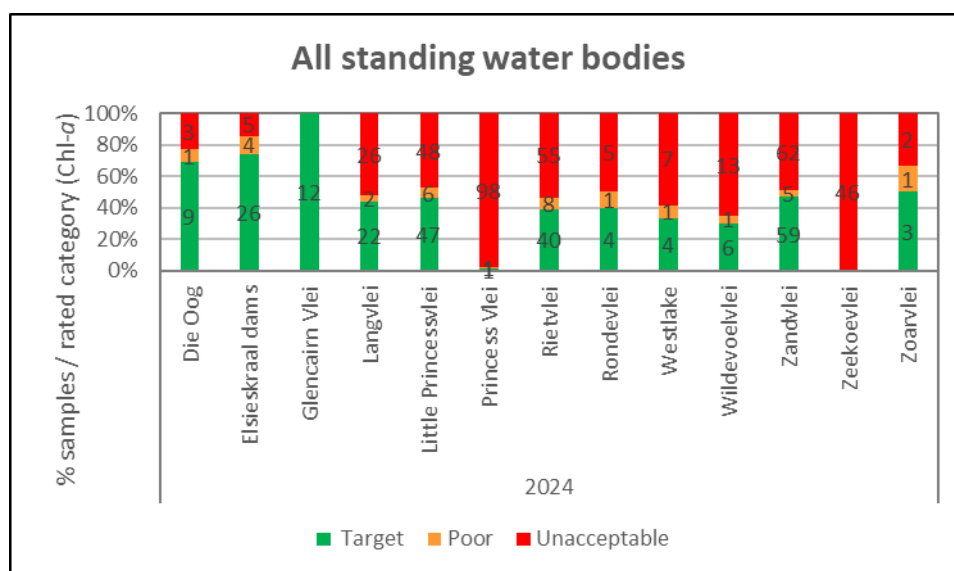
Note that mean annual Chl-a concentrations at individual monitoring points in each waterbody can be seen in **Appendix C**, as well as (for priority catchments) in the maps in **Section 8** for each catchment.

The compliance graphs for Chl-a concentrations in **standing water systems** (at vlei, dam and detention pond sites) (**Figures 5.4.1 & 5.4.2**) indicate that:

- The least problematic system was Glencairn Vlei, where all of the samples had Chl-a readings within the Target range for all three reporting periods;
- None of the other monitored waterbodies showed consistently good conditions (with close to or more than 80% compliance in terms of the Target range for Chl-a) in Reporting Years 2023 or

2024, and such conditions were only recorded for the Elsieskraal Dams in the 2020-2022 reporting period;

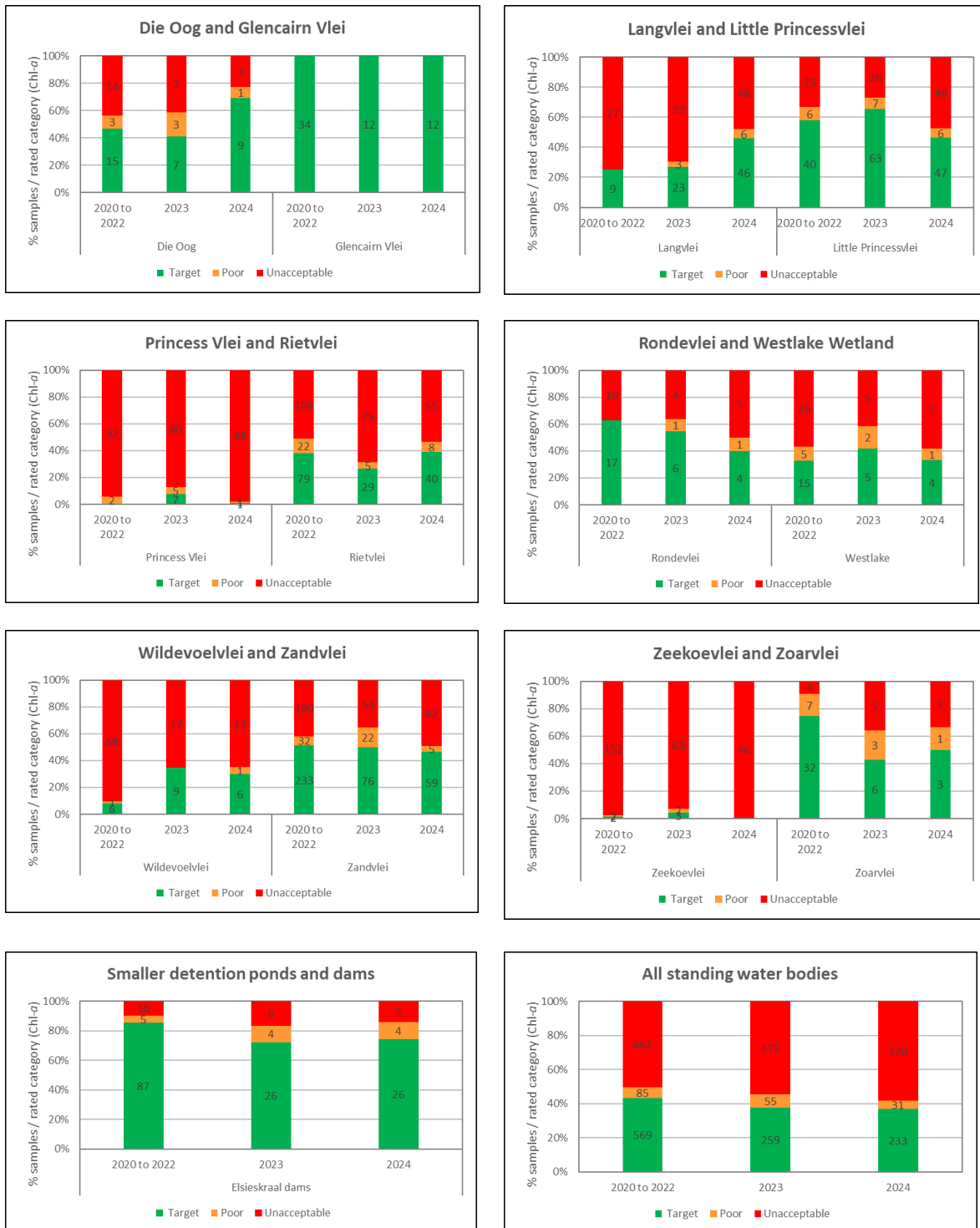
- Relatively high levels of compliance ( $\geq 60\%$  but  $< 80\%$  in Target category for Chl-a) were only recorded for Die Oog and the Elsieskraal Dams in Reporting Year 2024, with similar levels of compliance recorded previously for the Elsieskraal Dams and Little Princess Vlei in 2023, and at Rondevlei and Zoarvlei in the 2020-2022 reporting period;
- The most problematic systems in Reporting Year 2024 (with a similar situation in 2023 and in the 2020-2022 reporting period) were Zeekoevlei and Princess Vlei, where 85 to 100% of the samples that were collected fell into the Unacceptable category for Chl-a (i.e.,  $> 30 \mu\text{g/L}$ ), suggesting that the risk of algal blooms would have been particularly high in these waterbodies during the 2024 reporting period (as was the case in the 2023 and 2020-2022 reporting periods);
- The situation was also problematic in terms of Chl-a levels at Wildevoelvlei, Westlake and Rietvlei in Reporting Year 2024, with 60% or more of the samples in the Poor and Unacceptable categories combined;
- The situation improved significantly in Reporting Year 2024, compared to 2023, at Die Oog, Langvlei and Rietvlei, with 15-20% more samples in the Target category for Chl-a and/or 15-20% less samples in the Unacceptable category (but  $> 50\%$  of the samples were still outside of the Target range in the case of Langvlei and Rietvlei);
- Conversely, the situation declined by 15-20% in Reporting Year 2024, compared to 2023, in terms of Chl-a compliance at Little Princess Vlei, Rondevlei and Westlake;
- Considering all the data from standing water systems together (graph in bottom right panel of **Figure 5.4.2**), it can be seen that there was a similar proportion of samples within the Target range for Chl-a (i.e.,  $< 20 \mu\text{g/L}$ ) in Reporting Years 2023 and 2024, at only 35 to 40%, which was slightly less than the proportion of 40-45% recorded for Reporting Years 2020-2022.



**Figure 5.4.1**

**Percentage of samples falling within each rated category for chlorophyll-a (Chl-a) in Reporting Year 2024, per monitored standing waterbody. Thresholds for rated categories as defined in Table 3.3. Total number of samples considered shown in bars of each plot**

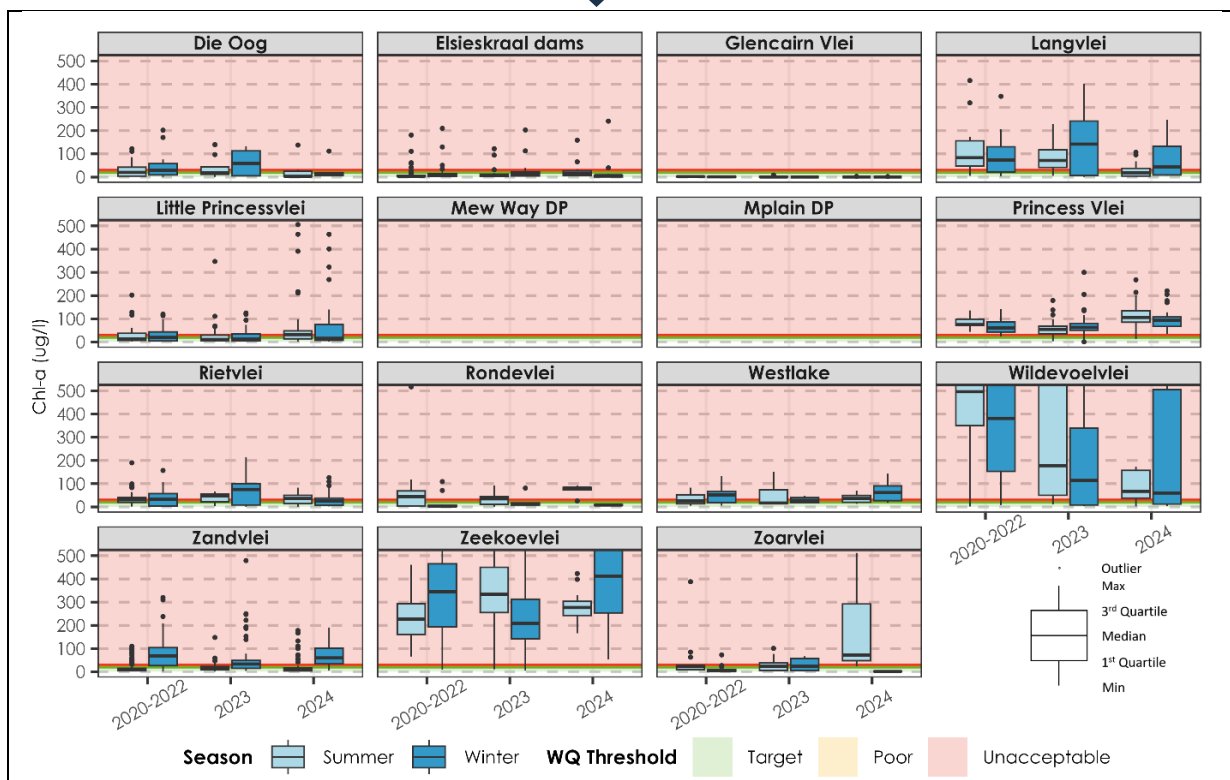
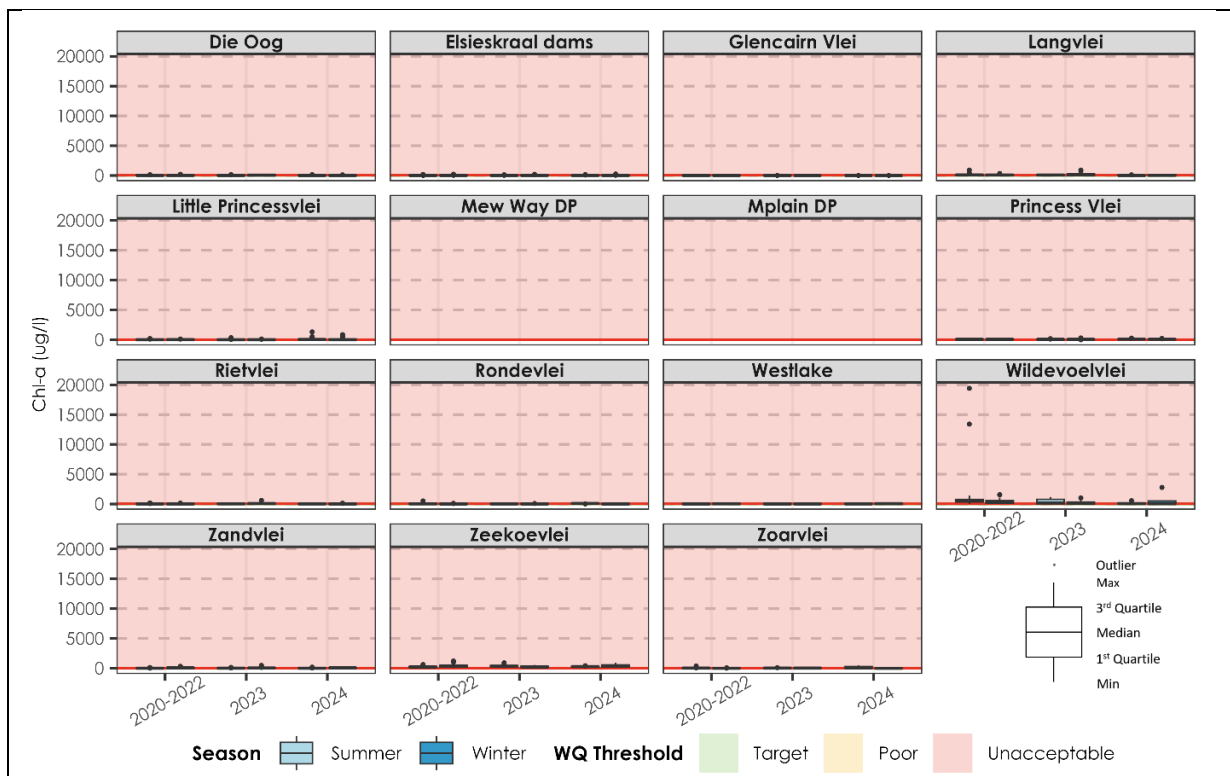
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**Figure 5.4.2**

Percentage of samples falling within each rated category for chlorophyll-a (Chl-a), per monitored standing waterbody, comparing Reporting Years 2020-2022, 2023 and 2024. Thresholds for rated categories as defined in Table 3.3. Total number of samples considered shown in bars of each plot.

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**Figure 5.4.3**

Comparison of chlorophyll-a data for standing water systems (vleis, dams and detention ponds) from Reporting Year 2024 with those from 2023 and the previous three years (2020 to 2022) combined. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.3. Closer view (reduced y-axis) shown in bottom figure. Note that there are no data for Mew Way DP and Mplain DP



The seasonal boxplots for Chl-a in **Figure 5.4.3** (and the annual boxplots in **Appendix D**) provide the following additional insight in relation to the potential for algal blooms in standing waterbodies during the reporting periods under consideration:

- The only system with Chl-a levels consistently within the Target range (i.e., <20 µg/L), irrespective of season, was Glencairn Vlei in all three reporting periods;
- At the Elsieskraal Dams in all three reporting periods, and at Die Oog in Reporting Year 2024 and Zoarvlei in the 2020-2022 reporting period, Chl-a levels were consistently below the threshold for Unacceptable (i.e., <30 µg/L), irrespective of season, as indicated by the inter-quartile ranges on the annual and seasonal boxplots;
- During all three reporting periods, the range of Chl-a values recorded in both summer and winter was significantly greater at Wildevoelvlei and Zeekoevlei, followed by Langvlei, compared to the other monitored waterbodies, as shown by longer boxes and whiskers on the respective boxplots;
- No consistent seasonal pattern was observed across the monitored waterbodies, which was somewhat surprising because algal production is generally lower during the colder winter months and should result in mostly lower Chl-a measurements compared to those recorded in summer.
- Contrasting seasonal patterns were, however, observed at Rondevlei and Zandvlei, with higher Chl-a values and a wider range of values recorded in summer for all three reporting periods at Rondevlei (median in Unacceptable category in summer and in the Target category for winter), versus the reverse pattern at Zandvlei in all three reporting periods (with higher Chl-a values and a wider range in winter, corresponding to median values in the Unacceptable category, compared to median values in the Target category for summer).

### **5.4.3 Key take-away points from assessment of Chlorophyll-a data**

The main findings in terms of algal productivity, as reflected in chlorophyll-a measurements recorded for the selection of standing waterbodies in Cape Town during the reporting periods under consideration, were:

- Considering all the data from standing water systems together, only 35 to 40% of the samples were within the Target range for Chl-a in Reporting Years 2023 and 2024, which was slightly less than the proportion of 40-45% recorded for the 2020-2022 reporting period;
- The least problematic system was Glencairn Vlei, where all of the samples had Chl-a readings within the Target range for all three reporting periods, whereas none of the other monitored waterbodies in the City showed consistently good conditions Reporting Years 2023 or 2024;
- The most problematic systems, where the risk of algal blooms would have been high during Reporting Year 2024 and the previous reporting periods being considered, were Zeekoevlei, Princess Vlei and Wildevoelvlei;
- The situation was also problematic in terms of Chl-a levels at Westlake and Rietvlei in Reporting Year 2024, with 60% or more of the samples in the Poor and Unacceptable categories combined;
- A significant improvement of 15-20% in terms of Chl-a compliance was recorded in Reporting Year 2024, compared to 2023, at Die Oog, Langvlei and Rietvlei (although >50% of the samples were still outside of the Target range in the case of Langvlei and Rietvlei), while a 15-20% decline in compliance was recorded at Little Princess Vlei, Rondevlei and Westlake for Reporting Year 2024 compared to 2023;
- The only waterbodies that showed a consistent but contrasting seasonal pattern in recorded Chl-a concentrations were Rondevlei and Zandvlei, with higher Chl-a values and a wider range of values recorded in summer for all three reporting periods at Rondevlei, and the reverse at Zandvlei.

## 5.5 Dissolved oxygen

### 5.5.1 Relevance in water quality monitoring

Oxygen is critical for the respiration of all aerobic organisms, and, in aquatic ecosystems, adequate supplies of dissolved oxygen are needed for the survival of all non-air-breathing organisms. In aquatic ecosystems, it is sourced from atmospheric oxygen which dissolves in water, particularly if there is turbulent flow or wind-generated waves. It is also generated by submerged aquatic plants and algae during photosynthesis.

Low oxygen availability, particularly if combined with high temperature, can compound impacts on aquatic organisms, and can increase the toxicity of certain toxic substances such as various heavy metals (e.g. zinc, lead, copper) as well as sulphides and ammonia (DWA 1996a). In conditions where dissolved oxygen is limited, important nutrient cycling may be retarded – for example, oxidation of ammonia ( $\text{NH}_3$ ) to Nitrite ( $\text{NO}_2^-$ ) and then Nitrate ( $\text{NO}_3^-$ ) may occur only very slowly, resulting in the accumulation of potentially toxic un-ionised ammonia. This is especially problematic for aquatic systems that are polluted with nitrogen-rich contaminants such as sewage. In standing waterbodies (e.g. vleis and dams), oxygen concentrations are also important in determining phosphorus release from sediments. At low oxygen concentrations, phosphorus can be released as biologically available orthophosphates, contributing to ongoing cycles of increased plant productivity (Cooke *et al.* 2005).

Dissolved oxygen concentrations vary with temperature and salinity/conductivity. Variations in photosynthesis through the day means that concentrations of dissolved oxygen also vary on a daily basis, with the highest concentrations occurring in mid-afternoon and lowest concentrations usually occurring near dawn. Consequently, the measurement of dissolved oxygen in water quality monitoring programmes should be carried out at the same time of day if data between sites or over time are to be comparable. Since the City's sampling programme follows a strict order of sampling, it is assumed that samples are indeed collected at approximately the same time in each sampling cycle.

Exposure to water with very low dissolved oxygen concentrations can trigger immediate death for some non-air-breathing organisms, as in the case of some fish kill incidents. Continuous exposure to water with non-lethal but sub-optimal concentrations may also be very harmful to aquatic organisms, including impacts on fish fecundity and/or mortality (DWA 1996a). Dissolved oxygen concentrations greater than that in air (i.e., super-saturated or >100% dissolved oxygen percentage saturation) can occur in waterbodies dominated by algae or aquatic plants, as a result of photosynthesis during the day. Although super-saturated DO concentrations are not, in and of themselves, as problematic as low DO concentrations, waterbodies with very high daytime DO levels due to photosynthesis will generally experience concomitantly low DO levels at night as a result of respiration by the algae and/or aquatic plants that drive the high daytime levels.

#### Box 5.5.1

##### Dissolved oxygen in open waterbodies

In shallow standing water systems, dissolved oxygen concentrations can be reduced (i.e., made worse) by:

- Re-suspension of anoxic sediments as a result of wind-induced turbulence;
- The presence of oxidisable organic matter (e.g. decaying plant matter);
- High concentrations of suspended material, especially phytoplankton.

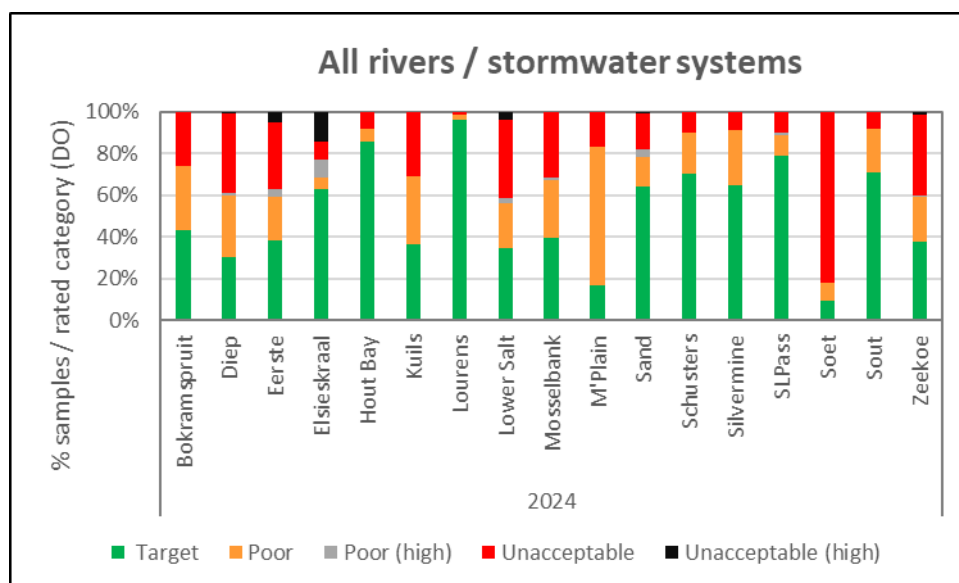
### 5.5.2 Current state and recent trajectory of change

In this section, dissolved oxygen is considered from the perspective of the degree to which suppressed dissolved oxygen concentrations (and super-saturated daytime concentrations) are likely to have contributed to aquatic ecosystem degradation at sampling sites. The next section (**Section 5.6**) considers ammonia toxicity as a potential issue in Cape Town's waterbodies. Total ammonia concentrations are directly affected by dissolved oxygen concentrations. This is because, with low DO availability, nitrification processes are slow to non-existent, and decomposing organic nitrogen remains as total ammonia nitrogen and does not oxidise readily to nitrites or nitrates.

The compliance graphs in **Figures 5.5.1 to 5.5.4** present data for dissolved oxygen concentrations in terms of the percentage of samples (per catchment or standing waterbody) in each reporting period that did not meet the minimum lower threshold of ecological acceptability – that is, a threshold concentration of 4 mg/l, below which DWAF (1996) suggests acute effects of oxygen scarcity would be expected if such conditions persisted for a day or more. The graphs also show the percentage of samples in each reporting period that are considered to be representative of poor conditions in terms of dissolved oxygen (i.e., concentrations of 4-6 mg/l) and the percentage of samples in the target range for dissolved oxygen concentration (i.e., 6-12 mg/l) during each reporting period. In addition, the compliance graphs show the percentage of samples in each reporting period with super-saturated DO concentrations considered to be Unacceptable (high) at >12 to 15 mg/l and Poor (high) at >15 mg/l.

The graphs for **river and stormwater channel sites, grouped by catchment, for Reporting Year 2024 (Figure 5.5.1)** indicate that, in terms of DO concentrations:

- The worst-performing catchment with respect to DO compliance in flowing systems was the Soet, where >80% of the samples collected in Reporting Year 2024 were in the Unacceptable category and <10% in the Target range for DO concentrations;
- Low to very low DO levels were also prevalent (with 60% or more of the samples falling into the Poor and Unacceptable categories combined) in the Diep, Eerste, Kuils, Lower Salt, Mosselbank, Mitchell's Plain and Zeekoe catchments in Reporting Year 2024 (with close to 40% of the samples in the Unacceptable category in the Diep, Eerste, Lower Salt and Zeekoe catchments);
- High DO levels within the Target range (reflective of good conditions) were recorded in >80% of the samples collected from the Hout Bay and Lourens catchments in Reporting Year 2024;
- Relatively high proportions (60-80%) of the flowing-water samples were within the Target range for DO concentrations, with <20% of recorded measurements in the Unacceptable category, in the Sand, Schusters, Silvermine, Sir Lowry's Pass and Sout catchments during Reporting Year 2024;
- More than 20% of the samples collected from flowing-water sites within the Elsiekraal catchment during Reporting Year 2024 were within the Unacceptable (high) and Poor (high) categories, combined, reflective of super-saturated DO concentrations, with such conditions also recorded for close to 10% of the samples in the Eerste catchment and approximately 5% of the samples in the Lower Salt catchment during Reporting Year 2024.

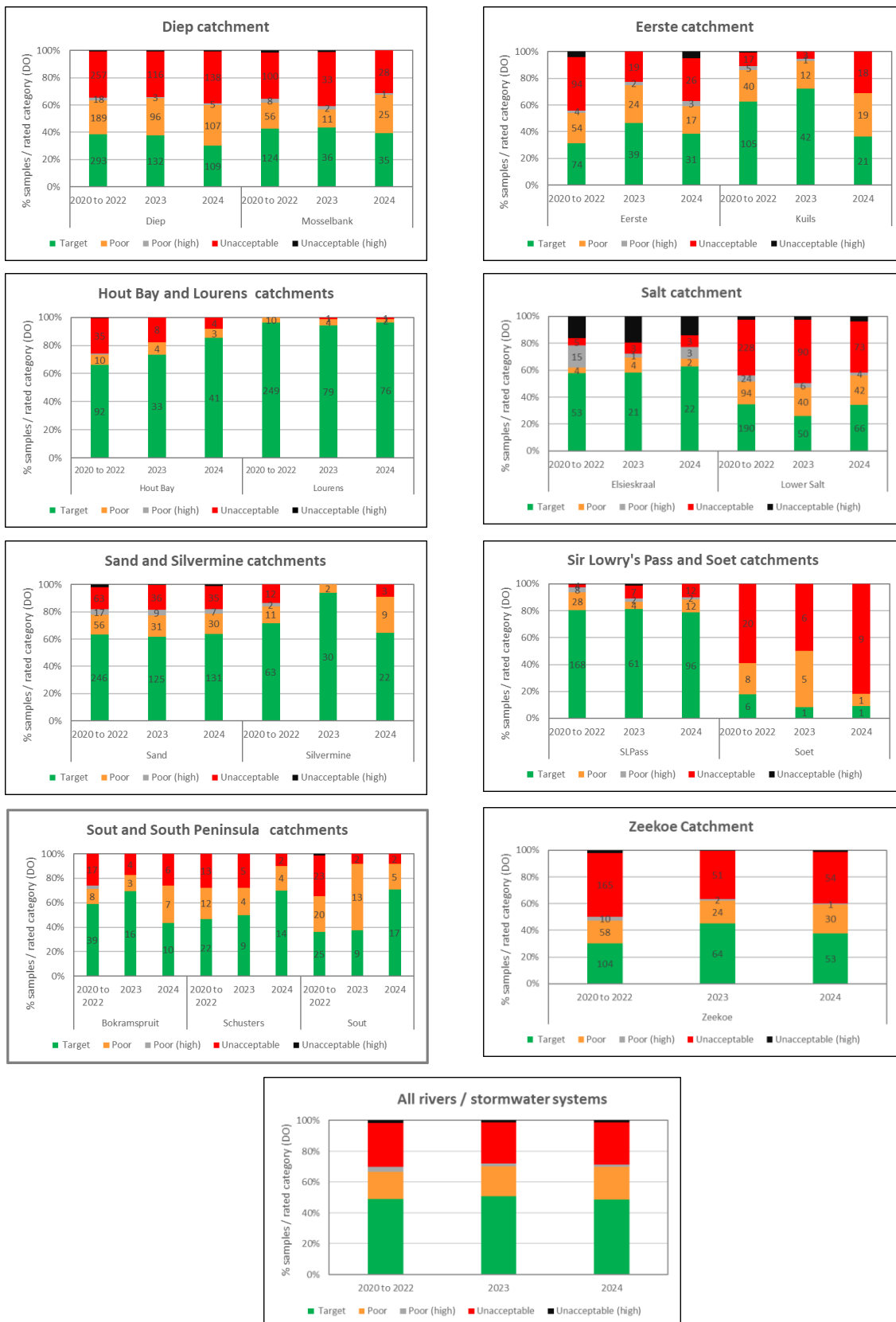


**Figure 5.5.1**  
**Percentage of samples falling within each rated category for Dissolved Oxygen (DO), per catchment for Reporting Year 2024. Thresholds for rated categories as defined in Table 3.2. Data for river / 'flowing' water monitoring points in each catchment. Catchments as shown in Figure 2.1.**

The DO compliance graphs for **river and stormwater channel sites, grouped by catchment**, comparing the three reporting periods considered in the current report (**Figure 5.5.2**) indicate the following in terms of the **trajectory of change** in DO concentrations:

- Taking all the data for flowing systems in all the monitored catchments across Cape Town together (bottom panel in the figure), the proportion of sampling sites with DO measurements within the Target category remained at only 45-50% through the 2020-2022, 2023 and 2024 reporting periods, indicative of a relatively steady but sub-optimal situation with respect to DO levels in flowing systems across Cape Town in recent years, with 50% or more of the measurements collected over the five-year period of analysis consistently being reflective of Poor to Unacceptable conditions;
- The conditions in the most recent year of analysis (Reporting Year 2024) improved compared to previous reporting periods, in terms of DO, in the Hout Bay, Schusters and Sout catchments, where the proportion of samples in the Target category for DO increased by 10-20% and the proportion within the Unacceptable category decreased by approximately 10% (except in the case of the Sout catchment, where the proportion of samples in the Poor category decreased while the proportion in the Unacceptable category stayed the same as previous reporting periods);
- A significant deterioration in the situation with regard to DO compliance in flowing systems was recorded for the Kuils, Silvermine and Bokramspruit catchments, where the percentage of samples in the Target category for DO decreased by more than 25% in Reporting Year 2024, compared to the previous (2020-2022 and 2023) reporting periods, coupled with >15% increases in the percentage of samples in the Poor category compared to the previous reporting periods (and 10% or more increases in the percentage of samples in the Unacceptable category from Reporting Year 2023 to Reporting Year 2024);
- There was a slight deterioration in DO compliance in the Diep, Mosselbank, Eerste and Zeekoe catchments in Reporting Year 2024, compared to 2023 (and compared to 2020-2022 in the Diep and Mosselbank catchments), where the percentage of samples in the Target category decreased by close to 10%;
- In the Soet catchment, the percentage of samples in the Unacceptable category for DO increased significantly (by 20-30%) during Reporting Year 2024, compared to the previous reporting periods.

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**Figure 5.5.2**

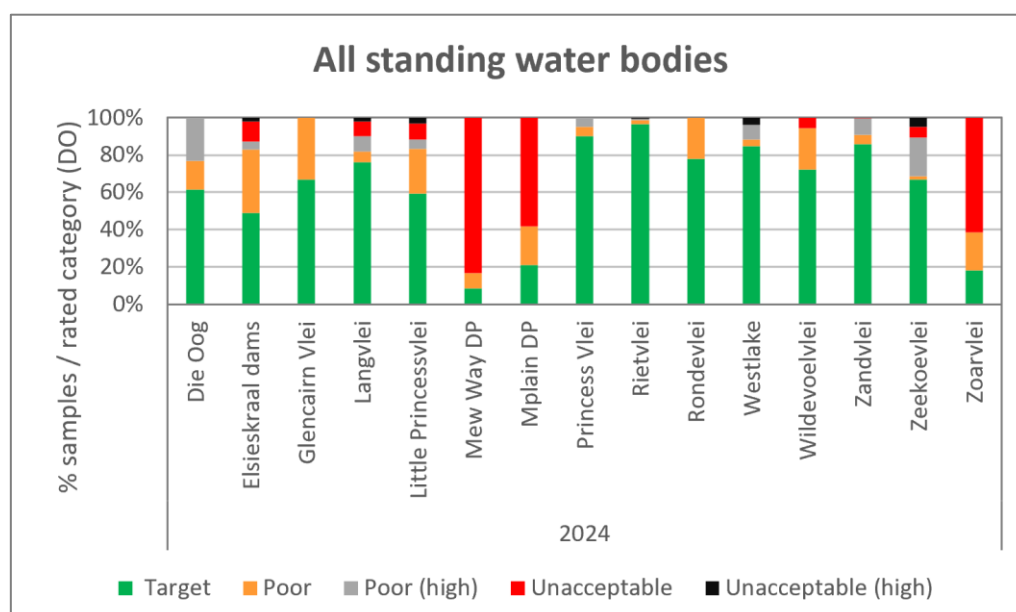
Percentage of samples falling within each rated category for Dissolved Oxygen (DO), per catchment for Reporting Years 2020-2022, 2023 and 2024. Thresholds for rated categories as defined in Table 3.2. Data for river / 'flowing' water monitoring points in each catchment. Catchments as shown in Figure 2.1. Total number of samples considered shown in bars of each plot.



Although standing waterbodies are typically more vulnerable to the development of low-oxygen or even anoxic conditions than riverine systems, the DO **compliance data for vleis, dams and detention ponds from Reporting Year 2024** (graph in **Figure 5.5.3**) indicate that, for most of the standing water systems, close to 60% or more of the samples were in the Target range for DO concentrations. These results were somewhat unexpected because standing water systems, which lack the turbulence created by flow, are generally assumed to be less oxygenated than flowing systems. The results were, however, probably skewed by the large number of flowing-water sites in the monitoring database that were selected specifically due to the presence of pollution problems (explained in Sections 3.5 and 3.6) and the presumed collection of water samples in standing water systems from near the water surface, as opposed to from deeper into the water column and closer to the bottom. Another complicating variable is that, if DO measurements are collected during the daytime (which is presumably the case), then the proliferation of algae in most of the monitored standing water systems, as indicated by relatively high Chl-a levels (**Section 5.4**), may be resulting in misrepresentative elevated DO values for many of the standing waterbodies.

The following findings for Reporting Year 2024 are apparent from the DO compliance graph for that reporting period (**Figure 5.5.3**):

- The standing waterbodies with the best conditions in terms of recorded DO concentrations during Reporting Year 2024 were Princess Vlei, Rietvlei, Westlake and Zandvlei, where >80% of the samples were in the Target range;
- Good conditions within the Target range were also relatively prevalent (70-80% compliance) at Langvlei, Rondevlei and Wildevoelvlei during Reporting Year 2024;
- The only significantly problematic standing waterbodies in terms of reduced or super-saturated DO levels in Reporting Year 2024 were the Elsieskraal Dams, where <50% of the samples were in the Target range for DO concentrations, and the Mew Way and Mitchell's Plain detention ponds as well as Zoarvlei, where <25% of the samples were in the Target range;
- The waterbodies with the highest proportion of super-saturated measurements during Reporting Year 2024 were Die Oog and Zeekoevlei, where 20-25% of the samples were in the Poor (upper) and Unacceptable (upper) categories for DO, followed by the Elsieskraal Dams, Langvlei, Princess Vlei, Westlake and Zandvlei, where approximately 10% of the samples were in these super-saturated categories.



**Figure 5.5.3**  
**Percentage of samples falling within each rated category for Dissolved Oxygen (DO), per monitored standing water system for Reporting Year 2024. Thresholds for rated categories as defined in Table 3.2**

The DO **compliance graphs for vleis, dams and detention ponds**, comparing the three reporting periods considered in the current report (**Figure 5.5.4**) indicate the following in terms of the **trajectory of change** in DO concentrations:

- Considering the data for all the monitored standing water systems across the City together (bottom right panel in **Figure 5.5.4**), the proportion of sampling sites with DO measurements within the Target category increased slightly from one reporting period to the next, rising from 65-70% in the 2020-2022 reporting period to approximately 75% in Reporting Year 2024, coinciding with a year-to-year decrease in the proportion of samples in the Unacceptable category for DO, from 10-15% in the 2020-2022 reporting period to only 5-10% in Reporting Year 2024;
- With respect to individual standing waterbodies, the most significant proportional improvements in terms of recorded DO concentrations in Reporting Year 2024 compared to 2023 were observed at Die Oog and Wildevoelvlei, where there was close to a 20% increase in the proportion of samples in the Target category and a similar reduction in the proportion of samples in the Unacceptable categories (in the case of Die Oog, the situation in Reporting Year 2023 was significantly worse than that in the 2020-2022 reporting period, whereas in the case of Wildevoelvlei the situation in Reporting Year 2023 was very similar to that in 2020-2022);
- Minor improvements in terms of DO compliance in Reporting Year 2024, compared to 2023, were also recorded at Little Princess Vlei, Rondevlei, Westlake Wetland, Zandvlei, and the Mew Way and Mitchell's Plain detention ponds, where in most cases there was close to a 10% increase in the proportion of samples in the Target range for DO and a reduction in the proportion of samples in the Unacceptable category;
- The most significant deterioration in terms of DO compliance from Reporting Year 2023 to 2024 was recorded at the Elsieskraal Dams, where there was approximately a 15% decrease in the proportion of samples in the Target range for DO from one year to the next and a similar increase in the proportion of samples in the Poor category;
- Minor deterioration in terms of DO compliance in Reporting Year 2024, compared to 2023, was also recorded at Glencairn Vlei, Langvlei, Zeekoevlei and Zoarvlei, where in most cases there was close to a 10% decrease in the proportion of samples in the Target range for DO and a similar increase in the proportion of samples in the Poor and/or Unacceptable categories;
- The only waterbodies where there was a noticeable change in the proportion of samples representative of super-saturated DO conditions in Reporting Year 2024, compared to the previous reporting periods included in this report, were Little Princess Vlei (where there was an increase from near-zero to close to 10% for the Poor(high) and Unacceptable(high) categories) and Wildevoelvlei (where there was a decrease from close to 10% to zero for those categories).

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**Figure 5.5.4**  
Percentage of samples falling within each rated category for Dissolved Oxygen (DO), per monitored standing water system for Reporting Years 2020-2022, 2023 and 2024. Thresholds for rated categories as defined in Table 3.3. Total number of samples considered shown in bars of each plot.

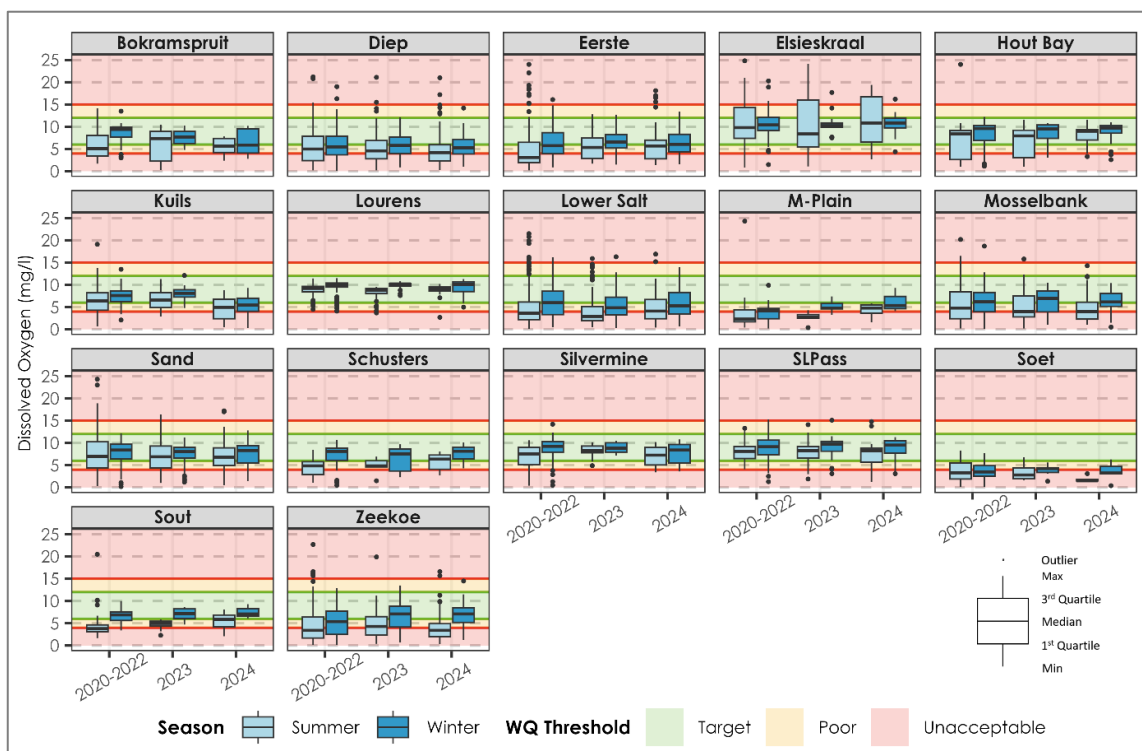
Boxplots of DO data for Reporting Years 2023 and 2024 compared to data from the previous three-year period (2020-2022), **separated into summer and winter seasons**, are presented below for river / stormwater channels (**Figure 5.5.5**) and dams / vleis (**Figure 5.5.6**). These graphs show that, for river and stormwater channel sites, there was a tendency for conditions to be worse (as reflected by lower median and 1<sup>st</sup> quartile DO concentrations) in summer compared to winter, as expected. For some of the catchments, at least over the three reporting periods analysed here, the range of variability was also greater during summer than in winter at the sites representative of flowing systems – namely the Elsieskraal, Hout Bay and Kuils catchments (in all three reporting periods), and the Bokramspruit and Sand catchments in the 2020-2022 and the 2023 reporting periods (but not in Reporting Year 2024). This pattern was, however, expected to be more prevalent than observed, due to the wider range of temperature fluctuations in flowing water systems during summer compared to winter.

The seasonal boxplots of DO concentration data for flowing-water sites also show that, even for the sites with median DO concentrations within the Target range, there are typically still many values recorded (as reflected by the boxes and whiskers of the plots) within the Poor and Unacceptable categories. The only exception to this was the Lourens River catchment, which contains a number of minimally impacted sites located at relatively high altitude in the mountainous areas, where the boxes and whiskers of the plots on the relevant graph in **Figure 5.5.5** are relatively “tight” and positioned wholly within the Target range.

In the Elsieskraal catchment, where super-saturated DO concentrations (>12mg/l) were most prevalent for flowing-water systems compared to the other catchments, the relevant box plots in **Figure 5.5.5** show (by wider boxes and longer whiskers) that the super-saturated values were mostly recorded during summer, as expected because this is when algal blooms (which generate excess dissolved oxygen through photosynthesis during the daytime) are generally more prolific. In the case of the Eerste and Lower Salt catchments (where super-saturated conditions were also highlighted as a potential concern), however, the whiskers of the winter (and not the summer) boxplots extend into the Poor (high) range. At the same time, more high-value outliers (within the high Poor and Unacceptable zones) were recorded during summer within these catchments, suggesting that sporadic but extremely high DO values were recorded at flowing-water sites within these catchments mostly during summer, presumably when algal blooms were present.

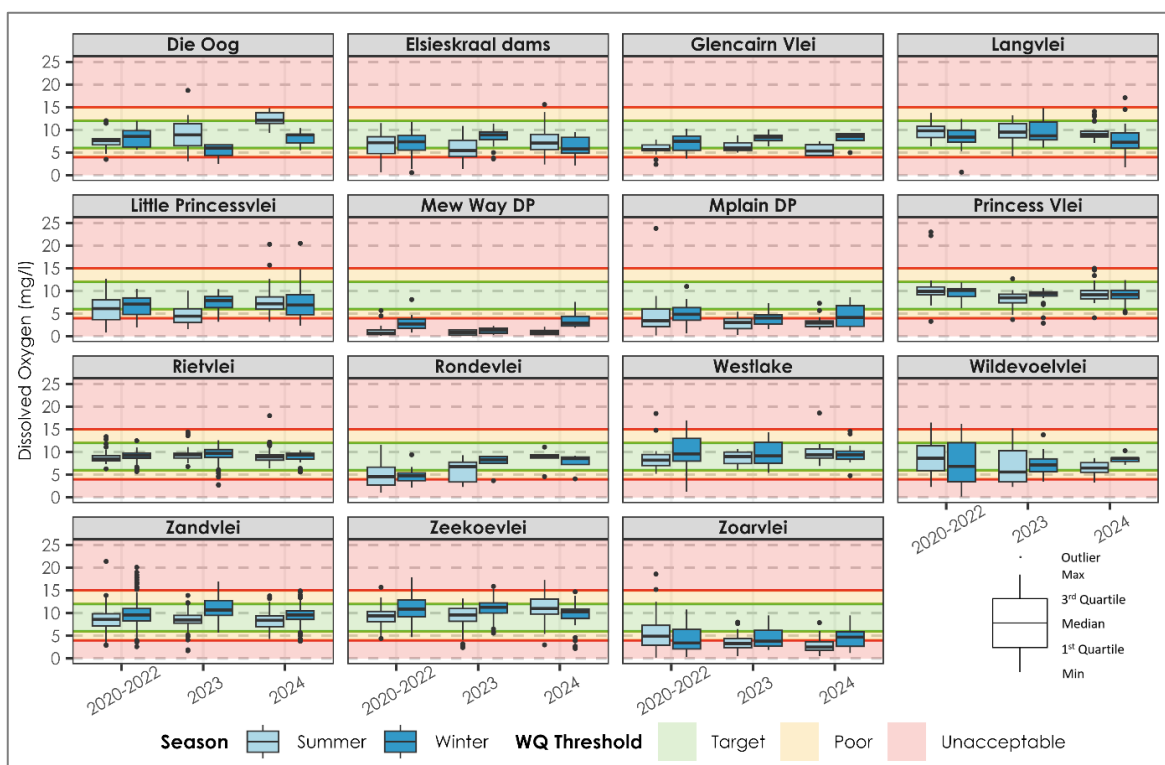
The above-mentioned patterns, in terms of summer versus winter differences, are not as consistently or strongly apparent in the data for the vlei, dam and detention pond sites (**Figure 5.5.6** vs. **Figure 5.5.5**), although there are small seasonal differences in some cases. The only real exception was for Die Oog in Reporting Years 2023 and 2024, when the DO values (in terms of the median, Q1 and Q3) were significantly higher during summer than they were in winter. Possible reasons for the lack of strong seasonal variability in the majority of monitored standing water systems include the following:

- Standing water systems are generally not exposed to strong seasonal variation (other than in Zeekoevlei and Rondevlei, which are both managed by seasonal draw-downs, with water levels in Zeekoevlei being drawn down in winter and those in Rondevlei being drawn down in summer);
- Standing water systems typically have a more stable temperature regime compared to flowing systems, due to a lack of flows and a deeper water column;
- The presence of a much greater volume of water with a larger surface area for standing water systems, exposed to atmospheric oxygen as well as wind-induced turbulence and mixing.



**Figure 5.5.5**

Comparison of dissolved oxygen for flowing systems (rivers and stormwater channels) from Reporting Year 2024 with those from 2023 and the previous three years (2020 to 2022) combined. Catchments as shown in Figure 2.1. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.2.



**Figure 5.5.6**

Comparison of dissolved oxygen for standing water systems (vleis, dams and detention ponds) from the Reporting Year 2024 with those from 2023 and the previous three years (2020 to 2022) combined. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.3.



### **5.5.3 Key take-away points from assessment of dissolved oxygen data**

The main findings with respect to dissolved oxygen levels in the monitored waterbodies across the City were as follows:

- The level of non-compliance in relation to the Target range of values for DO concentrations was more problematic for the monitored flowing water sites than it was for standing water sites (45-50% vs. 65-75% compliance) but this could be, at least partly, the result of many of the flowing system sites being purposefully located immediately downstream of known pollution sources, and because of photosynthesis by excessive algal growth in many of the standing waterbodies causing elevated daytime DO concentrations to be recorded in some of these systems;
- The worst-performing catchment with respect to DO compliance in flowing systems during Reporting Year 2024 was the Soet, where >80% of the collected samples were in the Unacceptable category, representing a significant (20-30%) decrease in compliance compared to the previous reporting periods;
- Low to very low DO levels were also prevalent in the Diep, Eerste, Kuils, Lower Salt, Mosselbank, Mitchell's Plain and Zeekoe catchments in Reporting Year 2024 (with 60% or more of the samples from flowing-water sites falling into the Poor and Unacceptable categories combined);
- The least problematic catchments in terms of DO compliance at monitored flowing water sites in Reporting Year 2024 were the Hout Bay and Lourens River catchments (with >80% of samples in Target range), both of which include less impacted upper river sites that are highly oxygenated;
- Relatively high proportions (60-80%) of the flowing-water samples were also within the Target range for DO concentrations in the Sand, Schusters, Silvermine, Sir Lowry's Pass and Sout catchments during Reporting Year 2024;
- Super-saturated DO concentrations were most prevalent in the Elsieskraal catchment during Reporting Year 2024 (and during the previous reporting periods under consideration), where >20% of the samples collected from flowing-water sites within the catchment were within the Unacceptable (high) and Poor (high) categories combined, with such conditions also recorded for 5 to 10% of the samples in the Eerste and Lower Salt catchments during Reporting Year 2024;
- Conditions improved in Reporting Year 2024 compared to previous reporting periods, in terms of DO, in the Hout Bay, Schusters and Sout catchments, where there was an increase of 10-20% in the proportion of flowing-water samples in the Target category for DO;
- A significant deterioration in the situation with regard to DO compliance in flowing systems was recorded for the Kuils, Silvermine and Bokramspruit catchments, where there was a decrease of >25% in the percentage of samples in the Target category for DO in Reporting Year 2024, compared to the previous reporting periods;
- With respect to individual standing waterbodies, the most significant improvements in terms of recorded DO concentrations in Reporting Year 2024 compared to 2023 were observed at Die Oog and Wildevoelvie, where there was close to a 20% increase in the proportion of samples in the Target category;
- The most significant deterioration in terms of DO compliance from Reporting Year 2023 to 2024 was recorded at the Elsieskraal Dams, where there was approximately a 15% decrease in the proportion of samples in the Target range for DO;
- The only standing waterbodies where there was a noticeable (~10%) change in the proportion of samples representative of super-saturated DO conditions in Reporting Year 2024, compared to the previous reporting periods included in this report, were Little Princess Vlei (where there was an increase in the proportion of samples in the super-saturated categories) and Wildevoelvie (where there was a decrease);
- For river and stormwater channel sites, there was a tendency for conditions to be worse (lower DO concentrations) in summer compared to winter, as expected;
- In the Elsieskraal catchment, where super-saturated DO concentrations were most prevalent for flowing-

water systems compared to the other catchments, the super-saturated values were mostly recorded during summer, as expected (because this is when algal blooms, which generate excess dissolved oxygen through photosynthesis during the daytime, are generally more prolific);

- In the case of the Eerste and Lower Salt catchments (where super-saturated conditions were also highlighted as a potential concern), more high-value outliers (within super-saturated range) were recorded during summer within these catchments, suggesting that sporadic but extremely high DO values were recorded at flowing-water sites within these catchments mostly during summer, presumably when algal blooms were present;
- The above-mentioned patterns, in terms of summer versus winter differences, were not as consistently or strongly apparent in the data for the vlei, dam and detention pond sites, although there were small seasonal differences in some cases (the only real exception was for Die Oog in Reporting Years 2023 and 2024, when the DO values were significantly higher during summer than they were in winter).

## 5.6 Ammonia toxicity

As explained in **Section 5.3.2**, inorganic nitrogen in aquatic ecosystems occurs in the form of nitrate and nitrite ions, and as total ammonia. There are two forms of ammonia, namely ionised ammonia ( $\text{NH}_4^+$ ), also known as ammonium, and un-ionised ammonia ( $\text{NH}_3$ ). Un-ionised (or 'free') ammonia can be toxic to some aquatic organisms, even at very low concentrations (DWAf 1996a and DWAf 2008).

The present section focuses specifically on the potential for ammonia toxicity as a result of elevated un-ionised ammonia concentrations at the City's water quality sampling points, both in flowing and standing water systems.

### 5.6.1 Relevance in water quality monitoring

In an aquatic environment, the relative proportion of un-ionised ammonia to ammonium ions in water is controlled primarily by pH and temperature. The City measures the 'total ammonia nitrogen' concentration in a water sample and calculates the proportion of this that is likely to be in the potentially toxic un-ionised form, taking into account pH, temperature and EC (or salinity in estuarine waters). At pH >8, a significantly larger proportion of total ammonia ions are present in the un-ionised form, which may give rise to acute toxicity at concentrations as low as 0.1 mg N/L (DWAf 1996a).

Concentrations of un-ionised ammonia above Target levels (see **Tables 3.1 and 3.2**) would increase the risk of ammonia toxicity in sensitive fauna, especially fish. The presence of low oxygen conditions would tend to increase the availability of reduced nitrogen forms such as ammonia, rather than more stable nitrates. Oxygen levels (discussed in **Section 5.5**) are thus also an important consideration when assessing the threat posed to aquatic ecosystems by ammonia toxicity.

Prolonged exposure to un-ionised ammonia at chronic toxicity levels (Poor category in **Tables 3.1 and 3.2**) could affect aquatic organism fecundity, general health and resilience, while exposure to elevated levels associated with acute toxicity (Unacceptable category in **Tables 3.1 and 3.2**) could result in the death of more sensitive organisms.

### 5.6.2 Current state and recent trajectory of change

Un-ionised ammonia data (abbreviated hereafter as  $\text{NH}_3$ ) are presented as compliance-type data, showing the proportion of samples from the reporting years under consideration that fall within the Target range compared to the proportions rated as 'Poor' and 'Unacceptable' (according to the toxicity criteria listed in **Tables 3.1 and 3.2**). In addition, the results are presented as boxplots, which show statistical data for all analysed watercourse groups and categories (as explained in **Box 3.7**).

#### Box 5.6.1

Note that median annual  $\text{NH}_3$  concentrations at individual monitoring points in each sub-catchment can be seen in **Appendix C**, as well as (for priority catchments) in the maps in **Section 8**.

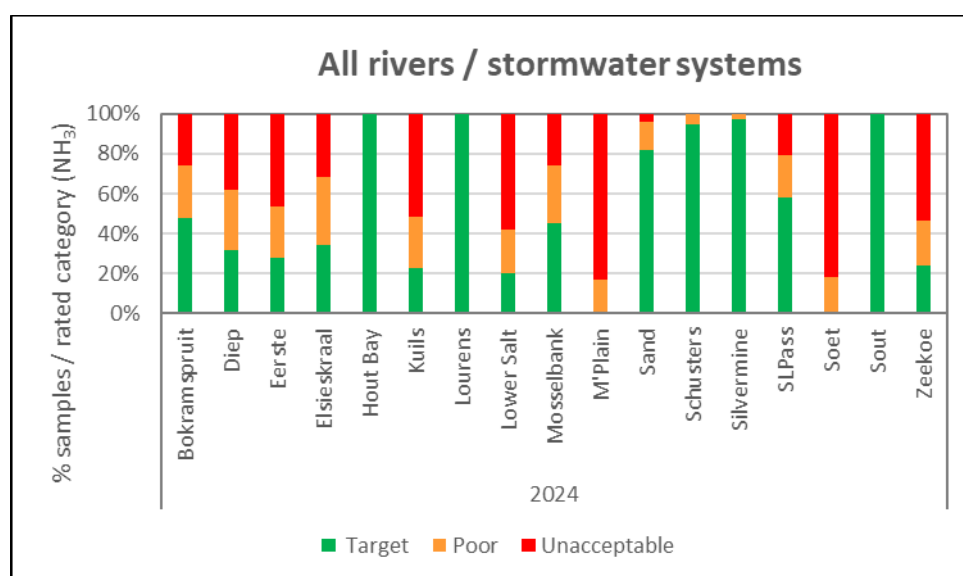
These data are presented separately for flowing water systems (rivers and stormwater channels) and standing water systems (vleis, dams and detention ponds). The compliance graphs and seasonal boxplots are shown in this section, while the annual boxplots are provided in **Appendix D**.

The compliance graphs for **river and stormwater channel sites, grouped by catchment, for Reporting Year 2024 (Figure 5.6.1)** indicate that, in terms of un-ionised ammonia ( $\text{NH}_3$ ) concentrations:

- There was a negligible risk of ammonia toxicity in the Hout Bay, Lourens, Schusters, Silvermine and Sout catchments in Reporting Year 2024, with 100% or close to 100% of the  $\text{NH}_3$  measurements from flowing-water sites in these catchments in the Target range for this variable;
- There was also a relatively low risk of ammonia toxicity in the Sand catchment in Reporting Year 2024, where just over 80% of the flowing-water samples had  $\text{NH}_3$  concentrations lower than the Target threshold, with <5% in the Unacceptable category;
- The most problematic catchments, in terms of the potential for ammonia toxicity in flowing water systems, were the Mitchell's Plain and Soet catchments where >80% of the samples collected during Reporting

Year 2024 had NH<sub>3</sub> concentrations in the Unacceptable category;

- Potentially toxic conditions were very prevalent in the Diep, Eerste, Kuils, Lower Salt and Zeekoe catchments in Reporting Year 2024, with NH<sub>3</sub> concentrations above the Target threshold (i.e., in the Poor and Unacceptable categories) recorded in close to 70% or more of the flowing-water samples that were collected, but the situation was particularly problematic in the Kuils, Lower Salt and Zeekoe catchments where more than 50% of the samples were in the Unacceptable category;
- Ammonia toxicity was also an issue of concern for flowing-water systems in the Bokramspruit, Elsiekraal and Mosselbank catchments in Reporting Year 2024, with 30-50% of the NH<sub>3</sub> measurements in these catchments falling outside of the Target range and >20% of the measurements in the Unacceptable category (indicative of potential acute toxicity).



**Figure 5.6.1**

**Percentage of river / flowing-water samples falling within each rated category for un-ionised ammonia (NH<sub>3</sub>), per catchment for Reporting Year 2024. Thresholds for rated categories as defined in Table 3.2. Catchments as shown in Figure 2.1.**

The NH<sub>3</sub> compliance graphs for **river and stormwater channel sites, grouped by catchment**, comparing the three reporting periods considered in the current report (**Figure 5.6.2**) indicate the following in terms of the **trajectory of change** in NH<sub>3</sub> concentrations:

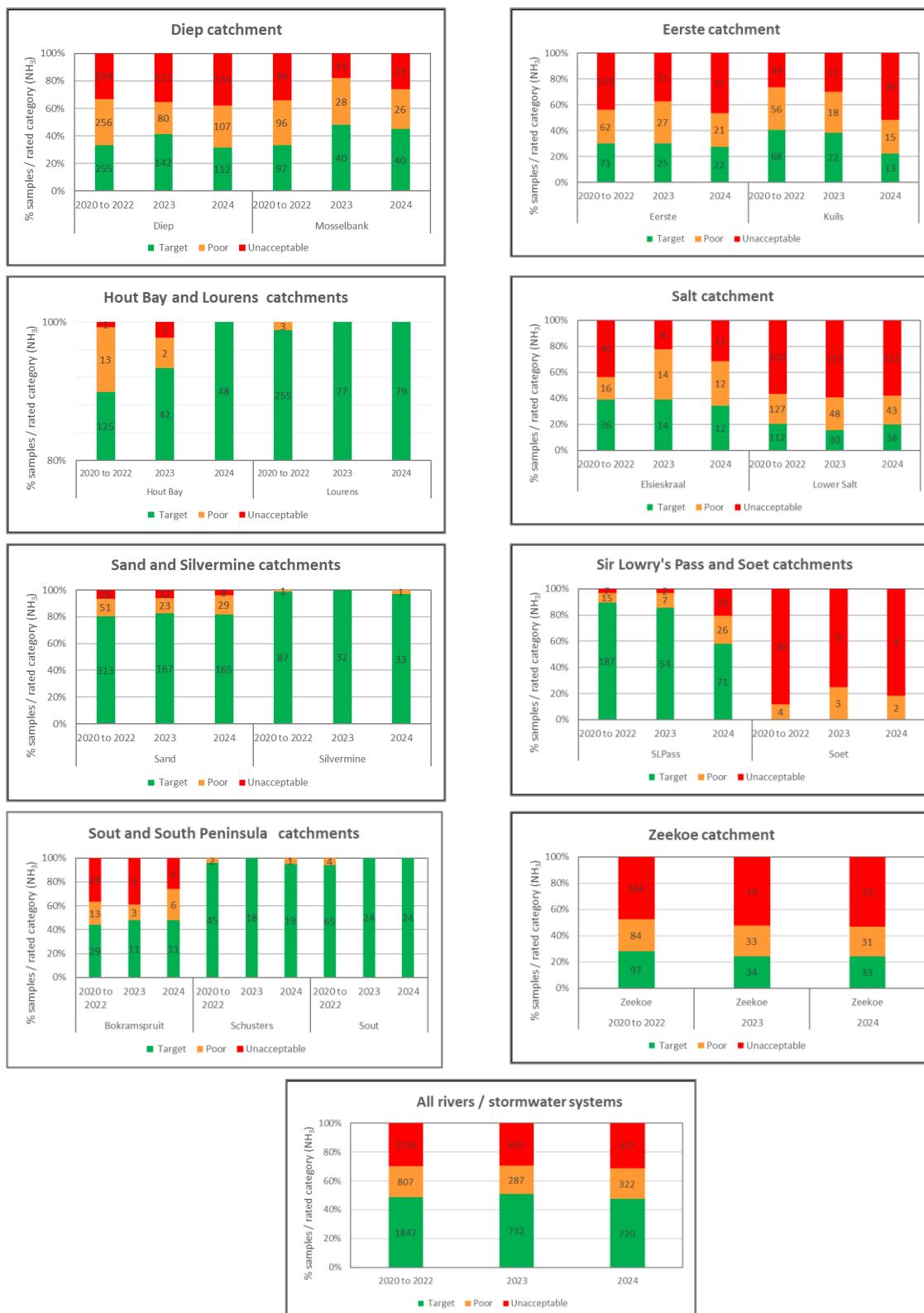
- Considering all flowing water sites across all catchments together (graph in bottom panel), only 45 to 50% of the samples had NH<sub>3</sub> concentrations within the Target range consistently for all three reporting periods, with 25 to 30% in the Unacceptable category;
- The most deterioration from Reporting Year 2023 to 2024, in terms of the potential for ammonia toxicity at flowing-water sites, was recorded for the Kuils and Sir Lowry's Pass catchments, where there was a decrease of 15-25% in the proportion of samples with NH<sub>3</sub> concentrations in the Target range, coinciding with an increase of close to 20% in the proportion of samples with measurements in the Unacceptable category (for both of these catchments, there was very little change from the 2020-2022 reporting period to Reporting Year 2023);
- Smaller deteriorations in NH<sub>3</sub> compliance from Reporting Year 2023 to 2024 were recorded in the Diep, Mosselbank, Eerste and Elsiekraal catchments, where there was a 5-10% decrease in the proportion of samples from flowing-water sites in the Target range and a similar increase in the proportion of samples in the Unacceptable category;
- Significant year-to-year improvements were recorded in the Hout Bay catchment, with big increases in the proportion of samples from flowing-water sites in the Target range for NH<sub>3</sub> observed from the 2020-

2022 reporting period to Reporting Year 2023 (~20%) and again from Reporting Year 2023 to 2024 (~40%);

- A small improvement was recorded for the Bokramspruit catchment from Reporting Year 2023 to 2024, where there was a 10-15% decrease in the proportion of flowing-water samples with NH<sub>3</sub> measurements in the Unacceptable category (but a similar increase in the proportion of samples in the Poor category and insignificant change in the proportion in the Target category).



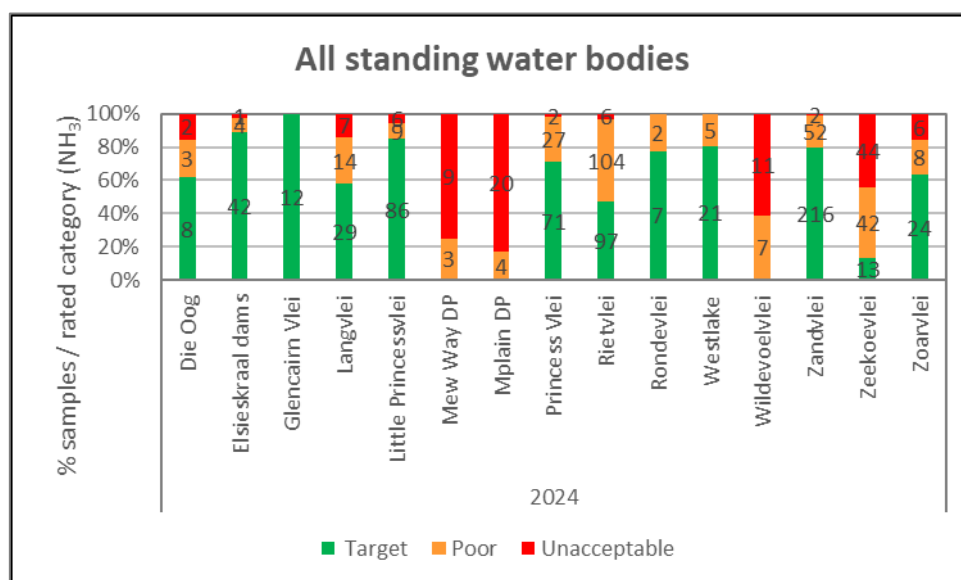
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**Figure 5.6.2**  
Percentage of river / flowing-water samples falling within each rated category for un-ionised ammonia (NH<sub>3</sub>), per catchment for Reporting Years 2020-2022, 2023 and 2024. Thresholds for rated categories as defined in Table 3.2. Catchments as shown in Figure 2.1. Total number of samples shown on bars of each plot.

The compliance graphs for **standing water systems** (at vlei, dam and detention pond sites) **for Reporting Year 2024** (Figure 5.6.3) indicate that, in terms of un-ionised ammonia (NH<sub>3</sub>) concentrations:

- There was a very low risk of ammonia toxicity at Glencairn Vlei (100% compliance), the Elsiekraal dams, Little Princess Vlei, Rondevlei, Westlake Wetland and Zandvlei in Reporting Year 2024, with close to 80% or more of the NH<sub>3</sub> measurements from these waterbodies in the Target range for NH<sub>3</sub>;
- Close to 60% to 75% compliance was recorded in relation to the Target threshold for NH<sub>3</sub> at Die Oog, Langvlei, Princess Vlei and Zoarvlei in Reporting Year 2024, indicative of a relatively low risk of ammonia toxicity in these systems the majority of the time during this reporting period;
- Potentially toxic conditions were particularly prevalent at Wildevoelvlei and at the Mitchell's Plain and Mew Way detention ponds during Reporting Year 2024, where all of the recorded NH<sub>3</sub> concentrations were in the Poor and Unacceptable categories (indicating chronic to acute toxicity), with >75% of the samples in the Mitchell's Plain and Mew Way detention ponds in the Unacceptable category;
- Potentially toxic conditions were also often present in Rietvlei and, particularly, Zeekoevlei during Reporting Year 2024, with NH<sub>3</sub> concentrations in the Poor and Unacceptable categories recorded for >50% and >80% of the samples that were collected, respectively (>40% of the samples from Zeekoevlei were in the Unacceptable category, indicative of a high risk of acute ammonia toxicity).



**Figure 5.6.3**

Percentage of samples falling within each rated category for un-ionised ammonia (NH<sub>3</sub>), per monitored standing water system for Reporting Year 2024. Thresholds for rated categories as defined in Table 3.2.

The NH<sub>3</sub> **compliance graphs for vleis, dams and detention ponds**, comparing the three reporting periods considered in the current report (Figure 5.6.4) indicate the following in terms of the **trajectory of change** in NH<sub>3</sub> concentrations:

- Considering all the data from standing water systems together (graph in bottom right panel), ammonia toxicity was generally less of a problem for these systems than it was for flowing water systems, with >60% of the standing water samples from all three reporting periods being in the Target category and less than 20% in the Unacceptable category, although there was a slight (5-10%) decrease from Reporting Year 2023 to 2024 in the proportion of samples in the Target range (coinciding with an increase in the proportion of samples in the Poor category);
- The situation deteriorated significantly in Reporting Year 2024, compared to 2023, at Princess Vlei, Rietvlei and Zoarvlei, where the proportion of samples in the Target category decreased by close to 20% (in the case of Zoarvlei, the proportion of samples in the Unacceptable category, indicative of a high risk of

acute ammonia toxicity, increased by 10-15%);

- There was also some deterioration in terms of ammonia toxicity at Die Oog, Little Princess Vlei and Zeekoevlei in Reporting Year 2024, compared to 2023, with a 10-15% decrease in the proportion of samples in the Target category for  $\text{NH}_3$  concentrations or (in the case of Die Oog) a similar increase in the proportion of samples in the Unacceptable category;
- A positive trajectory of change from Reporting Year 2023 to 2024 was observed at Langvlei, Rondevlei, Westlake Wetland and the Elsiekraal Dams, where there was generally a 5-10% increase in the proportion of samples in the Target range for  $\text{NH}_3$  (with a 25% increase in the case of Rondevlei);
- At Wildevoelvlei, while there were still no  $\text{NH}_3$  measurements in the Target range in Reporting Year 2024 (as in the previous reporting periods), there was a significant (>30%) decrease in the proportion of samples in the Unacceptable category (indicative of the potential for acute ammonia toxicity) from Reporting Year 2023 to 2024.

Boxplots of  $\text{NH}_3$  data for Reporting Years 2023 and 2024 compared to data from the previous three-year period (2020-2022), **separated into summer and winter seasons**, are presented below for river / stormwater channels (**Figure 5.6.5**) and dams / vleis (**Figure 5.6.6**). These graphs (and the annual boxplots in **Appendix D**) provide the following additional insight in relation to the potential for ammonia toxicity:

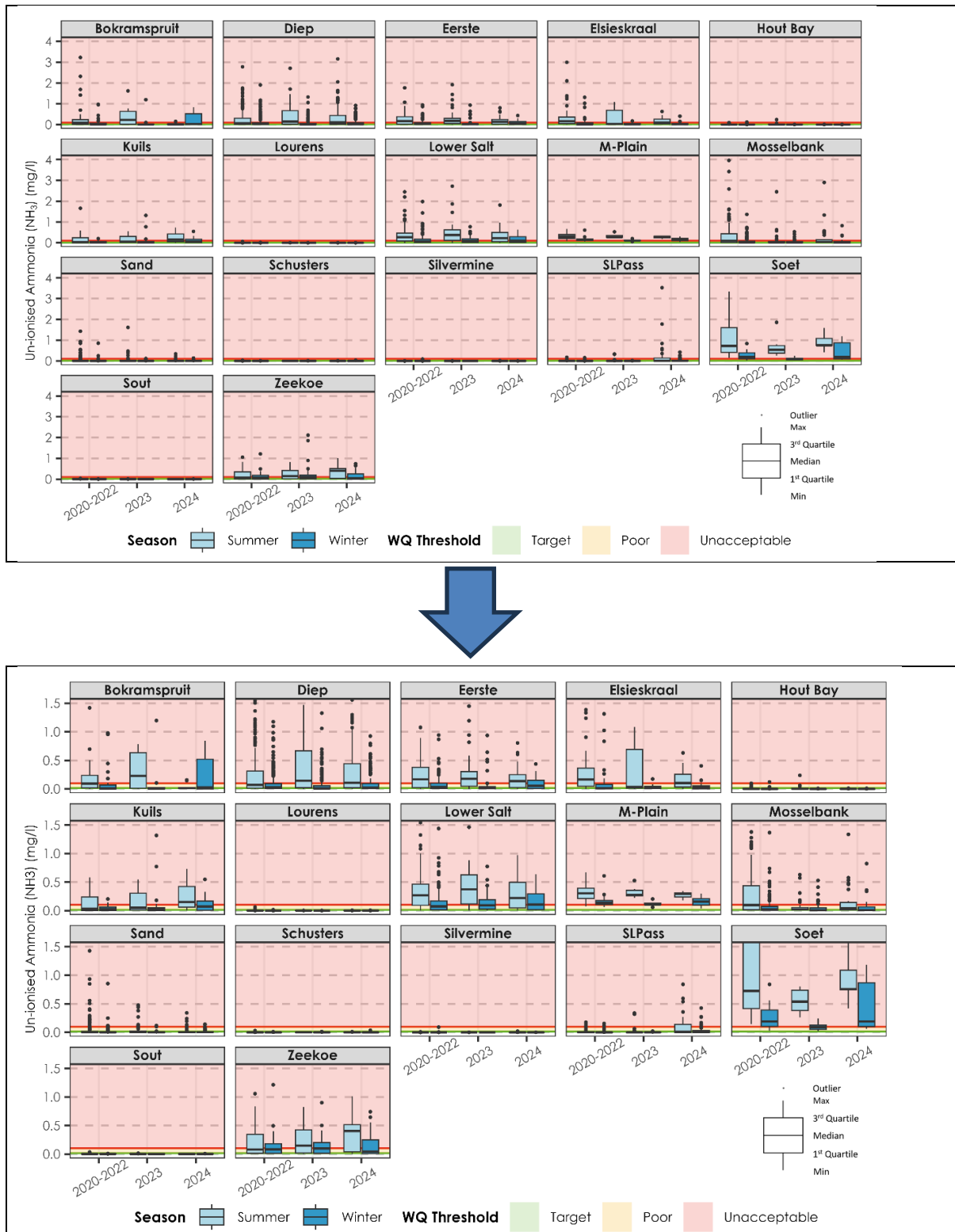
- The range of recorded  $\text{NH}_3$  values was noticeably greater in catchments and standing water systems with lower levels of compliance, as shown by longer boxes (representing the inter-quartile range) and whiskers (representing the range, excluding outliers) on the boxplots, especially in summer;
- The risk of toxicity associated with high levels of un-ionised ammonia, especially acute toxicity in the Unacceptable range, is clearly generally far greater in the monitored flowing water systems than it is in the monitored standing water systems, during both summer and winter, with the exception of the poorly performing standing water systems (i.e., Wildevoelvlei, Zeekoevlei and the artificial Mew Way and Mitchells Plain detention ponds);
- If the catchments and standing waterbodies with very high levels of compliance in terms of un-ionised ammonia are excluded, all the other (impacted) catchments and standing waterbodies showed a greater range of values in summer compared to winter, and generally higher median values (and thus more risk of ammonia toxicity) in summer than in winter (the only exceptions being the Bokramspruit catchment in Reporting Year 2024, and Zeekoevlei waterbody in the 2020-2022 reporting period and Reporting Year 2024). This is the expected pattern for ammonia toxicity, the risk of which increases at higher temperatures.

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**Figure 5.6.4**  
Percentage of samples falling within each rated category for un-ionised ammonia (NH<sub>3</sub>), per monitored standing water system for Reporting Years 2020-2022, 2023 and 2024. Thresholds for rated categories as defined in Table 3.3.

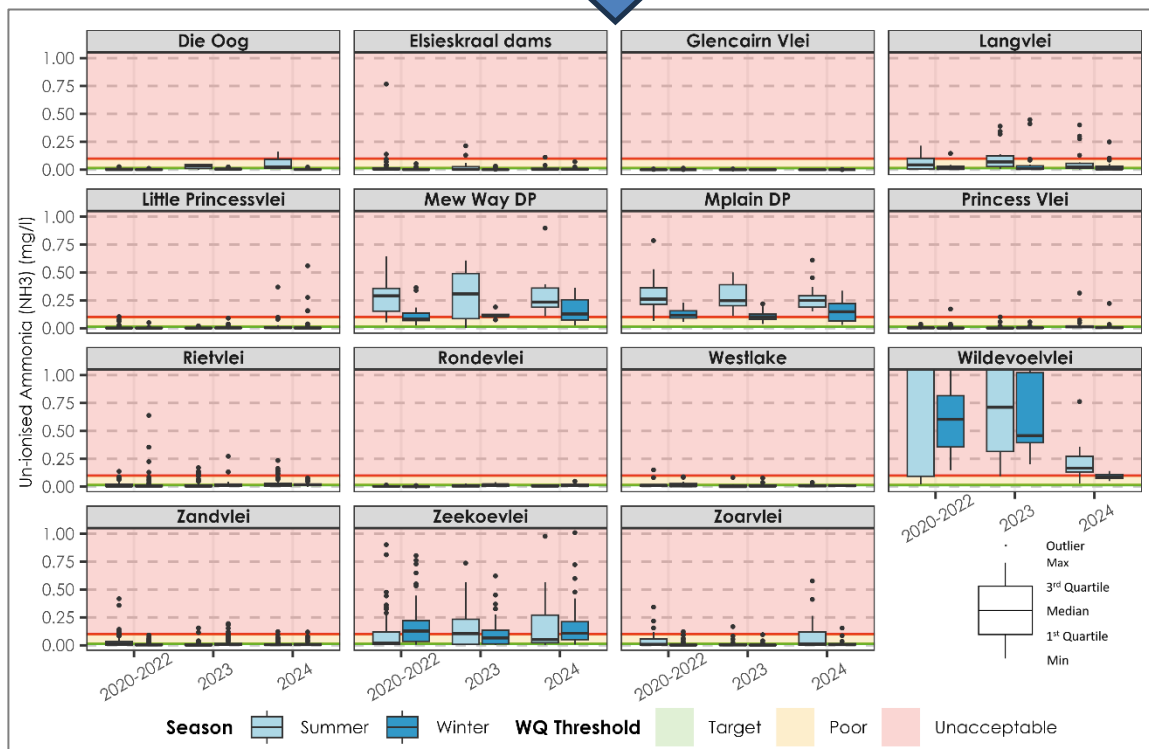
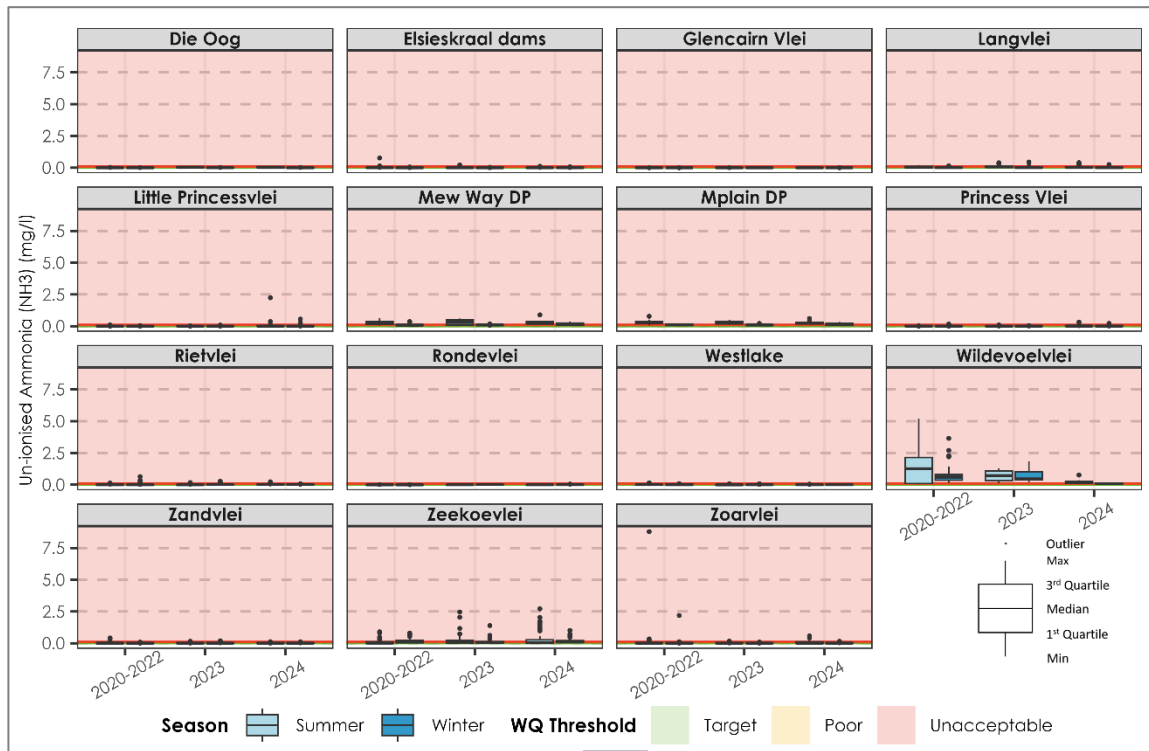
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**Comparison of un-ionised ammonia for flowing systems (rivers and stormwater channels) from Reporting Year 2024 with those from 2023 and the previous three years (2020 to 2022) combined. Data analysed as summer and winter datasets. Catchments as shown in Figure 2.1. Marked thresholds as per Table 3.2. Closer view (reduced y-axis) shown in bottom figure.**



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**Figure 5.6.6**

Comparison of un-ionised ammonia for standing water systems (vleis, dams and detention ponds) from Reporting Year 2024 with those from 2023 and the previous three years (2020 to 2022) combined. Data analysed as summer and winter datasets. Marked thresholds as per Table 3.3. Closer view (reduced y-axis) shown in bottom figure.

### 5.6.3 pH values and risk of ammonia toxicity at sampling points

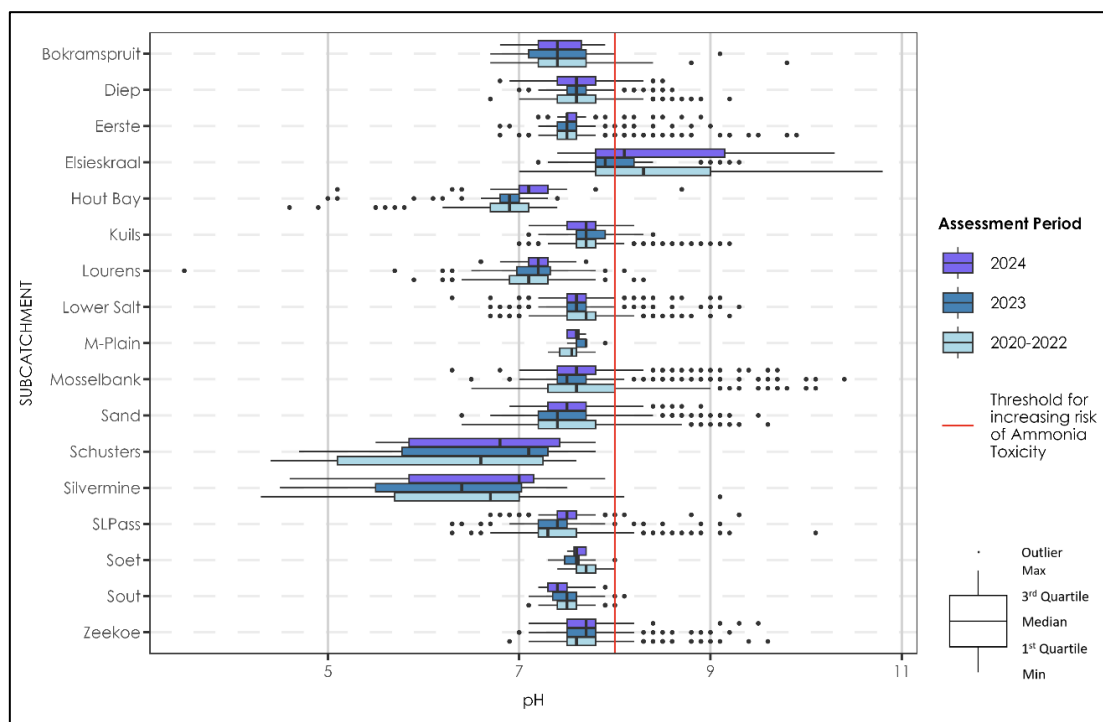
As explained in **Section 5.4.1**, particular attention should be paid to raised pH levels because of the relationship between pH, water temperature and the ratio of ammonium ions to un-ionised ammonia (DWAF, 1996a). In the current report, as a rough guideline, pH >8 is considered to be a potential trigger for ammonia toxicity when associated with elevated total ammonia concentrations. It is important to note that the focus of the analysis here is to assess the degree of ammonia toxicity risk as a result of high pH values, and not the degree to which pH has been altered from the presumed natural reference range (this aspect was discussed in **Section 3.6**).

For **river and stormwater channel sites, grouped by catchment**, the boxplot of recorded pH values for the three reporting periods considered in this report (**Figure 5.6.7**) suggests the following in relation to the risk of ammonia toxicity:

- Sampling sites in the Elsieskraal catchment were the most at risk of ammonia toxicity, especially in Reporting Year 2024 and the 2020-2022 reporting period when median pH values of >8 were recorded (and the 3<sup>rd</sup> quartile was ≥ 9), with less risk in Reporting Year 2023 when the median pH was just below 8 (and the 3<sup>rd</sup> quartile dropped to ~8.25);
- Catchments with flowing water sites least at risk of ammonia toxicity because of low pH values were the Schusters and Silvermine catchments in all three reporting periods, and the Hout Bay catchment in the 2020-2022 and 2023 reporting periods, where median pH values were <7 and the 75<sup>th</sup> percentile (3<sup>rd</sup> quartile) was <7.5 (<7.25 in the case of the Silvermine and Hout Bay catchments);
- There were also very low risks of ammonia toxicity because of low pH values at flowing water sites in the Lourens catchment in all three reporting periods, and in the Hout Bay catchment in Reporting Year 2023, where median pH values were ≤7.25 and the 3<sup>rd</sup> quartile was <7.5;
- All other catchments had median pH values for flowing water sites ranging between 7.2 and 7.8, with the 75<sup>th</sup> percentile ≤8), suggesting a generally low risk of ammonia toxicity unless ammonia concentrations were exceedingly high and/or there were particularly warm water temperatures.

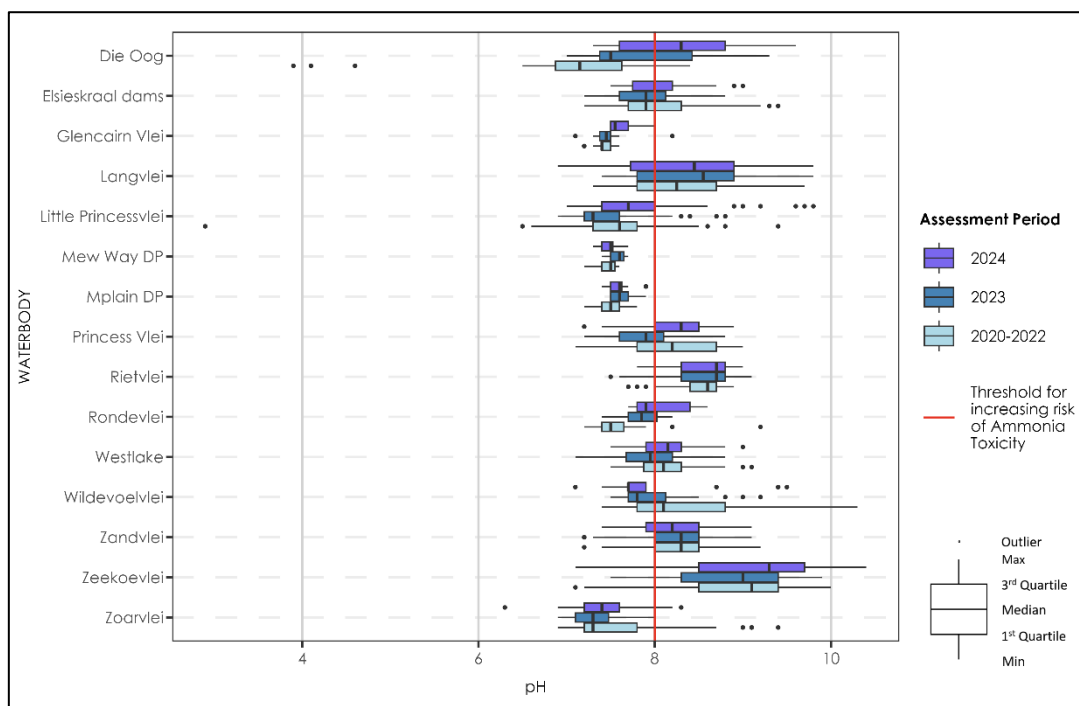
For **standing water (vlei and wetland) sites, grouped by waterbody**, the relevant boxplot of recorded pH values (**Figure 5.6.8**) suggests the following in relation to the risk of ammonia toxicity:

- A greater proportion of the standing water sites had relatively high pH values, resulting in an increased risk of ammonia toxicity, compared to the flowing water sites;
- There was a relatively high risk of ammonia toxicity, as a result of median pH values >8 and 3<sup>rd</sup> quartile values ≥8.5 (with 1<sup>st</sup> quartile approaching or exceeding 8), in the Langvlei, Rietvlei, Zandvlei and Zeekoevlei waterbodies during all three reporting periods, and in Die Oog during Reporting Year 2024, Princess Vlei and Westlake Wetland during the 2020-2022 reporting period and Reporting Year 2024, and in Wildevoelvlei during the 2020-2022 reporting period;
- During Reporting Year 2024, maximum pH values ≥9, indicating periods of particularly high risk of ammonia toxicity, were recorded in Die Oog, Elsieskraal dams, Langvlei, Little Princess Vlei, Rietvlei, Westlake Wetland, Wildevoelvlei, Zandvlei and Zeekoevlei.



**Figure 5.6.7**

**Boxplot of pH values recorded for rivers and stormwater channels, grouped by catchment, in the 2020-2022, 2023 and 2024 reporting periods. Red line shows pH value of 8, above which there is typically an increasing risk of ammonia toxicity.**



**Figure 5.6.8**

**Boxplot of pH values recorded for standing waterbodies (vleis, dams and detention ponds) in the 2020-2022, 2023 and 2024 reporting periods. Red line shows pH value of 8, above which there is typically an increasing risk of ammonia toxicity.**

#### **5.6.4 Key take-away points from assessment of un-ionised ammonia data**

The main findings with respect to the potential for ammonia toxicity in monitored aquatic ecosystems across the City were as follows:

- Potentially toxic conditions associated with elevated  $\text{NH}_3$  concentrations were more prevalent in flowing water systems than they were for standing water systems, partly attributable to the dilution effect of large standing water bodies;
- There was a negligible risk of ammonia toxicity for monitored flowing water systems in the Hout Bay, Lourens, Schusters, Silvermine and Sout catchments during Reporting Year 2024 (or the previous reporting periods under consideration), and there was also a relatively low risk of ammonia toxicity for flowing water systems in the Sand catchment;
- The most problematic catchments, in terms of the potential for ammonia toxicity in flowing water systems during Reporting Year 2024 (and the previous reporting periods under consideration), were the Mitchell's Plain and Soet catchments, while potentially toxic conditions were also very prevalent in the Diep, Eerste, Kuils, Lower Salt and Zeekoe catchments during Reporting Year 2024, with elevated  $\text{NH}_3$  concentrations in the Poor and Unacceptable categories recorded for close to 70% or more of the flowing-water samples that were collected;
- Ammonia toxicity was also an issue of concern, but to less degree, for flowing-water systems in the Bokramspruit, Elsieskraal and Mosselbank catchments in Reporting Year 2024, where small changes were recorded from the previous reporting period;
- The most deterioration from Reporting Year 2023 to 2024, in terms of the potential for ammonia toxicity at flowing-water sites, was recorded for the Kuils and Sir Lowry's Pass catchments, where there was a decrease of 15-25% in the proportion of samples with  $\text{NH}_3$  concentrations in the Target range, coinciding with an increase of close to 20% in the proportion of samples with measurements in the Unacceptable category;
- Significant year-to-year improvements were recorded in the Hout Bay catchment, with big (20-40%) increases in the proportion of samples from flowing-water sites in the Target range for  $\text{NH}_3$  observed from the 2020-2022 reporting period to Reporting Year 2023, and again from Reporting Year 2023 to 2024;
- For standing water systems, there was a very low risk of ammonia toxicity at Glencairn Vlei (100% compliance), the Elsieskraal dams, Little Princess Vlei, Rondevlei, Westlake Wetland and Zandvlei in Reporting Year 2024, with close to 80% or more of the  $\text{NH}_3$  measurements from these waterbodies in the Target range for  $\text{NH}_3$ , while close to 60% to 75% compliance was recorded in relation to the Target threshold for  $\text{NH}_3$  at Die Oog, Langvlei, Princess Vlei and Zoarvlei in Reporting Year 2024;
- Potentially toxic conditions were particularly prevalent at Wildevoelvlei and at the Mitchell's Plain and Mew Way detention ponds during Reporting Year 2024, where all of the recorded  $\text{NH}_3$  concentrations were in the Poor and Unacceptable categories (indicating chronic to acute toxicity);
- Potentially toxic conditions were also often present in Rietvlei and, particularly, Zeekoevlei during Reporting Year 2024;
- The situation deteriorated significantly in Reporting Year 2024, compared to 2023, at Princess Vlei, Rietvlei and Zoarvlei, where the proportion of samples in the Target category decreased by close to 20%;
- There was also some deterioration in terms of ammonia toxicity (with a lower proportion of samples in the Target range for  $\text{NH}_3$ ) at Die Oog, Little Princess Vlei and Zeekoevlei in Reporting Year 2024, compared to 2023, while a positive trajectory of change from Reporting Year 2023 to 2024 (with an increase in the proportion of samples in the Target range) was observed at Langvlei, Rondevlei, Westlake Wetland and the Elsieskraal Dams;
- At Wildevoelvlei, there was a significant (>30%) decrease in the proportion of samples in the Unacceptable category (indicative of the potential for acute ammonia toxicity) from Reporting Year 2023 to 2024, representing an improvement (although there were still no  $\text{NH}_3$  measurements in the Target range, as in the previous reporting periods);

- All the impacted catchments and standing waterbodies showed a greater range of  $\text{NH}_3$  values in summer compared to winter, and generally higher median values (and thus more risk of ammonia toxicity) in summer than in winter (the only exceptions being the Bokramspruit catchment in Reporting Year 2024, and Zeekoevlei waterbody in the 2020-2022 reporting period and Reporting Year 2024);
- The only catchment characterised by flowing water sites with elevated pH values indicative of an increased risk of ammonia toxicity was the Elsieskraal catchment, suggesting that ammonia toxicity problems in rivers and stormwater channels in the other catchments are being driven by excessively high ammonia concentrations and not elevated pH values;
- There was a relatively high risk of ammonia toxicity, as a result of median pH values  $>8$  (and 3<sup>rd</sup> quartile values  $\geq 8.5$ ), in the Langvlei, Rietvlei, Zandvlei and Zeekoevlei waterbodies during all three reporting periods, and in Die Oog during Reporting Year 2024, Princess Vlei and Westlake Wetland during the 2020-2022 reporting period and Reporting Year 2024, and in Wildevoelvlei during the 2020-2022 reporting period.



## 5.7 Salinity

Estuarine RQOs have been gazetted for the City's estuaries, as discussed in Section 3.8 (GN 1179 of November 2020). Of the various systems classified as estuaries in this notice, this and previous reports (Day et al 2020, 2023 and 2024) have recommended that the only systems in the City that should be evaluated against the Gazetted Estuarine RQOs for salinity and other estuarine variables, as part of the ongoing monitoring of water quality, are **Milnerton Lagoon** (excluding Rietvlei) and **Zandvlei** because these are the only currently functional estuarine systems.

This section comments briefly on salinity changes and trajectories in these two systems, for which specific salinity ranges have been outlined in the gazetted RQOs. Salinity is reflected here using electrical conductivity (EC) data, as a surrogate for salinity.

The boxplots in **5.7.1** provide a statistical summary of the EC data for Milnerton Lagoon and Zandvlei per reporting period, in relation to the gazetted mean and maximum salinity/EC thresholds for each. In the case of Milnerton Lagoon, the functional estuary is taken as the waterbody downstream of Otto Du Plessis Drive, as per the 2020 Estuary Management Plan for the Diep River Estuary (City of Cape Town and Infinity 2021). The gazetted maximum salinity values for both estuaries is <sup>13</sup>5310 mS/m (=35 PSU) and the gazetted mean values are 3210 mS/m for Milnerton Lagoon and 2470 mS/m for Zandvlei.

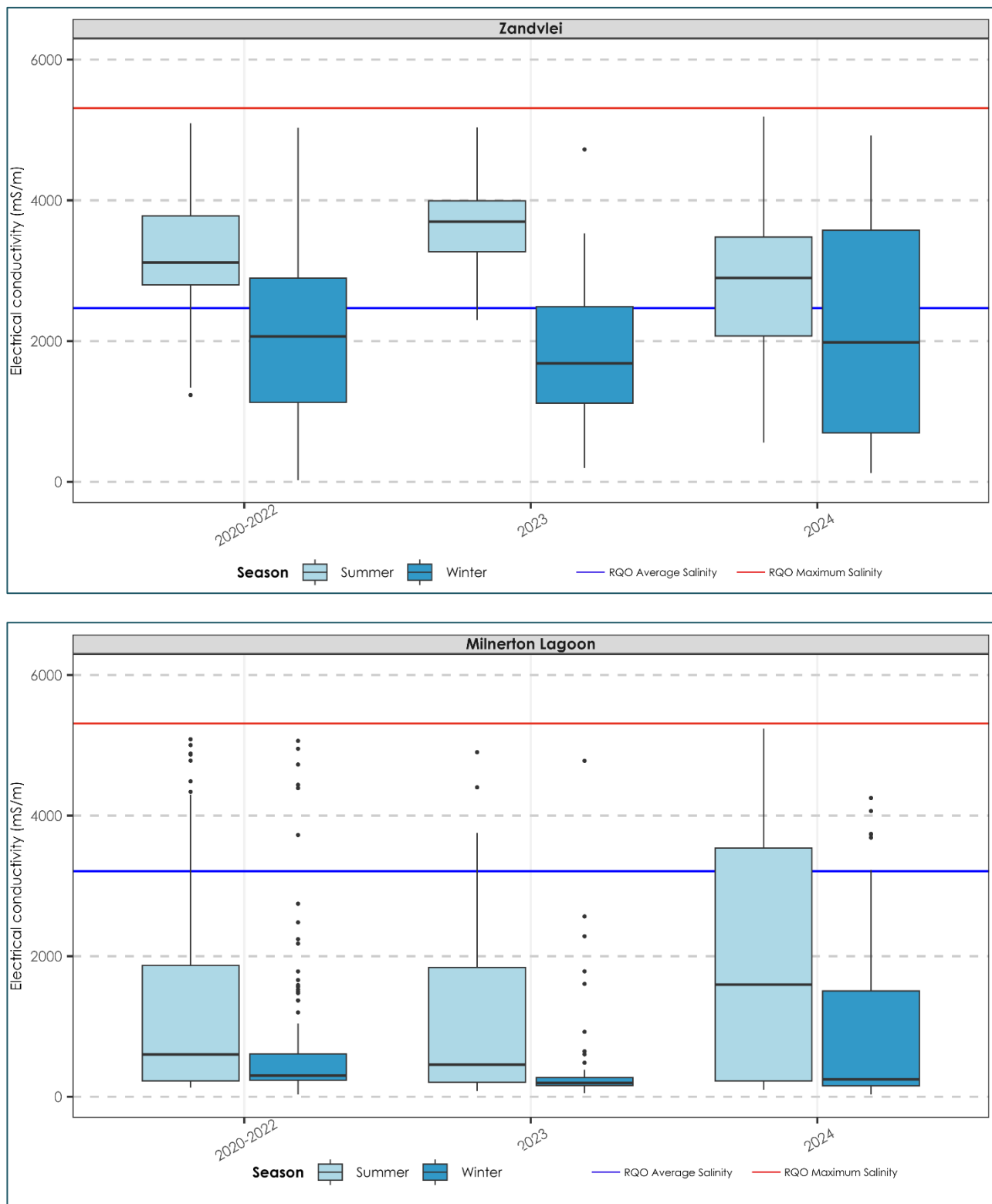
The plots suggest that:

- EC never exceeded the maximum RQO threshold of 5310 mS/m (equivalent to a salinity of 35) in either Milnerton Lagoon or Zandvlei during the measured 2020-2024 reporting periods, suggesting that hypersalinity was unlikely to have been a problem in either of these estuarine systems;
- In the case of the **Milnerton Lagoon**, the mean EC for all three reporting periods (ranging between approximately 795 and 1515 mS/m) was well below the minimum required threshold for average salinity (i.e. >3210 mS/m);
- When seasonal values are considered, as indicated in **Figure 5.7.1**, the third quartile of the summer data for the 2024 reporting period did extend above the average target, with a few outliers in the winter dataset also extending into the target range -these improvements over the previous year's data could be attributed to the documented flushing effect of major storms in 2024 (see data in **Figure 4.6**), which removed some of the built-up sediments accumulating in the lagoon, allowing increased tidal ingress, at least into the lower lagoon (Day et al 2024b);
- The above data, while showing limited summer improvement in the 2024 period, all suggest that there has been a significant 'freshening' of the Milnerton Lagoon estuary, relative to the expected reference range of salinities according to the RQOs, which is undoubtedly, at least in part, due to significant non-saline inflows from the Potsdam WWTW, as well as periodic inflows of raw sewage from the Koeberg and other pump stations, as well as from stormwater runoff;
- Data from **Zandvlei**, by contrast, showed relatively good compliance with the Estuarine RQOs for salinity/EC in all three reporting periods, with mean EC for the 2023 and 2024 reporting periods ranging between approximately 2690 and 2491 mS/m respectively, and thus above the gazetted minimum mean value of 2470 mS/m;
- There was however a greater range in EC in the 2024 winter wet season than in any other assessed season, with the winter mean dropping below the gazette annual average, and reflecting the influence of freshwater inflows from the catchment, for some reason having a greater influence than in the previous years – summer mean EC was also lower than in the preceding reporting periods;
- This said, the EC data do suggest that salinity in Zandvlei generally fell within the required range for this

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<sup>13</sup> Gazetted salinity values (in dimensionless practical salinity units (PSU)) were converted to EC values (in mS/m) to allow for a comparison with the data collected from Zandvlei and Milnerton Lagoon by the City. The conversion was using an online 'salinity unit calculator' (<https://reefapp.net/en/salinity-calculator>), which applies algorithms based on UNESCO (1983).

variable, for adequate estuarine function.



**Figure 5.7.1**  
**Comparison of electrical conductivity in Zandvlei and Milnerton Lagoon from the 2024 reporting period, with those from 2023 and the previous three years (2020 to 2022) combined. Marked salinity thresholds from the gazetted estuarine RQOs.**

## 6 CURRENT STATE OF CAPE TOWN'S RECREATIONAL WATERS

### 6.1 Background

While vleis and standing water bodies in general have been discussed in Section 5, in relation to the key water quality variables assessed in that section, the present section has been included to deal specifically with the current state of Cape Town's established recreational water bodies from the perspective of the risk, if any, that they pose to human health. Five main water bodies have been considered (identified in consultation with the City's CSRM):

- Rietvlei
- Milnerton Lagoon
- Princess Vlei
- Zeekoevlei
- Zandvlei.

With the exception of Princess Vlei, these vleis and estuaries are all used for various water sport activities, including sailing, kayaking, canoeing, fishing, kite-boarding, skiing, wind-surfing, rowing, and fishing. All of these activities expose users to some level of health risk if water quality is compromised.

Princess Vlei is not used for water sports. It is however used periodically for baptism ceremonies, requiring full immersion.

### 6.2 Background ecological condition

Data already presented in Section 5 suggest that the most pressing ecological issues affecting these and other standing waterbodies in Cape Town comprise high levels of phosphorus enrichment, which leads to high levels of plant productivity, variously in the form of emergent reeds, floating and rooted aquatic weeds, and filamentous and single-celled algae. Management of these is associated with high costs, either in the form of ongoing annual or more frequent removal, or periodic dredging of organic sediments that have built-up over decades (e.g. in Zeekoevlei).

Other water quality variables of potential concern include at times high concentrations of total ammoniacal nitrogen, sometimes associated with free ammonia at levels of concern (i.e. above acute toxicity thresholds / in the Unacceptable range). This issue is often associated with inflows into these waterbodies with water that has a high organic content and chemical and biological oxygen demand in excess of available dissolved oxygen, which means nitrification does not take place effectively. In Zeekoevlei and Milnerton lagoon in particular, such conditions also reflect in very low dissolved oxygen concentrations as well (Day et al 2022, Rose et al 2023) and Day et al (2024b).

As well as having significant negative impacts for aquatic ecosystems (e.g. chronic faunal health impacts from long-term exposure to elevated ammonia, methane and hydrogen sulphide in organic sediments and loss of habitat diversity from aquatic and emergent plant invasion), the above water quality impacts can also have profound impacts on the fitness of these water bodies for recreational use. This section thus provides a brief characterization of water quality issues in each of the waterbodies, and then moves on to discuss water quality from a direct human health perspective.

**Figure 6.2.1** presents summary compliance data for orthophosphate, TIN, dissolved oxygen, ammonia (NH<sub>3</sub>) and chlorophyll-*a*, all used to characterize the systems ecologically. *Escherichia coli* data are also included, to allow for later comment on human health risks. **Figures 6.2.2-6.2.6** by contrast present median annual data for orthophosphate, DO and free ammonia from individual monitoring sites in each of the five recreational waterbodies as well as in the immediate reaches of rivers that feed them.

These figures illustrate the following broad patterns and issues, already discussed in Section 5:

- Overall:
  - Zeekoevlei and Milnerton Lagoon were the worst performing of the recreational bodies, with both characterised by very high orthophosphate concentrations and ammonia frequently

above its acute toxicity threshold;

- Zeekoevlei and Princess Vlei were both characterised by high concentrations of chlorophyll-*a*, indicative of high phytoplankton (algae) concentrations, which in Zeekoevlei are dominated by *Microcystis aeruginosa*;
  - Although all vleis experienced episodes of poor water quality at some time in the focal reporting periods, Zandvlei, Rietvlei and Princess Vlei were generally in reasonably good ecological condition, with Zandvlei showing an improvement in compliance in all monitored variables over the 2024 reporting period except the frequency of chlorophyll-*a* concentrations rated Unacceptable
- More specifically, on a vlei-by-vlei level:
    - Data for **Milnerton Lagoon** show that this estuarine system was plagued by low DO and high TIN concentrations, with the latter mainly comprising ammonium nitrogen, as well as increasingly frequent, large inflows of raw sewage, indicated by the increasing proportion of samples rated as Level 2 and Level 3 Unacceptable (see **Figure 6.2.1**). The latter are assumed to derive primarily from inflows of often poorly treated sewage from the Potsdam WWTW, frequent overflows in the 2023 / 2024 reporting period from the Koeberg sewage pump station upstream and discharges of sewage and greywater from the Jo Slovo, Dunoon, Doornbach and other informal settlements or settlements with high levels of backyard dwellings (Rose et al. 2023);
    - Median dissolved oxygen concentrations were all at Unacceptable levels throughout the upper and middle estuary (**Figure 6.2.4**), and clearly linked to inflows from the Theo Marais channel as well as high organic loading from the Potsdam WWTW, described in Day et al 2024b) – the latter study showed however that internal loading of organic sediments in the lagoon itself also contributes to low oxygen to zero concentrations, particularly in bottom waters;
    - Low oxygen as a result of highly polluted inflows into the lagoon have contributed directly to the production of hydrogen sulphide in the lagoon, resulting in concerns over human health and high levels of discomfort to recreational users of the estuary and its surrounds and to local homeowners and businesses (Ms Caroline Marx, pers. Comm. to the City's Section 80 Committee on Water quality and wetlands, meeting of 23 May 2025);
    - Median DO concentrations improved substantially in the lower estuary, where flushing by incoming sea maintains high surface DO concentrations (Day et al 2024b);
    - High orthophosphate concentrations (median concentrations rated Unacceptable) promoted algal growths in the lagoon, as indicated by periodic high concentrations of chlorophyll-*a*, assumed to be associated with the late spring to autumn months (**Figures 6.2.1 and 6.2.3**);
    - **Rietvlei data** showed a marked increase in orthophosphate concentrations in the vlei over the 2024 reporting period, with a shift from the range for eutrophic ecosystems to conditions likely to promote hypertrophic ecosystems (**Figures 6.2.1 and 6.2.3**) – orthophosphate enrichment promotes the growth of (indigenous) aquatic plants such as *Stuckenia pectinata* (sago pondweed), which is harvested from the portion of Rietvlei that is used for recreational activities, using a mechanical harvester;
    - Nevertheless, DO concentrations remained mainly in the Target range for this variable, although there was a low frequency of samples where hypoxia (very high oxygen saturation) occurred, assumed to be associated with high rates of photosynthesis during algal blooms (**Figures 6.2.1 and 6.2.4**);
    - The frequency of samples with ammonia concentrations rated Poor (in the range for chronic toxicity) also increased in most parts of the vlei in the 2024 reporting period (**Figures 6.2.1 and 6.2.6**), with a trajectory of increasing concentrations, suggesting a decrease in water quality

entering the vlei via the Bayside Canal, although the frequency of raw sewage inflows appeared relatively low, as shown by *E. coli* data in **Figure 6.2.1**;

- **Zeekoevlei** was characterised by very high orthophosphate concentrations (well above the hypertrophic threshold), on an upward trajectory in the upper reaches of the vlei and sites in the Big Lotus River upstream (**Figures 6.2.1** and **6.2.2**);
- High orthophosphates promote significant plant growth, dominated in-lake by *Microcystin aeruginosa* (cyanobacteria), discussed in Section 6.6 with regards to their toxicity, as well as reeds (mainly *Typha capensis* and *Schoenoplectus scirpoides*), which also require removal, carried by local residents and the FBNR during annual draw-downs;
- Median ammonia concentrations were rated “Poor”, and likely to be associated with chronic toxicity for more sensitive aquatic biota (DWAF 1996). Concentrations of this aquatic toxin were moreover on an increasing trajectory in Home Bay and sites close to the mouth of the Big Lotus River, with the former probably driven by high levels of anoxic organic sediments in this part of the vlei (Day et al 2022), while the latter reflect high levels of organic pollution including raw sewage in the Big Lotus River (see Section 5) (**Figures 6.2.1** and **6.2.5**);
- Median surface DO concentrations remained, however, high throughout the vlei (**Figure 6.2.4**), although data in **Figure 6.2.1** suggest that at least at times some sites had much lower concentrations and, in addition, parts of the vlei were at times subject to hypoxia (very high oxygen saturation) associated with high rates of photosynthesis during algal blooms;
- **Princess Vlei** had lower median orthophosphate concentrations than the systems discussed above, with many samples rated as Poor rather than Unacceptable – nevertheless, nutrients were sufficient to promote major growths of water hyacinth over the past few years, requiring major efforts by the City as well as the Princess Vlei Forum, to remove it through mechanical, manual and biocontrol measures;
- Algal blooms (rated Unacceptable in almost all samples) also reflect the negative impact of even moderately high nutrient enrichment in aquatic waterbodies – the high LOQ for orthophosphate analyses means however that whether there have been increases in orthophosphate concentrations in this system over the past few years cannot be determined;
  - The increased frequency of ammonia above chronic toxicity concentrations (i.e. rated as Poor) does suggest periodically polluted inflows into the system also reflected by 30% and 10% of samples in the 2023 and 2024 reporting periods having a high loading of raw sewage, as reflected by *E. coli* samples rated Unacceptable (Levels 1-3) (**Figure 6.2.1**);





**Photo 6.2.1**

**Water hyacinth (*Pontederia crassipes*) increased in Princess Vlei and Zeekoevlei during the 2024 reporting period, necessitating on-going clearing to prevent significant invasion of the waterbody**

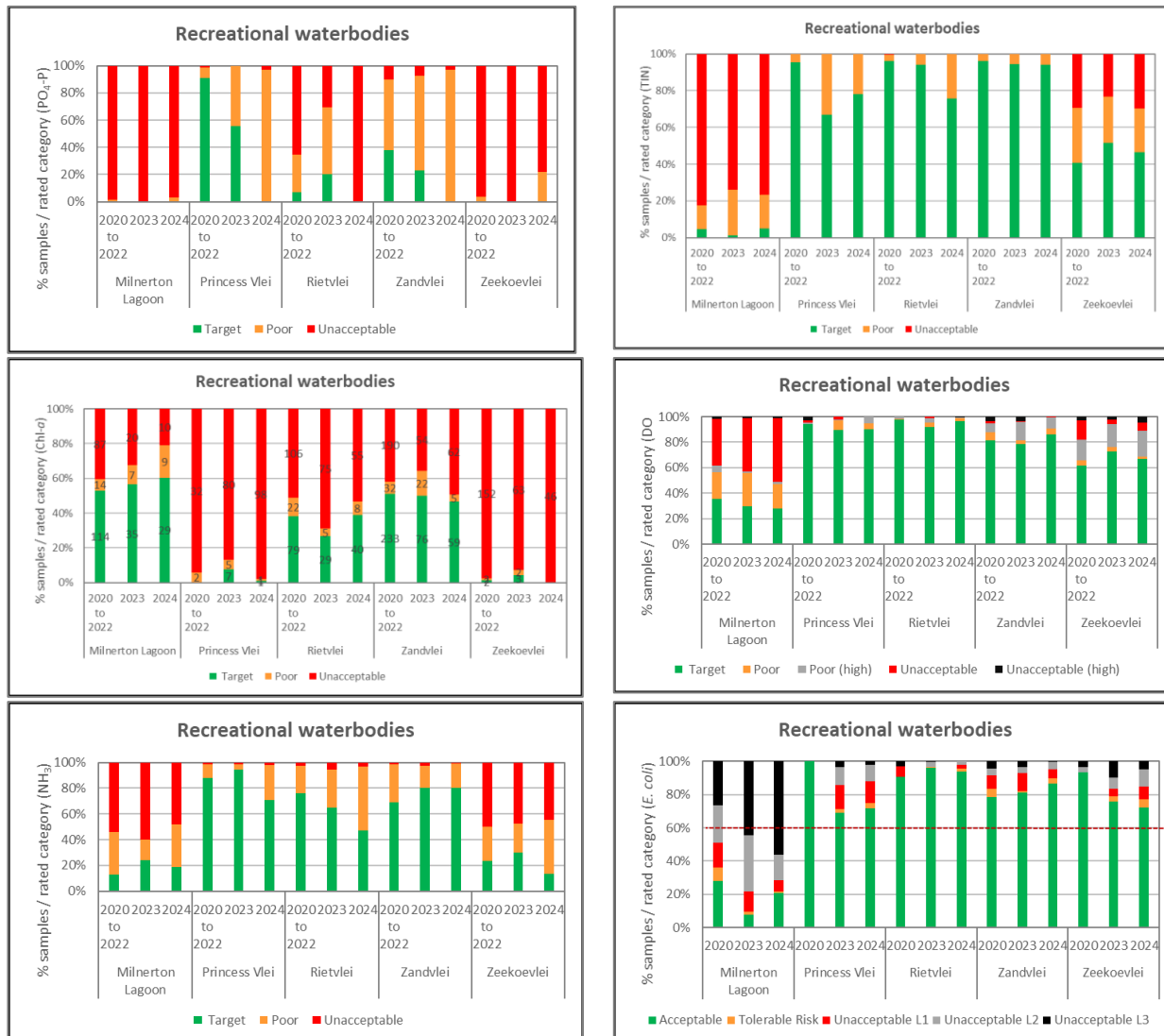
- Data for **Zandvlei** showed that this important estuary was in relatively good condition compared with the other waterbodies, despite periodic inflows of raw sewage, albeit with a decreasing frequency of major inflows (**Figure 6.2.1**);
- Like Princess Vlei, Zandvlei also had orthophosphate concentrations generally rated Poor rather than Unacceptable, and reflecting a catchment that has lower levels of informal settlements and other sources of raw sewage than the Diep and Zeekoe catchments (see Section 5 and Day et al 2024c);
- Orthophosphate concentrations were however sufficient to promote rapid growths of freshwater and estuarine aquatic weeds including sago pondweed (*Stuckenia pectinata*) and spiral tasselweed (*Ruppia spiralis*), which are controlled by two of the City's mechanical weed harvesters.



**Photo 6.2.2**

**Weed harvester used to control aquatic weeds on Zandvlei. Similar vessel used in Rietvlei.**  
Photo credit: City of Cape Town [<https://www.capetown.gov.za/Media-and-news/Cape%20Shoveler%20now%20patrolling%20Zandvlei?fbclid>]

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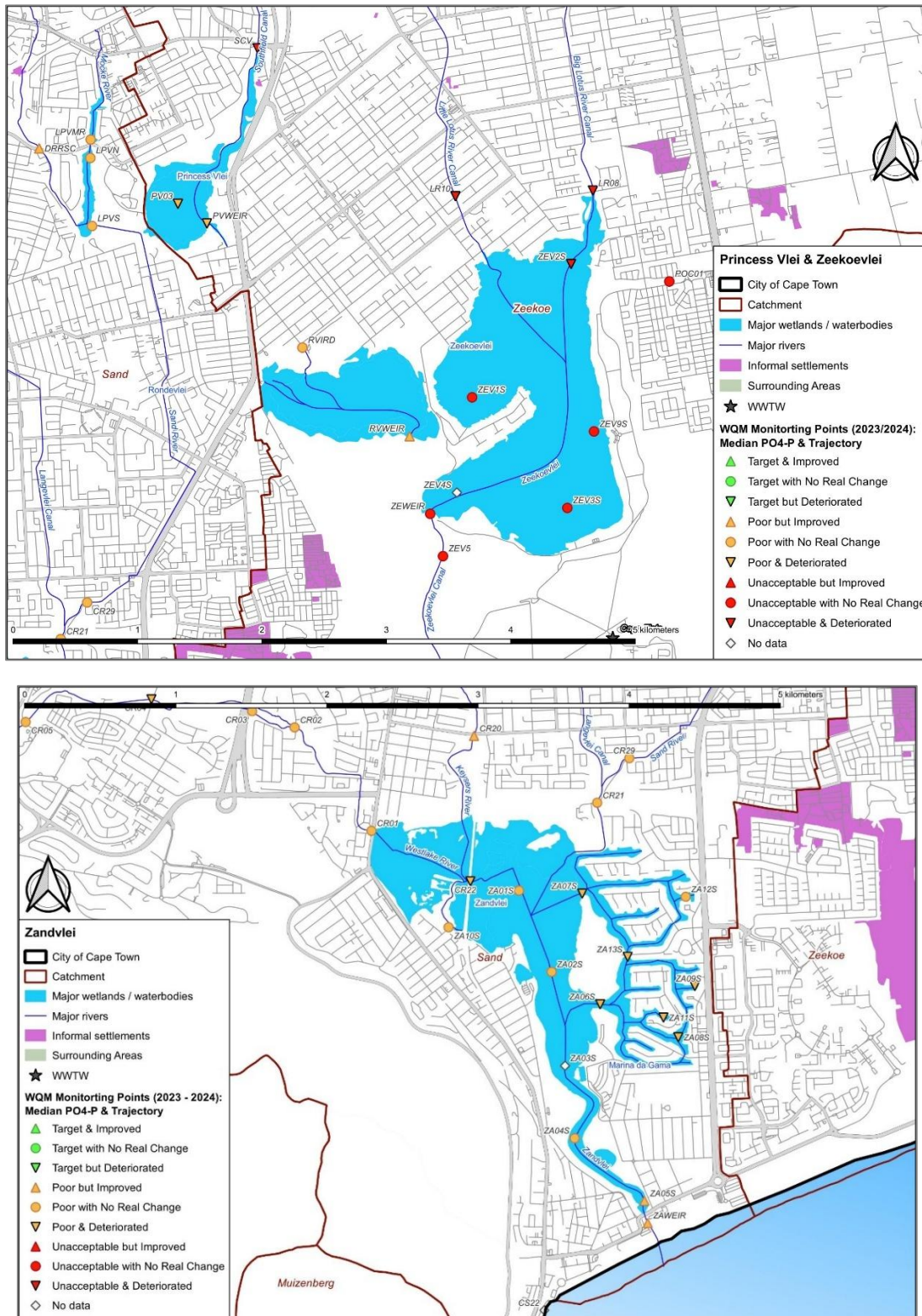


**Figure 6.2.1**

Percentage of samples falling within each rated category for different variables in Recreational waterbodies only. Thresholds for rated categories as defined in Table 3.2 (and Table 3.1 for orthophosphate). Note that the high LOQ for this variable means that no sample can be rated better than “Poor” (see Section 3.11.8)



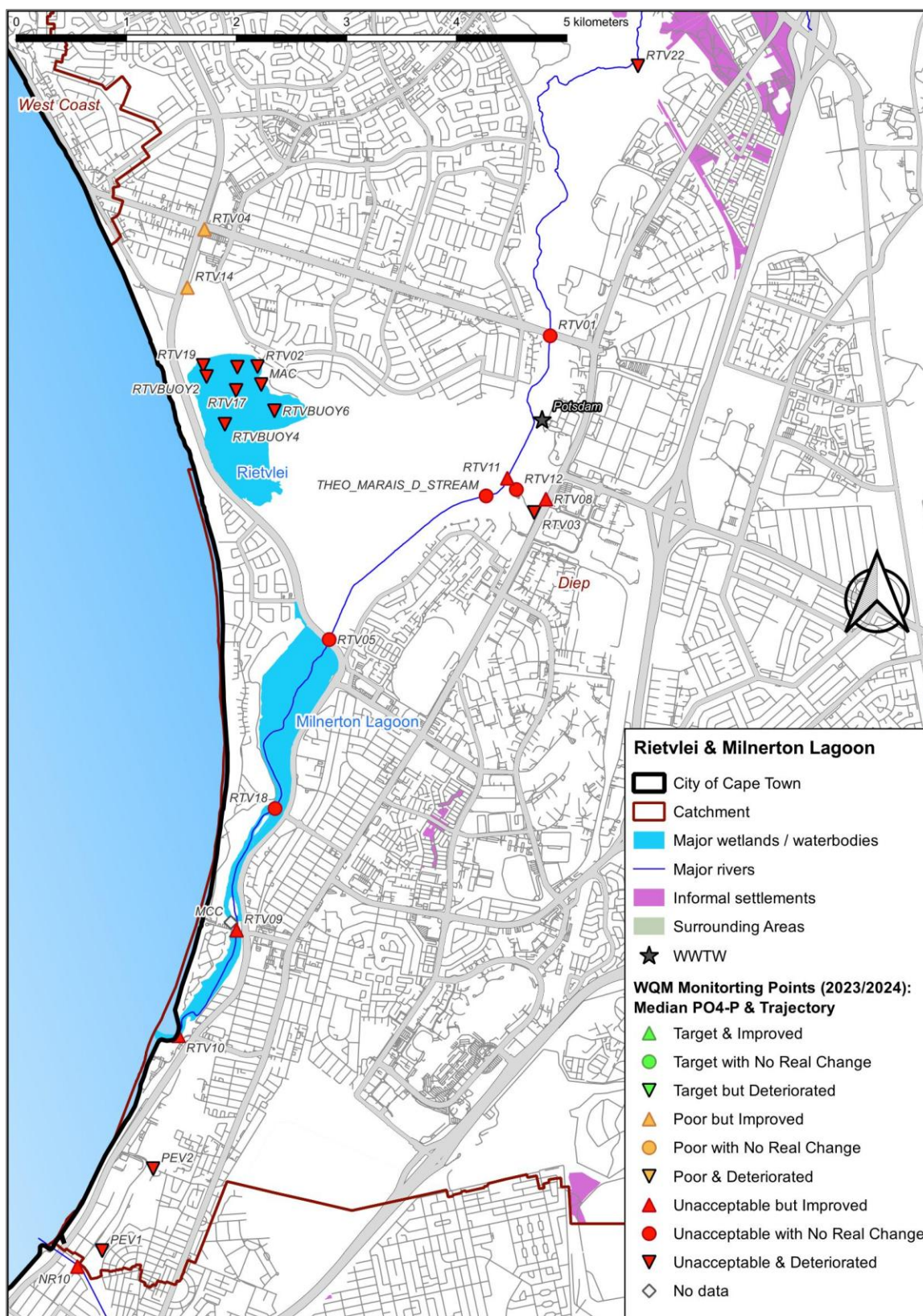
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**Figure.6.2.2**

Median annual orthophosphate phosphorus (PO<sub>4</sub>-P) data for rivers passing into and from Princessvlei, Zeekoevlei and Zandvlei over the 2023 and 2024 reporting periods, showing trajectory per site (as described in Section 3.11.14). Note that the high LOQ for this variable means that no sample can be rated better than "Poor" (see Section 3.11.8)

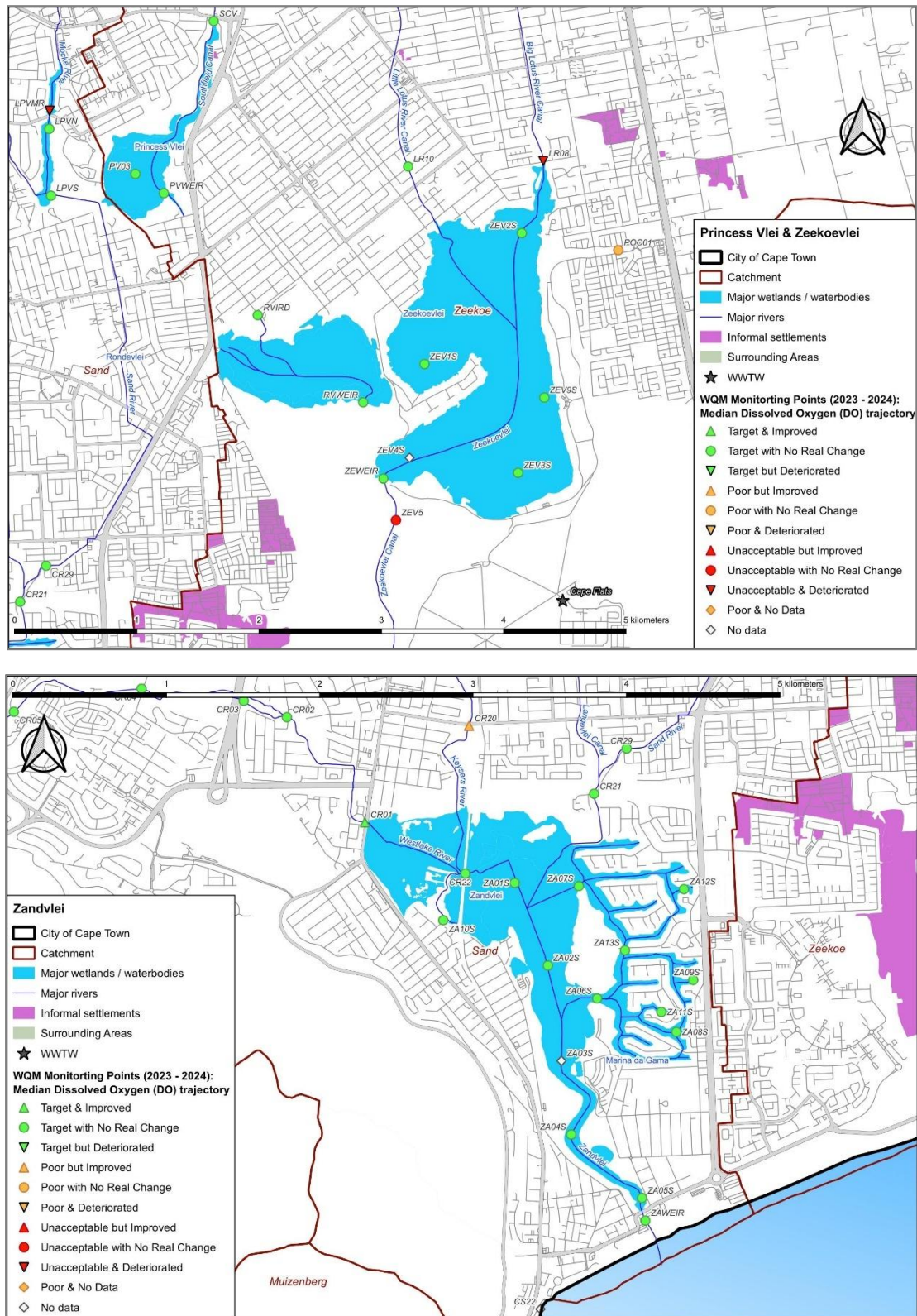




**Figure 6.2.3**  
Median annual orthophosphate phosphorus (PO<sub>4</sub>-P) data for Milnerton Lagoon and Rietvlei over the 2023 and 2024 reporting periods, showing trajectory as described in Section 3.8.14. Note that the high LOQ for this variable means that no sample can be rated better than “Poor” (see Section 3.11.8)

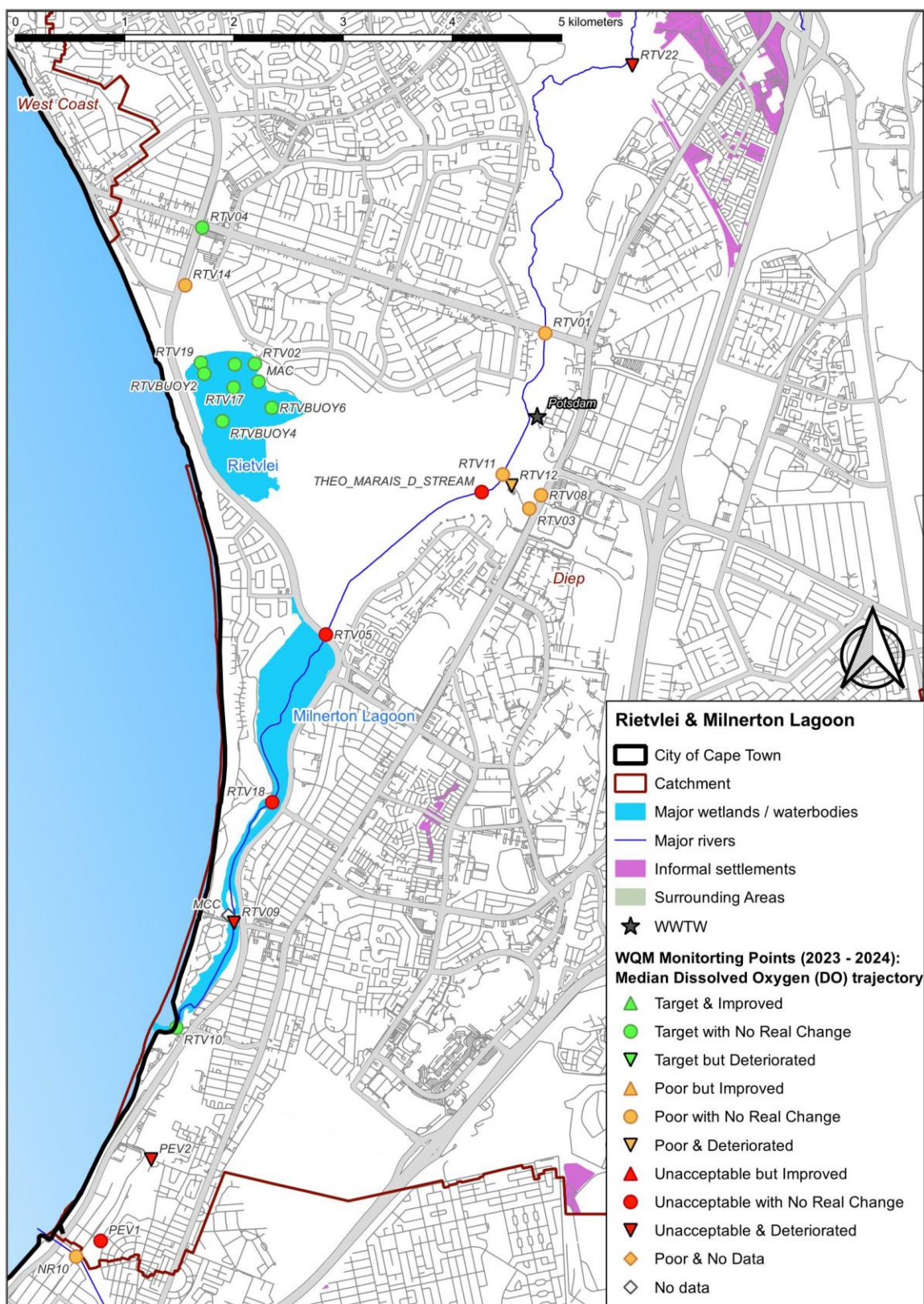


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**Figure 6.2.4**  
**Median annual dissolved oxygen (DO) data for Princessvlei, Zeekoevlei and Zandvlei over the 2022 and 2023 reporting periods, showing trajectory as described in Section 3.8.14**

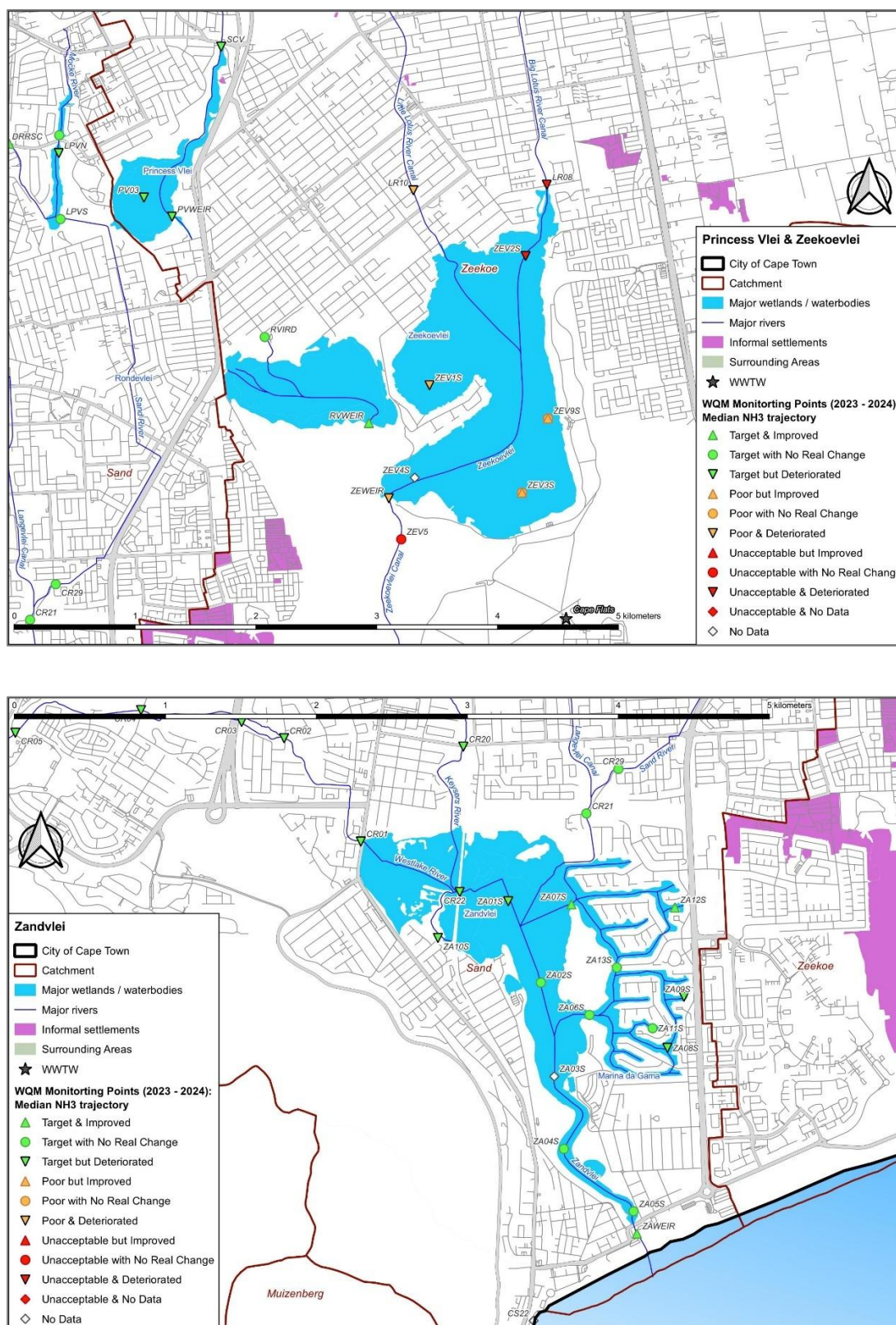




**Figure 6.2.4**  
Median annual dissolved oxygen (DO) data for Milnerton Lagoon and Rietvlei over the 2022 and 2023 reporting periods, showing trajectory as described in Section 3.8.14.

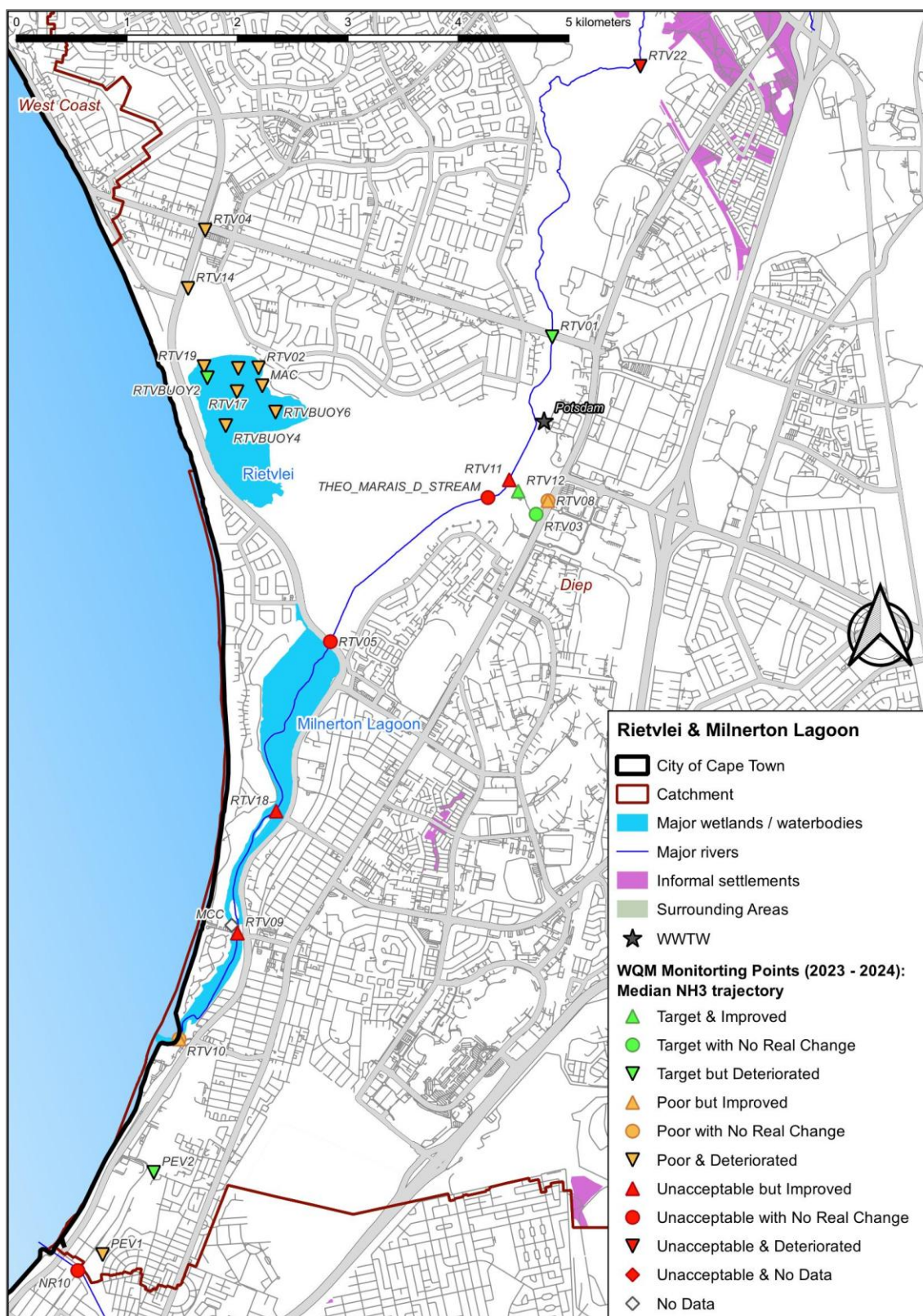


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**Figure 6.2.5**  
**Median annual free ammonia (NH<sub>3</sub>) data for Princessvlei, Zeekoevlei and Zandvlei over the 2022 and 2023 reporting periods, showing trajectory as described in Section 3.8.14**





**Figure 6.2.6**  
**Median annual free ammonia (NH<sub>3</sub>) data for Milnerton Lagoon and Rietvlei over the 2022 and 2023 reporting periods, showing trajectory as described in Section 3.8.14.**

## 6.3 Human health risks in Cape Town's recreational waterbodies

### 6.3.1 Data used to assess risks to human health

While the previous discussion presented an overview of aquatic ecosystem conditions in the City's main recreational waterbodies, the main focus of this section is on those water quality variables that relate directly to human health risks in Cape Town's recreational vleis, rather than to ecosystem condition that might impact on user experience (e.g. excessive water weeds or algae caused by nutrient enrichment). These water quality variables comprise **indicators of sewage contamination** (i.e. *E. coli*) and data reflecting concentrations of **microcystin toxins**, often associated with blue-green algal blooms. Data are assessed in this section for individual systems, rather than by catchment or grouped waterbodies, as presented in Section 5.

### 6.3.2 Assessment thresholds

The *E. coli* and microcystin toxin data presented here have been assessed with regard to the rated water quality thresholds presented in **Tables 3.3** and **3.4**.

It is however stressed that the City does not purport to manage any of its inland water bodies for full contact recreation, but rather sets 'Target', 'Tolerable Risk' and 'Unacceptable' thresholds, **based on risks posed by intermediate contact only** (City of Cape Town 2023a).

#### What is intermediate contact recreational use?

The City of Cape Town (2023) defines this as "All forms of water based recreation but excluding full-body water contact activities such as swimming or diving. Intermediate contact activities may involve a high degree of water contact, such as water skiing, wind surfing and canoeing". DEA (2012) does not distinguish between full contact and intermediate contact uses, but notes that exposure (and therefore risk) differs between activities.

Full-immersion baptism is short-term, and once-off, but nevertheless is arguably a full-contact use, rather than an intermediate contact use (see DWAF 1996).

**The City does not endorse full-contact use of its inland water bodies.**

## 6.4 Indicators of sewage contamination

### 6.4.1 *Escherichia coli*

#### 6.4.1.1 Background

*Escherichia coli* (abbreviated *E. coli*) is a species of fecal coliform bacteria that is commonly found in the lower intestine of warm-blooded organisms (birds and mammals). Most *E. coli* strains are harmless, but some (generally < 1%) can cause significant diarrhoea and other illness (WHO 2021).

The presence of *E. coli* in water is used as an indicator of fecal contamination of avian (bird) or mammalian origin, and therefore is indicative of other pathogens that may also be present in faeces. These include other bacteria, nematode cysts, viruses and others.

#### 6.4.1.2 *Escherichia coli* data for recreational water bodies

**Figure 6.4.1** presents the results of *E. coli* analyses for water samples from the recreational water bodies listed in **Section 6.1**. These data were available for reporting periods 2020, 2023 and 2024 (see Section 3.11.7).

Note that the *E. coli* data described here have already been presented in **Section 5.1**, along with data for other open water bodies and rivers, while **Section 5.2** presents data and discussion around the main sources of *E. coli* in different sub-catchments over the present main reporting periods.

The data in **Figure 6.4.1** are presented as compliance graphs, showing separate summer and winter samples (note that these data are also presented in **Figure 6.2.1**, without seasonal distinctions). The data show that:

- **Milnerton Lagoon** experienced very high levels of sewage contamination (mainly Unacceptable Level 3 and 2) over all three reporting periods, with data showing a major increase in the magnitude of sewage pollution in the 2024 reporting period, shown by an increased proportion of samples rated as Level 3 Unacceptable, even though samples rated as Acceptable increased slightly as well (25% and 15% in summer and winter respectively). The data showed slight seasonal variation, with a lower proportion of winter samples rated as Unacceptable Levels 3 and 2 in both the 2023 and the 2024 reporting periods,

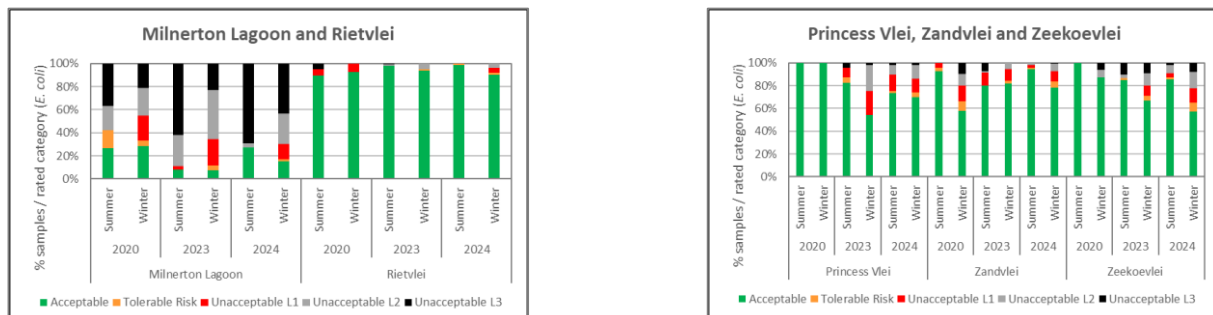
possibly reflecting some wet season dilution at times. However, sewage inflows were probably driven mainly by near-continual inflows of raw sewage from pump station failures (particularly the Koeberg pump station in the 2023 and 2024 reporting periods) and non-compliant treated effluent from the WWTW;

- The data suggest that, for most of the 2023 and 2024 reporting periods, Milnerton Lagoon was not a safe waterbody for even intermediate recreational use, with at best 25% of samples being rated as Acceptable in the summer 2024 reporting period (assumed to reflect samples mainly from the lagoon mouth (see **Figure 6.5.2**), and with all other samples in that summer being rated as Unacceptable Levels 2 and 3, reflecting major, sustained and highly polluted inflows into the lagoon;
- **Rietvlei** (also referred to as Flamingo Vlei in some documents (e.g. Rose et al 2022)) by contrast was rarely exposed to raw sewage over the three reporting periods shown in **Figure 6.4.1**, although data for the 2024 winter reporting period showed an increase in the frequency of measured sewage inflows (< 10% of samples, but including some of high magnitude (Level 2 Unacceptable)). It is assumed that such inflows would have contributed to the elevated orthophosphate previously described for this system. However, overall, these data reflect a cleaner upstream catchment, albeit still affected at times by overflows from pump-stations and sewer manholes, with *E. coli* concentrations in the vlei being further moderated by extended detention time in the vlei (compared with the flowing Milnerton Lagoon) and dilution;
- Rietvlei thus appears to have provided a relatively low-risk environment to recreational users, at least from the perspective of exposure to raw sewage;
- There was a slight reduction in the frequency of measured *E. coli* at Unacceptable levels in **Princess Vlei** over the 2024 reporting period, compared with 2023, although just under 30% of samples in both summer and winter were still rated as Unacceptable, and comparisons with the 2020 reporting period suggesting that the vlei remains prone to more frequent pollution events than in the past;
- Nevertheless, Princess Vlei also appears to have provided a relatively low-risk environment to intermediate contact users, at least from the perspective of exposure to raw sewage. IN Princess Vlei, these “users” include both people undergoing baptism, and workers engaged in manual clearing of water hyacinth and solid waste;
- **Zandvlei** data for the 2024 reporting period showed some reduction in the magnitude of sewage inflows, based on a reduced frequency in measured *E. coli* samples rated as Level 3 and Level 2 Unacceptable, although still with 20% of samples in the Unacceptable range. Of these, in the 2024 reporting period, winter samples were more prone to high *E. coli* counts, potentially reflecting wet-season surface wash-off of dirty parts of the catchment (e.g. the upper Sand River) but probably reflecting periodic pump station failures as a result of blockages. A reduced frequency of pump station failures in the catchment as a whole has been driven by repairs to the (previously highly problematic) Raapkraal Pump Station and the addition of a second pump, as well as by the addition of back-up power and telemetry in pump stations in Marina da Gama and Military Road (A. Lee, CSRM, pers. comm. to Liz Day).
- On the basis of measured water samples, recreational users of Zandvlei were generally not exposed to unsafe conditions, particularly in summer when water use was likely to be highest. However, the periodic inflows of sewage into the water body are still regarded with concern, and need to be further reduced;
- Users of **Zeekoevlei** were exposed to more frequent *E. coli* inflows of a higher magnitude (more samples at Level 2 Unacceptable) during the 2024 reporting period than over the previous reporting periods included in **Figure 6.4.1**, and these data show a clearly deteriorating trajectory in this vlei, since the 2020 reporting period. The most frequent samples with *E. coli* rated as Unacceptable typically occur in winter, and these are assumed to reflect a combination of catchment wash-off and increased frequency of pump station failure as a result of stormwater ingress. However, the 2024 reporting period also had less rainfall overall than the 2023 reporting period (see Section 4) and this means that 2024 winter data would have been less influenced by rainfall dilution, while during the winter drawdown (late April to end of July), there would also be less dilution in the vlei in winter. However, since at least the latter is an annual management intervention, the deterioration in winter water quality also clearly reflects elevated pollution events, highlighted in Section 5.1 as well as Section 8 for this priority catchment;



- Overall, Zeekoevlei was usually safe for intermediate recreational use, but the data indicate increasing periods (15% to 40% for summer and winter 2024 respectively) when exposure to this water would have been unsafe. As in Princess Vlei, users exposed to Zeekoevlei's waters include both a large number of watersport users, as well as teams of workers employed by the City and various community organizations such as FOZR for regular collection of solid waste, and removal of water hyacinth and reeds. At times, high measurements of *E. coli* in the vlei have led to its partial closure and to the cessation of water hyacinth removal (S. Jacobs, FOZR, pers. comm to Liz Day).

Generally, the data suggest that all of the City's recreational water bodies periodically posed risks to human health during the 2023 and 2024 reporting periods, but were largely in an Acceptable condition, conducive to their recreational use. Milnerton Lagoon was however mostly in an Unacceptable condition, and its use for recreation would have posed likely risks to human health most of the time.



**Figure 6.4.1**

Percentage of *E. coli* samples falling within each rated category for this variable for each recreational waterbody.



**Photo 6.4.1**

Workers engaged in solid waste and invasive plant removal in Zeekoevlei may be exposed at times to high *E. coli* levels, resulting in work stoppages at times to protect their health. (Photo: FOZR)

## 6.4.2 *E. coli* by site

In order to provide some spatial information about *E. coli* concentrations in different parts of the main recreational vleis, geometric mean *E. coli* data for the 2020 reporting period have been colour coded, using the threshold data for *E. coli* provided in **Table 3.3** as a guide, and plotted as individual monitoring sites in **Figures 6.4.2** and **6.4.3**, which show Zandvlei, Zeekoevlei and Princessvlei; and Rietvlei and Milnerton Lagoon, respectively. It must be noted that geometric mean data for *E. coli*, while useful for showing broad trends, cannot be used to infer overall risks to human health, as they do not show events when *E. coli* was elevated above thresholds of concern, and moreover, are impacted by reporting issues around upper and lower limits of analysis (see Sections 3.11.8 and 3.11.9), with the result that geometric means may well under-estimate actual values, had they been more accurately calculated. Nevertheless, the data do allow spatial variation in *E. coli* data within and around the recreational wetlands to be considered.

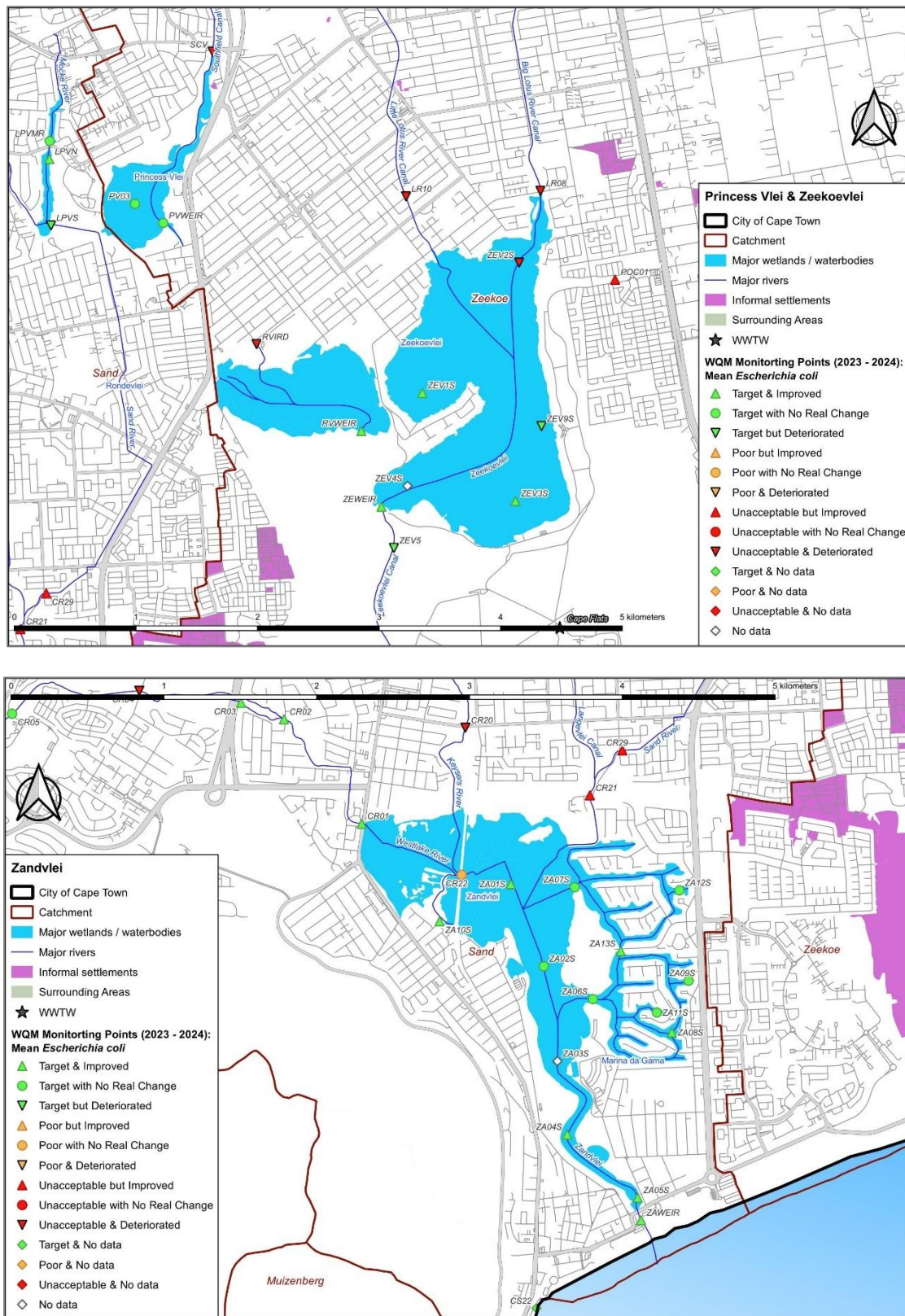
The data highlight what the compliance data have already indicated, namely that:

- **Princess Vlei** sites were generally in an Acceptable condition, albeit fed by more polluted water from the Southfield Canal (geometric mean rated as Unacceptable);
- Mean annual **Zeekoevlei** data were similarly within an Acceptable range across the vlei, other than in the upper vlei, near to the mouth of the highly polluted Big Lotus River, where mean *E. coli* concentrations were in the Unacceptable range, high-lighting the high level of risk associated with recreational use in this part of the vlei, which was closed for recreational use as a result for much of the 2024 reporting period;
- Mean **Zandvlei** data were also within the Acceptable range across most of the estuarine wetland, other than at CR22 (a site downstream of the Westlake and Keyzers River inflows, near the railway line, and presumed to be impacted by road runoff and periodic sewage manhole overflows – this is an ongoing trend at this site (see Day et al 2024a);
- Data for watercourses flowing into Zandvlei highlight generally less polluted water entering from the Westlake River, but more problematic water inflows from the Langvlei, Sand and Keyzers River systems. Of these, the Sand and Langvlei Rivers both flow through at least some areas in their lower catchments where there are high levels of solid waste on streets and in canals, and where associated sewer blockages and other impacts are likely to be more frequent. The Keyzers River data shows a deterioration from the previous reporting period, when its mean *E. coli* concentration was rated as Acceptable, versus Unacceptable in the 2024 reporting period;
- Monitored sample points in Rietvlei were all rated as within Target range – but the upstream catchment (Bayside channel) was clearly problematic and rated as Unacceptable, and is assumed to be a factor contributing to the increase in *E. coli* concentrations within the vlei in the 2024 reporting period, shown with the coded "Deteriorated" symbol;
- Sample points in Milnerton Lagoon were all rated as Unacceptable and Deteriorating, with the exception of RTV10 at the mouth, where dilution and die-off of *E. coli* with exposure to cleaner seawater exchange improve water quality.

It is however again reiterated that summary *E. coli* data are complicated, in that even using geometric means, the data include in some cases a wide range of values between spill and non-spill periods, and even those sites rated green (Target) in the figures provided may have experienced sewage spills at times, as indicated by the data in **Figure 6.4.1**.

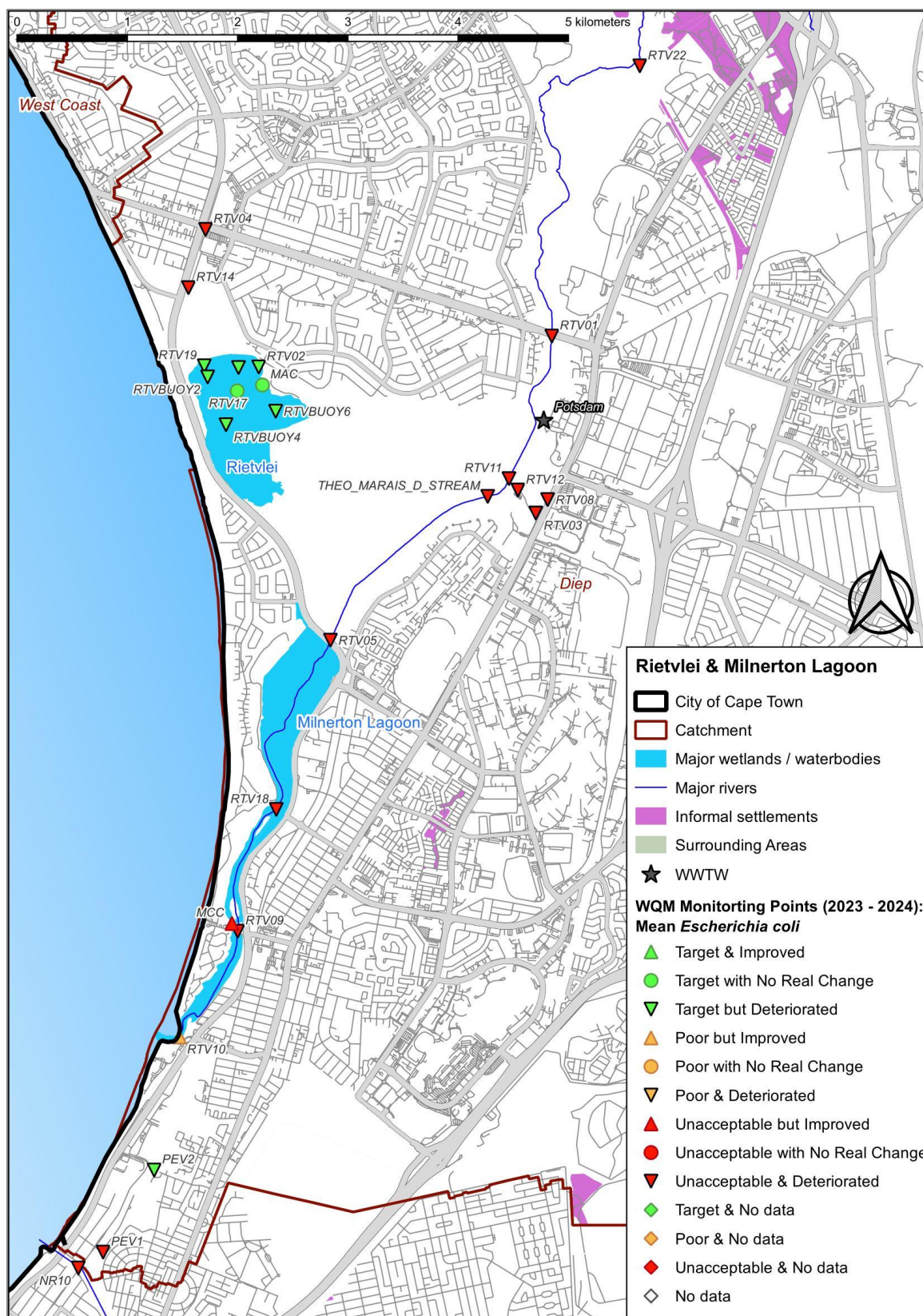


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**Figure 6.4.2**  
**Geometric mean annual *E. coli* data, focusing on Princessvlei, Zeekoevlei and Zandvlei for the 2023 and 2024 reporting period.**





**Figure 6.4.3**  
Geometric mean annual *E. coli* data, focusing on Milnerton Lagoon and Rietvlei for the 2023 and 2024 reporting periods.

## 6.5 Microcystin risks

### 6.5.1 Background

Cyanobacteria (or blue-green algae) are a common and naturally occurring component of most recreational water environments (WHO 2003). They are of potential public health concern because some types may, under certain conditions, produce a group of secondary metabolites known as microcystins, some of which are toxic.

Since microcystin toxin testing is expensive, it is not routinely included in the City's water quality tests but is instead undertaken when blue-green algal blooms have been detected. A 'bloom' is defined by the SSB as a cell count > 20 000 cells/ml. However, when field evidence suggests that bloom conditions are obvious (e.g. blue-green algal slicks), microcystin tests are carried out immediately, without the delay necessitated by microscopic enumeration of algal cells.<sup>14</sup>

### 6.5.2 Assessment of microcystin toxin data and sampling frequency

**Figure 6.5.1** presents the results of analyses of water samples from Cape Town's recreational water bodies for microcystin toxins, while **Figure 6.5.2** presents the number of samples collected in each water body, over the 2020-2022, 2023 and 2024 reporting periods.

The data show that, although blue-green algal blooms were clearly present on numerous occasions over the 2023 and 2024 reporting periods covered in this report, as indicated by the frequency of sample analysis at all vleis in the 2024 reporting period, the only vlei in which **microcystin toxins** were recorded at concentrations of any concern in the 2024 reporting period was in Rietvlei, where a single sample was rated as of Medium risk.

This means that, despite periodic blue-green algal blooms, Cape Town's recreational watercourses were assumed to be relatively safe for human use over the 2023 and 2024 reporting periods, from the perspective of exposure during intermediate contact use to microcystin toxins in water from these systems.

It is noted that, at the time of writing this report, Zeekoevlei had however been closed once in the 2025 reporting period as a result of very high microcystin toxins. This issue will need to be considered in the next reporting cycle.

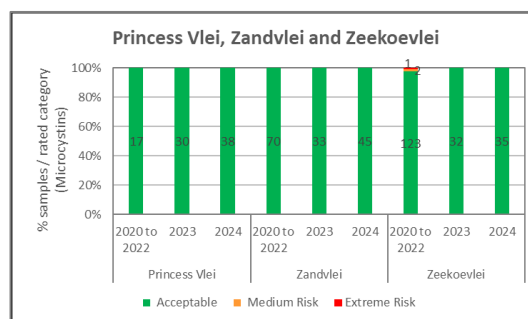
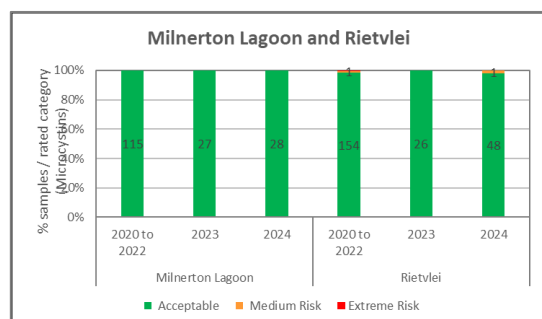
#### Box 6.5.1

##### Blue-green algae – why the name ?

Blue-green algae (an algal division also referred to as cyanophytes or cyanobacteria) produce green surface scums under bloom conditions. The algal cells also contain a blue pigment (phycocyanin), which is mostly visible when algal cells, in bloom conditions, die and rupture, releasing the pigment into the water. This sometimes appears as if turquoise-coloured paint has been spilled into the water body (adapted from WHO 2021).



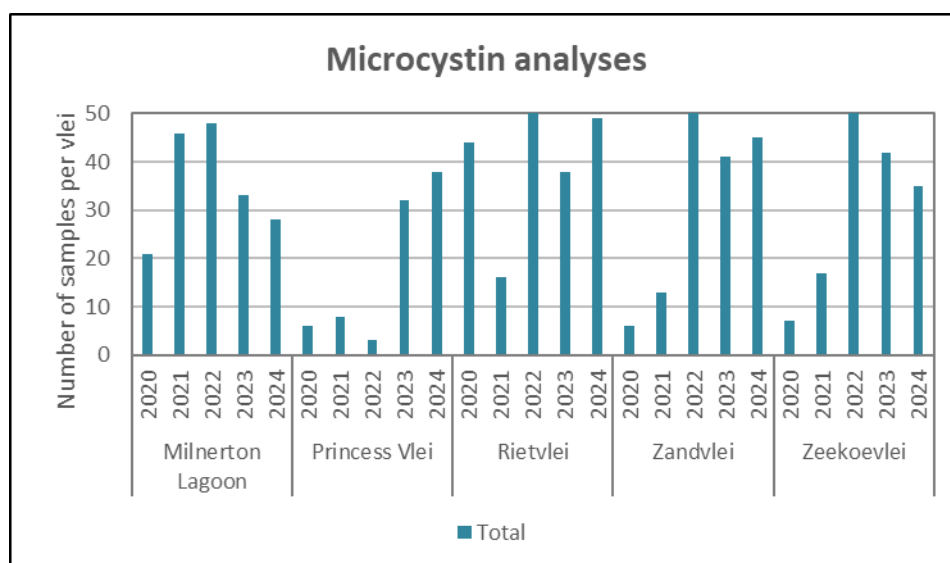
Photo: Early stage *Microcystis aeruginosa* bloom



**Figure 6.6.1**  
**Percentage of microcystin samples falling within each rated category for this variable, per recreational vlei.**  
**Thresholds for rated categories as defined in Table 3.4**

<sup>14</sup> See Day et al (2023)





**Figure 6.6.2**

Number of samples analysed for the presence and concentration of microcystin toxins over the past five reporting periods. Note: Sample number calculated as total sample numbers per vlei per date. This means that these data are not comparable with data from Day et al (2024a).

## 6.6 The Kuils River at the Khayelitsha Wetland Park

Previous reports (Day et al 2020, 2023 and 2024) all commented that the City's water quality monitoring programme does not include any sites that allow monitoring of water quality in a backwater section of the Kuils River, where the Khayelitsha Canoe Club operated from. Inclusion of such a site, for monitoring of at least *E. coli* was strongly recommended, from a human health perspective.

During the compilation of the present report, CSRМ noted that, although they had investigated inclusion of an additional site in the Khayelitsha Wetland Park, security issues were flagged, with high levels of crime associated with the informal settlements now characterizing much of the area. As a result, no additional site from this area has been added (N. Garcia, CSRМ, pers. comm. to Liz Day).

Moreover, discussions with Mr Siyanda Sopangisa (chair of the Khayelitsha Canoe Club) indicated that the canoe club is currently inactive, as a result of high levels of water hyacinth in the channel, preventing safe access. The Canoe Club is now focusing its efforts on the use of water hyacinth for biochar, and community recycling and environmental education activities. Water hyacinth invasion is exacerbated by high orthophosphate availability in the Kuils River (see Section 5.3.6).

These issues and activities are discussed further in Section 8 for the Kuils /Eerste Priority Catchment.

In the event that water hyacinth is brought under control, it is recommended that water quality monitoring be implemented in this water body, if necessary with samples being collected for analysis by members of the canoeing club themselves.

## 6.7 Key take-away points

- **Escherichia coli** data show that all of the City's recreational water bodies experienced periodic inflows of raw sewage at various frequencies and magnitude. More specifically:
  - **Milnerton Lagoon** experienced very high levels of sewage contamination over all three reporting periods, with data showing a major increase in the magnitude of sewage pollution in the 2024 reporting period. This was assumed to be driven mainly by near-continual inflows of raw sewage from pump station failures (particularly the Koeberg pump station in the 2023 and 2024 reporting periods) and often non-compliant treated effluent from the WWTW;
  - For most of the 2023 and 2024 reporting periods, Milnerton Lagoon was thus not a safe waterbody

for even intermediate recreational use;

- **Rietvlei** by contrast appears to have been rarely exposed to high magnitudes of raw sewage inflows over the three assessed reporting periods, and appears to have provided a relatively low-risk environment to recreational users, at least from the perspective of exposure to raw sewage;
  - The frequency of measured *E. coli* at Unacceptable levels reduced slightly in **Princess Vlei** over the 2024 reporting period, compared with 2023, although just under 30% of samples in both summer and winter were still rated as Unacceptable. Nevertheless, the vlei appears to have provided a relatively low-risk environment to intermediate contact users generally. These “users” include both people undergoing baptism, and workers engaged in manual clearing of water hyacinth and solid waste;
  - **Zandvlei** data showed some reduction in the magnitude of sewage inflows during the 2024 reporting period compared with those of 2023, reflecting *inter alia* a reduced frequency of pump station failures in the catchment, attributed largely to the positive impact of repairs and upgrades to key previously poorly performing pump stations, including provision of additional pumps, back-up power and telemetry at some. On the basis of measured water samples, recreational users of Zandvlei were probably not exposed to unsafe conditions as a result of exposure to raw sewage, particularly in summer when water use was likely to be highest. However, the periodic inflows of sewage into the water body are still regarded with concern, and need to be further reduced;
  - Users of **Zeekoevlei** were exposed to more frequent *E. coli* inflows of a higher magnitude during the 2024 reporting period than over the previous reporting periods, with in-vlei data indicating a clearly deteriorating trajectory since the 2020 reporting period. Winter samples were particularly problematic, and are assumed to reflect a combination of wash-off from a generally dirty catchment and increased frequency of pump station failure as a result of stormwater ingress. Although the vlei remained usually safe for intermediate recreational use, the data indicate an increased frequency of routine samples (15% and 40% for summer and winter 2024 respectively), when exposure to this water would have been unsafe. As in Princess Vlei, users exposed to Zeekoevlei's waters include both a large number of water sport users, as well as teams of workers employed by the City and various community organisations such as FOZR for regular collection of solid waste, and removal of water hyacinth and reeds. At times, high measurements of *E. coli* in the vlei have led to its partial closure and to the cessation of water hyacinth removal;
  - Generally, the data suggest that all of the City's recreational water bodies periodically posed risks to human health during the 2023 and 2024 reporting periods, but were largely in an Acceptable condition, conducive to their recreational use. Milnerton Lagoon was however mostly in an Unacceptable condition, and its use for recreation would have posed likely risks to human health most of the time.
- Section 5.3 highlights the fact that all five of the City's recreational waterbodies have, like most of the Cape Town's monitored watercourses, been impacted by high levels of orthophosphate contamination, making many of them prone to algal blooms, including blooms of cyanobacteria (or blue-green algae), which under certain conditions may produce a group of secondary metabolites known as **microcystins**, some of which are toxic. Assessment of microcystin data showed however that:
    - Although blue-green algal blooms were clearly present on numerous occasions over the 2023 and 2024 reporting periods, the only recreational vlei in which **microcystin toxins** were recorded at concentrations of any concern in the 2024 reporting period concern was Rietvlei, where a single sample was rated as of Medium risk;
    - This means that, despite periodic blue-green algal blooms, Cape Town's recreational watercourses were assumed to be relatively safe for human use over the 2023 and 2024 reporting periods, from the perspective of exposure during intermediate contact use to microcystin toxins;

- The Kuils River in the vicinity of the Khayelitsha Wetland Park, from where the **Khayelitsha Canoe Club** operates, is not included in the City's water quality monitoring programme. While inclusion of an additional site in this area has been recommended in past reports, the canoe club is currently not operating in terms of its original mandate, because of excessive water hyacinth growth in the canoeing waters. In the event that water hyacinth is brought under control, it is recommended that water quality monitoring be implemented in this water body, if necessary with samples being collected for analysis by members of the canoeing club themselves.

## 7 CITY PROGRAMMES TO IMPROVE WATER QUALITY

### 7.1 Background

The City's 2020 Water Strategy is based on meeting five commitments, namely:

- Safe access to water and sanitation
- Wise use of water
- Sufficient reliable water from diverse sources
- Shared benefits from regional water resources
- Transitioning to a "water sensitive city" (by 2040).

The overarching vision is that Cape Town will become a city that optimises and integrates the management of water resources to improve resilience, competitiveness, and liveability for the prosperity of its people. Achieving this vision will require a shift to water-sensitive urban design that encompasses all aspects of integrated urban water cycle management, including water supply, sewerage, and stormwater management, as well as protecting natural ecosystems.

Water quality is a key component affecting the City's ability to honour each of these components. Polluted water resources are not fit for use without costly treatment, rendering the City's most scarce resource a waste product in many cases.

Addressing the severe pollution that characterises many of Cape Town's watercourses and improving the ecological functioning and capacity of its watercourses to deliver ecosystem services, are thus all recognized by the City as critical milestones on its path to a water-sensitive city.

This section describes and reports on progress in a number of the City's programmes, which have been developed specifically to address various aspects of the problem of pollution of its watercourses and associated water resources.

### 7.2 The Mayor's Priority Programme on Sanitation and Inland Water Quality

#### 7.2.1 Background

The Mayor's Priority Programme (MPP) on Sanitation and Inland Water Quality (S&IWQP) is one of five MPPs identified by the Executive Mayor and City Manager, and is an infrastructure-focused MPP (Mayoral Minute, 2022, G. Hill-Lewis). The S&IWQP MPP (hereafter referred to simply as "the MPP") was developed against a backdrop of ongoing and increasing pollution of many of the City's watercourses; closure of three of the City's recreational vleis over several months of 2021 and 2022 as a result of extended suspected and/or actual pollution with raw sewage; poor public access to, and trust in, water quality data from the SSB; and a number of major pollution episodes, resulting in several Directives being issued to the City by the Western Cape's Department of Environmental Affairs and Development Planning (DEADP), in response to pollution of watercourses.

The MPP was developed as a strategic programme, aimed at improving urban sanitation generally and through this and various other interventions, improving the quality and ecological condition of the City's inland watercourses.

The work streams making up the S&IWQP MPP are shown in **Figure 7.2.1**, which lists sub-programmes under each work stream. Their effective and timeous implementation are intended to allow the MPP to improve the quality of life of Cape Town's residents, reduce the impact of sewage spills and wastewater effluent on the environment, and improve reliability of infrastructure. The figure includes **Work Stream 6** ("Reducing

#### Box 7.1.1

##### What is a water sensitive city ?

The City's Water Strategy describes this as a city "with diverse water resources and water infrastructure, making optimal use of stormwater and urban waterways for flood control, aquifer recharge, water reuse and recreation, according to sound ecological principles". The mechanism for achieving this would be through new incentives and regulatory mechanisms, as well as investments in new infrastructure.

#### Box 7.2.1

##### The City's Mayoral Priority Programmes

The Executive Mayor and City Manager have identified five priority programmes where additional resources have been allocated to ensure that progress is made during the current term of office. These five areas are broadly: sanitation, energy, land release, safety, and ease of doing business (City of Cape Town 2022).

pollution and solid waste in catchments and rivers"). This work stream was added to the other five work streams during the 2024 reporting period. The accumulation of solid waste in catchments and its passage into the City's sewers, pump stations and watercourses has been identified as one of the pervasive issues driving poor water quality in the City, poor sanitation in urban slums and informal settlements, and blocking sewers, pump stations and stormwater systems. Its inclusion in the MPP work streams was thus a positive and pro-active move.

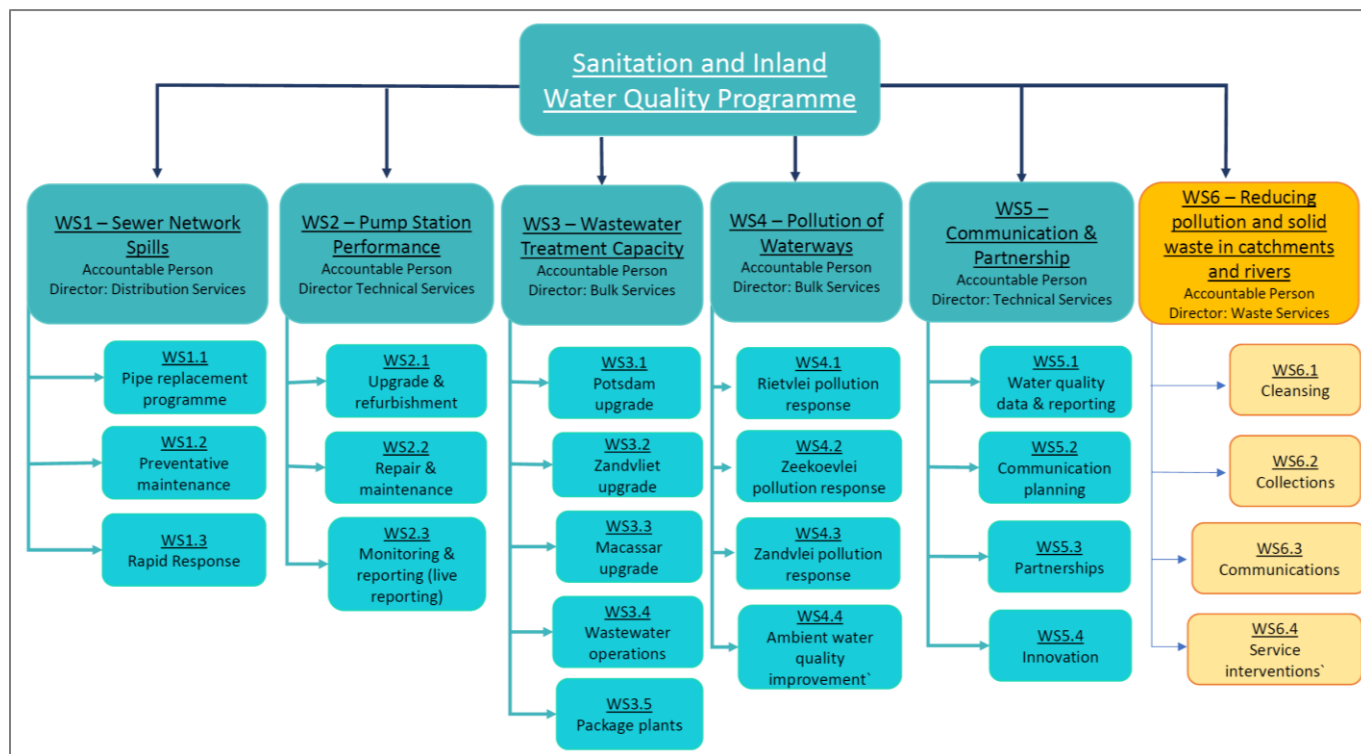


Figure 7.2.1

**The Mayor's Priority Programme (MPP) on Sanitation and Inland Water Quality is structured around six Work Streams, each comprised of a number of sub-programmes. WS6 (highlighted in yellow) was introduced during the 2024 reporting period.**

## 7.2.2 The MPP work streams

More details on the MPP's six work streams (WS) and their aims and focal areas are provided below.

- WS1 - Sewer Network Spills:** This work stream aims to reduce the frequency, duration, and impact of sewer network spills through preventative maintenance and a pipe replacement programme, as well as faster response in addressing such spills. Preventative maintenance involves pro-active cleaning of critical sewer networks, together with regular cleaning of pump station wet wells to reduce overflows. In addition, investigations to identify illegal connections between sewer and stormwater systems will be conducted to prevent both stormwater ingress into the sewer system and illegal discharge of sewage into the stormwater system.
- WS2 - Pump Station Performance:** This work stream aims to improve the reliability and performance of pump stations, which have electrical-mechanical equipment that is subject to wear and tear, requires ongoing maintenance and has a life span limited to 10 to 15 years. The aim is to reduce the frequency and duration of spills from pump stations, and hence their impact on the environment and on the recreational use of Rietvlei, Zandvlei and Zeekoevlei in particular. Apart from strategic interventions involving upgrades, refurbishment, repairs and maintenance, the Work Stream has a monitoring and reporting component that will improve near real-time monitoring via telemetry systems and a manned operational control room;



- **WS3 - Wastewater Treatment Capacity:** This work stream will increase the capacity of the three WWTWs (Potsdam, Zandvlei and Macassar WWTW) currently constraining development in their respective catchment areas and will also bolster training for operators at all WWTWs. This should improve the overall quality of treated wastewater and reduce operational incidents that result in poor effluent quality. Furthermore, the viability of package plants in addressing capacity constraints will be investigated to provide guidance to the City on how to manage decentralised wastewater treatment to enable development.
- **WS4 - Pollution of Waterways:** This work stream deals with addressing the causes of pollution of Cape Town's rivers and vleis, as well as short- and longer-term remediation measures to ensure that the vleis are managed and maintained in a healthy ecological state. The overall objective is to improve water quality in the City's catchments and ensure that Rietvlei, Zandvlei and Zeekoevlei remain open for recreational use.

Forming part of this workstream, the Kader Asmal Integrated Catchment Programme (a job creation and skills development programme) is being scaled up, and since it includes the appointment of river wardens, visibility on the river corridors should improve. Strategic interventions include planned canal and weir upgrades, deployment of litter booms, vlei dredging and weed removal, and review of estuary management plans, among others.

The workstream is underpinned by a Water Quality Improvement Plan (WQIP). The WQIP focuses on **six priority catchments** that have been identified as having significant water quality challenges, namely the Diep, Soet, Lower Salt, Eerste/Kuils, Hout Bay and the Big and Little Lotus River sub-catchments.

The Sand sub-catchment has been added to these priority sub-catchments, because of the high ecological and recreational value of the Zandvlei Estuary, and the promise the catchment is showing in improving watercourse condition, through management interventions (Day et al 2023).

- **WS5 - Communication and Partnerships:** This work stream aims to facilitate the development and implementation of a programme to effectively communicate and partner with residents on issues related to environmental pollution, including water quality, the causes of poor water quality, and community actions to improve water quality outcomes. Learning initiatives will be implemented and innovation supported to raise awareness within communities and to formulate solutions for pollution problems, including those emanating from diffuse sources. These activities will support a shift in communications by the City, with a focus on openness, acknowledgment of challenges and shortfalls in City operations, and the promotion of community stewardship. Existing forums and groups, such as Protected Area Advisory Committees, Friends groups, ratepayers associations and Catchment Management Forums will be engaged with – this workstream has driven the formation of several catchment management forums in the City since its inception.
- **WS6 - Reducing pollution and solid waste in catchments and rivers:** Implementation of this work stream, which was included in the MPP during the latter part of the 2024 reporting period, falls under the Urban Waste Management Directorate. Its key stated <sup>15</sup>objectives are to reduce waste pollution in each catchment; to improve waste collection and disposal systems; and to enhance community participation in waste management. Four focus areas (catchments) have been identified for initial attention, namely the Diep, Soet, Black and Zeekoe Catchments. These are all included among the City's Priority Catchments, with the Black River included in the Lower Salt Priority Sub-catchment. Sub-components of

**Box 7.3**

**The Water Quality Improvement Programme (WQIP)**

developed a city-wide Water Quality Improvement Programme (WQIP), as a strategic intervention to allow integration of short-term priority responses to water quality problems, with a medium- and long-term programme, with the overall objective of progressively improving water quality in the City's rivers and water bodies.

The WQIP comprises a series of **Pollution Abatement Strategies & Action Plans (PASAPs)** that set out strategies to address pollution and poor water quality on a river catchment or sub-catchment basis. The PASAPs include detailed **Transversal Action Plans (TAPs)**, which are supposed to outline short- to long-term interventions and projects across various directorates and work streams, aimed at achieving the PASAP objectives.

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<sup>15</sup> From Presentation to the Section Advisory Committee on WQWW&CE, 2 May 2025

this workstream comprise Cleansing, Collections , Communications and Service Interventions. Through baseline mapping and a review of baseline services, the Directorate is in the process of developing waste management plans for its focus areas. These plans will focus on developing strategies and monitoring their efficacy through Key Performance Indicators. They aim at reducing illegal dumping; increasing waste separation at source; encouraging recycling and diversion; and creating economic opportunities through waste. Baseline mapping and review of services highlighted that the following particularly problematic issues need to be addressed, namely: textiles (including “wet wipes”), Absorbent Hygiene Products (AHP), primarily nappies, bulky waste (e.g. mattresses); E-waste and recyclables.

### 7.2.3 Progress in the MPP work stream to date

This section draws on formal reporting on the timeframes and progress to date made on the various MPP workstreams, against planned interventions. It has been informed primarily by the latest reporting on progress made in the implementation of the Mayoral Priority Programme (MPP)'s Sanitation and Inland Water Quality Programme (SIWQ) (Reporting Cycle 32: 17 April – 14 May 2025) and by presentations to the Section 80 Advisory Committee meeting on Water Quality in Wetlands, Waterways and the Coastal Environment (WQWW&CE) on 25<sup>th</sup> April and 2 May 2025.

Central to bringing about the desired improvement in sanitation and inland water quality that drove the establishment of this particular MPP are investments by the City in:

- The City's new Water Programme;
- Refurbishment of existing Water Treatment Plants (WTPS);
- Sewage pump station upgrades;
- Sewer network replacements; and
- Wastewater Treatment Work (WWTW) upgrades and capacity increases.

Budgetary constraints are clearly a major consideration in achieving the combined goals of this MPP, and Day et al (2024a) noted that National Treasury budget cuts in January 2024 would have an impact on the roll-out of some projects and programmes. However, as per Killick (2024), budgets for the following critical interventions were not affected by funding changes:

- Key MPP projects (sewer pipe replacement and expansion);
- Critical pump station upgrades.

However, budgets for the Faure New Water Scheme (FNWS), the Cape Flats WWTW upgrades and the development of the proposed Biosolids Beneficiation Facilities were moved to operating budgets and will be implemented as Public/Private Partnerships (PPPs).

Among programmes that were initially cut was the implementation of some of the Liveable Urban Waterways projects. At the time of writing this report, these had however been included among priority projects for funding (see Section 7.3.3). This was a recommendation in the previous Inland Water Quality Report (Day et al 2024a).

The main workstream sub-programmes and the key interventions that have been implemented to date are summarized in **Table 7.2.1**. Progress in implementation of these interventions in priority catchments is explored further in Section 8.

Note that, as per previous annual inland water quality reports, progress is reported as of the date of compilation of the report (April/May 2025), and reflects some activities that have taken place subsequent to the end of the present reporting year (30 September 2024). Their impact, if any, on inland water quality will thus only be reflected in the next reporting cycle.

## City of Cape Town

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### Table 7.2.1

## Mayor's Priority Programme on Sanitation and Inland Water Quality.

Summary of main workstream sub-programmes and associated interventions that have been implemented by the City since its commencement in 2022. Information taken from the SIWQP Monthly Report: Reporting Cycle Period 32 (17 April 2025 to 14 May 2025)

[illegible]

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| Work stream focal area and sub-programmes                                                                                                                                                                                       | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Preventative maintenance                                                                                                                                                                                                        | 321.3km proactive sewer cleaning completed.<br>Term Tender for the Rehabilitation of Bulk Sewer Lines (500 Mm Diameter and Above) by CIPP Lining (Tender 62Q/2023/24) was awarded following appeal dismissal. Project kick off meeting held on 08 April 2025 and Contractor is currently on site.                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                |
| Rapid response                                                                                                                                                                                                                  | Generic Sewer Incident Response Protocols (SIRPs) have been developed.<br>SIRPS for specific pump stations in process of being developed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Critical pump stations (those within or near sensitive areas and those prone to failure and still feeding ultimately into ecologically sensitive areas or those with high risk of human exposure to sewage) should be identified and SIRPs for identified critical pump stations and sewer lines should be prioritised – with time lines for their completion. |
| <b>WS2:Pump station performance:</b><br>Budget (FY 2025): CAPEX: R411.8 million; OPEX: R210.5 million                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                |
| Upgrade and Refurbishment:<br><br><u>Objectives:</u><br>Review current pump station prioritisation list (“top 20”)<br>Prepare a rates based generic construction tender for pump station upgrade and refurbishment for priority | Pump station prioritisation and preparation of a rates-based generic construction tender for pump station upgrades for priority pump stations is in preparation, along with a condition assessment of the next priority pump stations, focusing on those most likely to impact on the environment.<br><br>Completed works include: Mechanical and electrical upgrades to selected substations; investigation of alternative upgrade and maintenance options; flow capacity assessment of critical pump stations affecting watercourses in the Diep Catchment; development of planning capacity in Reticulation Branch; Work on increasing capacity of operational and technical teams; implementation of security upgrades at selected | CSRM regional managers noted a decrease in the frequency of pump station failure in the Sand and Kuils Catchments, following the installation of (variously) back-up pumps, generators and telemetry, proving the efficacy of these approaches.                                                                                                                |

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| Work stream focal area and sub-programmes | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                                            |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| pump stations                             | <p>pump stations; procurement of spares for critical pump stations.</p> <p><u>In addition:</u></p> <p>All standalone pump station projects are progressing:</p> <p><b>Koeberg Phase 1:</b> The project (Sand trap and screens) is progressing well and on track with our revised programme. Expected completion date is June 2025.</p> <p><b>Koeberg Phase 2:</b> Currently, detailed design is underway, with the Professional Service Provider (PSP) having completed the draft detailed design report. Water Use License Application (WULA) is ongoing whilst Environmental Authorisation has been granted by DEADP.</p> <p><b>Gordon's Bay:</b> The contractor is behind programme by 13 weeks. This is due to inclement weather (2024 and 2025) and slow progress with the excavation of hard rock. Additional teams have been assigned in order to expedite progress, which is showing signs of improvement.</p> <p><b>Rietvlei pump station:</b> Detail design progressing well in accordance with approved programme.</p> <p><b>Raapenberg pump station:</b> Concept design stage gate passed. Stage 4 documentation currently underway.</p> <p><b>Langa pump station:</b> Concept design stage gate passed. Detail design currently underway.</p> <p><b>Sanddrift East pump station:</b> Bid specification phase complete and the tender was advertised on 25 April 2025</p> |                                                                                                                                                                                                                                                                       |
| Repairs and Maintenance                   | <p>Attention is being paid to the development of in-house capacity to repair faulty pumps.</p> <p>Performance measures and targets have been developed for effective, timely repairs and maintenance at pump stations, with monthly reporting.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>The ingress of sand and foreign objects contributes to pump station failures.</p> <p>Vandalism is an issue in some catchments, and increased security and fencing are recommended.</p> <p>Various reasons for pump station overflows, with rags (including wet</p> |



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| Work stream focal area and sub-programmes                                             | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                                                                                                                     |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>wipes) representing the most cited failures.</p> <p>Still a challenge to respond to Zeekoe Catchment pump stations, due to high criminality and law enforcement availability.</p> <p>Many of the 20 priority pump stations fall within the Zeekoe Catchment.</p> <p>Improved pump station failure reporting is a positive step forward.</p> |
| Monitoring and Reporting (Near Real Time)                                             | <p>The following activities have been completed:</p> <p>An audit of all telemetry associated with pump stations impacting on “the vleis”; implementation of a spatial dashboard to track pump availability, pump trips and wet well overflows; improvements in mobile telemetry for real-time monitoring; establishment of a manned operational control room for the Reticulation Branch; visual assessments of critical pump stations on a daily basis.</p>                           | <p>The findings of these assessments should be shared more broadly for reporting on in future Inland Water Quality and other reports.</p> <p>The outcomes of daily assessments should also be logged.</p>                                                                                                                                      |
| <b>WS3: Waste water treatment capacity</b><br>Budget (FY 2025): CAPEX: R1 216 million |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                |
| Upgrading of Wastewater Treatment Works:<br>Potsdam WWTW                              | <p><b>Zandvliet WWTW</b> upgrade (completed): Final effluent compliance decreased to 78% due to on-going process optimization efforts to consistently meet in particular the effluent nitrate limits. The recent results for E.coli show non-compliance, which is suspected to be a result of a sample or analysis issue, which requires further investigation.</p> <p><b>Potsdam WWTW</b> upgrade (under construction): Final effluent compliance remained at 55%, due to various</p> | <p>WWTW upgrades are large and capital intensive and can take up to a decade or more (comment from Mr M. Killick, City: Director: Bulk</p>                                                                                                                                                                                                     |

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| Work stream focal area and sub-programmes | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Zandvliet WWTW<br><br>Macassar WWTW       | <p>equipment failures on the aging plant and slow system recovery from the impact of multiple PSTs being out of operation. The upgrade is currently progressing ahead of schedule. Recent pollution events have been due to equipment failure.</p> <p><b>Macassar Upgrade</b> (in procurement phase): Final effluent compliance remained at 44%, with 2 of the 4 maturation ponds out of service due to cleaning. The Civil and M&amp;E construction tenders have both been awarded with no appeals received, they are currently in the Section 33 process and making good progress.</p> <p>Marine Outfalls: Engagements with DFFE are on-going. The marine outfalls refurbishment tender has been finalized for advertisement.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>Services - Water and Sanitation Directorate)</p> <p>Appeals on tender awards add additional delays (e.g. Potsdam WWTW)</p>                                                              |
| Wastewater Operations                     | <p>Treated effluent: Usage of treated effluent from Potsdam, Macassar &amp; Athlone has been limited, due to operational constraints at the WWTW (Potsdam PSTs, and Athlone upgrades required to improve treated effluent quality, sludge management is currently challenging due to limited wasting).</p> <p>Process Training Intervention rollout is under way.</p> <p>A WWTW <i>Status quo</i> / Strategic Evaluation Study was commissioned by the City in June 2023 for all 26 WWTWs.</p> <p>The status of this project is as follows:</p> <ul style="list-style-type: none"> <li>Phase 1 (<i>Status quo</i> of all WWTWs): Draft reports for all 26 WWTW were submitted to and reviewed by the City. Final reports to be issued by end June 2025 as final deliverable;</li> <li>Phase 2 (Future Planning): Draft reports for all 26 WWTW were submitted to and reviewed by the City. Final reports to be issued by end June 2025 as final deliverable;</li> <li>Phase 3 (Licensing and Green Drop considerations and requirements): Scope for Phase 3 was finalised and issued to the Consultants during Q1 2025. Work by the Consultants on Phase 3 has commenced.</li> </ul> <p>A Waste Water Sludge Strategy Study to review W&amp;SD's future regionalised sludge treatment and disposal</p> | <p>These findings should be reflected on in the next Inland Water Quality Report, and in internal (City) planning.</p> <p>Killick (2024) reported that the</p>                             |

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| Work stream focal area and sub-programmes | Progress                                                                                                                                                                             | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           | <p>approach was completed in February 2024. Its overall objective was to review future regionalised sludge treatment and disposal approach embarked on by the WW Branch in 2010:</p> | <p>sludge study concluded that:</p> <ul style="list-style-type: none"> <li>- There was confirmation that the ‘future’ wastewater sludge strategy embarked on in 2010 by the (then) WW Branch (three regionalised Biosolids Beneficiation Facilities with anaerobic digestion, nutrient recovery and onsite electricity generation utilising biogas and disposal of digestate to land) is still the most feasible way forward for City’s wastewater sludge treatment and disposal</li> <li>- Historical and current delays in implementing the first regionalised biosolids beneficiation facility pose a risk regarding City’s future Provincial and National regulations and legislation</li> <li>- The City should consider (among other recommendations) Public /Private Partnerships for regional facilities, however with reduced financial responsibility</li> </ul> |

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| Work stream focal area and sub-programmes                                                                  | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | for the Private entity                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Package WWT Plants                                                                                         | A Standard Operating Procedure has been developed and approved by the City<br><br>Eight temporary Package Plants have been approved or endorsed by the City, with a total treatment capacity of 995 kL/day. An additional 8 applications the submission process with City Master Planning (total capacity 1002 kL/day)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Day et al (2024a) recommended that the use of Package WWT Plants be limited to watercourses that are already impacted by WWTW effluent or major discharges from informal settlements only                                                                                                                                                                                                                                                                |
| <b>WS4: Pollution of waterways</b><br><u>Budget (FY 2025): CAPEX: R39.6 million; OPEX: R111.5 million</u>  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Response to DEADP Directives regarding pollution of Rietvlei and Milnerton Lagoon, Zeekoevlei and Zandvlei | Assessment and rehabilitation plans were compiled to address the Zeekoevlei. Milnerton Lagoon, Rietvlei and Zandvlei Directives (Day et al 2022a and b); Rose et al (2023); Day et al 2023; Rose et al 2022) and to consider the impacts of a trial aeration project (Milnerton Lagoon: Day et al. 2024c).<br><br>These reports included or were informed by bathymetric surveys and recommendations for/ specifications around dredging of Rietvlei, Zandvlei and Zeekoevlei.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Note that until upstream pollution sources of all of these vleis have been addressed, the responses to the DEADP Directives will achieve short-term remediation only (see Day et al 2022 and Rose et al 2023).<br><br>Note that if dredging takes place before current polluted flows from Potsdam WWTW and Koeberg Pump Station are addressed, there is unlikely to be any measurable reduction in odour or improvement in water quality in the lagoon. |
|                                                                                                            | Following the above, a number of projects have progressed through planning and other stages as follows:<br><b>1. Milnerton Lagoon Dredging Project:</b><br><br>Dredging of Milnerton Lagoon was recommended in Rose et al (2023) as a temporary response to high levels of pollution and anaerobic conditions creating noxious smells in the lagoon. A trial aeration project in the lagoon commenced in late 2023, as a short-term measure to treat H <sub>2</sub> S odour problems, but showed no efficacy given the scale of pollution. Dredging is currently being considered for urgent implementation, to address foul odours in the lagoon over late 2024/2025, from Potsdam WWTW effluent and Koeberg sewage pump station overflows.<br><br>The project is currently in the procurement phase, and the City is awaiting the scheduling of the Bid Specification Committee (BSC) meeting as the next critical step. The dredging methodology has been |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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| Work stream focal area and sub-programmes | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                          |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           | <p>approved by the Executive Director.</p> <p><b>2. Zeekoevlei dredging project:</b> Site establishment has been completed and the dredging unit has been delivered and is undergoing initial commissioning and testing. The project will be an approximately two year project.</p> <p><b>3. Zeekoevlei / Rondevlei weir upgrade and fish ladders:</b> Authorisation has been granted for lowering of the Zeekoevlei weir and fish ladder (Phase 1) and upgrading of the Rondevlei weir (Phase 2) with construction provisionally planned for late 2025. The tender is currently in the assurance phase, pending feedback from SCM. Once this step is complete, the documentation will be forwarded for Director sign-off and public advertisement.</p> <p><b>4. Zandvlei:</b><br/>The Estuary mouth management plan was updated in 2023.<br/>Dredging of sediments is recommended, but is still subject to sediment analysis and monitoring and still requires an EIA and other authorisation processes.</p> <p><b>5. Rietvlei:</b><br/>The rehabilitation plan of Rose et al (2022) did not recommend dredging at present but rather a focus on <u>sustainable</u> management of aquatic vegetation – three weed harvesters have been procured to control aquatic weeds in Zandvlei and Rietvlei. Two harvesters are operational at Zandvlei. The new harvester at Rietvlei has been out of commission since February 2025. It should be in working order by June 2025.</p> <p><b>6. Bayside Canal:</b> Work on this contract commenced in October 2023. Works are however currently stopped, pending settlement of a payment dispute with the Contractor. A provisional summons for the matter for 12 May 2025 has been postponed to February 2026.</p> <p><b>7. Langvlei and Sand River -</b> Detail design in process with report and drawings issued for inter departmental review. GA certificates issued by DWS on 08 April 2025. Revised Final BAR submitted to DEA&amp;DP. Discussions around security issues affecting the surrounding community are ongoing. This is discussed more in Section 7.3.</p> | <p>Not allowed for to date are the (EIA required) shore-based dredging of organic material from shallow areas of Zeekoevlei and the ultimate disposal of dredged organic material from its temporary dewatering area in the Strandfontein pans.</p> |



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| Work stream focal area and sub-programmes | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           | <b>8. Erica Road Outlet</b> – Detailed design for the rehabilitation of the Milky Way pond and Erica Rd stormwater system commenced in November 2023, and completed in August 2024, the report and technical drawings review comments issued to PSP, final report was expected end April 2025 however due to additional requirements, the submission of the report has been pushed back to July 2025. Flow monitoring in Joe Slovo & Erica Rd are on-going.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Ambient Water Quality Improvement Plan    | <p><b>1. Roll-out of implementation of litter booms/litter nets</b> – The target for FY2024/25 is 20 litter interceptors. To date, 8 have been completed (three in the Zeekoe Catchment) . The remainder are already specified and scheduled for completion by June 2025. These should reduce the passage of solid waste into important wetlands and into marine environments.</p> <p><b>2. Pollution Abatement Strategies and Action Plans (PASAPs):</b><br/>PASAPs and TAPs developed for:</p> <ul style="list-style-type: none"> <li>• The Hout Bay catchment (2023)</li> <li>• The Diep River (as part of the Diep River Estuary Management Plan) and the Soet River (both of these in response to Directives from the DEADP)</li> <li>• The Sand River sub-catchment(draft PASAP only, not available at the time of this study)</li> <li>• The Soet Catchment</li> <li>• Lower Salt catchment</li> <li>• Zeekoe catchment.</li> </ul> <p>Revision of the PASAP and TAP document structure is however currently underway, allowing for more transparent reporting and assignment of responsibilities across different Directorates and/or Branches and Departments. This will require specific sign-off on responsibilities for allocated tasks / interventions by relevant officials.</p> <p><b>3. Erica Road Outlet diversion (Diep River catchment):</b> Polluted low-flows from the Jo Slovo Park residential area are diverted into the sewer upstream of the Erica Road outlet. Detailed designs have also been developed for the diversion of polluted low flows further upstream at the Milky Way pump station</p> <p><b>4. Low Flow diversion study:</b> This has been completed. The study found that low flow diversions of polluted</p> | <p>Roll-out of PASAPs and associated TAPs has been slow and should be accelerated.</p> <p>PASAP and TAP implementation is hampered by the complexity of implementing environments, involving multiple departments and directorates (affected assets variously belong to/ are managed by CSRM, Sewage Reticulation, Solid Waste, Human Settlements, Biodiversity, Parks and Recreation etc.)</p> <p>Stormwater Planning Region managers reported that issues such as crime, vandalism, extortion and highly polluted unsafe watercourses also hinder the effective implementation of TAPs, which is further hampered by a culture of unaccountability in some City</p> |

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| Work stream focal area and sub-programmes                                         | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers                                                                             |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                   | <p>water to sewer is not feasible across the City until WWTWs, reticulation and pump stations are upgraded.</p> <p><b>5. Identification of storm water infrastructure (e.g. ponds, dams, etc.) and floodplains impacted by encroachment of informal settlements:</b><br/>Project expenditure below budget due to delays in obtaining data for canal capacities; high rainfall in July 2024 preventing surveys; some canals omitted from initial scope, requiring additional modelling.</p> <p><b>6. Development of Standard Operating Procedures (SOPs) for the opening and closing of recreational vleis:</b><br/>this SOP was approved in 2023 and is being implemented as necessary.</p> <p><b>7. Expansion of the Kader Asmal EPWP River Warden Programme in priority catchments:</b> This programme allows for the housing of river wardens at Rietvlei, Zandvlei and False Bay Nature Reserves. Its primary objective is to enhance ecosystem health in the City's catchment areas, championing the eradication of invasive plant species, rehabilitation activities along our waterways, and litter collection and removal. The River Warden Programme remains on track, with river wardens currently undergoing training. A key highlight was a water quality training workshop presented by the Biodiversity Branch in collaboration with Scientific Services. This hands-on training equipped participants with practical skills in freshwater ecology and water quality monitoring, covering critical topics such as key water quality parameters, biomonitoring using aquatic organisms, and ecosystem health indicators. In addition to the training, the teams continued with on-the-ground environmental restoration work, successfully removing 500 bags of alien vegetation and 829 bags of waste.</p> <p>149 new EPWP workers have been recruited during the current reporting cycle.</p> | <p>departments.</p> <p>Since many of the most polluted stormwater flows in fact comprise 100% sewage and grey water under dry weather conditions, this issue needs to be re-considered and priority effluent stream identified for diversion or on-site treatment.</p> |
| <b>WS5: Communication and partnership</b><br>Budget (FY 2025): OPEX: R4.5 million |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                        |
| Inland Water Quality Data & Reporting                                             | <p><b>1. Water quality data:</b> Water quality data for inland watercourses is published regularly on the City's data portal and is publicly accessible.</p> <p><b>2. Water Quality Dashboard:</b> This was launched in November 2024. It is a user-friendly platform to view and monitor the quality of the City of Cape Town's inland water bodies and assist in PASAP and TAP planning and tracking.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>In addition, annual to two-yearly water quality reports are produced (e.g. this project).</p> <p>Water quality data that are important for decision-making and</p>                                                                                                  |

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| Work stream focal area and sub-programmes | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers  |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           | <p><b>3. Inland Water Quality Index:</b> Review of the Inland Water Quality Index parameters and protocols is planned for the 2025 FY</p> <p><b>4. Water Quality Monitoring Reporting:</b><br/>Monthly monitoring report is provided by CSRM, based on <i>E. coli</i> data.<br/>Annual water quality reporting is provided by an external service provider, with the next (2024 Reporting Period) report due 30 June 2025 (this report).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | gauging watercourse trajectory are however at times unreliable, missing or have too high a detection level to be useful. Such issues must be addressed with urgency (see <b>Section 9</b> ) |
| Partnerships.                             | <p>1. A Section 80 Advisory Committee for Water Quality in Wetlands, Waterways and the Coastal Environment has been established and continues to meet and provide input roughly on a monthly basis.</p> <p>2. Existing City/ Public forums such as Protected Area Advisory Committees (PAACs) for the Table Bay, Zandvlei and False Bay Nature Reserves and site liaison committees for sensitive wetland/vleis/lagoons are liaised with on an ongoing basis.</p> <p>3. Catchment Management Forums: Catchment management forums have been established for the following catchments: Hout Bay (2016); Sand (2023); Zeekoe, Diep and Soet (2024); Kuils and Lower Salt (2025). Election of a (permanent) forum chairperson is still required for the Diep Catchment.</p> <p>4. The Economic Development and Partnering (EDP and Partnering Model): Agreements have been reached with 11 successful applicants.</p> <p>5. Outreach education and awareness sessions: An annual target has been set for 200 community and school outreach sessions – this target had been exceeded by 129 % by April 2025.</p> <p>6. Water Pollution Control Inspections: These are carried out on an ongoing basis, with monthly reporting on fines and contravention notices issued.</p> <p>7. Manhole covers: Two contracts have been awarded for the installation of approximately 80 lockable covers before end of June 2025. In addition an RFI will be drafted in June 2025 for other technologies that can assist blockages by eliminating waste.</p> | These initiatives are fully supported – provided that input from these forums and committees is both sought when necessary and considered when provided.                                    |
| Learning and innovation.                  | 1. Gates Foundation funding for sanitation technology in informal settlements (Innovative Sanitation Technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | These initiatives are fully supported                                                                                                                                                       |

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| Work stream focal area and sub-programmes                                                                                          | Progress                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers |
|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                    | <p>Pilot project): Implementation was achieved at the first two sites (Nyakathisa and Masincedane) in Dec 2024. Implementation at the 7 de Laan site is in progress. Implementation at the remaining two sites are delayed due to various challenges and are now scheduled to commence in May 2025 (Rasta Camp and OR Tambo). The 12-month Monitoring and Evaluation period remains active (for the first two sites).</p> <p>2. C40 CFF funding was sourced to drive development of recommendations for terms of reference and mandates for the planned Zeekoe Catchment Management Forum, and these project outcomes were used to drive the formation of other Catchment Management Forums.</p> <p>3. Funding for Green Infrastructure planning was provided by the C40 Cities Finance Facility (CFF) through the Liveable Urban Waterways Programme (see Section 7.4) (project completed in 2024).</p> | and if engaged with thoughtfully, will add to the knowledge-base and capacity for informed decision-making by the City                                                                     |
| <b>WS6: Reducing pollution and solid waste in catchments and rivers</b><br><u>Budget: Not specified in available documentation</u> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                            |
| Cleansing                                                                                                                          | Planned: <ul style="list-style-type: none"> <li>Regular cleaning of illegal dumping areas</li> <li>Collaborate with W&amp;S in hotspot areas</li> <li>Current costing and costing of alternate service provisions</li> <li>Partner with communities and NGO's clean up campaigns</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                            |
| Collection services                                                                                                                | Planned: <ul style="list-style-type: none"> <li>Weekly collection service (2/3 day service in some areas)</li> <li>Bin replacements/additional bin supply</li> <li>Current costing and costing of alternate service provisions</li> <li>Bulky waste collection days</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                            |
| Communications                                                                                                                     | Planned: <ul style="list-style-type: none"> <li>Education and awareness drives</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                            |

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| Work stream focal area and sub-programmes | Progress                                                                                                                                                                                                                                                                                                                                              | Challenges and additional comments and recommendations, drawn from MPP reports, project team experience and, mainly, from discussions with City officials including CSRM regional managers |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           | <ul style="list-style-type: none"> <li>• Messaging around targeted waste types</li> <li>• Schools competition</li> <li>• Cleanest community competition</li> <li>• Community surveys (online)</li> <li>• Aggressive social medial campaigns</li> <li>• Establish partners with NGO's/PRO's communities</li> <li>• MPP Workstream 4 &amp; 5</li> </ul> |                                                                                                                                                                                            |
| Service interventions                     | Planned: <ul style="list-style-type: none"> <li>• A3 and CEE for root cause analysis</li> <li>• Feasibility study for Eco-hubs</li> <li>• Establishment of swop-shops</li> <li>• Monitor diversion from incentive programmes/swop shops</li> <li>• Diversion of targeted waste streams</li> </ul>                                                     |                                                                                                                                                                                            |



## 7.2.4 General comments

**Table 7.1** highlights major investment by the City in infrastructure refurbishment, upgrades and innovation, as well as in projects to redress aquatic ecosystem impacts stemming from a long history of infrastructure failure catchment-scale pollution, coupled with extensive projects around improving communication (and thus trust) streams with public, private and NGO sectors outside of the City. The range of these projects, all in pursuit of improving water quality in the City's watercourses and through this, the quality of life and the surety of livelihoods for its residents, further highlights the complexity of this issue. Addressing water quality in the City's watercourses requires strategic, co-ordinated and complementary inputs from multiple Directorates, Branches and Departments. This is complicated by the fact that these often have very different mandates and responsibilities.

A repeating theme in **Table 7.1** as well as in Sections 5, 6 and 8 of this project, is that the main challenges in stormwater management in many of Cape Town's catchments derive not from the management of rainfall in the catchment, but from inflows of raw sewage and solid waste. Addressing these issues requires concerted input from WWTW, Reticulation, Pump Station and Solid Waste Directorates/Branches / Divisions – that is, Work Streams 1-3 and 6, with Work Stream 4 providing monitoring, tracking and remediation services to address the above issues and Work Stream 5 providing the highly necessary communication and reporting streams.

If the outcomes of this MPP are to be achieved, active engagement between all of these work streams will be required.

In addition, however, the MPP reporting also highlights the serious impact of high levels of criminality on water quality in many areas of Cape Town. High crime rates reduce the City's ability to respond rapidly to major sewage pump station failures or overflows in some areas, where only daylight site visits can be undertaken with some level of safety. There are also many areas where City staff enter reluctantly for solid waste removal or maintenance activities, for fear of their safety. These issues, as well as associated vandalism in many areas, impact directly on the City's ability to improve its water quality in an equitable manner across all areas.

## 7.3 The Liveable Urban Waterways Programme

### 7.3.1 Background

The Liveable Urban Waterways (LUW) Programme is a strategic and transversal programme developed by the City in response to the Water Strategy, Resilience Strategy and Environment Strategy. The programme aims to demonstrate how water sensitive design, waterway rehabilitation and a new approach to waterway management can achieve multiple benefits for society, the environment, and the economy (McDonald 2024).

**Implicit in the LUW approach is the concept of roll-out of projects at scale, to achieve measurable impacts at a catchment scale.**

Seven core principles are intended to guide the LUW Programme and its individual projects:

- Collaboration and partnering
- Identification of waterways as connectors and catalysts
- Designing with nature
- Designing for many users
- Building in resilience
- Designing for attractive and usable public places
- Allowing for post project care and maintenance.

#### What is a liveable waterway ?

In the LUW Programme, it

1. Has acceptable water quality
2. Makes space for the water
3. Has a functioning ecology
4. Connects the waterway to the water table and the floodplain
5. Connects communities; and used and enjoyed by communities
6. Provides a range of ecosystem services, economic and social benefits.

The pilot phase of the LUW Programme focused on the Sand River catchment, where several project sites, divided into five work packages, were identified. These projects are intended to be used to test different rehabilitation typologies and water sensitive design approaches, to develop and foster cross-departmental

collaboration and planning within the City, and to co-design appropriate solutions with communities who live near the waterways or who use the space. Additional projects are included in the Lower Salt Sub-catchment (Vygekraal River) and the Soet Sub-catchment (Asanda Wetland).

Following multidisciplinary specialist input into concept designs and a series of stakeholder engagements including a number of well-attended stakeholder co-design workshops (reported on in Day et al 2023), detailed project design and planning followed, in the current 2022-2023 reporting period.

The project designs all include some degree of river channel and bank reshaping, management of bed and bank erosion, creation of new wetlands and riparian habitats, enhancing public open space, and installing new amenity facilities. Some improvement in water quality might be envisaged as a result- the degree to which this would be measurable would depend on the magnitude of intervention and the level of water quality impairment.

### **7.3.2 Planned and implemented LUW projects**

After a hiatus in early 2024, when implementation / further planning around existing LUW projects was halted, due to financial constraints (see Section 7.2.3), funding of LUW projects resumed in early 2025, in part driven by public outcry and from recommendations from the Section 80 Advisory Committee on WQWW&CE.

These projects are testing different rehabilitation and water sensitive design approaches, to demonstrate the shared benefits that nature-based solutions and green infrastructure can provide (Mc Donald 2025a). The projects have all been designed in collaboration with communities, and will, once completed, allow for the rehabilitation of 13.3 km of river and 8 ha of wetland, with a total CAPEX budget of around R300 million (McDonald 2025b).

The seven projects that are already underway with completed designs include:

- Sand /Langvlei Canal
- Keyser River
- Spaanschemat Rivers
- Grootboschkloof River
- Westlake River
- Wynberg Stream
- Vygekraal River.

Various interventions have been proposed for the Upper Elsieskraal River – these are still in the feasibility, pre-concept phase.

Implementation of designs for the Asanda wetland was completed in the 2023 reporting period. This site is currently in its maintenance phase. Issues around removal of solid waste and vandalism (e.g. breaking of planted trees) impact on its potential to deliver its required benefits. Inclusion of a pedestrian bridge across the wetland has however reduced localised wetland impacts. Planting of areas of wetland that were intended to be rehabilitated had not however proceeded to any measurable degree at the time of this report.

### **7.3.3 Identification of opportunities for the inclusion of green infrastructure in the Zeekoe and Diep (Sand Catchment) projects**

These projects, which focused on the identification of opportunities for future projects in two of Cape Town's catchments, were carried out with funding of approximately R10 million by the C40 Cities Finance Facility (CFF) for the City's 'Green Infrastructure Options for Improved Waterway and Catchment Management Project'. The projects focused on the Zeekoe Catchment (upstream of Zeekoevlei) as well as the Diep (South

#### **What is Green Infrastructure?**

Green infrastructure can be defined as a strategically planned, designed and managed network of multifunctional natural open spaces and 'engineered' ecological systems, with other environmental features, that provide ecological, community and infrastructure services.

Peninsula)<sup>16</sup> section of the Sand catchment.

The projects developed masterplans for implementing waterway rehabilitation, green infrastructure (GI) and nature-based solutions (NbS) through the LUW Programme and the City's Green Infrastructure Programme (reported on in Turpie et al 2024). They included a number of technical studies, which were conducted to inform a climate change vulnerability and ecosystem goods and services assessment.

Going forward, the GI and NbS interventions will be designed to provide adaptation to the anticipated climate change impacts (such as flooding and deteriorated water quality), while improving the ecological status and functioning of waterways, where possible, and providing additional socio-economic benefits.

The Diep (South) study area focuses on the Diep (South) River and its minor tributaries, Wynberg Stream, Mocke River, Little Princessvlei, Sand River Canal, Langvlei and Langvlei Canal, while the Zeekoe study area includes the Big Lotus River, Little Lotus River, and Woodland Canal. The wetlands and open spaces of all these waterway corridors are also an integral part of the study.

#### **7.3.4 General**

The (2025) re-funding of the LUW programme in 2025 is strongly supported, as an integral and visually positive part of achieving key components of the City's Water Strategy (see Section 7.1).

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<sup>16</sup> Note that this river is not the main stem Diep River entering Milnerton Lagoon – this Diep River forms part of the Sand River catchment and rises on the Constantiaberg mountain range.

## 8 WATER QUALITY IN PRIORITY CATCHMENTS ADDRESSED BY THE CITY'S WATER QUALITY IMPROVEMENT PROGRAMMES

### 8.1 Context

#### 8.1.1 Overview

The various City programmes that have been developed to improve water quality and general watercourse condition as part of the S&I WQP MMP (see **Section 7**) focus in particular on the six priority catchments already mentioned in **Section 2.6**, as well as on the Sand Catchment.

These catchments (and/or sub-catchments) are considered more holistically in this section, which presents key water quality data for individual monitoring points in each priority catchment and also highlights areas where particular interventions are planned or have been implemented. This allows interested readers to home in on water quality issues in particular parts of each priority catchment. Note however that only key interventions relevant to improving inland water quality are highlighted here.

The priority sub-catchments considered in this section are indicated in **Figure 8.1.1** and comprise the following (in order of presentation in this section):

- The **Lower Diep River** (upstream of Milnerton Lagoon) (Central and Northern Stormwater Management Regions)
- The **Soet River** (Eastern Stormwater Management Region)
- The **Lower Salt River** (Northern and Central Stormwater Management Regions)
- The **Kuils / Eerste Rivers** (Eastern Stormwater Management Region)
- The **Hout Bay River** (Southern Stormwater Management Region)
- The **Big and Little Lotus Rivers** (within the Zeekoe catchment) (Southern Stormwater Management Region)
- The **Sand catchment** (upstream of Zandvlei) (Southern Stormwater Management Region).

#### 8.1.2 Summary of key issues highlighted in discussion with Stormwater Planning Region teams

Input into this section was informed by data and information presented and discussed in previous sections, but more specifically by information gained during on-line discussions with the CSRMs' Stormwater Planning Region managers and their teams, from the City's four stormwater management regions (see **Section 2.7**).

Although officials from each region were engaged with separately, common threads emerged across all four regions, regarding critical issues impacting on water quality (and the City's ability to improve ambient water quality as a result). The most pervasive of these issues comprised the following:

- The most serious issues affecting the water quality of the City's rivers and wetlands comprise **solid waste and sewage**, and the passage of the latter into watercourses by way of dry-weather flows from settlements; stormwater flows; sewage pump station overflows; sewer manholes and failed sewer lines. These issues are controlled by other line departments, but CSRMs regional managers and their teams are at the receiving end of failed systems, and accountable for polluted watercourses and the ecological and other impacts of this pollution, but are powerless to effect change at source.

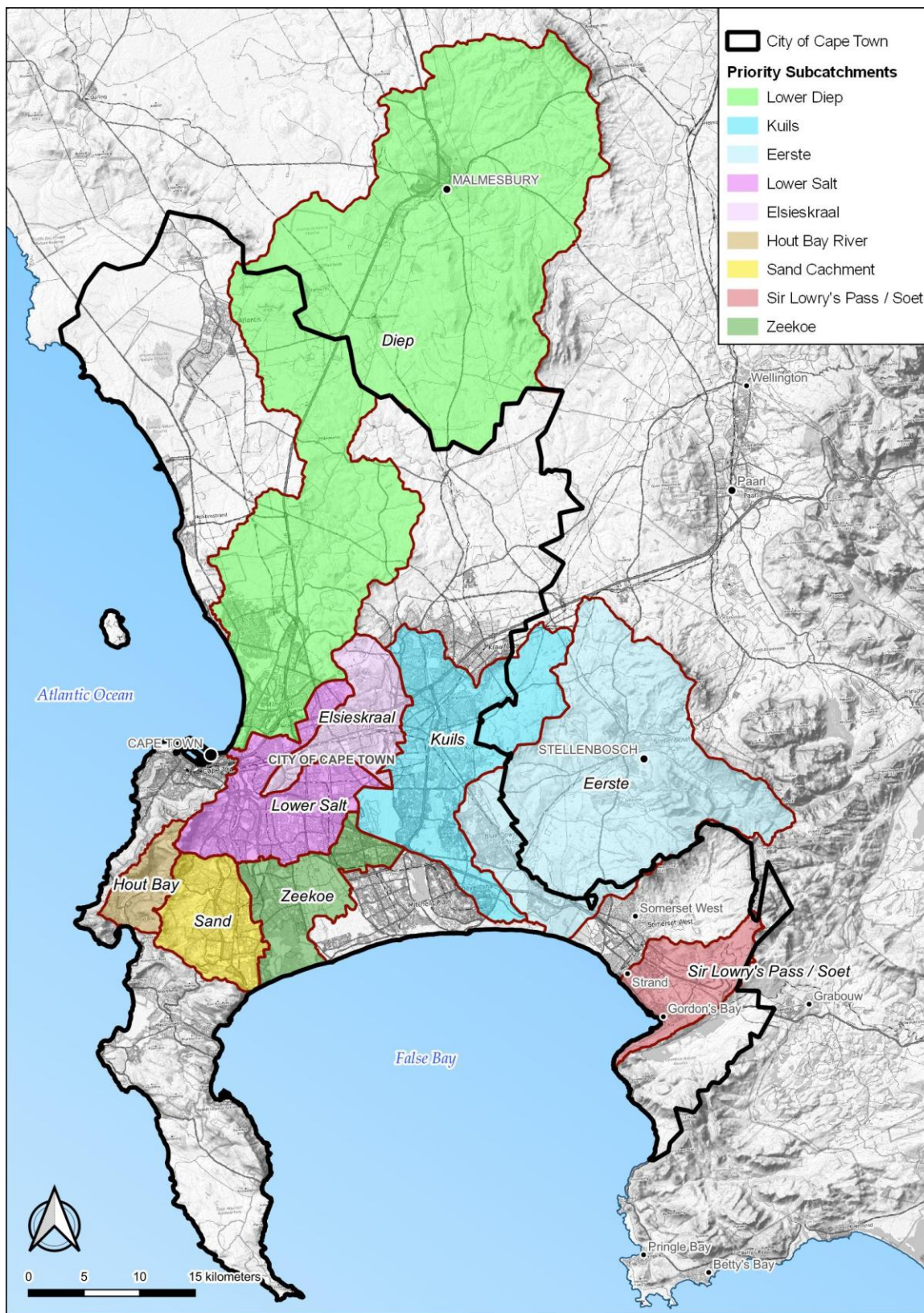
This issue is flagged as a major concern in managing (or trying to improve) the City's watercourse condition, in light of the view-point held by reticulation and WWTW officials, that there is no capacity in these systems to deal with raw sewage and grey water discharges, which must therefore be managed by the CSRMs – this clearly has serious implications for water quality in receiving river and wetland environments, which do not have the assimilative capacity for such pollutant loading.

- Issues such as repeatedly failing pump stations; pump stations with inadequate capacity for low-flow sewage diversions to sewer; and the years required for upgrades to WWTWs to be carried out, mean that important watercourses (e.g. the lower Diep River and Milnerton Lagoon) are likely to remain direly polluted until at least the upgraded Potsdam WWTW comes on line and the Koeberg pump station is upgraded, and even then these will remain severely impacted by pollution from unmanaged informal settlements.

- The Big Lotus River, Zeekoevlei, the Mosselbank River (downstream of the Bloekombos settlement), parts of the Lower Diep River catchment and the lower Kuils / Eerste Rivers and their wetlands are also examples of watercourses that are at the mercy of expanding, largely unserviced urban informal settlements beyond the mandate or resources of CSRM to manage.
- Issues such as crime, vandalism, extortion and highly polluted, unsafe watercourses also hinder the effective implementation of PASAPs and their TAPs, which is further hampered by a culture of unaccountability in some City departments, with critical interventions required for essential sewer and stormwater maintenance and service delivery simply not taking place in some areas.
- Criminality in many areas (e.g. the Lower Salt and upper Zeekoe catchments) hinder rapid responses to pollution events (e.g. pump station overflows), with response teams only able to access some areas safely in daylight, if then.
- Budget issues (e.g. 2024 moratoriums on over-time and out-of-hours work, as a result, at least in part, of Treasury budget-cuts) affect response rates to sewage overflows and basic repair and maintenance issues, as well as pollution mitigation measures, such as over-pumping to sewers, which has also been stopped as a result of budgetary constraints.
- The focus of the City's attention has largely been on areas for which it has received Directives or Pre-Directives from DEADP for pollution. These tend to be areas with high levels of public or political interest (e.g. Zeekoevlei, Milnerton Lagoon), while large areas with extremely high levels of pollution remain unmanaged (e.g. Bloekombos, Wallacedene areas of the Mosselbank and Kuils River Sub-catchments respectively).
- Expanding (largely unserviced) informal settlements in parts of catchments such as the Sir Lowry's Pass, Zeekoe, Hout Bay, Kuils and Diep Catchments, as well as expanding backyard settlements in many catchments, including the Lower Salt catchment, place increasing burdens on solid waste management, while threatening stormwater quality, as a result of the passage of grey and black waters into these stormwater systems.



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**Figure 8.1.1**  
**The City's priority sub-catchments**

## 8.2 The Lower Diep River sub-catchment

### 8.2.1 Catchment overview

The Diep catchment as a whole extends well beyond Cape Town's boundaries into the Swartland, Drakenstein, and Stellenbosch local municipalities, with a total extent of 1 495 km<sup>2</sup>. The mainstem of the Diep River originates in the Riebeek Kasteel Mountains north-east of Malmesbury, and flows for about 65 km south-west towards Cape Town. It passes through agricultural areas, primarily wheat and vineyards, as well as the urban area of Malmesbury, before reaching Cape Town. The river is impacted by abstraction from instream and off-channel dams, which have reduced average summer flows reaching the estuary by about 39% compared with reference levels (Clark, 2018). Agricultural runoff from the extensive cultivated areas of the catchment, as well as urban stormwater and treated wastewater from the Malmesbury WWTW, which has a daily treatment capacity of 10 Ml/day, impact on the water quality.

The Diep River has one major tributary – the Mosselbank River – which drains the northern slopes of the Durbanville Hills and flows north- and westward to its confluence in the Philadelphia area. The Mosselbank River passes through mainly residential and peri-urban areas in its upper reaches, and agricultural areas including stock farming and feedlots in its lower reaches. Historically, the Mosselbank River would have been seasonal but is now impacted by the perennial receipt of treated wastewater from the Kraaifontein WWTW (28 Ml/day treatment capacity) and Fisantekraal WWTW (58 Ml/day treatment capacity, from which the bulk of the flows are reportedly diverted to treated effluent supply) and the Klipheuwel WWTW (0.09 Ml/d, currently being decommissioned and converted to a pump station to direct flows to the Fisantekraal WWTW).

The Mosselbank's largest tributary is the Klipmuts River, which drains parts of the Drakenstein Municipality and is also impacted by flows from the Klipmuts WWTW.

The Diep River enters the urban area of Cape Town immediately downstream of the Malibongwe Drive bridge, where it flows through extensive unserviced informal settlements (Du Noon and Doornbach) in and adjacent to the floodplain. A minor tributary, the Kleine Stink River, enters the Diep River within this zone, passing under Malibongwe Drive some 780 m south east of the Diep River crossing.

Some 600 m downstream of the Blaauwberg Road bridge, the remnant waterbodies and surrounding undeveloped areas form a broad triangle with Rietvlei and Flamingo Vlei extending westward towards the coast to the west; the Potsdam WWTW to the east; and dense urban development to the north, including industrial areas, residential suburbs and the Jo Slovo Park and Phoenix residential areas, characterised by extensive backyard settlements. Otto Du Plessis Drive forms the western boundary of the upper part of this area, and downstream of the Otto Du Plessis bridge, forms the eastern edge of Milnerton Lagoon.

No natural tributaries enter the Diep River between the railway bridge and the estuary mouth, with all point source inflows in these reaches today emanating from piped or channeled (and in some cases highly polluted) stormwater flows and treated effluent from the Potsdam WWTW.

The Diep River Sub-catchment, which forms the focus of this section, extends northward and eastward from Milnerton, including the urban areas of Milnerton, Tableview, Bloubergstrand, and the rapidly expanding Parklands, as well as Montague Gardens and Killarney Gardens. It straddles both parts of the Central and Northern Stormwater Management Regions.

### 8.2.2 Major sources of pollution in the catchment

The Diep River Sub-catchment is affected by the following major pollutant sources (Rose et al. 2023; Day et al 2024b; Rose et al. 2025):

- **In the Mosselbank sub-catchment:**
  - Treated wastewater from three WWTWs, of which one is being decommissioned;
  - Inflows from informal settlements in the Fisantekraal area as well as the larger Bloekombos in Kraaifontein;
  - Inflows from agricultural feedlots and effluent from various chicken farms in the Fisantekraal area;
  - In the Diep River catchment upstream of the City's boundary, runoff from agricultural areas,

- feedlots and from the Malmesbury and Klapmuts WWTWs;
- In the Diep River sub-catchment within the City's boundary;
  - The extensive Du Noon and Doornbach informal settlements without adequate access to sewerage services, where raw sewage and grey water from domestic use pass into the Kleine Stink River and the Diep River via its floodplain;
  - Smaller informal settlements and informal backyard dwellings throughout the broader Milnerton urban area, including Phoenix and Joe Slovo Park, where sewage and greywater flow into stormwater systems leading to the Diep River, most significantly through the Erica Drive low-flow diversion;
  - Discharges of treated wastewater of varying quality from the Potsdam WWTW - data presented in Section 5.2 show that this WWTW accounted for //% of the City's average daily effluent volume in the 2024 reporting year, with effluent that did not comply with general limits for several key variables (e.g. COD and total ammoniacal nitrogen). Poor effluent quality coupled with high and increasing volumes mean that the Potsdam WWTW remains a major, permanent contributor to downstream nutrient loading and chemical oxygen demand, with severe effects on the river and downstream estuary. Rose et al (2023) showed that the loading of suspended solids, total ammonia and COD from the Potsdam WWTW far exceeds polluted inflows from the upstream catchment throughout most of the year, as the Diep River upstream of Blaauwberg Bridge has no measurable flow through most of summer. This means that while inflows from Du Noon via direct channels and the Kleine Stink River, which runs through Du Noon, have high concentrations of orthophosphate, ammonia, total ammoniacal nitrogen and *E. coli*, these tend to dissipate in summer into pools within the floodplain. During winter, they are flushed downstream. Flows from the WWTW, however, pass continually into the diversion channel and thence into the lagoon, or overflow and pass into the Theo Marais channel and thence into the Milnerton Lagoon. They result in permanent loading of the lagoon with high levels of organic sediment and nutrients with high CODs;
  - Surcharges from sewers due to blockages or collapses, including eleven collapses in the Montague Drive bulk sewer during the period assessed in this report, which result in the diversion of flows to stormwater systems and ultimately to the Diep River;
  - Overflows from pump stations that at times discharge large volumes of raw sewage into the Diep River via the stormwater system – these include the Koeberg pump station that discharges into the Theo Marais channel and which, during the period assessed in this report, had extended periods of failure and overflow;
  - Solid waste, particularly from areas with high levels of informal and backyard settlement, and often high levels of crime, which affect the City's service delivery capacity;
  - Illegal effluent and sewage discharges from industry and other users into the stormwater system, in the Montague Gardens and Killarney Gardens industrial areas and elsewhere (Photo 8.2.1);
  - Stormwater runoff from urban areas, carrying residues from petrol and oil on roads (e.g. various heavy metals and hydrocarbons); solid waste; runoff from fertilized sportsfields and gardens and other contributors to conventional urban stormwater quality.

Of the above sources of pollution in the Diep River Sub-catchment, most are not stormwater at all. The major contributors to river and wetland water quality in the sub-catchment are all derived from sewage and solid waste streams, highlighting the complexity and challenges of dealing with water quality in the receiving environment.





**Photo 8.2.1**

Photographs of typical surface flows in the Theo Marais Canal during pollution events  
(Left: 20 November 2024; Right: 7 May 2025). Credit: H. Johnstone

### **8.2.3 Water quality through the catchment – condition and trajectory**

The Diep River estuary, and specifically the section known as the Milnerton Lagoon, has been assessed as being in a state of ecosystem collapse due to ongoing pollution of the system by inadequate treatment of wastewater at the Potsdam wastewater treatment works as well as significant sewage spills and overflows from failing pump stations, bulk sewer main collapses, and inadequately serviced informal settlements and residential areas in the catchment (Rose et al., 2023, Rose et al., 2025, Day et al., 2025). These result in prolonged inflows of water with high Chemical Oxygen Demand, high levels of (mainly organic) suspended sediments and high total ammonia concentrations, as well as high counts of fecal indicator bacteria.

**Figures 8.2.1 to 8.2.4** present summary annual water quality data for orthophosphate (as  $\text{PO}_4\text{-P}$ ), dissolved oxygen (DO), free ammonia ( $\text{NH}_3$ ) and *E. coli* data, with actual analyses as outlined in **Section 5** of this report.

These figures, viewed in conjunction with data presented in **Sections 5** and **6**, suggest that:

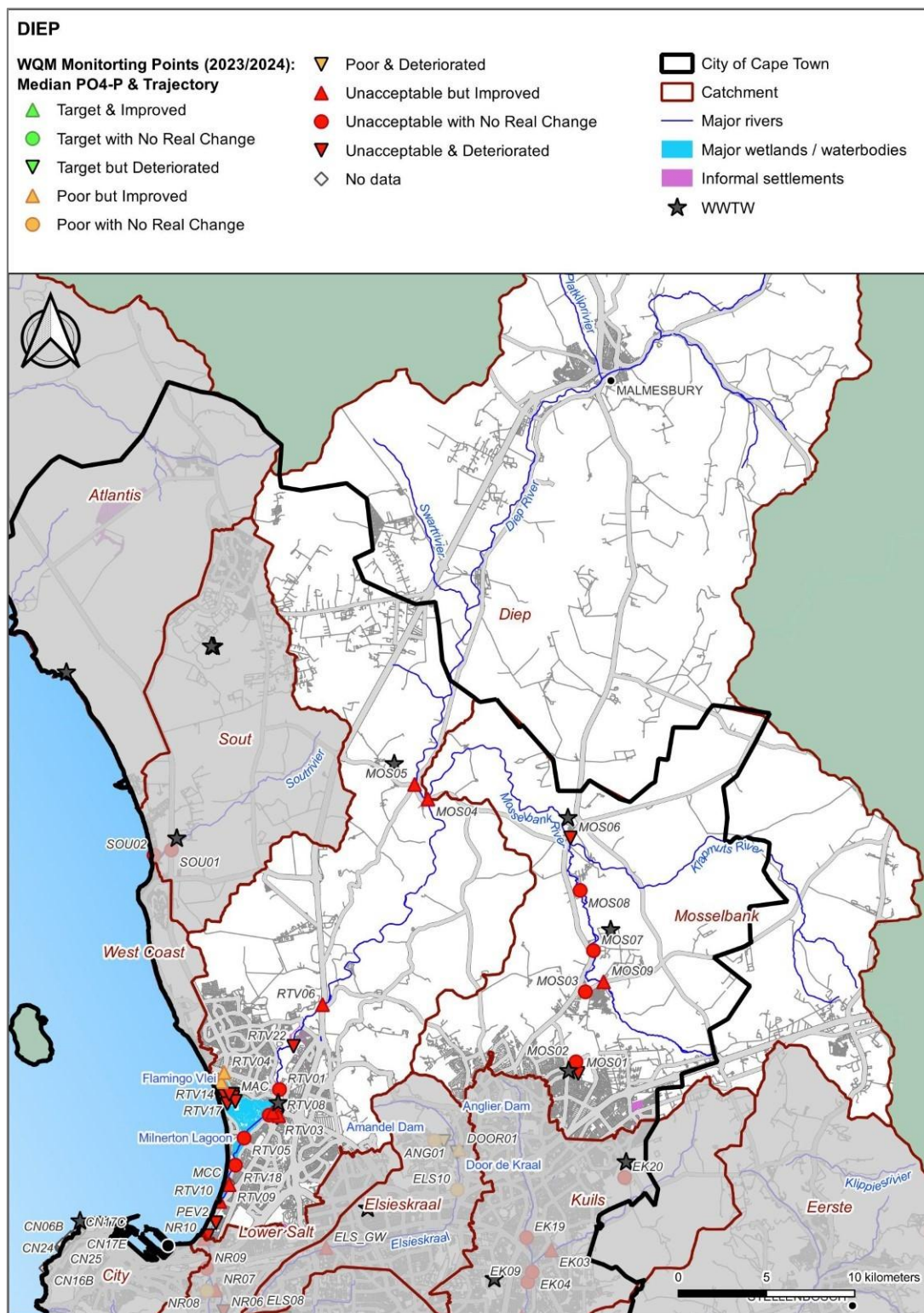
- Water quality entering the Diep River estuary is compromised by activities throughout its catchment, including sources both inside and outside the municipal boundary.
- High levels of abstraction as well as the impacts of alien and invasive vegetation in the catchments and riparian area reduce natural summer flows in particular, reducing the ability of the river to dilute polluted inflows.
- **Median annual orthophosphate** phosphorus concentrations shown in **Figure 8.2.1** suggest that:

- Median orthophosphate concentrations remained largely unchanged in the Unacceptable range in the upper Mosselbank River, with some deterioration near Bloekombos and at the confluence with the Klappmuts River; conversely, median concentrations improved slightly in the downstream Mosselbank near its confluence with the Diep River, possibly due to large flood flows in the 2024 reporting period;
- The Diep River itself was orthophosphate-enriched, with samples rated as Unacceptable (i.e. hypertrophic) at all sites monitored, including at sites near the City's boundary, where water quality is affected by upstream activities;
- Median orthophosphate concentrations in the lower Milnerton lagoon improved slightly relative to the previous (2023) reporting period, potentially also attributable to the 2023 and 2024 flood events that may have led to flushing and dilution. Nevertheless, water at these sites remained within the Unacceptable range indicative of hypertrophic conditions;
- Poor and declining quality flows in respect of orthophosphates entered Rietvlei from the Bayside Canal, and contributed to the ongoing hypertrophic condition and increasing nutrient enrichment of Rietvlei; and
- Zoarvlei, located south of the estuary outlet (sites PEV1 and PEV2), and discharging into the sea via a pipeline, also showed high median total phosphorus concentrations, indicative of hypertrophic conditions with runoff from a highly urbanized industrial area, and showing a decline since the 2023 reporting period.
- Median annual **Dissolved oxygen** concentrations (DO) shown in **Figure 8.2.2** suggested that:
  - DO median concentrations were generally very low (in the Unacceptable and Poor ranges) in the upstream Mosselbank Sub-catchment in the upstream Mosselbank River (within the CITY boundary, in the Fisantekraal area);
  - DO in the Diep River in the agricultural areas upstream of the Mosselbank confluence improved to the Target range in the 2024 reporting period;
  - Median DO concentrations remained Poor as far as the start of urban settlements, declining (both with distance and since the 2023 reporting period) to Unacceptable downstream of the informal settlements of Du Noon and Doornbach (site RTV22);
  - Within the estuary, median DO concentrations remained Unacceptable at all sampling sites between Blaauwberg Road and the Woodbridge. These reflect the high COD of this watercourse, with high COD loading from Potsdam and raw sewage creating an excessive demand for oxygen (see **Section 5.5.2**);
  - A decline in median DO concentration was apparent at the Woodbridge site (RTV09) relative to 2023 when flood events had resulted in improved tidal penetration of the lagoon (see e.g. Rose et al., 2025, Day et al., 2025);
  - Median DO concentrations were within Target ranges at the estuary mouth due to the contribution of oxygen-rich marine water;
  - DO concentrations remained Unacceptable, with some decline, in the polluted Zoarvlei wetland south of the Diep River estuary mouth.
- Spatial patterns in median annual **free ammonia (NH<sub>3</sub>)** concentrations shown in **Figure 8.2.3** suggest that:
  - Ammonia toxicity was unlikely to have been a concern in the upper reaches of the Diep and Mosselbank Rivers outside of urban areas;
  - Significant downstream deterioration is however evident in the data, which indicate a spatial deterioration (Unacceptable in all reaches downstream of the Potsdam WWTW);
  - Minor improvements between 2023 and 2024 reporting periods are apparent in the estuary between Potsdam WWTW and the Woodbridge, but median concentrations remained within



the unacceptable range;

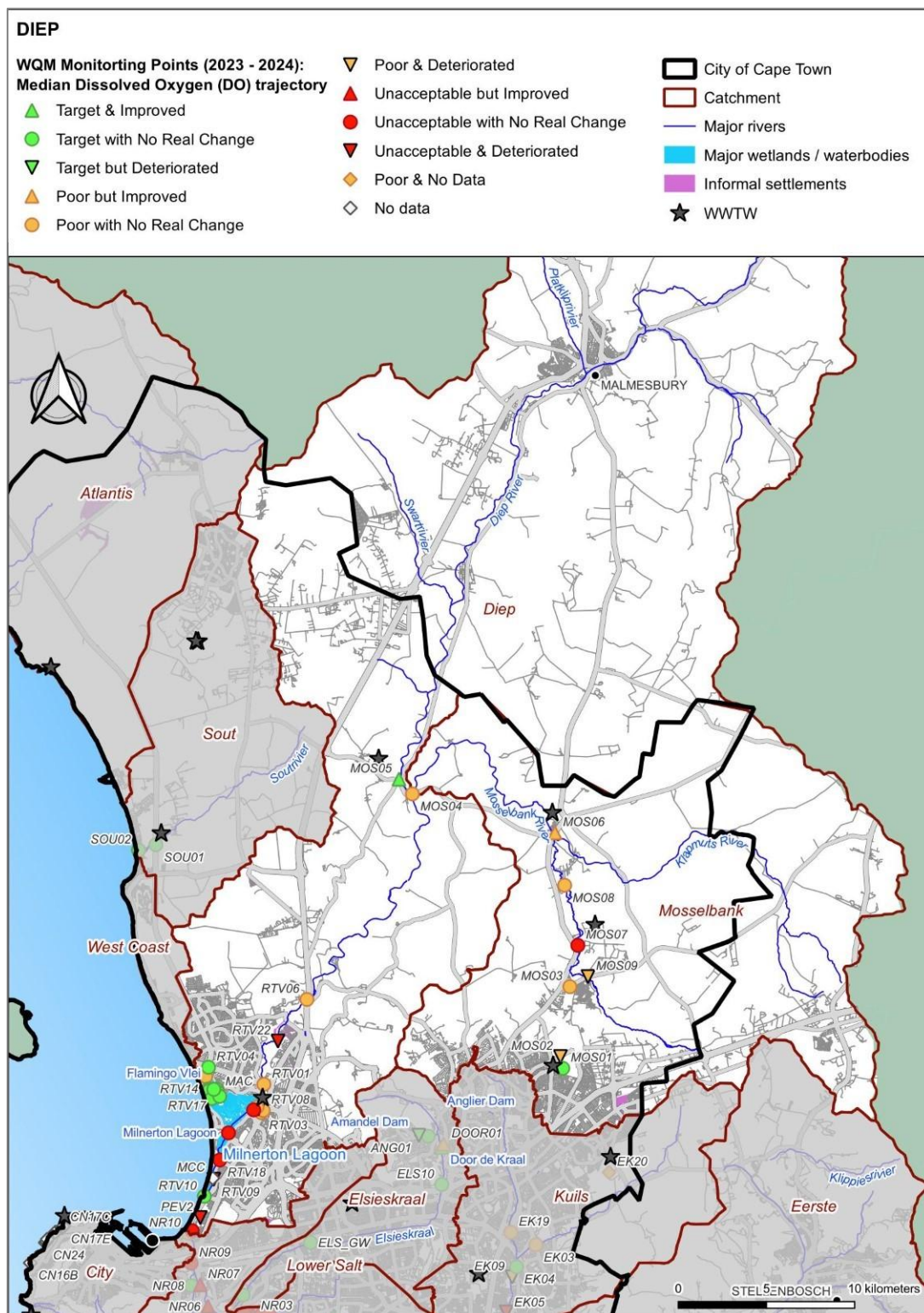
- The above results are not surprising – **Figure 5.2.7** shows high ammonia concentrations well above general limits for this variable in Potsdam effluent, resulting in very high downstream loading. Elevated ammonia concentrations would persist under low dissolved oxygen conditions in the estuary, relative to the chemical and biological oxygen demand of the system;
  - Ammonia toxicity was thus likely in the estuary over extended periods of time – very low oxygen concentrations in the estuary would in any case have exerted severe pressures on any aquatic species reliant on access to dissolved oxygen in estuarine waters over this time;
  - Zoarvlei data suggest that, despite low oxygen and elevated phosphorus concentrations, ammonia toxicity was probably not a factor affecting this waterbody over the current reporting periods – this reflects much lower nitrogen pollutant loads into this system; a longer retention time than in the flowing lagoon; and more effective relative nitrification processes as a result. However, a temporal decline was apparent at both sites in the Zoarvlei, between the 2023 and 2024 reporting periods.
- Geometric mean annual ***Escherichia coli*** data within the City's boundary in the Diep Sub-catchment (**Figure 8.2.4**) showed that:
    - *E. coli* counts in the upper Mosselbank River outside of urban areas were within the Target range for this indicator of fecal pollution, but were unacceptable at the sites in the urban areas of the sub-catchment;
    - *E. coli* counts in the Diep River at the N7 road bridge were generally within Target range, but deteriorated both spatially and temporally (between 2023 and 2024 reporting periods), with counts within the Unacceptable range at all sites downstream of the N7 to the lower Milnerton lagoon;
    - The data indicate high levels of raw sewage that enter the river from informal and backyard settlements, via the Kleine Stink River past Dunoon and Doornbach settlements, and from Jo Slovo and other similar settlements in this area, which discharge sewage and grey water into the stormwater system;
    - Significant raw sewage inputs also occurred from pump stations and from bulk sewer main collapses, with flows discharged from the Koeberg pump station and other sources via the Theo Marai channel;
    - Data presented in Rose et al. (2024 and 2025) show at least episodic severe declines in the final effluent quality at the Potsdam WWTW; these, coupled with the raw flows referred to above, are reflected in the declines in this indicator of fecal pollution at all sites within the Diep River bypass channel and Milnerton Lagoon relative to 2023;
    - The Bayside channel also receives overflows of sewage from both blocked pump stations and low-lying manholes in the Bayside area, and from the Table View West pump station in particular, contributing to its Unacceptable rating in Figure // . The Rietvlei recreational water body (also referred to as Flamingo Vlei), however, showed mean *E. coli* concentrations in the Acceptable range throughout the waterbody;
    - *E. coli* concentrations from WWTWs in the Mosselbank Sub-catchment upstream showed however that at least some of these facilities produced final effluent in the range of Unacceptable risk, and potentially impacting on downstream agricultural and other users;
    - Zoarvlei data showed high *E. coli* at the upstream (southern) end of the vlei, reducing to Acceptable in the northern end of the vlei, reflecting both reduced sources of contaminated stormwater inflows in the north, and die-off of *E. coli* as a result of exposure to sunlight with distance through the vlei; similar to other indicators, however, there was a decline in this indicator relative to the 2023 reporting period.



**Figure 8.2.1**

**Median annual orthophosphate phosphorus (PO<sub>4</sub>-P) data, focusing on the DIEP Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period.  
Trajectory calculations explained in Section 3.11.14**

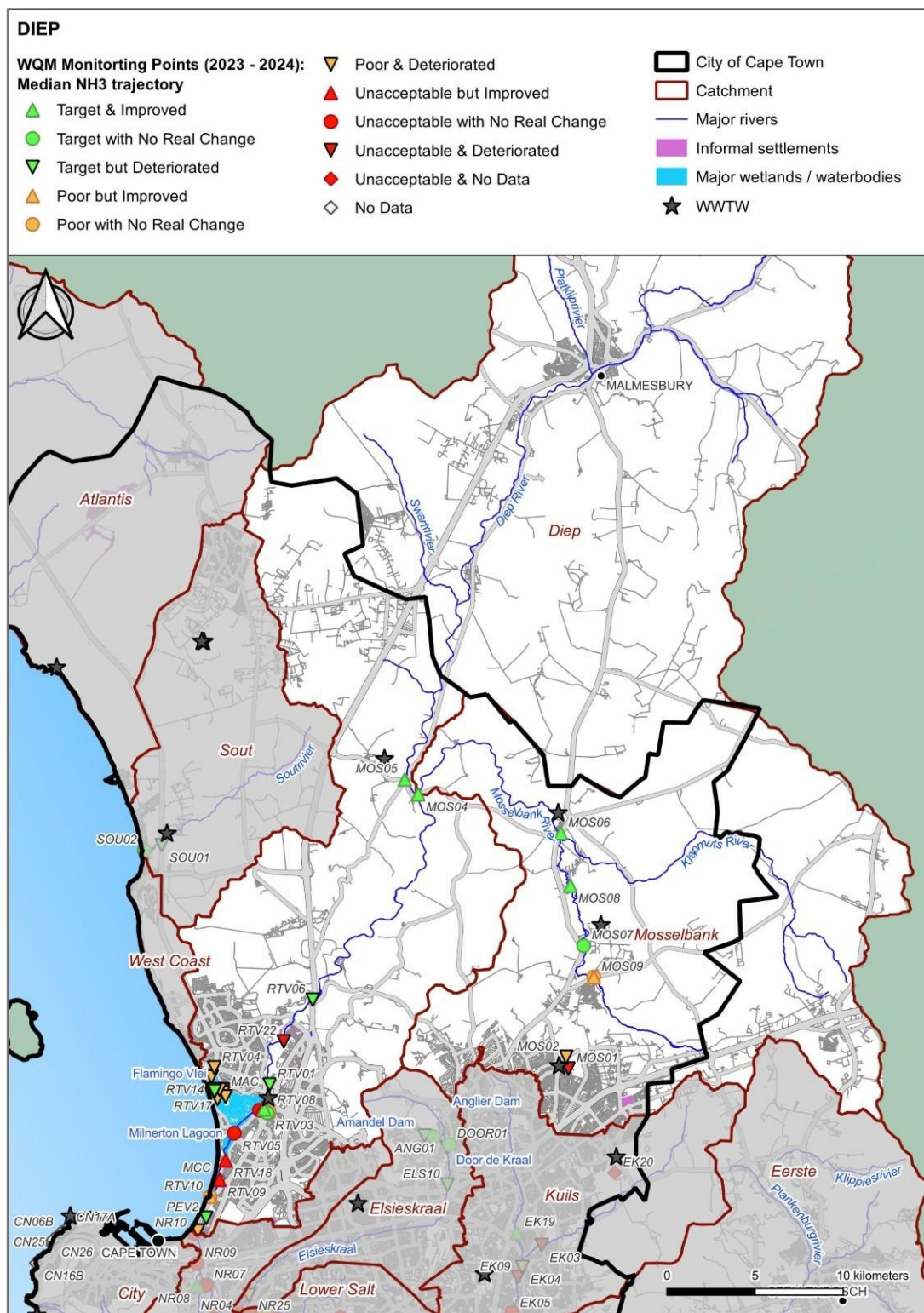




**Figure 8.2.2**

**Median annual Dissolved Oxygen (DO) concentrations, focusing on the DIEP Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14**

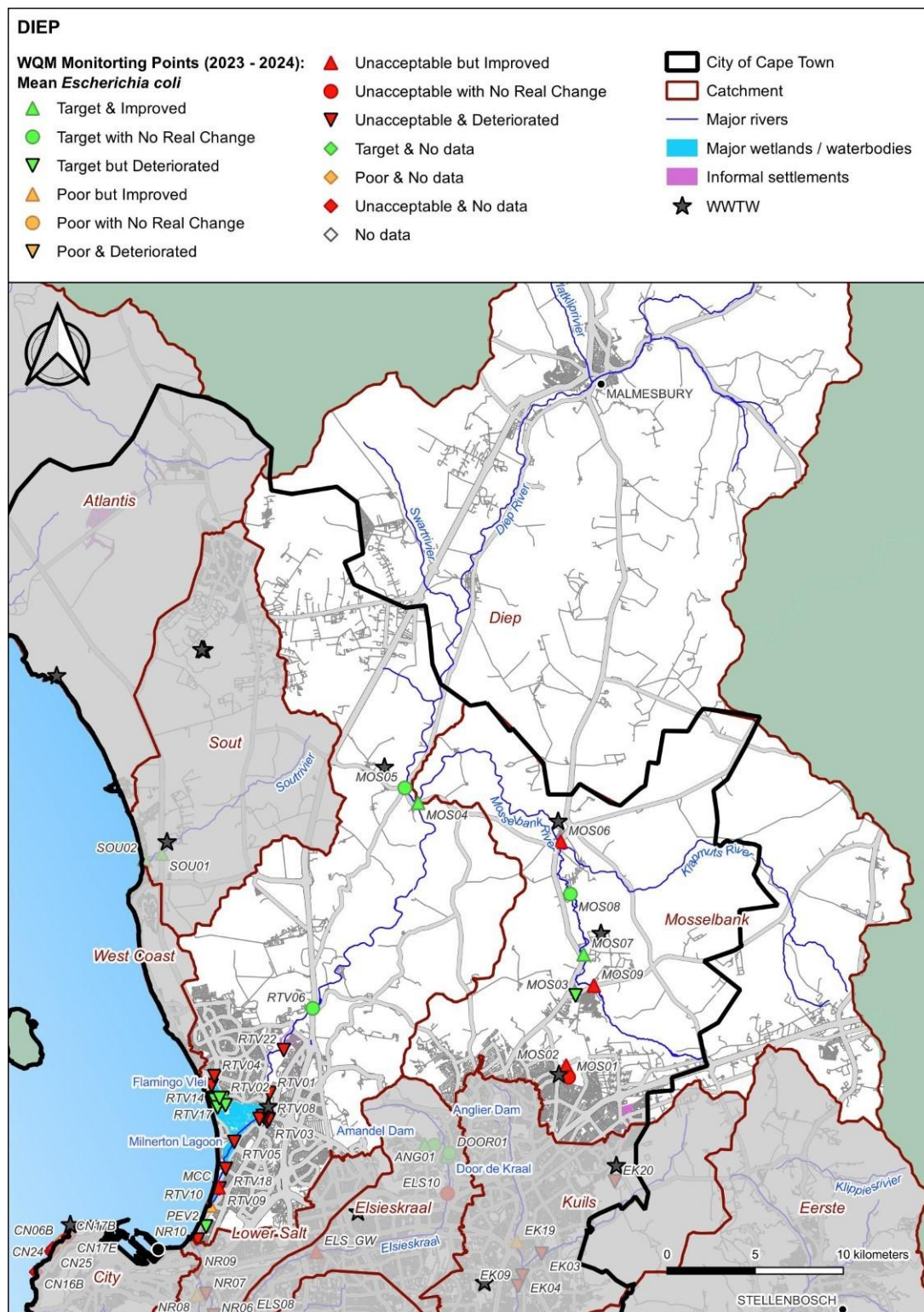
**City of Cape Town**  
Inland Water Quality Report covering rivers and major vleis  
with a focus on the period October 2022 to September 2024 (2023 and 2024 Reporting Periods)



**Figure 8.2.3**

Median annual free ammonia (NH<sub>3</sub>) concentrations, focusing on the DIEP Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14.





**Figure 8.2.4**  
**Mean *E. coli* data (geometric means), focusing on the DIEP Sub-catchment.**  
Data coded as to human health risk (see Table 3.3). Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14.



### 8.2.4 Major challenges

The Diep River sub-catchment has experienced declining water quality for over two decades (ICE 2009, Day et al., 2024, Day et al., 2025, etc.) and appears to have undergone a further decline in its lower reaches during this reporting year. Based on discussions with the City's Stormwater Planning Region managers responsible for different parts of this sub-catchment, which straddles parts of two regions, the main issues confronting the CSRMs' regional managers working in this area comprise:

- Frequent discharges of raw sewage from pump stations, pipe collapses, manhole surcharges, and cross-connections between the foul sewer and stormwater reticulation systems – these have in the reporting year included major spill events from the Montague Drive bulk sewer after repeated collapses of this pipeline, as well as frequent surcharges from the Koeberg pump station resulting from the accumulation of sediment in the pump station following these collapses;
- Large volumes of poor and declining (relative to 2023) quality final effluent from Potsdam WWTW, exposing downstream systems to high COD loading, with the resultant impact on downstream DO concentrations; ammonia toxicity; production of noxious hydrogen sulphide gases and methane from anaerobic systems; resulting in an ecologically dysfunctional estuary;
- Continued growth and densification of informal settlement in the Diep and Kleine Stink River floodplains, resulting in direct loss / degradation of floodplain wetlands and river channels; and permanent streams of sewage and greywater waste into the Diep River, well beyond any natural ameliorative or assimilative capacity of this system and its estuary;
- Extensive backyard dwellings across large parts of the urban environment east of Potsdam Road, in some cases comprising two or three story stacked structures with little access to formal sewerage networks that were designed for far smaller populations in these areas;
- Uncontrolled accumulations of solid waste including organic waste in many areas;
- Industrial effluent discharges to the stormwater system, both unintentionally (e.g. as a result of factory fires and other incidents) and intentionally via illicit discharges; and
- A misalignment between the key issues (sewage pollution) and the focus of programmes and projects to address pollution (often focused on the receiving environment or the stormwater system, rather than the sources of polluted flows) – and a gap in the roles and responsibilities within the CITY structure in relation to how sewage pollution is managed, with no clear line of accountability for this matter.

### 8.2.5 Focus areas of the CITY's water quality interventions within the sub-catchment

The following activities have been undertaken by the City in an effort to at least moderate the impacts of the above on water quality in the Sub-Catchment:

- The following **investigative reports** have been contracted to external consultants over the 2021 to 2023 reporting periods, to provide recommendations on management and other pollution abatement interventions by the City:
  - A remediation plan for Rietvlei (Infinity 2023a and 2023b), which recommended focused management of pondweed habitat in the vlei, mitigation of upstream pollution sources (mainly in the Bayside canal) and future (but not immediate) dredging of vlei sediments;
  - A water quality remediation plan for Milnerton Lagoon (Rose et al 2023), which recommended a number of interventions to address water quality in the Lagoon, including measures to address pollution from the WWTW and Erica Road outlets; dredging of Milnerton Lagoon remediation measure; short-term aeration of the lagoon, and the pumping of seawater into the lagoon, to try to address odour issues;
  - A stormwater management plan for the Dunoon / Doornbach areas of the Diep River, including consideration of the merits of diversion of the Klein Stink River from the informal settlement area, to reduce river pollution, along with other measures to improve water quality and reduce aquatic ecosystem risk (Lukhozi 2024);

- A series of intensive sampling efforts in late 2024 and early 2025 to assess and characterise pollution sources in the Milnerton Lagoon (Rose et al. 2025a and 2025b); and
- Detailed design and modelling of the proposed Milnerton Lagoon dredging intervention by PRDW South Africa, Infinity Environmental and Anchor Environmental, which found that the effects of dredging would be limited and potentially short-term under the current water quality conditions.
- **Commencement** of a number of interventions based on previously approved designs:
  - Trialing of an aeration system in the Milnerton Lagoon between November 2023 and June 2024, in an effort to reduce the prevalence of anaerobic decomposition and resulting production of hydrogen sulphide from the lagoon sediments – an intensive monitoring programme was implemented during the latter part of this trial and confirmed that, while measurable improvements in dissolved oxygen occurred, these were not sufficient to address the scale and intensity of the pollution (Day et al 2024b);
  - Upgrading of the Potsdam WWTW to include ultrafiltration of treated effluent for the new works, and improved filtration systems for the existing (upgraded) works – this project commenced in 2023 and the first aspects are scheduled to be commissioned in mid-2025;
  - Phase 1 upgrades of the Koeberg sewage pumpstation, to include a new sandtrap and screening station – scheduled for completion during 2025;
  - Installation of a new bulk sewer pipeline through the Montague Gardens area, which will allow maintenance / repairs to the existing Montague Drive bulk outfall sewer that has undergone periodic collapses and failures;
  - Diversion of polluted low flows from the Erica Road stormwater pipeline via a gravity-fed low flow diversion to the sewer on the upstream side of Otto Du Plessis Drive – this system is however vulnerable to any blockages in the pipeline, which can cause polluted flows to continue down the stormwater pipeline to the discharge point into Milnerton Lagoon, from which they are pumped using vacuum tankers for discharge into the Montague Drive sewer;
  - Procurement of a weed harvester for Rietvlei, to allow improved management of pondweed in the wetland, from the perspective of both water quality improvement and recreational use (as per Infinity 2022) – this weed harvester is scheduled for commissioning during 2025;
  - Construction of a flood attenuation pond with allowance for water quality filtration through a reedbed wetland between Rietvlei and the Bayside Canal, to address polluted inflows from this point source – this project stalled during November 2024 due to a contractual dispute between the CITY and the contractor, and remains incomplete as at the time of writing – see Photo 8.2.2;
  - Detailed design of the Phase 2 upgrade to the Koeberg pump station, including provision for a bypass pond for effluent storage during breakdown or load-shedding periods; and
  - Although outside the sub-catchment, various interventions in the Wallacedene / Bloekombos areas of the upper Mosselbank catchment to improve sewerage infrastructure provision and maintenance – watercourses in these areas are prone to pollution from failed pump stations, particularly during load-shedding. One of these has now been fitted with a supplementary generator, leading to improved performance. A short-term action plan was also implemented with good results, but then was halted in 2024. Efforts have been made to revitalise its implementation (Mr J. Terblanche, CSRM, pers. comm. to Liz Day).
- **Completion of detailed design** of interventions in the stormwater system in the vicinity of Milky Way, just downstream of the Jo Slovo settlement, to:
  - Include pumped offtakes of contaminated low flows to the adjacent Phoenix pump station;
  - Rehabilitate the Milky Way pond and Erica Road stormwater system;
  - Include screens to capture rags, and other solid waste upstream of the pump station and so reduce the frequency of blockages;

- Potential construction /re-design of ponds as holding areas for sewage overflows to allow back-pumping;
- Potential implementation of stormwater biofiltration systems in this area (as per Rose et al 2023).
- Implementation of the above project has had to be delayed, as the affected pump stations do not have sufficient capacity for the additional sewage load that would result from the planned diversion. Pump station upgrades are thus urgently required (Mr B. De Wet, CITY, pers. comm to Liz Day).



**Photo 8.2.2**  
**Photographs of the Bayside Canal flood attenuation structure and reedbed under construction in 2025.**  
**Photo credit: City of Cape Town**

### **8.2.6 Institutions and fora**

The Diep River Catchment Management Forum was established in 2024 – an interim chair is currently serving, and it is expected that a new chair will be elected during June 2025. An Estuary Advisory Forum has also been established to advise on management of the Diep River Estuary. It meets on a quarterly basis. A protected area advisory committee (PAAC) is established for the Table Bay Nature Reserve, to advise the City on reserve management issues.



### 8.2.7 Recommendations

The key interventions required in this priority sub-catchment are all related to sewerage infrastructure, rather than to stormwater management per se. As expressed by the Stormwater Planning Region managers, this means that interventions required to improve water quality in the City's watercourses must be executed by other branches and departments and cannot be driven by CSRM alone. Engagement with and ownership of the challenges by the City's Human Settlements, Waste Water Treatment Works, Sewage Reticulation; Waste Services; Engineering and Asset Management and Law Enforcement Branches / Departments are essential to effect real long-term water quality change in this catchment going forwards.

From a water quality perspective, it is recommended that the following interventions be prioritised:

- Urgent interventions to improve the current quality of effluent discharged from Potsdam WWTW, which has deteriorated significantly over the past year;
- Continued efforts to fast-track the upgrading and expansion of the Potsdam WWTW, the construction of the new bulk sewer outfall for Montague Gardens and the subsequent rehabilitation of the existing Montague Drive bulk sewer, the upgrading of the Koeberg pump station, Phoenix pump station, and other sewerage infrastructure in the sub-catchment;
- Diversion of the Kleine Stink River from the Dunoon and Doornbach informal settlements on the Diep River floodplain, and of the Milky Way channel flows from Joe Slovo Park and Phoenix, to sewer for treatment;
- Institutional and/or management changes that allow for greater agility and urgency in response to spills, breakdowns, and failures in the sewerage system;
- Defence against informal settlement expansion in the remaining areas of the Diep River floodplain that have not been settled on, not only for ecological reasons, but also because *inter alia* they represent a rapidly shrinking resource, urgently needed for improving urban flood resilience; and
- A programme to identify and locate the sources of illicit industrial and sewage discharges in the Killarney and Montague Gardens industrial areas through, for example, deployment of flow loggers, on-the-ground tracking of flows in the stormwater reticulation system, and subsequent enforcement and intervention where issues are identified.

## 8.3 Soet River Sub-catchment

### 8.3.1 Catchment overview

The Soet River (also referred to as the 'Soete River' in some maps and documents) is a small stream that rises in the Schapenberg Hills above (and north of) the suburb of Dennegeur in Somerset West, forming a small catchment wedged between the Lourens and Sir Lowry's Pass River catchments, within the City's Eastern Stormwater Planning Region. Several minor tributaries feed into it from the hillslopes to the north, and the river and its associated seeps pass through a number of large housing developments upstream of the N2, including Heritage Park Estate, where flow from these streams as well as stormwater generated in Heritage Park and other near-by developments are managed in a series of large detention ponds. Upstream erosion results in significant sedimentation at times in catchpits, both upstream of Heritage Park and in the detention ponds immediately upstream of the N2. Prior to urban development in this area, the gently sloping foothills of the Schapenberg included extensive hillslope seep wetlands, most of which were destroyed by agriculture (Day 2004).

The other main tributaries of the Soet River lie some 500 m further southeast, and are conveyed downslope, east of Chris Nissen Village, and under the N2, from where they pass through the Asanda and Nomsamo settlements. These comprise high-density suburbs with large numbers of informal settlements and backyard dwellings. Accumulation of solid waste in open space areas is high.

A small remnant wetland (Asanda Wetland) remains between the N2 and Asanda Village. This wetland was previously subject to infilling, dumping of solid waste including abattoir waste, and encroachment by informal settlement, urban agriculture and livestock. In early 2021, following extensive community engagement, the City initiated a community-driven rehabilitation project in the wetland. The rehabilitation project was completed in 2023 as the first of the LUW programme projects (see Section 7.3).

The Asanda wetland itself is fed mainly by one of the Soet tributaries, channeled along the edge of Heritage Park. Downstream of the wetland, these flows are piped through the Asanda and Nomsamo settlements, as are the other stream flows. They emerge downstream of these settlements, and converge to flow within a single, wide, mainly earth, channel between more formal developments. In these reaches, the open channel is visibly polluted, with high levels of organic waste, raw sewage from the informal settlement upstream, as well as from overflowing manholes, and high levels of solid waste. These polluted flows are piped from Naomi Street, daylighting again as a polluted stream downstream of the R44. From here, the river flows through Greenways Golf Estate – a private golf course and housing development, before it passes into False Bay.



**Photo 8.3.1**

**Fast flows from a steep erosion-prone catchment bring sediment via the upper Soet, depositing it in stormwater ponds and channels (inset)**



**Photo 8.3.2**

**Build-up of solid waste in the Soet River catchment downstream of the N2**





**Photo 8.3.3**  
**Tributaries of the Soet River downstream of Asanda and Nomsamo (June 2025)**  
Photo: J. Jacobs



**Photo 8.3.4**  
**Tributaries of the Soet River downstream of Asanda and Nomsamo (June 2025)**  
Photo: J. Jacobs



**Photo 8.3.5**  
**Off-channel bioremediation pond in the Soet Catchment (Greenways Golf Estate)**  
Photo: D. Walker



**Photo 8.3.6**  
**Waste interceptor devices installed in the Soet Catchment (April 2025)**  
Photo: D. Walker

In response to complaints raised about the condition of the Soet River and the dire pollution in the catchment at large, the DEA&DP issued a Directive to the City in March 2020, relating to pollution of the Soet River (reference 14/1/1/E1/323/0563/19). This prompted inter alia the development of a PASAP and TAP for this catchment.

### **8.3.2 Major sources of pollution in the catchment**

Major sources of pollution in this priority sub-catchment have been identified (from data presented in Section 5; site drive-overs by the present study team; from the City's PASAP for the Soet River Sub-catchment (City 2023b) and from engagements with the Soet Catchment Management Forum chair (Mr David Walker)) as the following:

- Overflows from sewage pump stations – in the event of pump station failure, three of the four pump stations located in this catchment discharge directly into the Soet River, while the fourth discharges into the ocean. None of the pump stations have emergency ponds or bund walls (City 2023b);
- Unmonitored inflows from private sewage package plants located in the catchment;
- Runoff of raw sewage and grey water from informal settlements in the N2 and other road reserves as well as from backyard developments in the Nomzamo/Lwandle and Asanda settlements;

- Runoff from activities such as a car washing, open air cooking, informal butcheries into the adjacent canals
- Seepage from piled solid waste including offal, dead dogs and other waste along pavements and in the roads in these areas (pers. obs.) – City of Cape Town (2023b) notes that there is no door-to-door solid waste removal;
- Sewer overflows – these are often not reported and may persist for long periods of time;
- Illegal dumping into wetlands and canals and windblown pollution;
- Pollution from oil and toxic substances, disposed of into grid inlets, catchpits or road surfaces;
- Inadequate solid waste removal compared with daily loading, particularly in the informal settlements (comment from Mr D. Walker, Soet Catchment Management Forum Chair, to Liz Day, April 2025).

### **8.3.3 River water quality through the catchment – condition and trajectory**

This assessment has been informed by only one monitoring point in the Soet catchment (SOE02, located within the Greenways Golf Estate), noting however that subsequent to the 2024 Inland Water Quality report (Day et al 2024a), the City expanded its water quality monitoring points in some areas including the Soet Catchment. The data for these additional sites should be presented in the next Inland Water Quality Report.

Data presented spatially in **Figures 8.3.1-8.3.4** show that (for site SOE02, located within the Greenways Golf Estate):

- Median annual orthophosphate, dissolved oxygen and free ammonia (NH<sub>3</sub>) concentrations were all in the Unacceptable range in both the 2023 and the 2024 reporting periods, with data indicating deteriorating conditions in all three variables;
- Similarly, compliance type data presented in Section 5 showed that:
  - Dissolved oxygen was usually in the Unacceptable category in the 2024 reporting year, dropping from 50% of samples rated Unacceptable in the 2023 reporting period to over 80% rated Unacceptable, reflecting high levels of organic waste with high chemical and oxygen demand;
  - Free ammonia (NH<sub>3</sub>) concentrations also increased over the 2024 reporting period, with most samples rated Unacceptable and the remaining ones rated Poor, and with the proportion of samples rated Unacceptable increasing from 75% in the 2023 reporting period to >80% in the following year;
  - Orthophosphate concentrations were always rated in the Unacceptable category, and data in **Table 5.3.1** show a 51.4% increase in this nutrient between the 2023 and 2024 reporting periods;
- The above data indicate a catchment (albeit measured only at one point in the downstream river reaches) that was (and is assumed to remain) in a critical condition, with high ammonia and low oxygen all indicating toxic conditions that are unlikely to support aquatic ecosystems of any desirable quality;
- Median annual *E. coli* data shown in **Figure 8.3.4** also show a deterioration in this variable over the 2024 reporting period, and data in **Figure 5.1.5** show that, in this period, 94% of samples were rated as Unacceptable Level 3, with the rest being rated Unacceptable Level 2. These data reflect the volumes of raw sewage in the system, which at least in dry weather, are assumed to constitute the full volume of flow in the river.
- **Figure 5.2.5 (Section 5.2)** also shows the Soet Sub-catchment to be a hot-spot for sewage spills from sewer manholes. Although it does not rate as one of the worst sub-catchments in terms of pump station overflows (**Figure 5.6.9**), these data are deceptive, as the Soet is a relatively small sub-catchment compared to the others and the data are not weighted for area.

### 8.3.4 Major challenges

Improving water quality in the Soet River catchment has been identified as the key focus area of the City's Stormwater Planning Region management team for the Eastern Region (Mr. G. Muller, CSRM, pers. comm. to Liz Day). Key issues comprise:

- High levels of informal settlement, often in land not owned by the City (e.g. SANRAL-owned), which<sup>17</sup>complicate management interventions;
- Despite door-to-door collection of waste within the informal settlements in the catchment (Lwandle and Nomzamo), dumping of solid waste continues unabated, suggesting that the frequency of solid waste collection is too low for the volumes generated;
- The difficulty in engaging with communities in the informal settlements regarding solid waste and pollution issues – this is in part because these are transitional communities that will be relocated away from the river within the next few years into new housing areas, and thus have no sense of ownership in their current location (Mr D. Walker, Chair: Soet Catchment Management Forum, pers. comm. to Liz Day);
- Frequently overflowing sewage manholes and pump station, with low levels of reporting by local communities;
- Block ablution facilities provided to informal settlement residents are often not used (because of security concerns, distance and hygiene considerations) and sewage and grey water are often disposed of into stormwater catchpits or the roads instead;
- Increasingly blocked access to channels for machine maintenance (e.g. dredging of solid waste and sludge), as a result of expanding informal settlements along channel edges – this means that maintenance needs to be carried out with manual labor, exposing staff to highly polluted waters. The need for protective gear and vaccinations against disease makes manual labour increasingly problematic to use in these areas;
- Inadequate collection of solid waste and management of informal settlement encroachment in public open space areas such as Asanda Wetland Park;
- High levels of criminality in and near informal settlements, affecting service delivery;
- Vandalism and dumping in public open spaces (e.g. the LUW Asanda Park) affecting their sustainability.

Although a PASAP and TAP have been developed for the catchment, Day et al (2024a) described them as vague and the City's own Environmental Compliance unit noted that the PASAP submitted by W&S to DEA&DP should "be reviewed with an emphasis on the short comings of actions which were not implemented or actions which were only partially implemented" (Smith 2025a).

In addition to water quality issues, there is a growing reduction in attenuation capacity in stormwater detention ponds in the catchment upstream of the T2. Private developments such as Heritage Park include stormwater detention ponds that are in need of sediment and reedbed removal. Such works are however expensive to implement.

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<sup>17</sup> Discussions with the Eastern Region manager, Mr Gerhard Muller, it emerged that the City has a Memorandum of Understanding with SANRAL, allowing for removal of solid waste by City staff



### 8.3.5 Focus areas of the City's current remediation programmes

The Soet Catchment is the focus of several interventions aimed at reducing pollution in this catchment. Many of these are the result of public /private partnerships (e.g. Greenways Golf Estate and the City) and intergovernmental partnerships (e.g. between the City and SANRAL) and include the following, as discussed during meetings with the City's Eastern Stormwater Region's management team:

- Investment by SANRAL in cleaning stormwater channels through its property – a Request for Quotations (RFQ) for a three month contract to undertake such cleaning was out at the time of writing this report – if this approach yields positive results, it will be continued;
- A (SANRAL-funded) River Warden programme is planned, and a RFQ for this contract is also being prepared – the River Warden programme would focus on the collection of solid waste but would also provide eyes on the ground for identification of sewer and pump station overflows and other issues such as dumping of oil and other waste into the stormwater system;
- Recycling initiatives are being encouraged by the City and the introduction of "Swap Shops" and similar to exchange waste for items such as air time or other or planned, although it was noted in discussion that the City's swap shop programme has very limited capacity at present;
- Upgrading of the problematic Trappies sewer that runs through the area and frequently discharges into the Soet River is planned, and this should reduce pollution frequency and magnitude when this upgrade comes on line;
- An RFQ has been put out by the City's SSB for trialing of bioremediation interventions along the Soet River upstream of Greenways Golf Estate – noting that Greenways Golf Estate has, since December 2023, been undertaking bioremediation on the Soet River using nano bubbles and enzyme inoculation, with reported high levels of success;
- The introduction of four waste interceptors is planned for the Soet River – these will be in place by the end of June 2025 and they will be maintained by the City;
- Rehabilitation of the Asanda wetland to incorporate it into a community wetland park: This is a LUW project - management of illegal dumping, removal of solid waste, alien plant invasion and management of goats are however an ongoing challenge (Day et al 2024a), and on-site assessments as part of this project suggest continued dumping and vandalism of trees, with no compliance (as per the City's MMP for this site) with requirements for the establishment of indigenous plants in wetland areas disturbed by construction activities; the established pedestrian bridge crossing remain intact, highlighting the importance of such interventions that address human needs and dignity, while assuring aquatic ecosystem function;
- Development of a PASAP for the sub-catchment (City 2023b), which identifies problem issues in the sub-catchment and recommends implementation of the following:
  - Management of pollution at source through pollution prevention measures such as law enforcement, education, public engagement, enforcement of "polluter pays principles" and increased service delivery with regard to waste removal;
  - Regulation of sewage treatment package plants, including *ad hoc* inspections and assessment of testing results (it is assumed however that these would in any case need to comply with the City's Standard Operating Procedure for package plants (see **Table 7.2** in **Section 7.3**);
  - Upgrading of pump stations to include bunding and stand-by generators – it is noted in the PASAP that none of the Soet River pump stations have been prioritized for upgrades;

#### Box 8.3.1

##### **Greenways Golf Estate bioremediation and nano-bubbling project**

In response to the visibly polluted and malodorous Soet River channel through this estate, at the downstream end of the catchment, the Estate appointed Blue Planet to apply a combined bioremediation and nano-bubbler intervention in the channel in its reaches through the Estate. This intervention commenced in December 2023, and continues to date.

- Increased frequency of inspections and pro-active cleaning of sewer manholes;
- Appointment of river wardens to clean rivers of solid waste and to report sewer overflows that would otherwise remain undetected;
- Improving conditions in temporary informal settlements by:
  - Covering over open drains to reduce human exposure to polluted waste streams;
  - Upgrading ablution facilities to include provision of washing facilities and formalized access to clean structures linked to the sewer network;
- Improving solid waste removal through:
  - The provision of wheelie bins to informal settlement residents;
  - Implementation of a “swap shop” system – cleaned, recyclable items that can be traded for items in the “swap shop” (e.g. clothes, air time etc.);
- Removal of people from the SANRAL road reserve in the medium to long term and provision of basic services to these people in the interim;
- Compilation of a TAP for the sub-catchment (City 2023c), which outlines specific actions aimed at addressing the issues outlined in the PASAP. These include:
  - Attention to litter removal – although the TAP does not define clearing frequency, which is clearly a major issue affecting current solid waste accumulation
  - Consideration of a low flow diversion to sewer along the southern river channel;
  - Inspection and pro-active repairs to problem sewers and manholes;
  - Consideration of the installation of nano-bubbler generators along the river;
  - Improved water quality monitoring in the catchment;
  - Law enforcement to intervene on illegal discharges to the stormwater system (e.g. from car washes and informal garages);
  - Re-location of public toilets in informal settlements away from open stormwater systems, away from the open SW system.

### **8.3.6 The Soet Catchment Management Forum**

The Soet River Catchment Management Forum was formed in June 2024. Since formation, the forum, led by its Chair, Mr D. Walker, has actively engaged with the City and has contributed to the motivation for and design of four solid waste interceptors, currently being placed in key problem areas in the catchment.

Progress in gaining traction at a catchment level has however been slow, with lack of interest and participation by upstream communities, in both the informal and formal sectors, and the Greenways Golf Estate at the downstream receiving end of the catchment driving all forum initiatives.

Changes that would improve the forum's efficacy include:

- Attendance of forum meetings by SANRAL and City reticulation teams, to contribute to solution-finding
- Engagement by upstream communities in both the formal and informal sectors;
- Regular communication between City officials (CSRMs) and the forum regarding, intervention planning and issues.

### **8.3.7 Recommendations**

Large areas of poorly or unserviced dwellings, with associated disposal into the stormwater system of black



and grey water as well as dumped solid waste that causes frequent overflows from sewage pump stations and manholes, mean that management of the Soet catchment is challenging for the City.

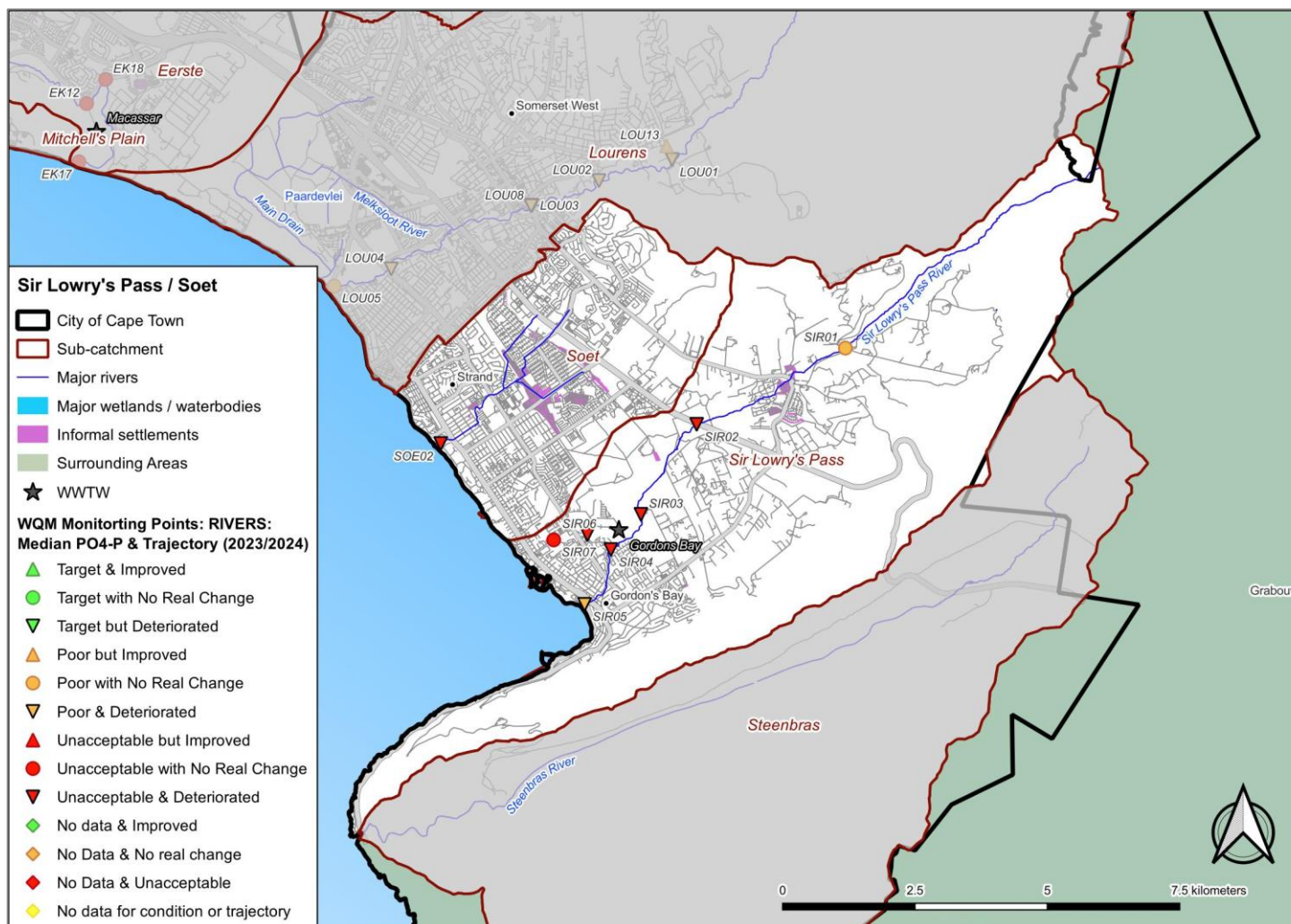
Implementation of the interventions outlined in Section 8.3.5 would however go a long way towards effecting measurable change in the catchment, and the proposed inclusion of a River Wardens programme in particular would be strongly supported. It is recommended that such a programme should be implemented on longer time-scales than the proposed initial three month period, given time taken for training and the need for River Wardens to feel part of a less transient programme, and thus contribute more fully.

Implementation of other recommendations outlined in the PASAP would go a long way towards addressing pollution in this relatively small, and therefore theoretically more manageable catchment. However, the TAP, which is intended to give impetus to the PASAP, lacks detail and structure, and moreover most of the interventions are allowed for only in the long-term, making them irrelevant from a pollution abatement perspective. As per the previous water quality report, it is recommended that the TAP be amended to include:

- Specifications for the frequency of solid waste collection from informal settlements that are in line with the rate of solid waste accumulation;
- Reduced time frames for symptomatic interventions such as:
  - Low flow diversions to sewer;
  - The introduction of nano bubbler (or similar) techniques, even without enzyme inoculation;
  - Canal enclosure studies, design and implementation (if supported by study outcomes);
- Specific attention to implementation of the Asanda Wetland Park MMP, in order to ensure that this project remains a City and community asset.

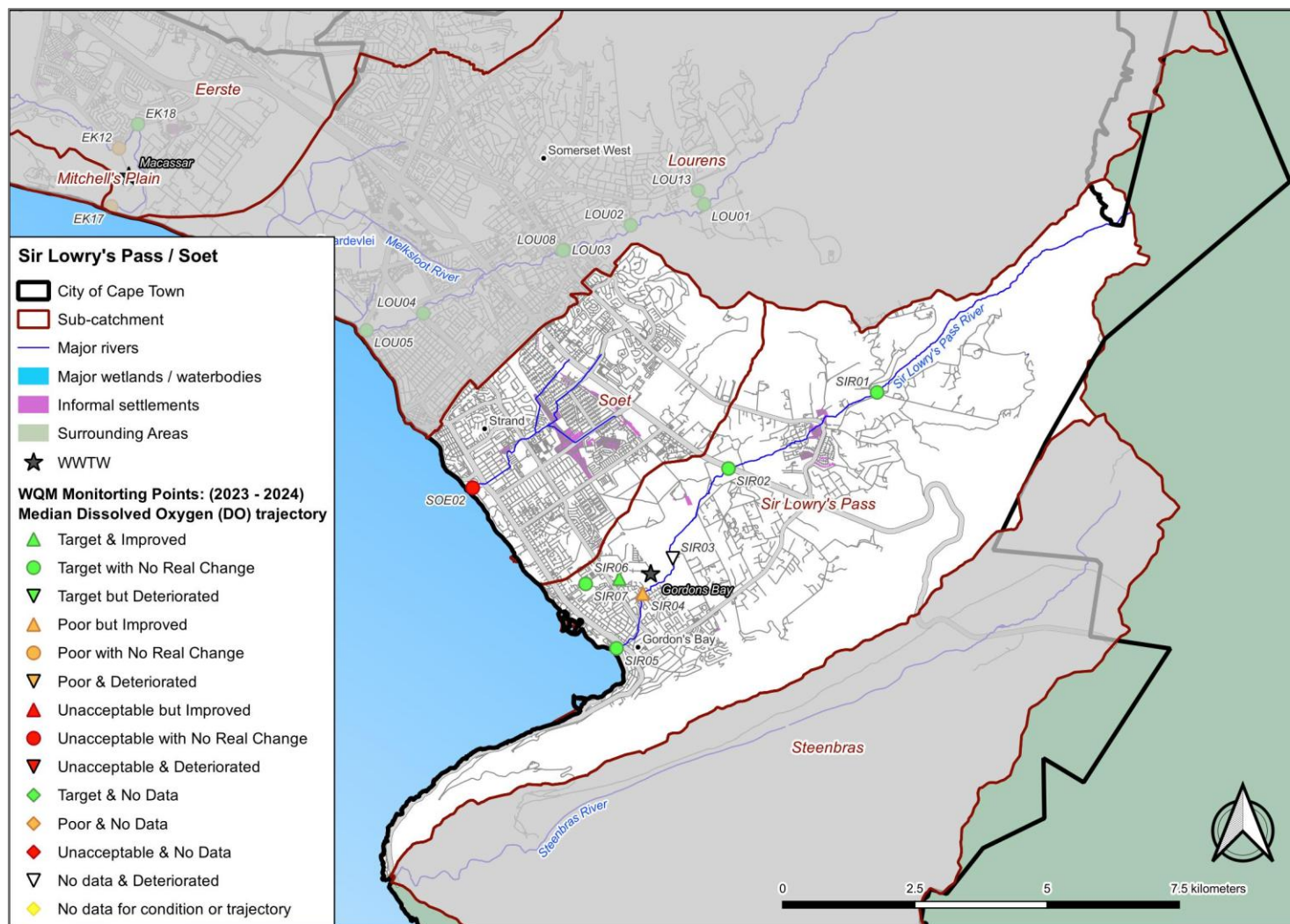
Finally, it is also recommended that the Soet Catchment Management Forum be used as a mechanism to bring together different City Directorates, Departments and Branches, along with civil society, to allow effective planning and implementation of measures to address the dire pollution that currently affects not only communities living within the catchment but also has knock-on effects on the beaches and False Bay coastline, and the tourists and other recreational users of these areas.

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**Figure 8.3.1**  
**Median annual orthophosphate phosphorus (PO4-P) data in the SOET RIVER Catchment.**  
**PO4-P trajectories calculated as explained in Section 3.11.14**

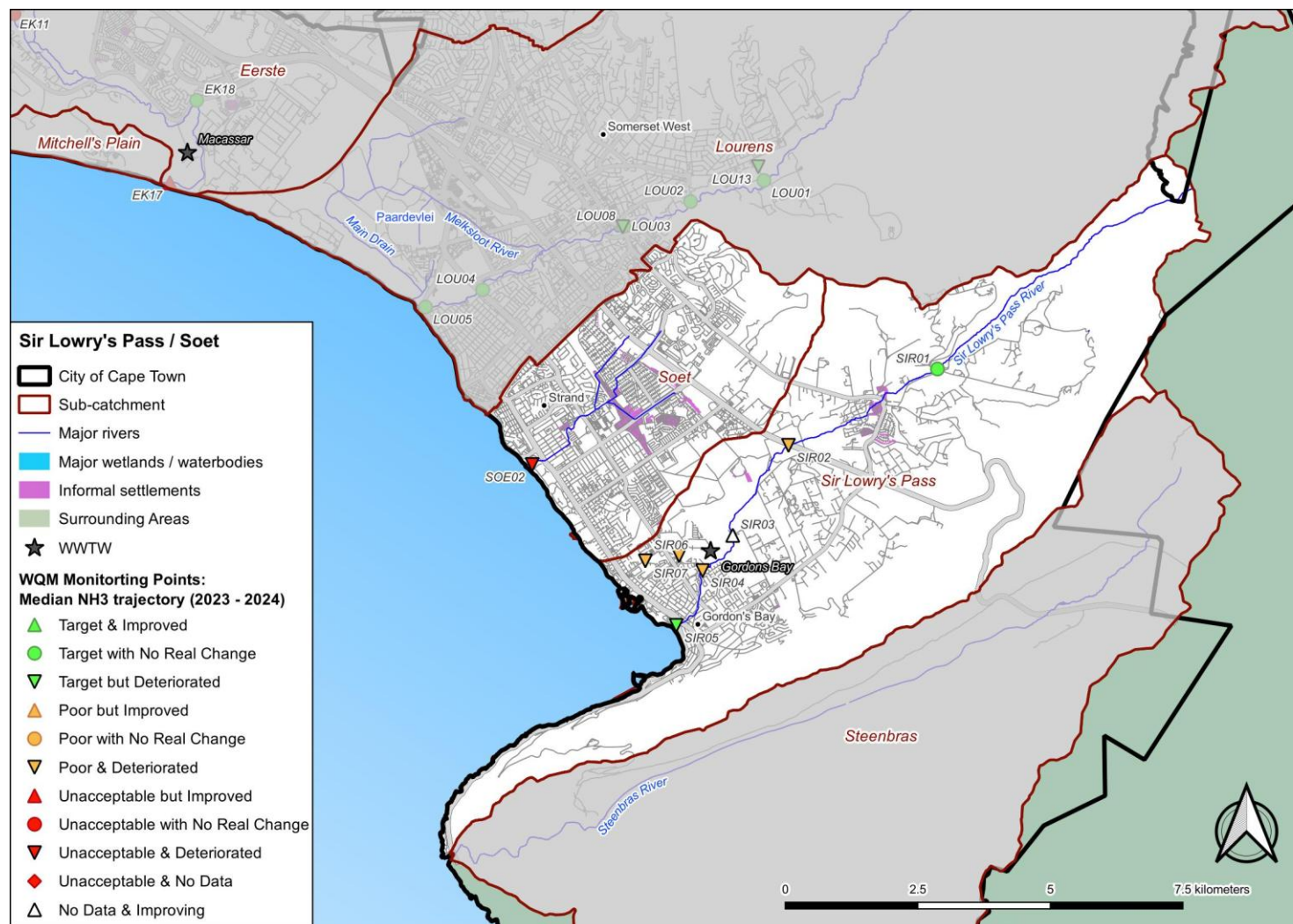
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**Figure 8.3.2**  
**Median annual Dissolved Oxygen (DO) concentrations in the SOET RIVER Catchment.**  
**Data trajectories calculated as explained in Section 3.11.14.**

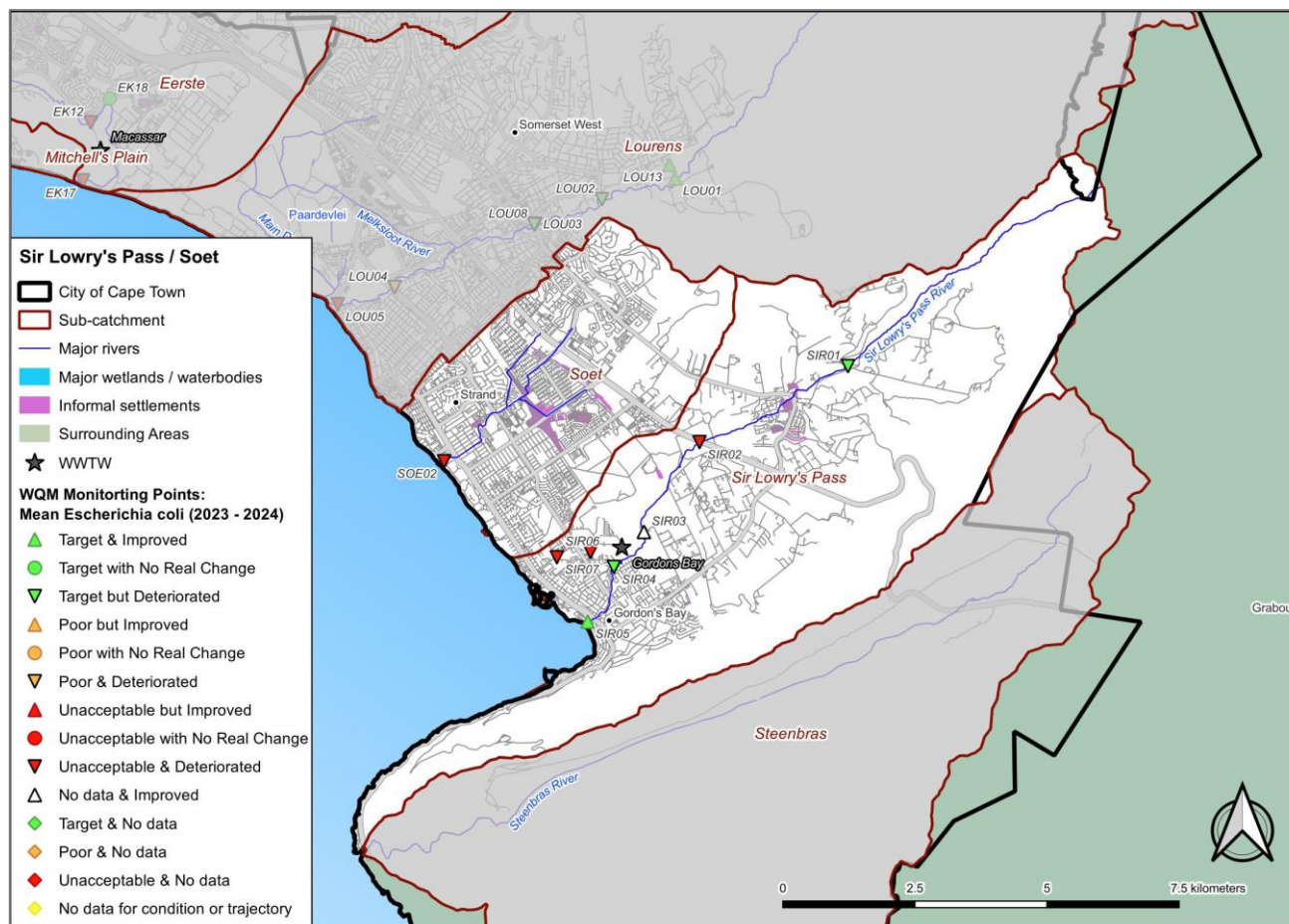


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**Figure 8.3.3**  
**Median annual free ammonia (NH<sub>3</sub>) concentrations in the SOET RIVER Catchment. Trajectory calculations explained in Section 3.11.14.**

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**Figure 8.3.4**

Mean *E. coli* data (geometric means), in the SOET RIVER Catchment. Data coded as to human health risk (see Table 3.5). Trajectory calculations explained in Section 3.11.14. See Section s 3.11.7-3.11.9 for information about data and assessment limitations.



## 8.4 Lower Salt River

### 8.4.1 Catchment overview

The Lower Salt River sub-catchment is relatively large, ranked 6<sup>th</sup> by area of the 17 major sub-catchments within the City boundary. It overlaps three of the four City Stormwater Planning Regions (Central, Northern and Southern regions), meaning that three different CSRM regional managers are responsible for different sections (see **Figure 2.2**). The sub-catchment includes inflows from the Elsieskraal River (upstream of the sub-catchment) and includes the Jakkalsvlei, Lange Canal, Kalksteinfontein, Vygekraal, Blomvlei, Bokmakierie, Black River and Liesbeek Sub-catchments.

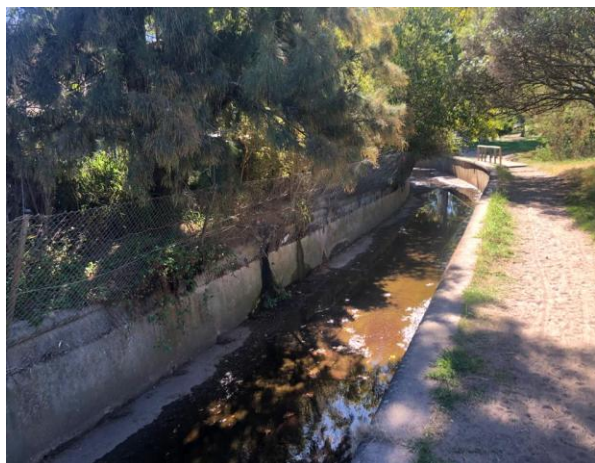
The sub-catchment is highly developed to the north, east and south, and most of the 'rivers' in these portions of the sub-catchment are in fact concrete canals (e.g. **Photo 8.4.1**), many of which were originally constructed in an attempt to drain historically extensive wetland areas on the low-lying land that are fed by the high water-table associated with the underlying Cape Flats Aquifer (Brown and Magoba 2009). An exception to this is the Vygekraal River, which flows within an earth channel through at least some of its reaches, including through the Nantes Park area (the site for one of the City's LUW projects), as well as the Liesbeek River sub-catchment, which includes some of Cape Town's most natural watercourses in the upper reaches of the catchment, albeit becoming rapidly channelised, canalised and impacted by other aspects of urban development within the municipal boundaries.

Many of the low-lying rivers in the sub-catchment pass through socio-economically challenged suburbs characterised by high levels of informal settlement and/or backyard settlements (e.g. in the suburb of Langa and surrounds, and the north-western edge of the KTC informal settlement), which are often plagued by high levels of crime and gang activity, affecting both local communities and the ability of the City to conduct routine monitoring and implement effective interventions. These rivers all join the Black River in the vicinity of the N2, and flow from there until just downstream of the confluence with the Liesbeek River in Observatory. Permanent flows of nutrient-enriched water support the growth of water hyacinth, which requires ongoing management by the City. Downstream of the railway bridge, the river channel is canalised to its outlet into Table Bay, and is referred to as the Salt River canal.

Rivers draining into the sub-catchment from the west form part of the catchment area of the Liesbeek River, which flows into the Black River in the downstream reaches of the Lower Salt sub-catchment. These rivers drain the eastern slopes of Table Mountain. Their upper reaches lie within the Table Mountain National Park, where they flow as mountain streams first through relatively unimpacted fynbos in the areas above former forestry plantations, Kirstenbosch Botanical Gardens and high-lying affluent suburbs on the lower mountain slopes. With distance downstream into densely urbanised areas such as Newlands, Claremont and Rondebosch, most of the rivers are canalised or in some cases piped. An active Friends Group (Friends of the Liesbeek River) partners with the City in alien plant and litter clearing along the Liesbeek River.

The Borchard's Quarry WWTW and Athlone WWTW (see **Photo 8.4.2**) are both located in the Lower Salt sub-catchment. The former discharges treated effluent into the Jakkalsvlei Canal flowing immediately north of and along the N2, through the southern edge of Langa, before joining with the Vygekraal River opposite the Athlone WWTW, and passing under the N2. Treated effluent from the Athlone WWTW is discharged into the Vygekraal River, which is then known as the Black River. Sludge is also disposed of at times into the Cape Flats WWTW via the Cape Flats main sewers.

Apart from being exposed to inflows of treated effluent, the Black River is also subject to high levels of solid waste as well as inflows of raw sewage from adjacent, inadequately serviced settlements, and periodic inflows of untreated sewage from the Borchard's Quarry WWTW (Mr J. Terblanche, CSRM, pers. comm. to Liz Day).



**Photo 8.4.1**  
**The canalised Black River upstream of the N2,  
through Keurboom Park**



**Photo 8.4.2**  
**November 2024 Google Earth image of Langa informal  
settlement, showing shack dwellings abutting and overhanging  
the Jakkalsvlei Canal**

## 8.4.2 Major sources of pollution

The main sources of water pollution within the Lower Salt Sub-catchment include:

- Poorly treated effluent from the under-performing Athlone WWTW (discharging into the Vygekraal River, just upstream of its confluence with the Black River) – this is one of the largest WWTWs in Cape Town in terms of discharge volume, and one of its worst-performing in the 2024 reporting period, with 1% E. coli compliance; median annual total ammoniacal nitrogen at > 20 mg/L (> 10 times the general Limit); median COD (192 mg/L) seriously above the General Limit of 75 mg/L; and median orthophosphate concentrations at least 30 times higher than the hypertrophic threshold;
- Inflows of raw sewage from adjacent, inadequately serviced settlements (e.g. Langa informal settlement (Photo 8.4.2);
- Periodic inflows of untreated sewage from the (generally better performing) Borchard's Quarry WWTW (see Section 5.2.1);
- Compliance challenges over the 2024 reporting period included sludge wasting and disposal problems at the Athlone WWTW; inlet works capacity problems and a lack of screening at the Borchard's Quarry WWTW, as well as no backup generators being present at this plant currently (Moodley 2024);
- Sewer spills into watercourses, resulting from blockages (typically caused by high levels of uncollected solid waste entering stormwater and sewerage infrastructure; and/or sewer pump station failures (often related to load-shedding) (Section 5.2.3); as well as leakages from an ageing sewerage network in many parts of the sub-catchment (Section 5.2.3 and 5.2.4). Some of the areas with the highest frequency and severity of sewage overflows in the City are located in the Lower Salt Sub-catchment, which was ranked the third worst performing catchment in Cape Town, with regard to compliance with General Limits for E. coli compliance (Section 5.1.4)];
- Inflows of solid waste from parts of the catchment exposed to serious levels of dumping adjacent to and within watercourses, with the Jakkalsvlei, Vygieskraal and Kalksteen Canals being particularly exposed to dumping;
- Runoff of contaminants from the limited industrial areas in the sub-catchment, mainly around Epping, Ndabeni and Maitland, and from numerous roads through the highly urbanised sub-catchment; and
- Runoff of nutrient-enriched water from fertilised lawns and extensive gardens (including Kirstenbosch Botanical Garden) in the more affluent suburbs into the Liesbeek River portion of the sub-catchment –



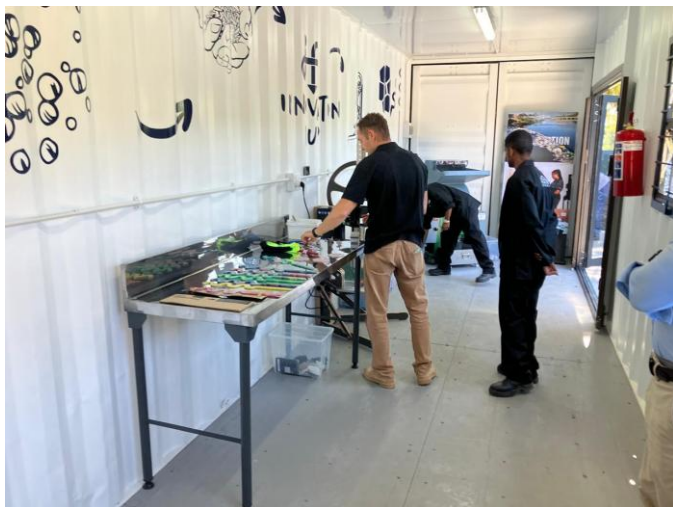
these inputs are low compared with the highly contaminated inflows into other tributaries of the Black River, but may have a more significant ecological impact, in moving ecological ecosystems from mesotrophic to eutrophic or even (lower) hypertrophic conditions, but would similarly also be more readily reversible with minor interventions, than more impacted parts of the catchment.



**Photo 8.4.1**  
**Informal housing built right over the edge of the Jakkalsvlei Canal, along the N2 past Langa**



**Photo 8.4.2**  
**Accumulation of solid waste in the Bokmakierie Canal just upstream of the Black River confluence, despite City's attempts to reduce access for dumping with fences**



**Photo 8.4.3**  
**Recycling hub at The Litter Boom Project's base at Rondebosch Golf Course, on the Black River**

### **8.4.3 Water quality through the catchment – condition and trajectory**

**Figures 8.4.1 to 8.4.4** illustrate river and wetland condition with regard to orthophosphate, dissolved oxygen, un-ionised ammonia and *E. coli* concentrations in the Lower Salt sub-catchment for the 2024 reporting period, including trajectory compared with the 2023 reporting period.

These figures show that, for the Lower Salt sub-catchment:

- The Liesbeek River and Kromboom / Black River (upstream of the Athlone WWTW) Sub-catchments were in relatively good condition, with all monitoring sites lying within the Target range for median ammonia and dissolved oxygen concentrations in the 2024 reporting period, and with orthophosphate

concentrations within the Poor range, but with data probably reflecting the high LOQ for this variable rather than actual eutrophication. The catchment area does however include extensive landscaped gardens, and nutrient enrichment may be a problem in these reaches. This highlights the problem of the current high LOQ for orthophosphate, which does not allow tracking of nutrient concentrations at levels to inform decisions around where minor interventions in least-impacted systems might bring about measurable improvements in river condition;

- *Escherichia coli* data for the above watercourses showed that *E. coli* contamination increased with distance downstream in the Liesbeek, with median annual (2024) concentration in the lower Liesbeek being rated as Poor, but improved since the 2023 reporting period, potentially reflecting decreased to load shedding impacts. However, the Black (upstream of the WWTW) and Kromboom Rivers were both rated Unacceptable, with deterioration over the 2024 reporting period;
- Throughout the rest of the Lower Salt sub-catchment, water quality was severely compromised and in the Unacceptable range during the 2024 reporting period, for most of the mapped variables (orthophosphates, dissolved oxygen, un-ionised ammonia and *E. coli*) at all but one of the sample points (NR03, for unionised ammonia);
- *Escherichia coli* data indicated a deterioration in annual (geometric) mean concentrations in the 2024 reporting period, at all sites in this sub-catchment outside of the Liesbeek, and Black River upstream of the Athlone WWTW.

#### **8.4.4 Focus areas of the City's water quality interventions within the sub-catchment**

A TAP has been compiled for the Lower Salt Sub-catchment. It focuses on specific measures for the Salt, Black, Jakkalsvlei, Bonteheuwel, Kalksteenfontein and Bokmakierie Sub-catchments, and includes the following:

- Cleaning of the Jakkalsvlei and removal of solid waste at least weekly;
- Unspecified measures to reduce sewage spills into the canal (no measures are specified in the TAP but the PASAP suggests increasing provision of back-up generators and UPS systems for pump stations to reduce sewage overflow frequency as a result of load-shedding – Section 5.2.3 noted that load shedding impacted more heavily on the Salt Sub-catchment than on any other catchments in the City in the 2024 reporting period, suggesting that fewer pump stations had access to back-up generators in this sub-catchment than in other parts of Cape Town;
- Increasing community awareness and education around dumping of solid waste;
- Clearing of water hyacinth from the Black River;
- Pollution tracking in the lower black River;
- Installation of additional solid waste interceptors (The Litterboom Project already manages one litter boom in the Black River);
- Design and construct barrier structures at the cul-de-sacs along the Bokmakierie Canal adjacent to Jan Smuts Drive;
- Expansion of the River Warden programme to include the Bonteheuwel Canal and increased law enforcement in this area.

Although the above are critical intervention, the TAP lacks detail and measurable outcomes against which its success can be audited.

In addition to the above, the following other measures have been initiated by the City:

- Re-funding of the LUW Programme, including the planned Nantes Park Project along the Vygekraal River. The main aims of this project are not, however, to improve water quality *per se* but, rather, to improve/create wetland and instream aquatic habitat, and to increase amenity value. This is to be done through rehabilitation of the river corridor between Jakes Gerwel Drive and the Athlone WWTW, involving, amongst other interventions, naturalisation of channel embankments, repairing erosion,



removing sediments and invasive plants, planting indigenous vegetation and trees, installing new footpaths, seating, lighting and informational signage, replacing footbridges, and integrating the river corridor into the surrounding urban landscape as far as possible (Mc Donald 2024);

- Formation of catchment management forums for the Lower Salt, Vygieskraal and Jakkalsvlei Sub-catchments – these were formed in the first half of 2025;
- Investigations into the feasibility of covering up sections of the more polluted canals in the lower sub-catchment, including the Jakkalsvlei, Bonteheuevel and Kalksteenfontein Canals;
- Compilation of a stormwater master plan (not yet finalised) for the Lower Salt, which has identified the need for stormwater attenuation ponds in the lower catchment.

#### **8.4.5 Major intervention challenges**

The main challenges to implementing water pollution abatement measures in the Lower Salt sub-catchment include:

- Theft, vandalism and destruction of stormwater, sewage and sanitation infrastructure, which is a major problem in many parts of the Lower Salt sub-catchment;
- Hampering of more frequent collection of solid waste in certain areas within the sub-catchment that are hotspots for criminal activities, often linked to gangs, including the violent intimidation and extortion of City workers and contracted service providers;
- The failure of WWTW equipment and sewage pumps at pump stations throughout the sub-catchment, typically related to load-shedding and electrical faults;
- Fragmented management, with three City Stormwater Planning Regions having jurisdiction over the sub-catchment, which severely hampers the implementation of strategic interventions and possibly results in economically inefficient duplication of efforts in relation to certain water pollution control activities;
- the need for involvement by City multiple departments from the City in the implementation of pollution control measures, including the Environmental Management Department, Recreation and Parks Department, Waste Services Department, and the Water and Sanitation Department, amongst others, with the Water and Sanitation Department itself including separate Branches for CSRM, Reticulation, Wastewater Treatment Works, and Scientific Services.

#### **8.4.6 Recommendations going forward**

The measures outlined in the TAP form a useful starting point for addressing major pollution in this sub-catchment. However, the current TAP (currently being updated) lacks detail or auditable outcomes, and does not assign responsibility, or timelines to specific City entities for its implementation. It is recommended that these issues are addressed in the updated TAP, which should also indicate cost implications of pollution abatement measures.

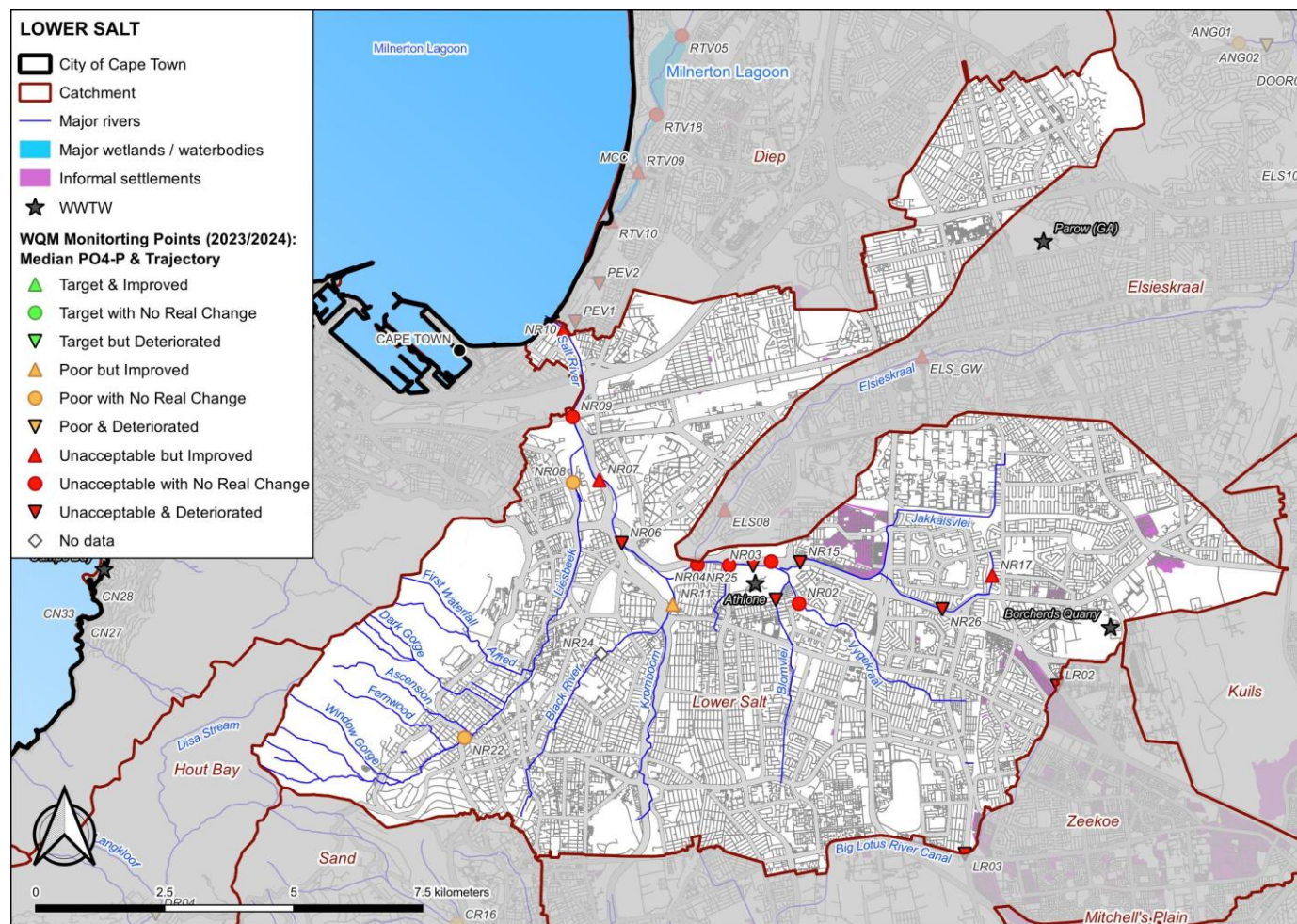
Like many of the City's sub-catchments, the Lower Salt is managed by multiple CSRM regional managers. As stated elsewhere in this report, it is recommended that consideration should be given to the rationalisation of the management system into one that is catchment-based, to facilitate more holistic management and responsibility within City structures. In the interim, it is recommended that procedures and communication channels should be formulated to ensure more effective coordination between the various management structures that have jurisdiction over matters that affect the water quality of watercourses in the Lower Salt sub-catchment.

Support of the newly formed catchment fora in this sub-catchment is important, and could be a valuable tool for facilitating communications and assigning task-driven responsibilities and timelines to different City Directorates, departments and branches, as well as in the formation of Public-Private partnerships to assist in management of waste and the introduction of meaningful recycling initiatives.

As noted in previous reports, the sub-catchment includes some river reaches that are less polluted, and water quality in these should be protected – these rivers include the Liesbeek River and its tributaries; the Black River

(Upstream of the Athlone WWTW, and the Kromboom River. Opportunities should be actively sought to implement SUDS treatment interventions in these parts of the catchment, designed for water quality polishing and removal of low pollution loads. These rivers should respond well to such interventions because the main present-day water quality issues are related primarily to real stormwater-driven urban runoff only, and not to the mix of sewage and stormwater that affects watercourses in many other parts of Cape Town. The pursuit of such interventions would at least facilitate the maintenance relatively good water quality in this portion of the sub-catchment. Focus areas for such measures should be reaches showing signs of water quality degradation. The Inland Water Quality Dashboard should be used by CSRM regional managers in these areas to highlight changes in water quality indicative of pollution, and to initiate pollution tracking to identify pollution sources, before pollution becomes entrenched.

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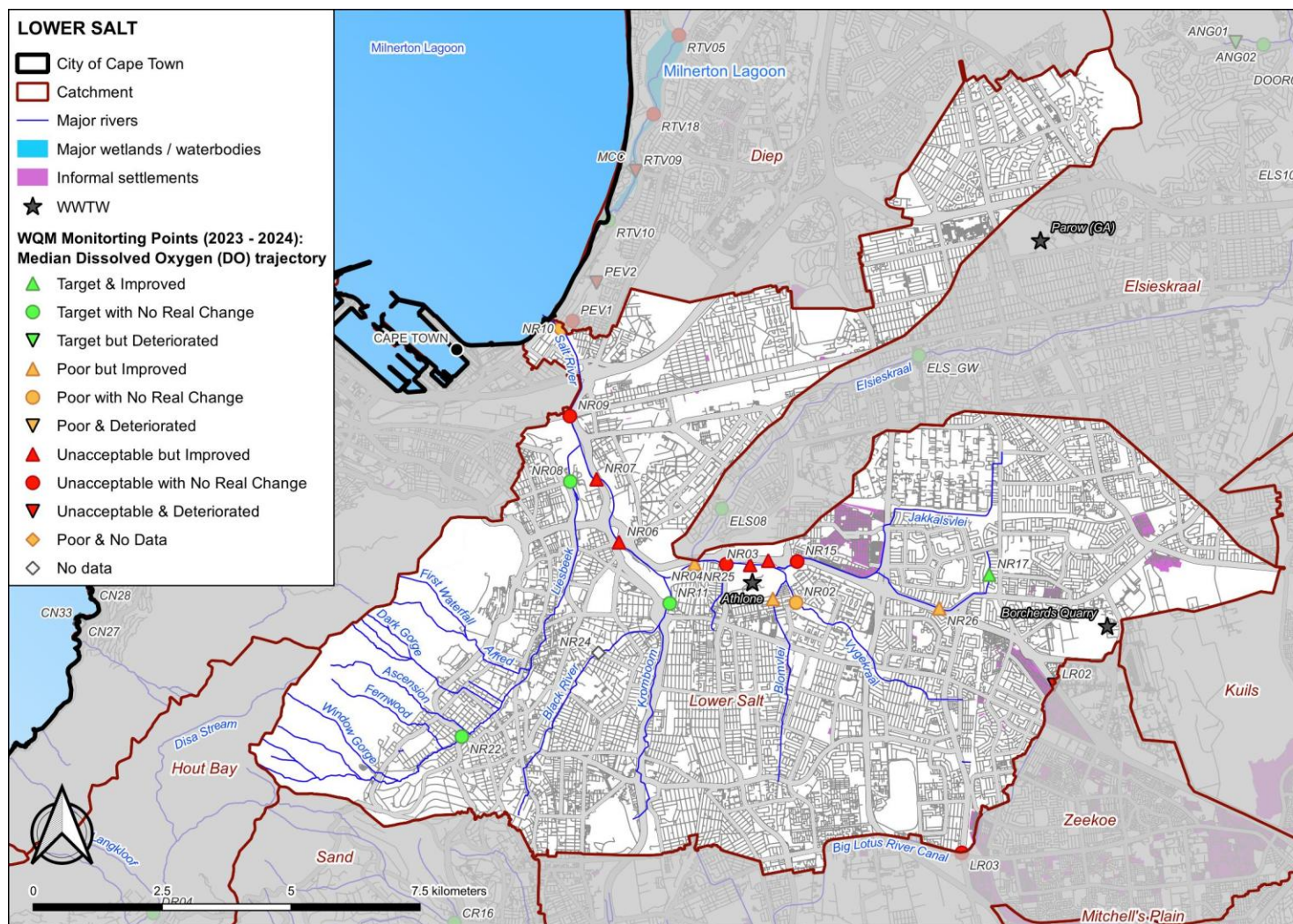
**Figure 8.4.1**

Median annual orthophosphate phosphorus (PO<sub>4</sub>-P) data, focusing on the Lower Salt sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period.

Trajectory calculations explained in Section 3.11.14



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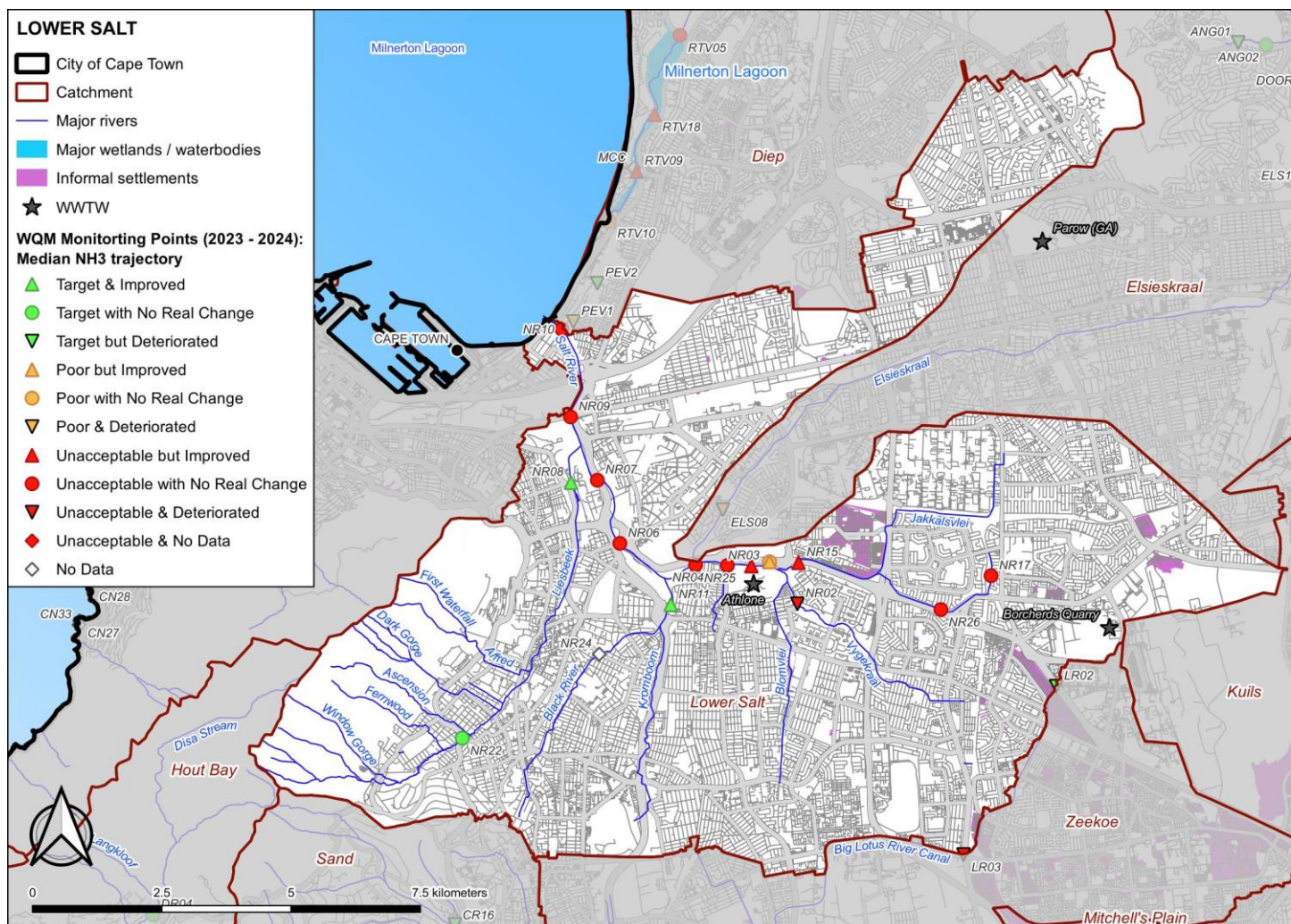


**Figure 8.4.2**

Median annual dissolved oxygen (DO) data, focusing on the LOWER SALT Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14



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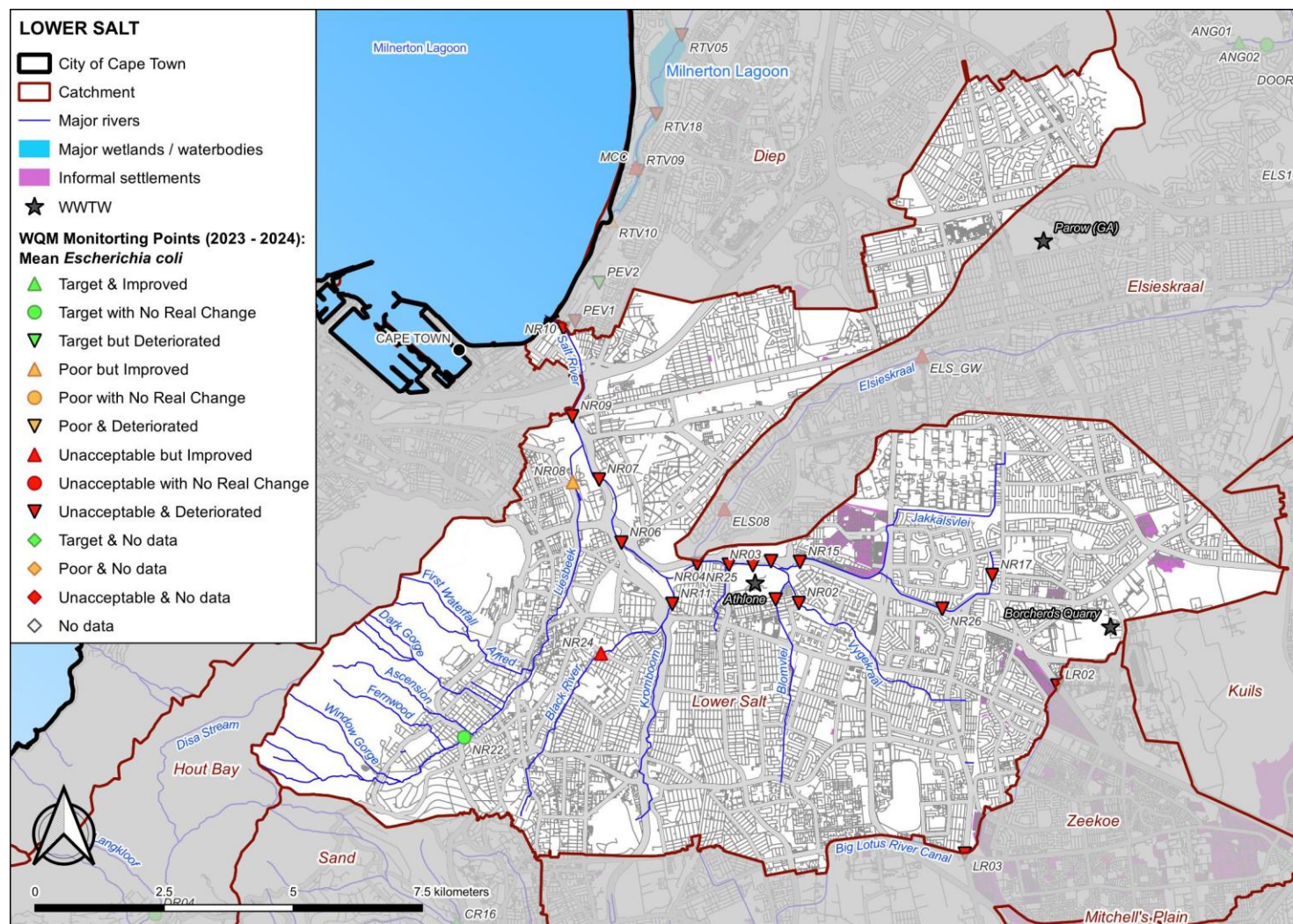


**Figure 8.4.3**

**Median annual free ammonia (NH3) data, focusing on the LOWER SALT Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14**



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**Figure 8.4.4**

Mean *E.coli* data (geometric means), focusing on the LOWER SALT Sub-catchment.

Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14

## 8.5 Kuils / Eerste River

### 8.5.1 Catchment overview

This large priority catchment includes the Kuils River sub-catchment and the lower Eerste River Sub-catchment. Most of the Kuils River and its tributaries lie within the City boundary, while most of the Eerste sub-catchment lies in the Stellenbosch Municipal area, only entering the City boundary in its lower reaches just downstream of Faure Road. Four City municipal WWTWs are in operation in the catchment, which also receives runoff from the Stellenbosch WWTW and various industries and informal settlements in the Stellenbosch Municipal area upstream. Of the City's WWTWs, the Zandvliet works has recently undergone a major upgrade, to increase treatment capacity and improve effluent quality. The upgrade was completed in the 2023 reporting period, and Section 5.2.2 indicates that, since its upgrade, the WWTW has been producing final effluent of a good quality and almost always within General Limits. The Macassar WWTW was generally poorly performing, producing high loads of effluent with median annual COD and total ammoniacal nitrogen loads well above General Limits (Section 5.2.2).

Land use in the Kuils sub-catchment is primarily urban, and includes major industrial and commercial areas such as Bellville CBD, Brackenfell, Stikland and Kuilsrivier, likely to reflect in stormwater quality typical of these land uses. An exception is the north-eastern portion of the sub-catchment in the vicinity of the Scottsdene WWTW, which includes some agricultural land use (mainly wine estates) and more open spaces including golf courses. With distance south through the sub-catchment, land use moves to primarily residential, with high density, low-cost housing predominating downstream of the Stellenbosch Arterial Road (M12).

The Driftsands Nature Reserve is located in the largely built-up southern portion of the sub-catchment, but this now de-proclaimed Nature Reserve has been subject to significant land invasion and encroachment of informal settlement into the area (e.g. see **Photo 8.5.1**). These invasions have resulted in the loss of important, previously protected wetlands. In nearby City-owned land in Khayelitsha, similar land invasions have resulted in marked expansion of informal and unserviced areas into wetlands (e.g. see **Photo 8.5.2**), and this plus the extensive growths of water hyacinth in the river have resulted in the cessation of canoeing by the Canoe Club and a switch in focus of its activities to education and the manufacture of biochar from water hyacinth.



**Photo 8.5.1**

**Land invasion and encroachment of informal settlement into the Driftsands Nature Reserve**



**Photo 8.5.2**

**Encroachment of informal settlement into wetlands in Khayelitsha, just west of Baden Powell Drive**

In the relatively small portion of the Eerste River sub-catchment that falls within the City boundary, the dominant land uses in the northern half of the sub-catchment (to the north of Old Faure Rd) are high-density housing (to the east of the R102, Voortrekker Rd) and agriculture (to the west of the R102). To the south, the land-use is predominantly rural to semi-rural, with the exception of the urbanised areas of Macassar and Croydon. The Eerste River floodplain extends over much of this area, with some homes and other buildings located within the 1:100 year flood line and prone to flooding (**Photo 8.5.3**). These floodplains include floodplain wetlands, which are important remnant habitats, and representative of a wetland habitat type



(floodplain wetlands) that is rapidly disappearing within Cape Town, with land invasion a primary cause of its loss (Day 2024). The floodplains themselves perform important ecosystem services.



**Photo 8.5.3**  
**Remnant floodplain wetlands on the Eerste River floodplain**



**Photo 8.5.4**  
**Flooding of the Eerste River floodplain in 2024 (Macassar area)**  
Photo: J. Rose

The Macassar WWTW is located at the lower end of the sub-catchment, just upstream of the Eerste River estuary.

### **8.5.2 Major sources of pollution**

The main sources of water pollution within the Eerste/Kuils catchment within the City's boundaries include:

- Inflows of polluted water in the upper Kuils catchment, from the Blokedoms and Wallacedene informal settlements (Mr. J. Terblanche, CSRM, pers. comm to Liz Day);
- Raw sewage inflows in the upper reaches of the catchment, largely as a result of blockages, predominantly rags (Mr. G. Muller, CSRM, pers. comm to Liz Day);
- Raw sewage inflows as a result of frequent failures at the Serepta 1,2 and Nooiensfontein pump stations, passed into the Kuils River via the stormwater culvert at Rietvlei Road - the Rietvlei stormwater culvert also passes final effluent from the Bellville WWTW and unidentified polluted stormwater flows from within the Sacks Circle area into the Kuils River. Smith (2025b) described these inflows as chronic, since at least February 2024, and "causing a catastrophic impact to the Kuils River [downstream] and significant risks to the health and wellbeing of residents and animal stock". Affected reaches include downstream to the Stellenbosch Arterial crossing and beyond (Smith 2025b);
- Frequent surcharging of manholes located in the Kuils River floodplain, often close to the river;
- Dumping of solid waste and sewer overflows in the vicinity of the Klein lei Canal;
- Input of inadequately treated sewage effluent from under-performing WWTWs, especially into the Kuils River, although this has improved significantly for the Lower Kuils River since the Zandvliet WWTW was upgraded;
- Runoff and direct input of untreated sewage and highly polluted grey water from informal settlements and areas with high levels of backyard dwelling into stormwater systems, and from there either directly or indirectly into rivers and wetlands – these continue to expand within the Kuils River floodplain, and many



of these discharge through isolated areas, where their visibility is low;

- Stormwater runoff from commercial and industrial areas within the catchment, and from roads and built-up urban areas; and
- Pollution inputs into river and wetland systems from the remnant agricultural areas (mainly livestock) within the catchment, mainly in the form of nutrients (orthophosphates and nitrates);
- Inflows of night soil (informal settlements) and leachate from septic tanks (Sandvlei and Kramat areas of the lower Kuils / Eerste River).



**Photo 8.5.5**  
**An overflowing sewer manhole near Mfuleni in the Kuils sub-catchment**



**Photo 8.5.6**  
**Accumulation of litter in a major stormwater drain within the Kuils sub-catchment**

### **8.5.3 Water quality through the catchment – condition and trajectory**

**Figures 8.5.1-8.5.4** present summary water quality data for orthophosphate (as PO<sub>4</sub>-P), dissolved oxygen, free ammonia (NH<sub>3</sub>) and *E. coli* for the 2023 and 2024 reporting periods, with present condition and trajectory of change analyses undertaken as outlined in **Sections 3.11.14** of this report.

These figures show that, for the Kuils and Eerste sub-catchments:

- Median annual orthophosphate concentrations at all sampling sites throughout both the Kuils and Eerste sub-catchments within the City's boundaries lay in the Unacceptable category (representative of hypertrophic conditions) in the 2024 reporting period, reflecting similar trends previously reported for each reporting period since 2015 (Day et al. 2020, 2023 and 2024a). These data highlight the influence of WWTW effluent on river water quality, even when treated to General Limits (as discussed in **Section 5.2.2.4**);
- Slight improvements within the hypertrophic range were however noted in the lower Bottelary River, compared with the 2023 reporting period. This system receives treated effluent from the Scottsdene WWTW and runoff from parts of the under-serviced Wallacedene / Bloekombos areas, a small portion of which falls into the northern part of the Kuils sub-catchment;
- High levels of orthophosphate enrichment occurred even at the Kuils River main-stem monitoring point EK19, located upstream of both the Bellville WWTW and inflows from the Bottelary River, suggesting other polluted inflows, including from suburban gardens (fertilisers etc) and from problem sewage pump stations (e.g. Serepta 1 and 2 pump stations) and from the SACKS Circle area (Mr G. Muller, pers. comm. to Liz Day);
- The lower Eerste River (EK05) showed a deterioration over the past reporting period;

- Median DO concentrations for the 2024 reporting period were in the Target range at only four of the 13 sites monitored, with two of these being in the Eerste River upstream of the Kuils River confluence and one in the Moddergatspruit. The only Kuils River monitoring point where these data fell within the Target Range was EK04, upstream of the Bellville WWTW;
- All sites downstream of the Bellville WWTW inflows were in the Unacceptable or Poor range, with EK05 and EK09 both showing deterioration compared with the previous reporting period, and the data suggesting that it is the lower Kuils River that drives poor DO concentrations in the lower Eerste River. EK05 is located in the canal upstream of Stellenbosch Arterial. The river in these reaches is prone to overflows from the sewer mains that runs parallel to the river through Nooiensfonteinville wetlands (pers. obs.), resulting in slow-flowing organically enriched water in these lowland river reaches.
- EK08 was in the Unacceptable range, reflecting poor water quality in the polluted river water at the Baden Powell crossing, where extensive informal settlements discharge or pass their domestic waste into the river. An improvement in DO concentrations downstream (to Poor) is assumed to reflect dilution by better-treated sewage effluent from the upgraded Zandvliet WWTW as well as downstream natural pollution assimilation with distance downstream;
- Median un-ionised ammonia concentrations suggest that the upstream catchment of the Kuils River was unlikely to have been significantly impacted by ammonia toxicity during the 2024 reporting period, with monitoring points upstream of the Bellville WWTW in the Kuils River main stem within the Target range for  $\text{NH}_3$ ;
- A similar situation, with median ammonia concentrations in the Target range for Reporting Year 2023 (suggesting a low risk of ammonia toxicity), were recorded in the Eerste River (at sampling point EK13, just upstream of the Kuils River confluence) and the Moddergatspruit (at EK18, just upstream of the Eerste River confluence);
- Threats to aquatic ecosystems posed by ammonia toxicity increased markedly in the Kuils River downstream of the Bellville WWTW inflow, with median concentrations for all sites in the Kuils River in the Unacceptable range in the 2024 reporting period, and reflecting both inflows from the Bellville WWTW (Section 5.2.2.4 shows that median annual concentration of total ammoniacal nitrogen from this WWTW was > 20 times the General Limit for this variable, associated with extremely high loadings into a naturally seasonal river) as well as loading from unserviced informal settlements abutting the river between the N2 and Baden Powell Drive (EK08);
- Deterioration in ammonia concentrations in the Kleinvele Canal (EK15) into the Eerste River were also shown in the data, reflecting high levels of pollution in this visible contaminated system;
- Median annual ammonia concentrations were all in the Unacceptable range (i.e. associated with acute toxicity to aquatic ecosystems) in the Eerste River downstream as far as the estuary – these data must be viewed with concern as they indicate a toxic ecosystem that would be unlikely to support fish, frogs and desirable aquatic invertebrate fauna, despite the fact that these river reaches are generally in moderately to good geomorphological condition. Water quality is thus a major impediment to river or estuarine ecosystem rehabilitation.
- With regard to mean *E. coli* concentrations, only sites in the lower Eerste and Moddergatspruit Rivers upstream of the Kuils River confluence were within the Target range for this variable, and indicative of systems with relatively infrequent and low exposure to *E. coli*, at least in these reaches;
- EK19, on the Kuils River upstream of both the Bellville WWTW and the Bottelary River had mean *E. coli* concentrations in the Poor range, indicative (as already discussed) of chronic or episodic sources of pollution in the upper reaches of the catchment, as suggested in conversation with Mr G. Muller (Regional Stormwater Manager – Eastern Region);
- All other sites on the Kuils River and in the Eerste River downstream of the Kuils River confluence showed mean annual *E. coli* concentrations in the Unacceptable range, and with deterioration compared with the previous (2023) reporting period, indicative of a significant (> 25%) increase in *E. coli* concentrations in this part of the catchment, and reflecting a deterioration in effluent quality at the Bellville WWTW (< 35% compliance in the 2024 reporting period (Section 5.2.2.4) as well as increased

informal settlement along the Kuils River between the N2 and Baden Powell Drive in particular. Focus areas of the City's water quality interventions within the sub-catchments.

#### **8.5.4 Focus areas of the City's water quality interventions within the sub-catchment**

As outlined during discussions with the City's Eastern Region CSRM stormwater management team, the following interventions are planned or in progress for the Kuils/Eerste Catchment in particular:

- Investigation (via the City's Water Pollution Control Unit) of chronic (i.e. ongoing) pollution sources into the Kuils River via the Rietfontein stormwater channel;
- Installation (and management) of a litter trap / fence in the Kleinvlei Canal in the vicinity of the Cape Town Film Studio site;
- Increasing education and community awareness in the catchment, and particularly in the sub-catchment of the Kleinvlei Canal, along which there is significant dumping of solid waste;
- Installation of bollards to reduce vehicle access to the Kleinvlei Canal;
- Extension of the sewer network to include the Kramat and Sandvlei areas and link them to the Zandvlei WWTW (long term plan);
- A service delivery turn-around programme (Van Geer 2021a) and interim solutions for sewer overflows (Van Geer 2021b) were drafted and were initially implemented for the under-served Wallacedene / Bloekombos areas, a small portion of which falls into the northern part of the Kuils sub-catchment (the greater proportion of Wallacedene / Bloekombos falls within the Mosselbank sub-catchment). This programme was however halted, and efforts to re-instate it have not yet realised (Mr Terblanche, CSRM's Northern Region stormwater manager);
- Formation and development of a Catchment Management Forum (the Eerste- Kuils River Catchment Management Forum was established in May 2025).

Although the above measures will be positive interventions, that could impact on water quality trends going forwards, over the reporting period under consideration here (2023 and 2024 reporting periods), there were very few direct interventions by the City to address water quality in these large, socially and economically complex sub-catchments.

No PASAPs have however been compiled to address the Kuils / Eerste sub-Catchments, and Smith (2025b) comments that: *"The Mitigation Action Plan/Pollution Abatement Plan submitted [by the City] does not provide any substantial evidence that the Water and Sanitation Directorate is investigating or taking responsible measures and actions to ensure that the required compliance is achieved, and how to avoid the ongoing reoccurrence of similar incidents"*.

#### **8.5.5 Major intervention challenges**

The greatest challenge to interventions by CSRM to address pollution in the catchment is, as mentioned repeatedly in this report for other catchments, the fact that most pollution sources are associated with inflows of raw or poorly treated sewage and solid waste accumulations, rather than with stormwater *per se*. This means that the development of detailed, practical and auditable PASAPs and TAPs that address the issue of transverse responsibility across multiple City Directorates and Branches is critical. Again, as already noted, different budget and Key Performance Indicators between different Directorates can hinder the effective take-up of PASAPs, and the willingness of different officials to take on responsibility for specific activities.

In the case of the Kuils/Eerste Catchment, the PASAP and TAP have not yet been finalised. Smith (2025b) moreover notes that *"the CSRM's Mitigation Action Plan/Pollution Abatement Plan [to address the (2021) DEADP Directorate] does not provide any substantial evidence that the Water and Sanitation Directorate is investigating or taking responsible measures and actions to ensure that the required compliance is achieved, and how to avoid the ongoing reoccurrence of the similar incidents"*.

Other issues affecting implementation of planned interventions include:



- Budget cuts over the 2024 reporting period, affecting *inter alia* the service delivery turn-around programme (Van Geer 2021a) and interim solutions for sewer overflows (Van Geer 2021b), which were initially implemented and then suspended in the under-serviced Wallacedene / Bloekombos areas;
- High rates of land invasion and non-serviced informal settlement in many areas of the catchment (particularly the Kuils Sub-catchment). The City does not have the resources or budget to timeously provide sanitation and waste collection services to these areas, which are also often plagued by rampant criminal activity and intimidation or extortion of service providers;
- Fragmented jurisdiction over these sub-catchments. In the case of the Kuils sub-catchment, part of it falls within the Eastern Region of the City and another part within the Northern Region while the most northern portion of the sub-catchment falls outside of the City boundary, extending into the Stellenbosch Municipal Area. Although the Eerste sub-catchment is only under the jurisdiction of one City Stormwater Planning Region (the Eastern Region), most of this sub-catchment falls within the Stellenbosch Municipal Area, yet many of the impacts from upstream are experienced within the portion of the sub-catchment forming part of the City;
- Apparent lack of capacity for low-flow diversion of polluted stormwater into sewers for treatment at WWTWs – this statement is informed by the
- With regard to specific parts of the sub-catchments:
  - The (highly problematic) Serepta 2 sewer pump station is designed to have four pumps but is frequently blocked by rags and at times operates on one pump, making it vulnerable to failure);
  - During manual cleaning of the Serepta 2 sewer pump station screens, a lot of debris material flows into the wet well and pumps (Smith 2025b);
  - The stormwater systems entering the problematic Rietvlei stormwater channel are piped / in covered culverts, making identification of pollution point-source inflows difficult;
  - Solid waste dumping and accumulation alongside and within canals and channels is extensive in parts of the catchment (e.g. Kleinvlei Canal);
  - There is considerable pressure from local residents in the lower sub-catchment for infilling of floodplains and/or berming the river channels to prevent them overtopping into the floodplain.

### **8.5.6 Recommendations going forward**

Important recommendations for implementation in this priority catchment area include:

- PASAPs and TAPs should be finalized for these sub-catchments as a matter of urgency. These should include realistic targets with measurable and auditable outcomes, assignment of responsibility for implementation and timeframes that convey the necessary sense of urgency for their implementation.

The following measures, amongst others, should be considered for inclusion in the PASAPs:

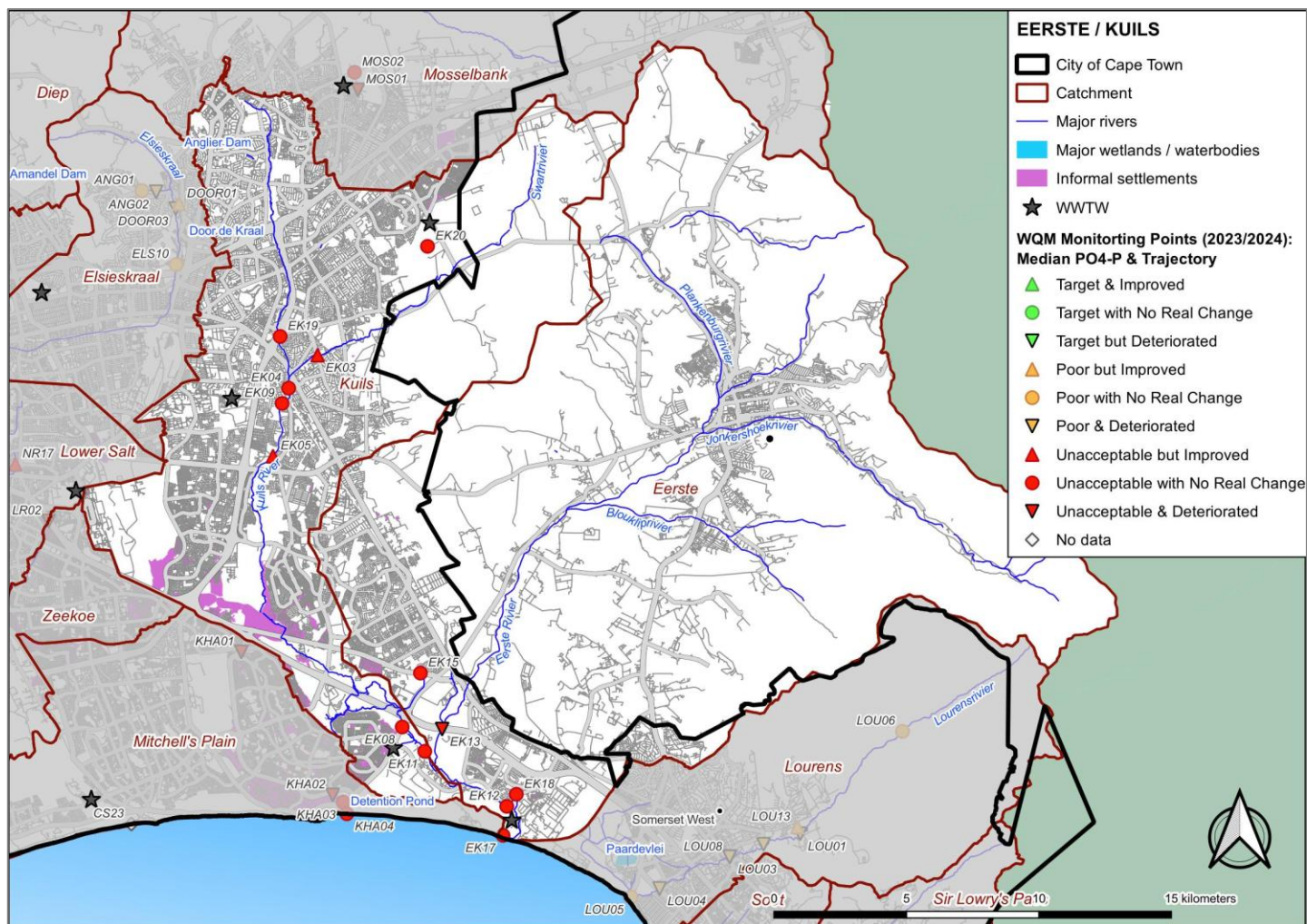
- A sustained and measurable increase in solid waste collection, in terms of both the frequency and volume of solid waste removal at source, to prevent the build-up of organic, plastic and other waste in the sub-catchments – this is supported by the CSRM's planned introduction of a waste interceptor in the Kleinvlei Canal);
- Pollution-tracking within new and existing high-density housing areas to identify pollution streams and sources (e.g. to discern between pollution stemming from non-serviced backyard or informal housing elements, versus that caused by blocked or vandalised infrastructure);
- Pollution tracking up the closed stormwater system feeding into the Rietvlei Canal – since chronic flows are suspected in this area, this can be achieved effectively during dry weather conditions by the systematic opening up of manhole covers from the Rietvlei channel upstream, and tracking upstream to follow liquid flows in the system upstream, their source(s).
- Implementation of appropriate measures to address the sources of pollution identified – where these



are raw sewage, their diversion to sewers must be considered, at points close to source to prevent dilution by stormwater flows;

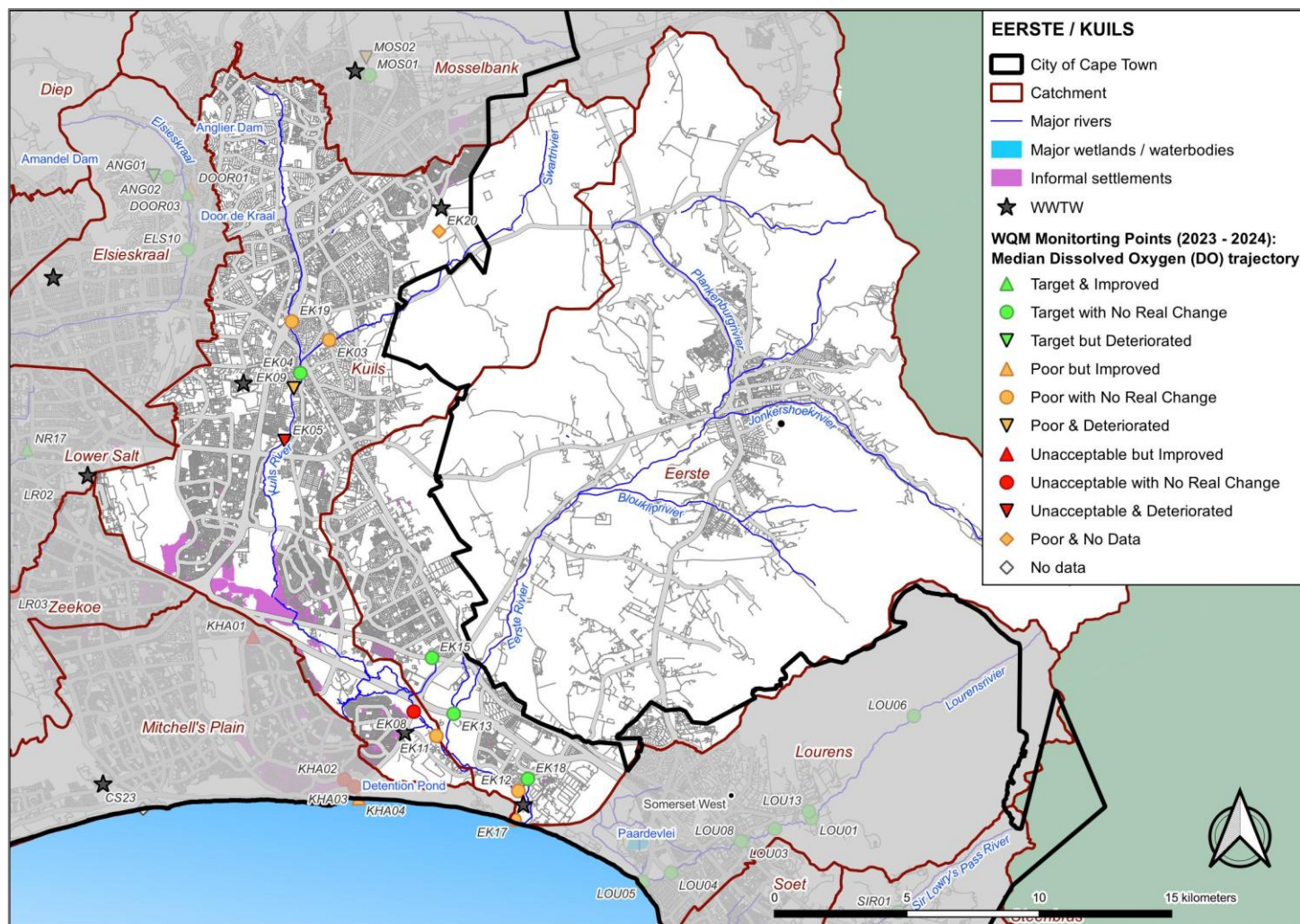
- Independent *in situ* inspections and assessment of water in the Rietvlei Channel and at the Bellville WWTW effluent outlet to identify compliance issues;
- Urgent implementation of interventions to provide sewage and stormwater servicing to the rapidly expanding informal and backyard settlements in the area;
- Implementation of measures to minimise sewage pump station failures related to load-shedding and electrical faults, including:
  - Attention to provision of the full complement of pump station pumps and spares required for all pump stations, but with particular attention paid to the Sarepta 2 pump station;
  - Re-design of pump station screening systems, to allow for frequent maintenance without causing downstream blockages;
- Attention to the management and (where necessary) refurbishment or upgrading of existing WWTWs, to address existing poor levels of compliance;
- Implementation of the recommendations made by Smith (2025b) to address risks to the City of litigation or enforcement action by Provincial and National authorities as a result of sustained pollution of the Kuils River.

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**Figure 8.5.1**  
Median annual orthophosphate phosphorus (PO<sub>4</sub>-P) data, focusing on the KUILS and EERSTE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14

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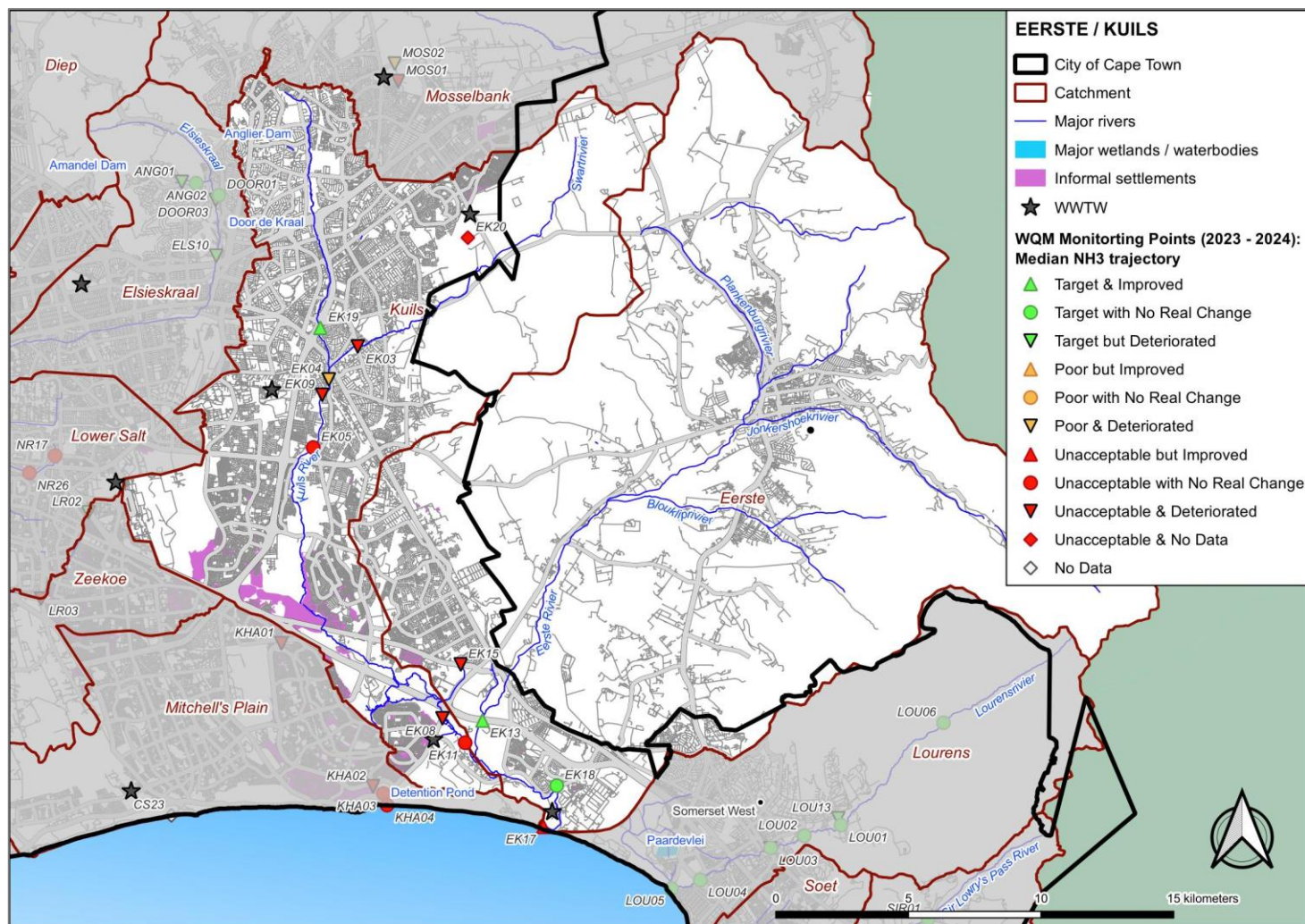


**Figure 8.5.2**

Median annual dissolved oxygen (DO) data, focusing on the KUILS and EERSTE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14



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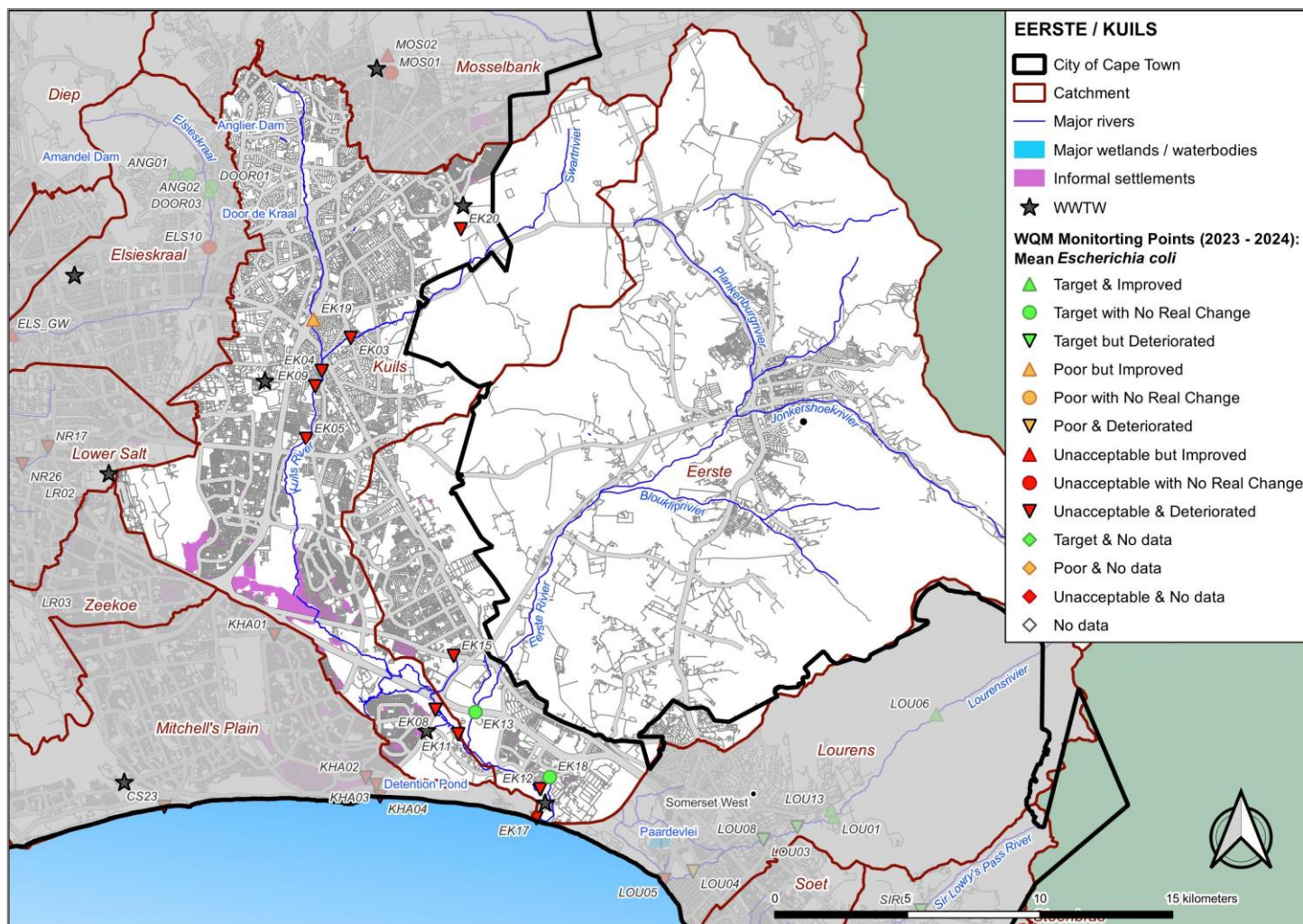


**Figure 8.5.3**

Median annual free ammonia (NH<sub>3</sub>) data, focusing on the KUILS and EERSTE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14



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**Figure 8.5.4**

Mean *E.coli* data (geometric means) data, focusing on the KUILS and EERSTE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14

## 8.6 Hout Bay River

### 8.6.1 <sup>18</sup>Catchment overview

The Hout Bay River catchment is a relatively small catchment (approximately 40 km<sup>2</sup> in areal extent), with the entire upper catchment located within the Table Mountain National Park consisting mostly of natural areas. The middle to lower portion of the catchment is, however, dominated by urban, peri-urban, and commercial land-uses, occupying approximately 20% of the catchment area. There is a relatively large (especially in relation to the catchment size) informal settlement known as Imizamo Yethu in the lower reaches of the catchment. A number of dams in the upper catchment (see **Box 8.6.1**) have significantly affected the flows of the Hout Bay River.

The Disa and the Original Disa tributaries originate on Table Mountain at an altitude of 720 m AMSL. These streams join to form the Hout Bay River in the access-controlled Orange Kloof section of the Table Mountain National Park, which contains a relatively large, intact area of Afromontane forest. The Hout Bay River is approximately 12 km long, with steep and fast-flowing, naturally acidic waters in the more natural upper to middle reaches. The river meanders through farmlands and residential areas in the lower reaches, where extensive reed beds flank the river channel, before it widens into a small lagoon which discharges into the sea on Hout Bay beach.

The name “Hout Bay” refers to the abundance of indigenous trees that once occurred in the middle to upper catchment (“hout” is the Afrikaans word for wood). The lower reaches of the Hout Bay River originally consisted of a naturally braided channel flowing through an extensive palmiet (*Prionium serratum*) and reed wetland area. Large-scale harvesting of the indigenous forest in the upper catchment and removal of palmiet and other reedbeds in the naturally wide floodplain further downstream (Grindley 1988) resulted in severe erosion along the middle and lower reaches of the Hout Bay River, which was addressed by the construction of the rather extensive concrete Longkloof weir that had its own negative impacts on the ecological functioning of the downstream reaches of the river.

Other impacts in the middle to lower reaches of the Hout Bay River include channel straightening, dredging of sediments from the channel and construction of levees to prevent flooding of riverside properties. There is also extensive encroachment of invasive alien vegetation along the riverbanks and (especially reeds such as *Arundo donax* (Spanish reed)) on mid-channel sand bars that have formed as a result of the deposition of eroded sediment, which often causes further bank erosion through the deflection of flows (e.g. see **Photo 8.6.1**).

There are no WWTWs that discharge wastewater into rivers in the Hout Bay catchment, because primary treated wastewater from the area is released into Hout Bay via a deep-sea outfall. There are, however, sewage pipelines in the catchment, as well as septic tanks and the (largely unserved) informal settlement of Imizamo Yethu, which cause sewage-related pollution problems and the proliferation of algae, reeds and other alien instream vegetation in the middle to lower reaches of the Hout Bay River (e.g. see **Photo 8.6.2**).

There are three main stormwater to sewer diversions from the Imizamo Yethu area, and a few minor ones. These comprise mainly greywater and night soil. However (Mr G. Martin, CSRM, Southern Region, pers.

<sup>18</sup> Most of this contextual information is taken from the State-of-Rivers Report prepared by the River Health Programme (RHP 2003), with updates where relevant based on more recent consulting and other reports

#### **Box 8.6.1** **Dams in the upper Hout Bay catchment**

The Hout Bay River was an important water resource for Cape Town over 100 years ago, with some of the earliest domestic water supply dams for the City having been constructed in the upper reaches of the catchment (on top of Table Mountain). There are five in-stream dams, namely:

- **Woodhead Dam** (built in 1897) and **Hely-Hutchinson Dam** (built in 1904) on the Disa tributary; and
- **Alexandra and Victoria Dams** (built in 1903), and **De Villiers Dam** (built in 1907) on the Original Disa tributary.

The total storage volume of the five dams is approximately 2.5 Mm<sup>3</sup>, representing 24% of naturalised MAR of the catchment (RHP, 2003). Water from the dams is led via a tunnel through the Twelve Apostles to Kloof Nek. These dams now supply < 15% of Cape Town’s water requirements.



comm. to Liz Day):

- There is insufficient capacity in the sewer for these, and surcharges into the Hout Bay River are common;
- The diversions are bypassed in winter;
- They require major maintenance, as a result of solid waste blockages (daily to weekly cleansing)
- The pump stations are designed for the current sewage capacity (i.e. excluding large areas of Imizamo Yethu and its grey water and night soils).



**Photo 8.6.1**

**Bank erosion along the middle reaches of the Hout Bay River caused by stabilization of a sandbar (from alien vegetation and debris) resulting in deflection of flows towards the bank**



**Photo 8.6.2**

**Visibly polluted lower reaches of the Hout Bay River at the Victoria Road bridge crossing, where there is a proliferation of algal growth and invasive instream vegetation**

[Image from Petersen *et al.* (2022)]

## **8.6.2 Major sources of pollution**

While the causes of pollution to the Hout Bay River system are complex and often interlinked, the primary pollution types within the catchment have been categorised in the Hout Bay Catchment Pollution Abatement Comprehensive Study (Lukhozi 2023) as comprising raw sewage spillages; grey water; solid waste; and sediment.

The Hout Bay PASAP of Martin (2024) ascribes the main sources of such pollution to:

- Smallholdings and horses in the middle reaches of the Hout Bay River;
- Sewage overflows from blocked pipes and pump station failures, mainly in the middle to lower reaches of the catchment (e.g. see **Photo 8.6.3**), as well as from surcharging sewers as a result of low-flow stormwater diversions;
- Input and runoff of sewage-contaminated water into the stormwater system from the largely informal Imizamo Yethu settlement, which flows into the lower reaches of the Hout Bay River, as well as from the Hangberg area where a large portion of the formal housing is associated with backyard dwellings.

Although it is not a direct source of water pollution, the accumulation of litter in the Hangberg and especially Imizamo Yethu settlements is a major problem that often leads to the blockage of sewerage and stormwater infrastructure (e.g. **Photo 8.6.4**), which in turn results in sewage overflows into watercourses. This problem is exacerbated by solid waste collection challenges, particularly in Imizamo Yethu. Another issue highlighted by the Comprehensive Study of Lukhozi (2023) is the runoff of sediment from the Imizamo Yethu informal settlement and other parts of the catchment, which results in blockages of sewerage and stormwater infrastructure as well sedimentation of the river channel.



**Photo 8.6.3**  
**An overflowing sewer manhole in Imizamo Yethu, caused by a blockage, running into a stormwater drain**  
[image from Lukhozi 2023]



**Photo 8.6.4**  
**Litter blocking a stormwater drain in Imizamo Yethu**  
[image from Lukhozi 2023]

### **8.6.3 Water quality through the catchment – condition and trajectory**

**Figures 8.6.1-8.6.4** present summary water quality data for orthophosphate (as PO<sub>4</sub>-P), dissolved oxygen, free ammonia (NH<sub>3</sub>) and *E. coli* for the 2023 and 2024 reporting periods, with present condition and trajectory of change analyses undertaken as outlined in **Section 3.11.14** of this report.

These figures show that, for the Hout Bay River and associated catchment:

- Water quality was generally better upstream of the more urbanised portion of the catchment (at sites DR04 and DR06) than it was at sites further downstream, with summary data for DO, NH<sub>3</sub> and *E. coli* all in the Target range and not deteriorating at the most upstream site (DR04) – compliance type data presented and discussed in Section 5.1.4 indicate however that:
  - The hitherto generally unimpacted upper reaches of the river (DR04 and DR06) were both subject to infrequent sewage inflows of a high magnitude (Level 2 Unacceptable) in the 2024 reporting period;
  - While DR01 and DR05 (at the estuary) remained highly contaminated and in the Unacceptable Range for over 90% of the time in the 2024 reporting period, the magnitude of contamination reduced (less Level 3 Unacceptable), compared with the previous reporting periods;
- Median PO<sub>4</sub>-P concentrations at both upstream sites were, surprisingly, in the Poor category for the 2024 reporting period (indicating eutrophication), having deteriorated by more than 25% from since the previous reporting period;
- At sampling site DR06 (Bethel Road), there was also a significant deterioration in the median concentration of NH<sub>3</sub> and mean concentrations of *E. coli* from the 2023 to 2024 reporting periods;
- At all three sampling sites downstream of Imizamo Yethu (i.e., at and below DR02 at Victoria Road), median PO<sub>4</sub>-P and mean *E. coli* concentrations were in the Poor and Unacceptable categories, respectively, in the 2024 reporting period, indicating orthophosphate enrichment and sewage contamination in these lower reaches of the river, also evidenced in the compliance-type data referenced above;
- Median DO concentrations for the 2024 reporting period were also in the Poor category at the most downstream sampling site (DR01. Rather unexpectedly, median DO concentration at the sampling site



immediately downstream of Imizamo Yethu (i.e. DR02) was however within the Target range in Reporting Year 2024, having improved significantly from the 2023 reporting period;

- At sampling site DR02 (immediately downstream of Imizamo Yethu), there was a significant improvement in all four parameters that were analysed for trajectory of change (PO4-P, NH<sub>3</sub>, DO and *E. coli*) in the 2024, reporting period, compared with 2023, possibly indicating improvement as a result of low-flow diversions of polluted stormwater to sewer;
- While median NH<sub>3</sub> concentrations were within the Target range at all sampling sites along the Hout Bay river in both the 2023 and 2024 reporting periods, this is largely attributable to the generally (naturally) low pH values currently prevalent in the river (median <7.2 with Q3 <7.5 in both reporting years), which reduces the proportion of total ammonia that exists as free ammonia and thus reduces the risk of ammonia toxicity, rather than low concentrations of total ammonia in the river.

#### **8.6.4 Focus areas of the City's water quality interventions within the sub-catchment**

The environmental water quality challenges in Hout Bay and the Hout Bay River, which emanate primarily from informal settlements, are common to many other areas of Cape Town and other South African cities (Lukhozi 2023). The eutrophication and bacterial contamination of the middle to lower reaches of the Hout Bay River are largely attributable to inflows of untreated sewage from the Imizamo Yethu informal settlement into the stormwater network and sewer overflows as a result of blocked pipes and/or pump station failures, exacerbated by significantly reduced river flows during summer from dams and other abstraction in the catchment.

Taking cognizance of this, the main focus areas for the interventions by the City to address water quality issues in the Hout Bay catchment revolve around minimising the incidence of and dealing more effectively with sewer overflows throughout the catchment, and putting measures in place to prevent or at least reduce the input of bacteriologically contaminated water from Imizamo Yethu into stormwater systems.

In March 2023, a Pollution Abatement Strategy and Action Plan (PASAP) was drafted by the City for the Hout Bay Catchment (Martin 2024), informed to a large degree by the Hout Bay Catchment Pollution Abatement Comprehensive Study that was completed by Lukhozi Engineering Consultants (2023) for the City. The strategic approach and recommendations put forward in the Hout Bay Catchment PASAP, to address pollution issues in the catchment, include:

- Ongoing involvement by the relevant departments within the City as active roleplayers within the Hout Bay Rivers Catchment Management Forum, which is a community collaboration of stakeholders from various City departments, local residents and businesses working towards improving the water quality and integrity of rivers in the Hout Bay catchment;
- Increasing the frequency of repair and maintenance schedules for sewage and stormwater infrastructure in the catchment, to keep the systems functional;
- Installation of sufficient pumps and effectively functioning telemetry systems at sewage pumpstations, and UPS systems at high-risk greywater pumpstations to aid with the problems arising as a direct result of load-shedding;
- Elimination of existing grey water connections incorrectly connected to the stormwater infrastructure and correctly connecting these wastewater streams to the sewerage system;
- Elimination of solid waste dumping through provision of sufficient formal solid waste collection centres, swap-shops and recycling centres.

The proposed approach, as set out in the PASAP, will require input from, and coordination between, a number of different Directorates, Departments and Branches within the City, as well as external parties. **The stipulated focus of the proposed interventions is to address pollution sources, at source within the affected catchment.** A detailed Transverse Action Plan (TAP) was compiled and included as an annexure to the PASAP. This TAP itemises each pollution source, identifies the affected / responsible City department, and the actions and interventions required. The plan also indicates the recommended timeframes for implementing the stipulated interventions for each specified pollution issue.

Drawing on the above, the following interventions *inter alia* were undertaken by the City (or by contractors for the City) in the Hout Bay catchment during the 2023 and 2024 reporting periods:

- Ongoing periodic cleaning of key bulk sewer lines, to address and prevent the blocking and surcharging of sewer pipes (e.g. see **Photo 8.6.5**);
- Investigations into the recommended modification of existing sewer lines in the catchment with 90-degree bends, which are vulnerable to blockage, as a more cost-effective option than upsizing the pipes;
- Repair and maintenance of existing stormwater-to-sewer low-flow diversions from Imizamo Yethu;
- Implementation of additional security measures at key infrastructure, such as pump station control boards and telemetry systems;
- Addition of a new water quality monitoring point to the CSRM WQ monitoring programme for the Baviaanskloof River, which is an important tributary of the Hout Bay River affected mainly by erosion, sedimentation and alien vegetation;
- Continued involvement of relevant City departments as active members of the Hout Bay River Catchment Forum, including attendance of meetings, assistance with pollution investigations and participation in awareness-raising initiatives.

In addition to these interventions by the City, the Hout Bay River Catchment Forum and the Friends of the Rivers of Hout Bay (FORHB) continued to play an active and important role in removing litter and waste from the Hout Bay River and inlets into the river, through weekly river clean-ups by locally employed workers.



**Photo 8.6.5**

**Clearing of debris from a blocked sewer pipe in the Hout Bay catchment** [Image from Lukhozi 2023]

### **8.6.5 Major intervention challenges**

The main challenges to implementing water pollution abatement measures in the Hout Bay catchment have been identified (in discussion with the area CSRM regional manager Mr G. Martin) as follows:

- A lack of funding for many of the proposed initiatives, due to severe cuts to both capital expense and operating budgets for the relevant departments within the City;
- Related to the lack of funding, an absence of clear implementation dates and deadlines for many of the interventions that have been proposed to address pollution issues in the catchment;
- In some instances, the lack of an integrated, cross-departmental (transversal) response to water quality problems in the Hout Bay River, with the recommendations of Lukhozi (2023) not all being considered realistically feasible by the City's Sewage Reticulation Branch;

- Theft, vandalism and destruction of stormwater, sewage and sanitation infrastructure;
- Hampering of more frequent collection of solid waste in the informal areas, especially Imizamo Yethu, through protests about service providers, and extortion and intimidation of service providers;
- Insufficient capacity in the existing sewage reticulation system for the stormwater-to-sewer diversions proposed as one of the main solutions in the Pollution Abatement Comprehensive Study, with existing pumpstations designed for the current sewage capacity (i.e. excluding large areas of Imizamo Yethu and its grey water and night soils), resulting in regular surcharges into the Hout Bay River from sewer pipe blockages [upgrades to the existing reticulation system are only planned for 2029];
- Other problems with the low-flow stormwater-to-sewer diversions are that they are bypassed in winter (when there are high flows) and they require major maintenance as a result of more frequent solid waste blockages in the sewage reticulation network (daily to weekly cleansing);
- A lack of awareness amongst some community members within the catchment about how their actions might contribute to pollution, water quality and human health risk (e.g. how illegal connections of stormwater lines to sewer lines typically results in blockages and spillage of sewage-contaminated water, which flows into downstream watercourses and pollutes them, representing a major human health risk both at the spill site and in downstream watercourses).

#### **8.6.6 Insights from the Hout Bay River Catchment Forum**

The Hout Bay River Catchment Forum (HBRCMF) was formally constituted in 2016, and has been working with the City to improve water quality and other aspects in the catchment for much longer. Drawing on the recommendations of Lukhozi (2023), the Forum has prioritised interventions that it believes will have the greatest impact on pollution in the catchment, and submitted these to the City for consideration.

Key insights from the Forum with regard to pollution abatement in the catchment are as follows, as supplied to Liz Day by the HBRCF Chairperson, Mr Janssen Davies:

- Key essential interventions are:
  - Provision of budget and funding for the implementation of the recommendations outlined in Lukhozi (2023), as prioritised by the HBRCF and submitted to the City – to date, no funds have been allocated for these specific interventions in the City's 25/26 and 26/27 budgets;
  - Integrated, urgent transversal responses to pollution events (involving the W&S Directorate's CSRM, Sewage Reticulation and informal Services Basic Services Branches, as well as inputs from Urban Waste Management and other Directorates or Departments);
- A key gap is establishing effective transversal co-operation in pollution problem-solving – the HBRCMF has recommended the creation of a new City post for a dedicated transversal facilitator, to help to breach gaps between different transversal departments and their officials, specifically to integrate necessary interventions in the Hout Bay Catchment;
- Water quality data are used to monitor ongoing, long-term and unacceptable pollution in the Hout Bay River, but do not seem to trigger any action to address them at source or instream.

#### **8.6.7 Recommendations going forward**

The main water quality issues in the Hout Bay catchment are associated with a lack of adequate sanitation in the Imizamo Yethu informal settlement and the subsequent inflows of untreated sewage into the stormwater network that discharges into the lower reaches of the Hout Bay River.

The following recommendations are made, to facilitate improvement in the water quality of the middle to lower reaches of the Hout Bay River catchment:

- An urgent focus on interventions to provide proper sanitation facilities to the Imizamo Yethu informal

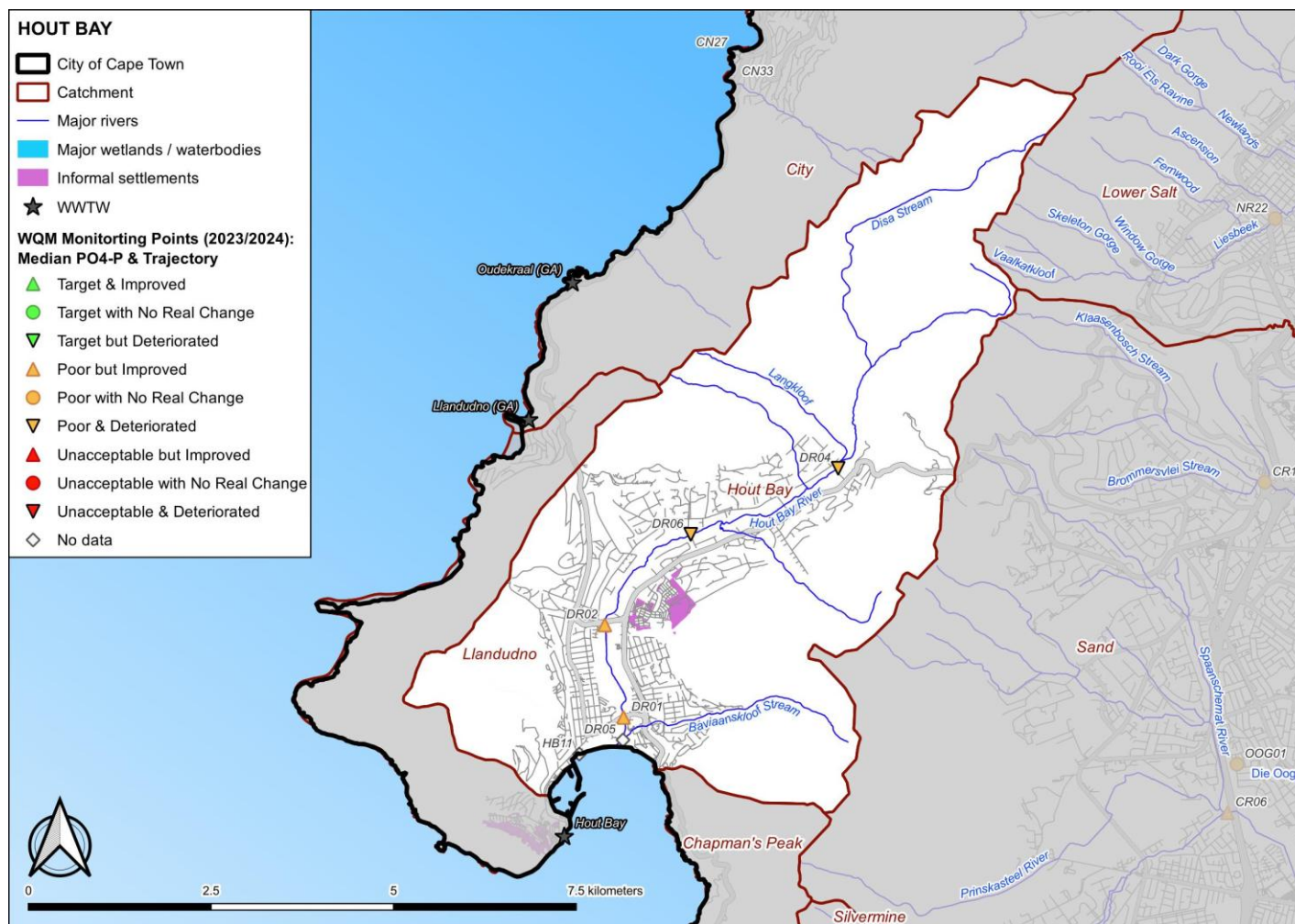
settlement, in conjunction with the provision of formalised housing;

- Urgent attention to improving integrated transversal interventions to achieve pollution abatement – the recommendations by the HBRCF for the appointment of a dedicated transversal facilitator for these interventions in the Hout Bay Catchment are supported;
- Facilitating access to funding for the recommended interventions already proposed in the Hout Bay Catchment PASAP and associated Strategic Action Plan, which could be through the formation of private-public partnerships and/or motivating for additional budget to be allocated to the Hout Bay catchment as one of the priority catchments within the City;
- Urgent consideration of the use of Package Plants for the treatment of sewage from the Imizamo Yethu area as an interim measure, instead of relying on the use of low-flow diversions – this is an alternative strategy suggested by the area manager within the CSRM regional management structure (Mr G. Martin) to that recommended by the Hout Bay Catchment Pollution Abatement Comprehensive Study (Lukhozi 2023), and takes cognisance of limited current capacity in the sewerage reticulation works for the (recommended) low-flow sewage and grey-water diversions to sewer. The use of Package Plants would require a decanting facility in the Imizamo Yethu area, followed by treatment in appropriately designed Package Plants, and subsequent discharge of treated water to the Hout Bay River;
- With regard to the above, **any proposed new formal developments within the Hout Bay catchment should also be required to install and use Package Plants for the treatment of sewage, until there is sufficient capacity within the sewage reticulation network and the marine outfall has been upgraded as necessary;**
- Urgent implementation of measures to address the current issues hampering the more frequent collection of solid waste from Imizamo Yethu; and
- Increased attention to education and awareness-raising amongst community members about water quality issues in the catchment, and the use of more innovative approaches to this through the involvement of environmental education specialists.

Although the Hout Bay catchment is split into two City stormwater management regions (see **Section 2.7** and **Figure 2.2**), the portion of the catchment that falls within the Central region is almost all within the mostly unpolluted Table Mountain National Park, while the portion that falls within the Southern region includes the middle to lower portions of the catchment where there are serious water quality issues that need to be addressed. As such, the problem of fragmented management of water quality due to the stormwater management regions not aligning with topographical catchments is less of an issue in the case of the Hout Bay catchment than it is for other “split” catchments in the City.



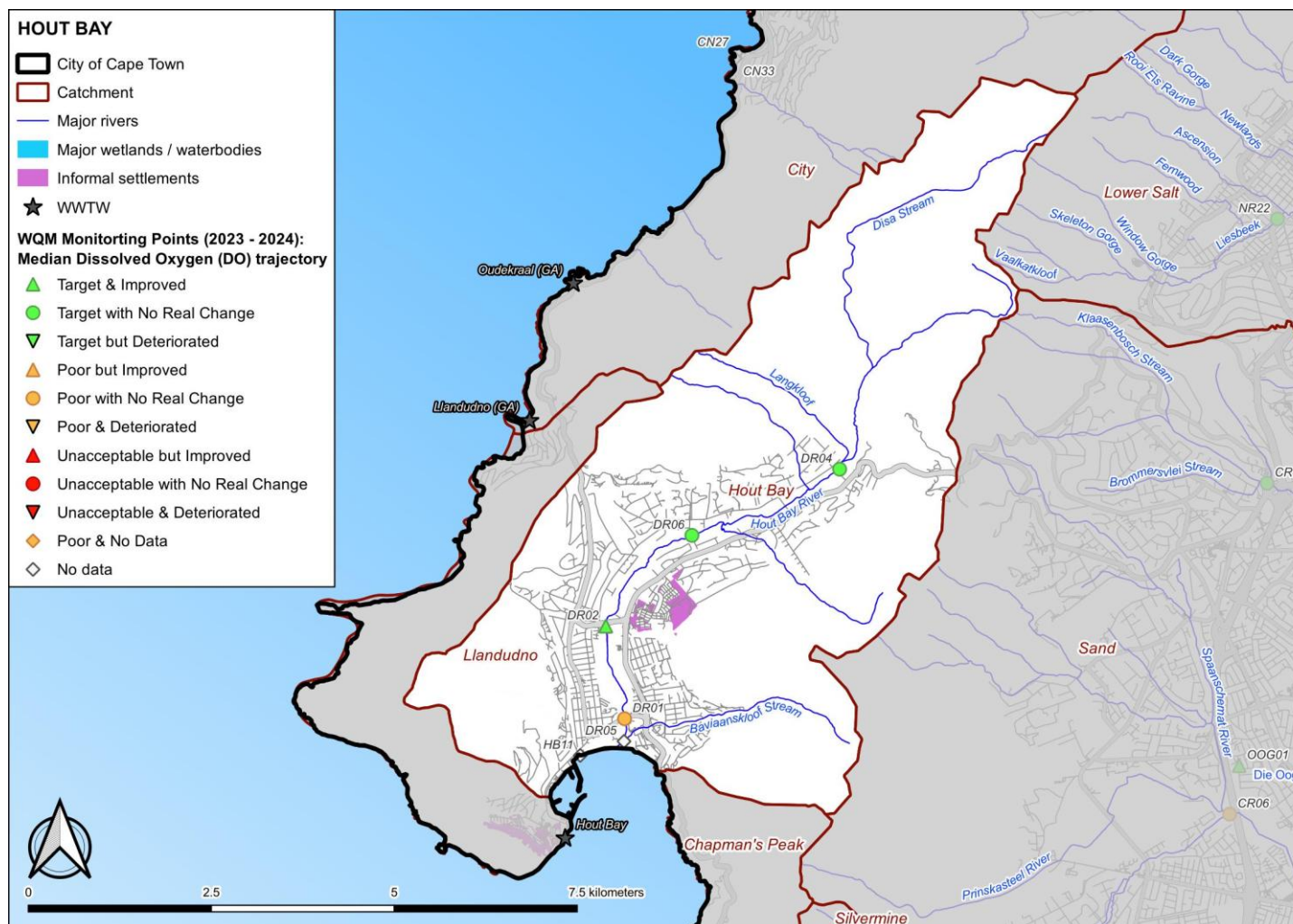
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**Figure 8.6.1**

Median annual orthophosphate phosphorus (PO<sub>4</sub>-P) data, focusing on the HOUT BAY Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14

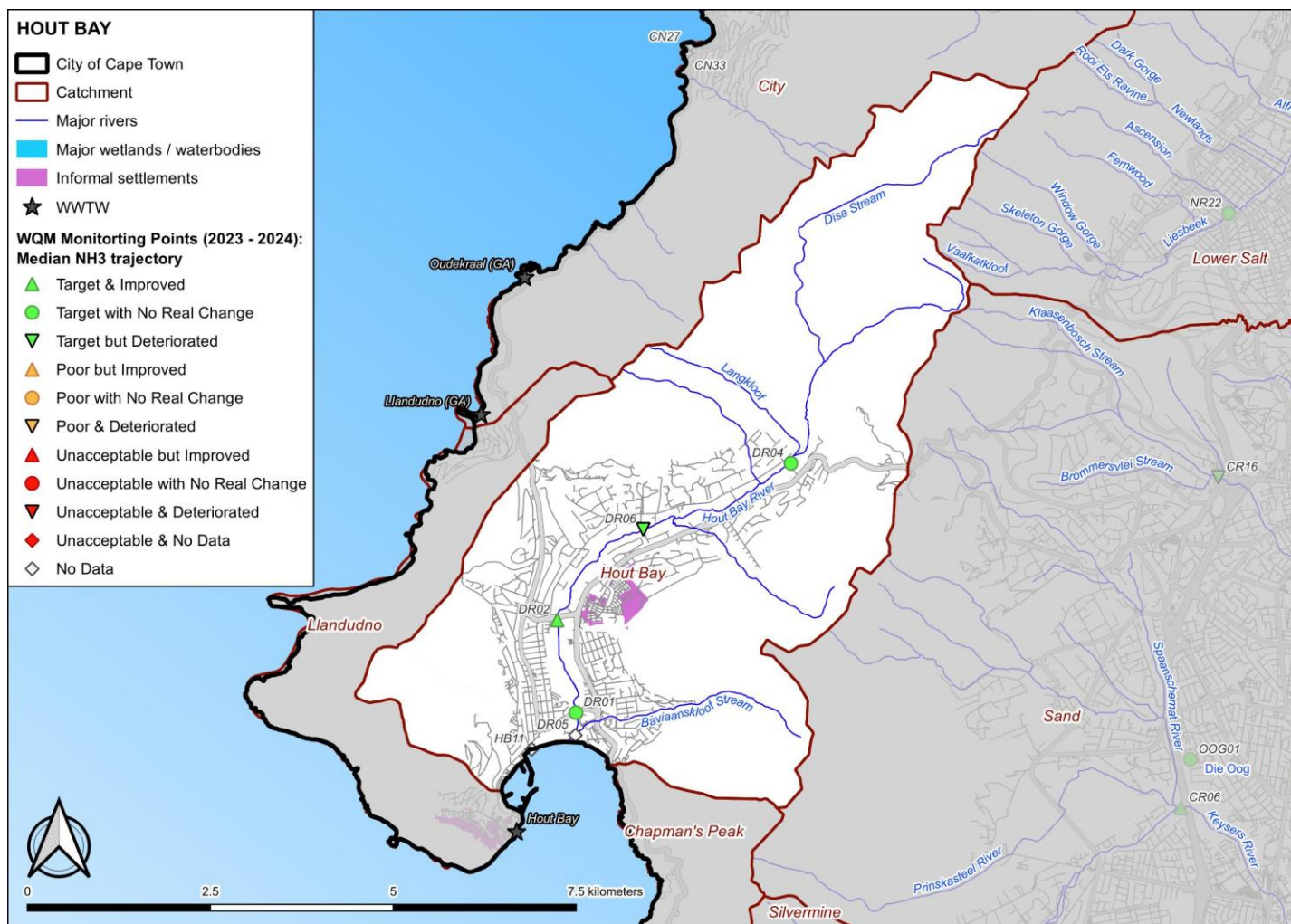
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**Figure 8.6.2**

Median annual dissolved oxygen (DO) data, focusing on the HOUT BAY Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14

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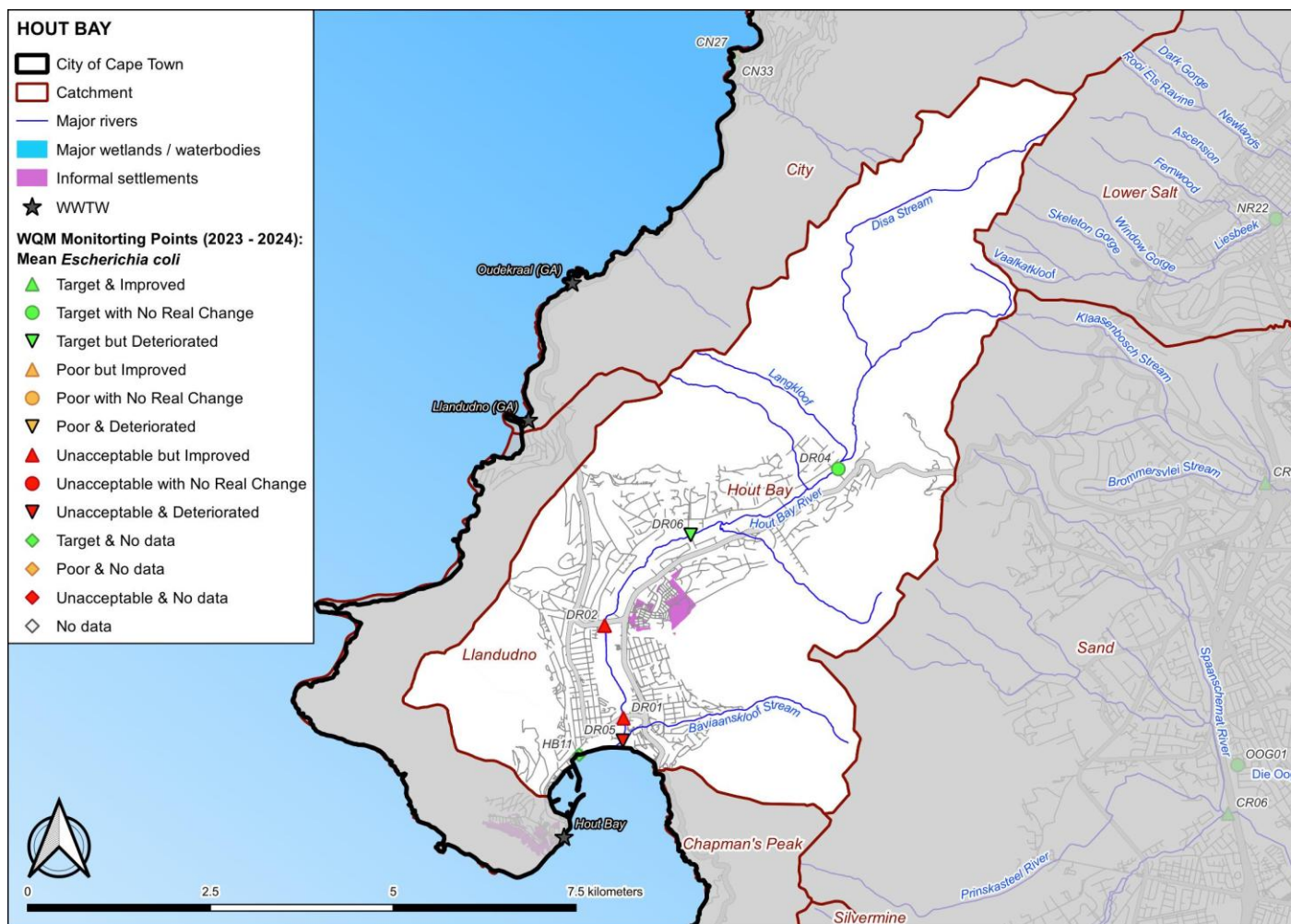


**Figure 8.6.3**

Median annual free ammonia (NH<sub>3</sub>) data, focusing on the HOUT BAY Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14



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**Figure 8.6.4**

Mean *E. coli* data (geometric means), focusing on the HOUT BAY Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14



## 8.7 Sand River Catchment

### 8.7.1 Catchment overview

Unlike most other catchments – and all other priority catchments – in Cape Town, the Sand catchment is not impacted on by any WWTW or major informal settlements. This means that its water quality is impacted on primarily by overland and stormwater runoff, along with episodic sewage spills that make their way into watercourses.

Zandvlei is an estuarine vlei, one of only two in Cape Town that are major recreational water bodies. Zandvlei is situated at the downstream end of the Sand catchment, and drains into False Bay at Muizenberg beach. It receives the bulk of its fresh water from three river systems originating on the east-facing slopes of the Table Mountain - Constantiaberg mountain chain. These are the Sand/Diep, Keyzers and Westlake Rivers.

The **Diep River** rises above Constantia and flows through several green belts and open spaces before discharging into Little Princess Vlei. In addition to the Diep River itself, the sub-catchment includes a number of tributaries, of which the most significant comprise the Wynberg, Klaassenbosch, Brommersvlei, Burgersboskloof and Cecilia Forest Streams, all of which enter the Diep River upstream of Main Road. The Diep River is canalised downstream of Main Road, and flows into the lower reaches of Little Princessvlei. A small informal settlement has developed along the river margins, just upstream of Roscommon Road.

Little Princessvlei is also fed by the Mocke. Its outlet is the Sand River, which is a canal that flows southwards and then in a south-westerly direction from the outlet of Little Princessvlei to Zandvlei. The canal is prone to high levels of accumulation of solid waste, particularly downstream of Retreat Road.

The Langvlei system, which enters the Sand River just upstream of its confluence with Zandvlei estuary is also canalised throughout its reaches to the confluence with the Sand River Canal.

Two significant open water bodies (or vleis) occur within the Diep/Sand sub-catchment, namely Little Princessvlei, on the lower Diep River near Elfindale, and Langvlei, on the Langvlei Canal in Retreat. In addition, the sub-catchment includes several on- and off channel stormwater detention and retention basins, forming part of the City's stormwater management system.

The **Keyzers River** rises on the east-facing slopes of the Constantiaberg mountain as a series of small streams, including the Grootbosch, Spaanschemat and Prinskasteel Rivers. The upper reaches of the Grootboschkloof and Prinskasteel Rivers are located within the undeveloped Table Mountain National Park. Upstream of the M3 freeway, the tributaries of the Keyzers River flow through forestry, agricultural (vineyards) and residential land-uses in Constantia and Tokai. From the confluence of all the tributaries just to the west of the freeway, the Keyzers River flows south-eastwards under the freeway and through urban open space (old farmland) in Dreyersdal until it reaches Main Road where commercial land-use dominates. After passing under Main Road, the river turns southwards and flows through an industrial area and a portion of the high-density residential suburb of Steenberg before reaching the wetland area on the north-western fringes of Zandvlei.

The **Westlake River** has its source on the lower slopes of the Constantiaberg mountain, within the Steenberg agricultural estate below Silvermine Nature Reserve. It flows through the gardens of the Norval Foundation, under Steenberg Road and past a commercial node (Steenberg Village shopping centre), before turning eastward and flowing alongside the Westlake low-income settlement and then through the agricultural fields of Polsmoor Prison into the Polsmoor Dam. Downstream of the dam, the Westlake River flows under the M3 freeway and then south-eastwards through the residential suburb of Kirstenhof via the Kirstenhof Wetlands Park before turning sharply southwards to flow via a canal under Steenberg Road. Downstream of Steenberg

Road, the river turns south-eastward again and flows under Main Road, straight into the wetland area on the north-western fringes of Zandvlei.

The entire Sand catchment ultimately drains into Zandvlei, which means that the vlei is particularly susceptible to water quality impacts emanating from the catchment. Catchment land use includes extensive agricultural areas (vineyards on the Constantiaberg mountains); suburban areas; small areas of informal and backyard settlements; commercial areas (shopping centers and parking lots) and light industrial areas. Water level, salinity, and flushing are controlled through manipulation of conditions at the estuary mouth. The mouth is managed by manipulating the height of a rubble weir in the mouth canal, and more frequently, through breaching and reinstating a sand berm (mound) with a bulldozer or tracked excavator. Improved mouth management has resulted in increased salinities and has improved the overall estuarine conditions in recent years, with increased indigenous fish diversity and reduced proliferation of *Stuckenia pectinatus* (pondweed) (Rose et al. 2023b).

### 8.7.2 Major sources of pollution in the catchment

Although the Sand catchment is relatively unpolluted compared with the other priority catchments presented in this section, it does include a number of land uses that contribute to persistent or episodic pollution events in its watercourses. The most significant sources of pollution in this priority sub-catchment have been identified as follows:

- The catchment of Zandvlei includes some of Cape Town's few remaining agricultural areas, primarily under vineyards in the Constantia and Tokai areas. Runoff from this part of the catchment is a source of excess nutrients, pesticides, herbicides, and sediment, all of which pass into Zandvlei (Rose et al., 2023);
- The catchment also includes two golf courses, both of which make use of treated effluent water for irrigation. This part of the catchment is most heavily enriched with phosphorous, rather than nitrogen;
- Stormwater runoff from suburban areas, including extensive affluent suburbs to the west and northwest – stormwater from formal residential areas may contain fertilisers, salts, and pathogens, as well as heavy metals
- Runoff from parts of the catchment such as Steenberg and Westlake which have formal housing but may be considered underserviced given the high prevalence of backyard shacks. Greywater, untreated sewage, and solid waste are often discharged to stormwater in the absence of sufficient formal drainage.
- Overflows and spills of raw sewage into watercourses via the stormwater system occur frequently as a result either of blockages in the sewer infrastructure in the catchment or malfunctions of sewer pump stations.

### 8.7.3 Water quality through the catchment – condition and trajectory

The CITY includes 29 routine water quality monitoring points in this catchment, with most monitoring points lying in the lower reaches of the catchment and in Zandvlei itself.

**Figures 8.7.1 to 8.7.4** present summary annual water quality data for orthophosphate (as  $\text{PO}_4\text{-P}$ ), dissolved oxygen (DO), free ammonia ( $\text{NH}_3$ ) and *E. coli* data, with analyses undertaken as outlined in **Section //** of this report.

These figures suggest that:

**Orthophosphate** phosphorus concentrations shown in **Figure 8.7.1** show that:

- Median concentrations did not improve above the Poor range for any sample sites in the 2024 reporting period, with some minor improvements within this range at certain sites relative to 2023;
- All sites within the Keyzers and Westlake River systems showed median annual orthophosphate

concentrations (2024 reporting period) in the range of Poor – but generally with no real change;

- Orthophosphate enrichment in the Langvlei system remained in the Unacceptable range, with no change since 2023, while water quality in the Diep/ Sand system showed slight improvement at some sites, with all sites still falling within the Poor rather than Unacceptable range;
- Within Marina Da Gama, at the downstream receiving end of the catchment, orthophosphate enrichment was in the Poor range for most sites in Marina Da Gama, showing decline in 2024 relative to 2023;
- Median orthophosphate concentrations within Zandvlei itself remained largely unchanged since 2023, staying in the Poor range, except at the outlet channel to the sea where some improvement was noted (presumably due to active mouth management and/or the effects of flooding during the 2023 and 2024 winter periods.

- **Dissolved oxygen** concentrations (DO) showed:

- Sample sites within the catchment generally performed well in terms of measured DO concentrations, with most sites within the Target range for this variable. This is indicative of relatively low levels of eutrophication and low chemical and biological oxygen demand, and suggest that river ecosystem health was likely to have been good from a water quality perspective over the assessment period;
- Site CR20 at Military Road, on the lower reaches of Keyzers River, improved to within the Poor range in 2024 from 'Unacceptable' in 2023, as did site CR01 in the upper reaches of the Westlake River into Zandvlei from Poor to 'Target';
- The only sample site affected by median DO in the Poor range in 2024 was at the Mocke River inflow to Little Princess Vlei (LPVMR) – this site has been on a declining trend since 2021, possibly due to excessive alien and invasive vegetation mats, reducing available surface oxygen;

- Spatial patterns in median annual **free ammonia (NH<sub>3</sub>)** concentrations shown in **Figure 8.7.3** suggest that:

- All sites in the sub-catchment remained within the Target range during the 2024 reporting period;
- There was however notable deterioration throughout the Westlake River sample sites, each of which showed an increased in median free ammonia concentrations relative to 2023 – suggesting a possible increase either in sewage spills and discharges, or in the runoff of orthophosphate-laden fertilisers from golf courses and suburban gardens in the upper catchment; and
- Sites in Langvlei and the upper reaches of Little Princessvlei, where NH<sub>3</sub> was rated as Poor in 2023, returned to the Target range during 2024;
- There was a low risk of ongoing ammonia toxicity within the Zandvlei catchment, but that occasional spikes in NH<sub>3</sub> concentrations (into the Poor and Unacceptable categories) have been recorded at certain sites within the catchment, so ammonia toxicity could at times have been a problem in certain river and wetland areas;

**Escherichia coli** data within the City's boundary in the Sand Sub-catchment (**Figure 8.7.4**) showed that:

- Mean *E. coli* counts were within the Acceptable Risk range for this variable at most sites in the upper catchment and in the estuary and associated waterbodies;
- Sites with Unacceptable risk included the upper Langvlei (LVI), the Diep River at Roscommon Road (CR20 - assumed to be impacted by inflows from a small informal settlement at this location); sites at and upstream of the Sand-Langvlei Canal confluence (CR21 and CR29), and a site on the Westlake river downstream of the Westlake residential area and Pollsmoor, where an increased number of sewage surcharges and spills took place during the reporting year (Mr A. Lee, CSRM, pers comm. to Liz Day);

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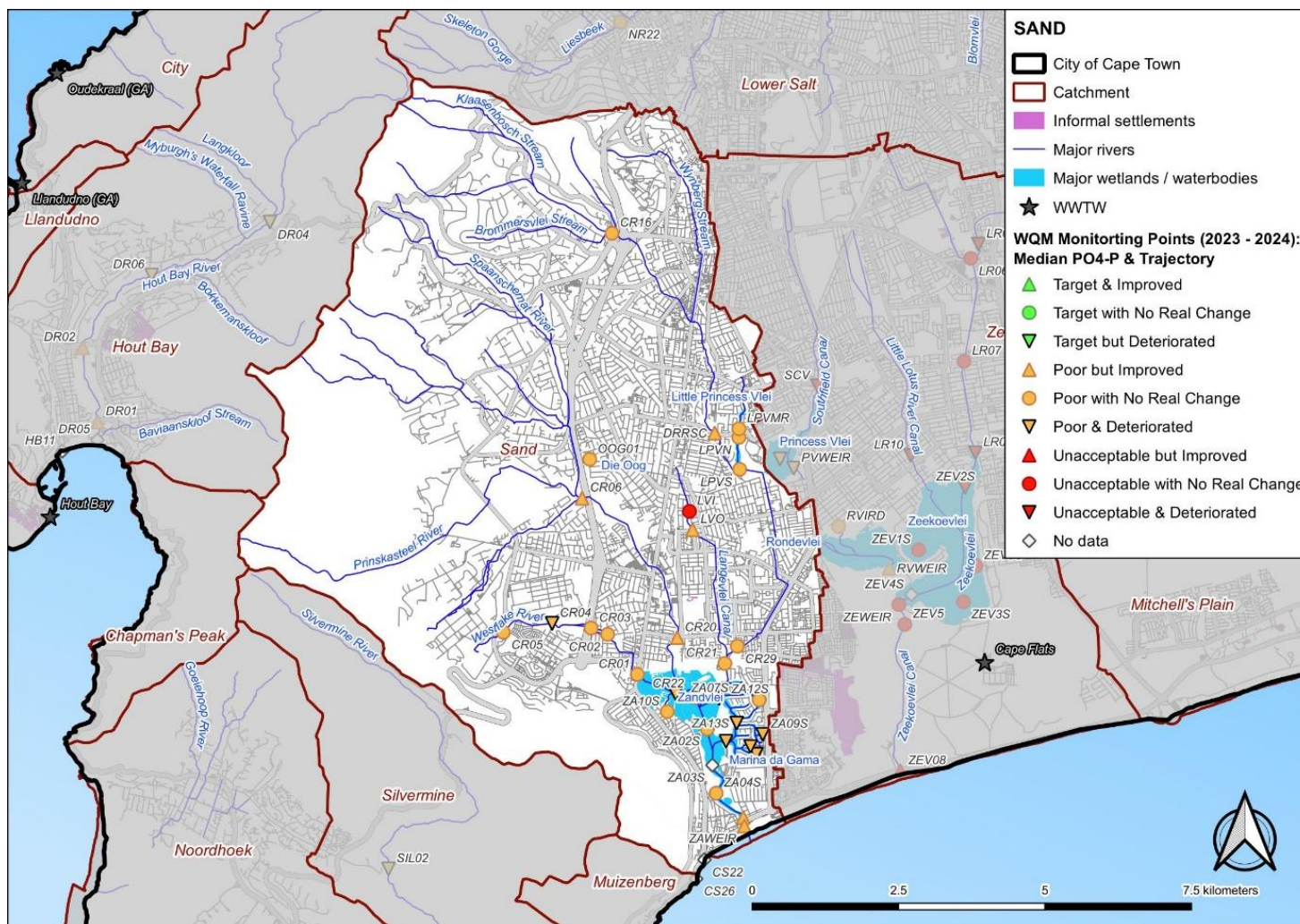
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- These sites tally with sites prone to discharges from problem sewage pumpstations and manholes, or affected by informal settlement or backyard densification along river corridors.



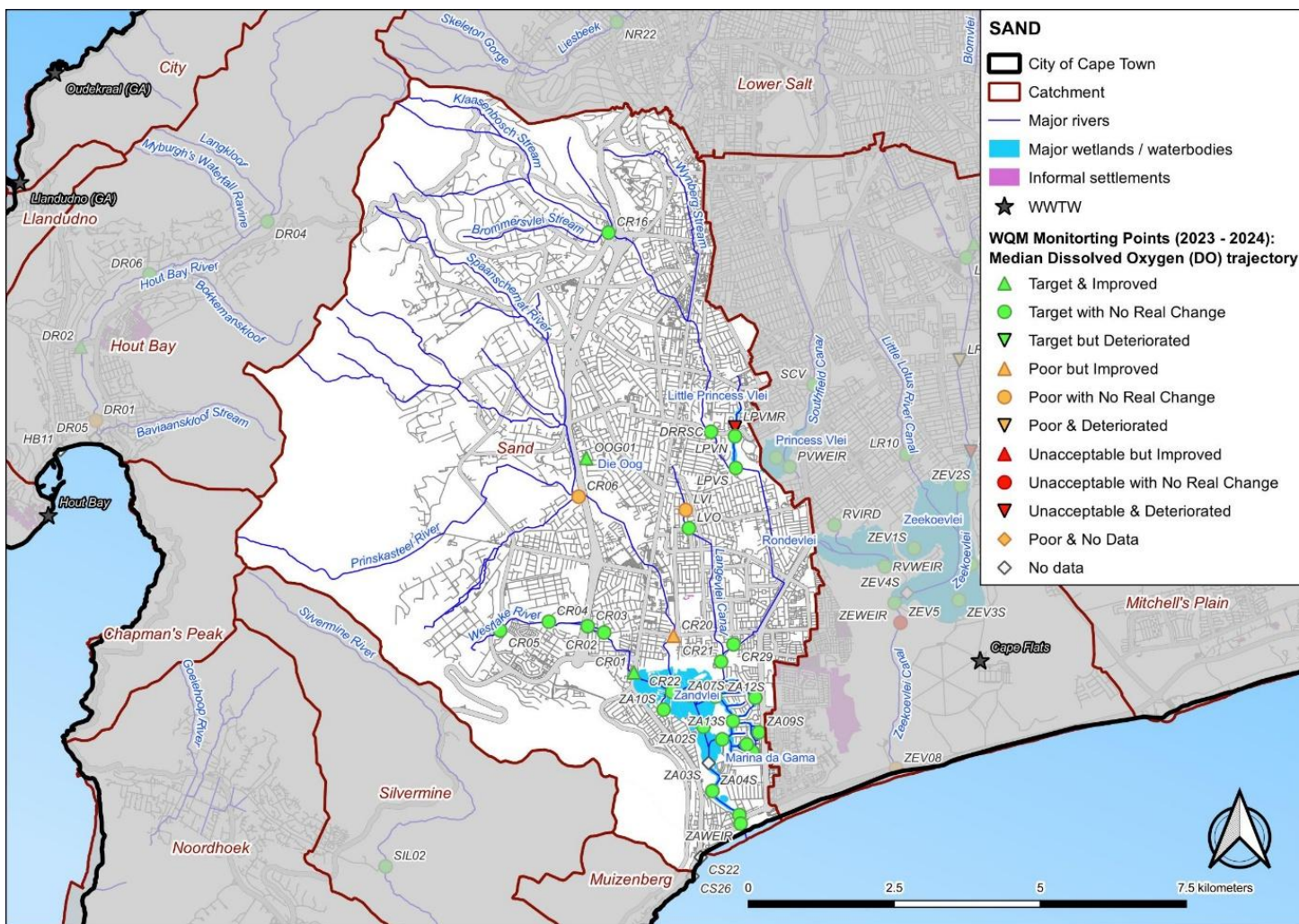
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**Figure 8.7.1**

**Median annual orthophosphate phosphorus (PO<sub>4</sub>-P) data, focusing on the SAND Sub-catchment.** Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14.

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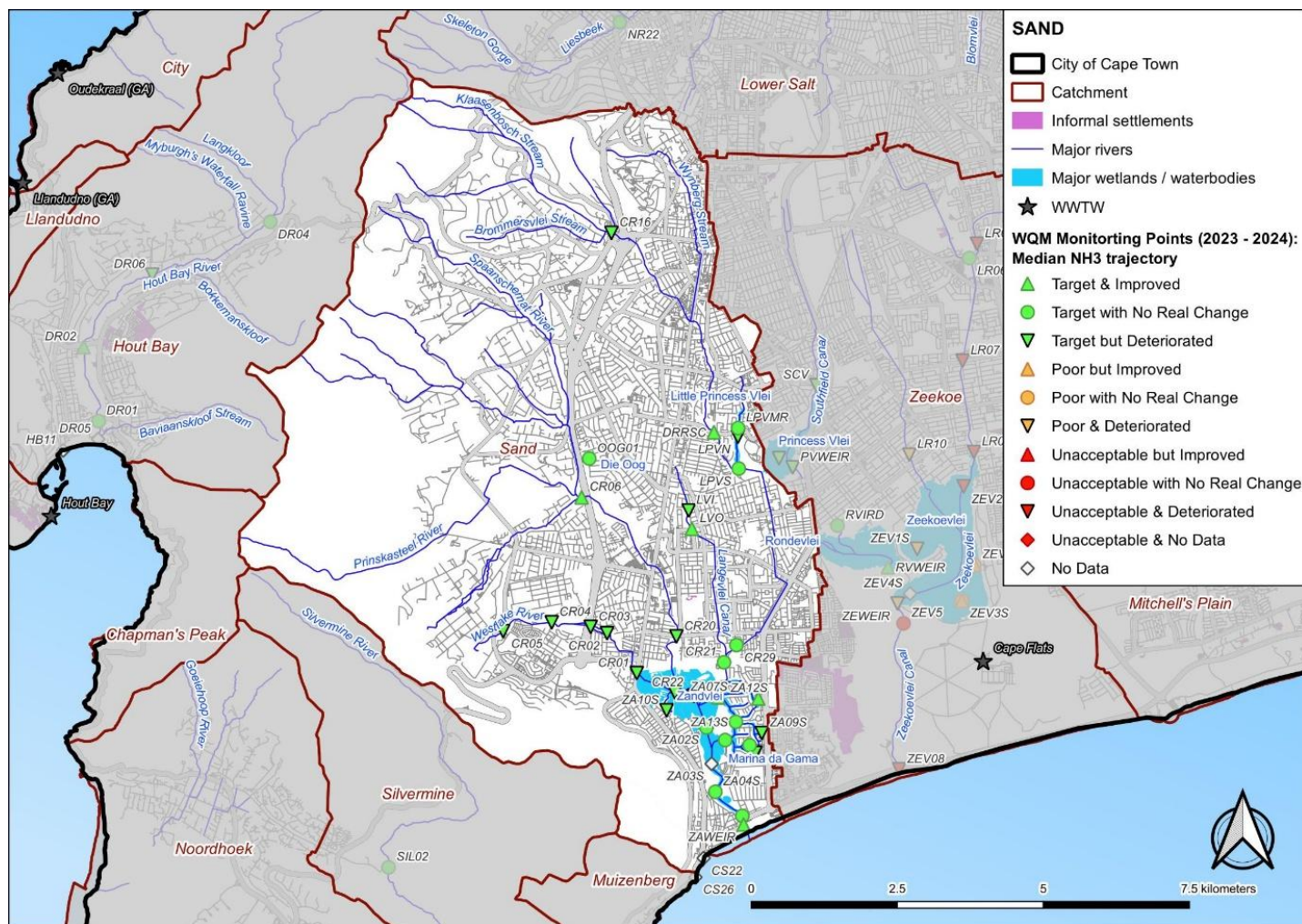


**Figure 8.7.2**

**Median annual Dissolved Oxygen (DO) concentrations, focusing on the SAND Sub-catchment.** Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14.



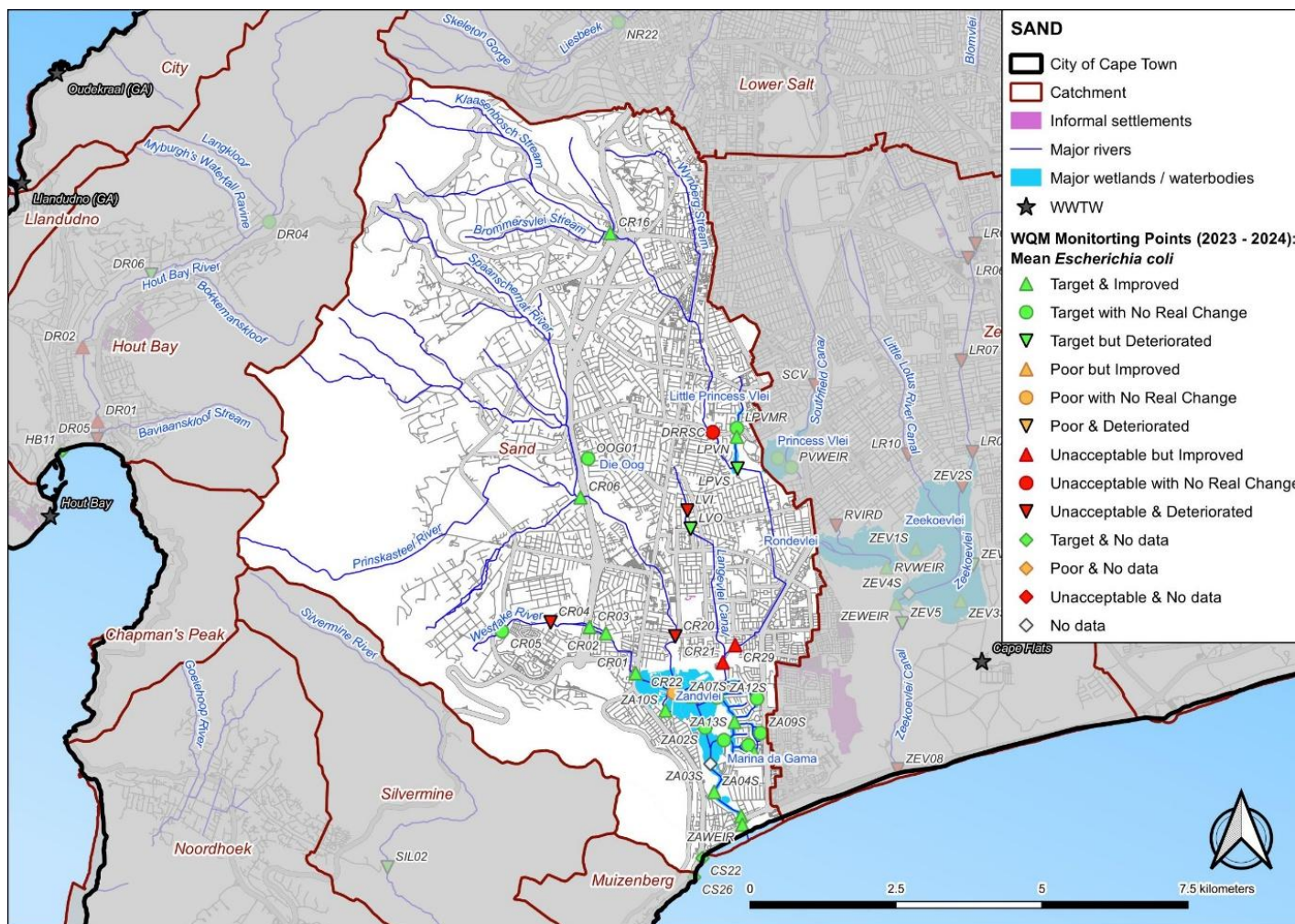
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**Figure 8.7.3**

**Median annual free ammonia (NH<sub>3</sub>) concentrations, focusing on the SAND Sub-catchment.** Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14.

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**Figure 8.2.4**

**Mean *E. coli* data (geometric means), focusing on the SAND Sub-catchment.** Data coded as to human health risk (see Table 1/). Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14.



#### **8.7.4 Challenges and successes**

The Sand River sub-catchment has, at least relative to other priority catchments, generally acceptable water quality in most of its watercourses. Based on discussions with the City's Stormwater Planning Region managers responsible for different parts of this sub-catchment, which straddles parts of two regions, the main issues confronting the CSRM's regional managers working in this area comprise:

- The management of solid waste in watercourses and wetlands, particularly in the Sand River between Retreat Main Road and Coniston Park, but also in the Zandvlei itself and in the Westlake River system – apart from the challenges of management of **excessive volumes of solid waste** in the river system, **security issues** have affected the safety of teams working in the Retreat / Steenberg areas;
- **Alien invasion** of riparian habitats in the upper catchment, particularly by alien grasses that resprout rapidly after clearing efforts;
- **Sedimentation** of the estuary and lower catchment due to **erosion** in the agricultural and urban areas of the catchment, resulting in a significant buildup of organic-rich sediment and a shallowing of the Zandvlei (Rose et al., 2023b); and
- Episodic sewer spills and surcharges, especially along the Westlake River and the Sand River.

#### **8.7.5 Focus areas of the City's water quality interventions within the sub-catchment**

Some of the active interventions undertaken by the CITY in the Sand catchment included:

- Interventions to upgrade the Raapkraal sewage pump station, including through the addition of a standby pump, which have significantly reduced the number of failures and resulting sewage surcharges / discharges into the Westlake wetland and Zandvlei;
- Interventions at the Marina da Gama and Military Road pump stations to install backup power and telemetry have also reduced the number of spill events at these pump stations;
- Collection and clearing of litter from the waterways by both the City and civil society organisations – litter grids are installed on the Sand River and nets in the lower Sand and Westlake Rivers, the latter installed by the Zandvlei Trust, and during 2024 a new litter trap was installed on the Blue Route Slood to intercept solid waste entering the Keyzers River – this is managed by an adjoining private landowner at no cost to the City (pers comm., Cllr C. Franklin)
- Implementation of invasive clearing efforts on the various river corridors, by the City's Invasive Species Unit;
- Implementation of the River Wardens project, which provides for patrol, cleansing, and minor maintenance along river corridors in the Keyzers river area;
- Ongoing repairs and upgrades to the sewerage reticulation network and more rapid responses to blockages and overflows by CITY officials;
- Active engagement and interest by local ward councilors as well as residents and community organisations through the Catchment Management Forum, the section 80 committee, the various 'Friends' groups, and the Zandvlei PAAC, that have resulted in partnerships with the City and contributed to improved catchment management;
- Conclusion and continued implementation of the new Mouth Management Plan for the Zandvlei, which has seen a (desirable) increase in in-vlei salinity;

- Preparation of a new Estuarine Management Plan for the Zandvlei Estuary;
- A water pollution control investigation into sources of pollution within the Pollsmoor Prison grounds (pers comm., Cllr C. Franklin); and
- Progression of the detailed design and procurement for the first Living Urban Waterways (LUW) Programme project, namely the Sand and Langvlei Canal Rehabilitation;

#### **8.7.6 Institutions and fora**

The Sand River Catchment Management Forum was one of the first catchment fora established in Cape Town, and remains very active and involved in catchment management issues since its relaunch in 2022.

A protected area advisory committee (PAAC) also exists for the Zandvlei Estuary Nature Reserve, to advise the City on reserve management issues.

#### **8.7.7 Recommendations**

A number of actions are ongoing to improve water quality and the general ecological state of Zandvlei and the aquatic ecosystems in the Sand catchment, as described above. Some of these have already resulted in improvements in the ecological health of the estuary, such as more effective saline intrusion and tidal interchange through better management of the estuary mouth, and a subsequent increase in the diversity of indigenous fish species as well as expansion in the area of occurrence of sand prawns. The relatively good water quality of Zandvlei compared to many other aquatic ecosystems in Cape Town, outside of sewage spill incidents, is largely attributable to a relatively unpolluted catchment area, with no WWTW inflows and limited areas of informal settlement.

Notwithstanding the above, Sections 8.7.2 and 8.7.3 highlight a number of water quality problems. The following recommendations are made with a view to facilitating improvement in water quality in Zandvlei and its catchment:

- Rapid response protocols for all problem sewage pump stations in the catchment should be rolled out, using the Raapkraal protocol as a proto-type, and thus facilitating the ongoing attention to the repairs to and upgrades of sewer infrastructure in this catchment;
- Pro-active relining and clearing of sewer pipes in the catchment is supported and should continue as required;
- Improvement in the frequency and volume of solid waste collection in open spaces in some parts of the catchment is urgently required, to prevent the passage of solid waste into watercourses. The Sand and Langvlei Canals are particularly vulnerable to dumping of solid waste, which accumulates along the canal banks and bed;
- Dredging of the main portion of Zandvlei, which is currently being designed, should be implemented as a priority action in this catchment as this should help to lower nutrient levels (especially orthophosphate concentrations), raise DO levels and improve the hydrological functioning of the estuary;
  - Land management in the upstream areas of the catchment should be improved to reduce erosion as a source of sediment, and ultimately reduce the frequency of future dredging requirements in the estuary going forwards. This means that the City should engage with landowners, particularly golf courses, agricultural landowners, and SANParks, regarding addressing erosion in these areas;
  - Implementation of SUDS approaches should be encouraged throughout the catchment, as these interventions might achieve measurable impacts at least in moderately impacted systems such as the Westlake and Keyzers River systems and their upstream reaches in particular;

- The City should engage actively and supportively with the Sand River Catchment Management Forum and the various civil society groups active in the catchment;
- Re-funding of the LUW projects in this catchment (as from early 2025) is strongly supported as a means towards achieving catchment-scale improvement in aquatic ecosystem condition and function.

## 8.8 Zeekoe Catchment: Big and Little Lotus River Sub-catchments

### 8.8.1 <sup>19</sup>Catchment overview

The Big and Little Lotus Rivers are the main sources of surface flow into Zeekoevlei, and the False Bay Nature Reserve (FBNR) (see Figures 8.8.1-8.8.4 for context). Of these, the Big Lotus River has a far larger catchment, starting as a small stormwater channel just north of the N2, through the airport industrial area. Immediately downstream of the N2, it flows through parts of Nyanga, Gugulethu and New Crossroads, mainly as a lined canal. These areas are all densely populated, with high levels of backyard and other informal settlement. Downstream, the river flows along the southern edges of Manenberg and Hanover Park. Many of these areas have significant socio-economic problems and high levels of crime and gang violence, which challenge effective catchment management activities, including the City's capacity to effect basic service delivery in the form of solid waste removal in some areas.

The Big Lotus River swings south just east of Wetton. It is crossed by Govan Mbeki Road and passing through parts of the Philippi Horticultural Area, where agriculture as well as associated manure and composting forms the main land use. In these river reaches, a low-flow diversion (the Springfield Diversion) diverts a portion of flow from the river to the nearby Cape Flats WWTW, in an effort to reduce downstream water quality impacts on Zeekoevlei. From the Springfield Diversion, the river flows, still as an open channel, through residential and commercial land uses in Ottery and is joined by the Woodlands Canal, just east of the remnant and ecologically highly important Bamboesvlei seasonal wetland (see Day 2024 and Emms 2022). The canal flows from here through parts of the residential areas of Lotus River and Grassy Park, before entering Zeekoevlei, just south of Fisherman's Walk.

The **Big Lotus River** has been subjected to numerous inflows of raw sewage from blocked manholes and failed pump stations over the past few years, contributing to the documented progressive decline in water quality and wetland ecosystem quality in Zeekoevlei (see Day et al. 2022) and the need for its dredging (Day 2023).

The **Little Lotus River**, by contrast, drains a smaller and less impacted catchment. It rises just south of Ottery Road (east of the Royal Golf Course) and flows through the mainly residential areas of Parklands and Grassy Park, mainly as a lined canal, before entering Zeekoevlei, south of the Big Lotus River confluence. The river is generally less vulnerable to raw sewage inflows and solid waste accumulation than the Big Lotus River, but nevertheless also experiences periodic pollution episodes (Day et al. 2022). High levels of criminality in parts of the Little Lotus River Sub-catchment also impact on services such as solid waste removal.

As a result of ongoing receipt of unacceptably high loads of solid waste (including health hazards such as loads of used disposable nappies) into Zeekoevlei, and the high costs and effort required for its removal once in the vlei, local community / City partnerships have facilitated and funded litter fences at the outlet of both the Big and the Little Lotus Rivers into Zeekoevlei and, as of June 2025, an additional three litter fences in the upstream catchments of both rivers.

See photo illustrations (**Photos 8.8.1-8.8.6**).

**Box 8.8.1:**  
**Natural watercourses in the Zeekoe catchment**

Typical of many areas of the Cape Flats, the Zeekoe catchment is characteristically sandy, with a high wet season water table in many areas. This feature gave rise, under natural circumstances, to an abundance of seasonal, groundwater-fed wetlands across low-lying areas of the catchment. In some areas, localised lenses of calcrete have also given rise to perched, seasonally inundated wetlands, many of which have high biodiversity importance.

The Big and Little Lotus Rivers are not natural rivers, but were both constructed to drain water from areas with a high water table and so allow expansion of urban development.

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<sup>19</sup> Background information taken from Day et al (2024a)





**Photo 8.8.1**  
**Solid waste and raw sewage / grey water in channel into Big Lotus River past Riemvasmaak Informal Settlement (December 2024)**



**Photo 8.8.2**  
**Recent (May 2025) clearing of solid waste from channel into Big Lotus River past Riemvasmaak Informal Settlement – solid waste still to be removed**



**Photo 8.8.3**  
**Significant inflows of polluted water (grey water and raw sewage) into the Big Lotus River from the Sweet Home informal settlement, via the stormwater system (December 2024)**



**Photo 8.8.4**  
**Visibly polluted flows in the Big Lotus River past Hanover Park (December 2024), including inflows from Sweet Home informal settlement and other upstream pollution sources**



**Photo 8.8.5**  
**Visibly polluted inflows of raw sewage into the Lotus Stormwater Wetland Ponds, south of Old Landsdowne Road, Zeekoe Catchment – these wetlands overflow into the important seasonal wetlands in the Edith Stephens Nature Reserve, north of Jakes Gerwel Drive**



**Photo 8.8.6**  
**Early results of daily clean-ups of solid waste in the Big Lotus River – clean-up team provided by The Litter Boom Project, with daily removal of waste by the City (to prevent vandalism of bags, if left overnight)**

### 8.8.2 Major sources of pollution in the catchment

The most significant sources of pollution in the catchment stem mainly from large areas of informality and backyard settlements in the upper reaches of the Big Lotus River, from just downstream of the N2 crossing, as far as the Govan Mbeki river crossing into the Philippi Horticultural Area (PHA). These areas discharge grey water from domestic use and night soils into the Big Lotus River, either directly or by way of stormwater drains. (see **Photo 8.8.3**).

The most significant (but currently unmeasured) inflows appear to comprise (primarily) inflows into the Big Lotus River from the Sweet Home informal settlement (**Photo 8.8.3**), as well as inflows from the Barcelona and KTC informal settlements further upstream, which discharge into the river as visibly contaminated, but smaller inflows.

Episodic sewage blockages, sewage pump station failures, sewer manhole overflows and occasional failure at the Cape Flats WWTW inlet are also major contributors to river and vlei pollution (e.g. **Photo 8.8.5**), occurring at a rate throughout the catchment that cumulatively is probably permanent rather than episodic, and exacerbated by load-shedding and vandalism (see Section 5.2).

A total of 48 sewage pump stations are located in the Zeekoe Catchment (CSRM 2025). This large number is because the generally flat topography prevents the use of conventional gravity-fed sewer systems, necessitating an extensive network of wastewater pump stations to convey sewage to the Cape Flats WWTW. These pump stations are largely sited along major and minor stormwater networks, and use them as overflow pathways during failures or capacity exceedance events, thus posing significance environmental and public health risks due to the increasingly frequent pump station failures and resultant sewage overflows into the stormwater systems (CSRM 2025). **Figure 5.2.10** (Section 5.2) shows that 60 pumps station failures occurred in the catchment over the 2024 reporting period, including three "major" events.

Adding to this issue, security concerns in parts of the catchment mean that the timeframes for addressing sewage pump station failures and sewer blockages in this catchment are among the slowest in the City, because night-time attention to such issues is precluded because of very real safety concerns (MPP reporting to Section 80 Committee: Reporting Cycle 30 V10: 25 March 2025: Work Stream 2).

Other important sources of pollution in the catchment include the accumulation of solid waste, both in terrestrial areas (from where it is blown or washed into watercourses) and from dumping into river margins and channels. Solid waste includes offal, dead animals, used nappies and other sources of pollution to aquatic resources.

In addition, the following serious issues have also been identified (e.g. Abbot Grobbicki 1998; Day et al 2022):

- Runoff from agricultural areas (mainly in the Philippi Horticultural Area), including from fertilisers, manure, insecticides and herbicides;
- Illegal discharges of oil and other waste into watercourses – Day et al (2022) presented the findings of a 2022 fish study in Zeekoevlei (Clark and Gammon 2022), which found extremely high levels of lead and mercury in fish tissue in this vlei, well above safe levels for human consumption. This is assumed to derive from light industrial and agricultural land uses in the sub-catchment;
- Runoff from roads and parking areas, in places with high levels of solid waste.

Rapid growth of reedbeds, aquatic alien invasive water hyacinth and (at times toxic) algal blooms are all both ecological and management issues in the Zeekoe Catchment rivers and, particularly, in Zeekoevlei itself. They result from the high nutrient concentrations passing into this system, while vlei closures as a result of high *E. coli* concentrations and/or microcystin toxins in Zeekoevlei have serious socio-economic and human health impacts.



**Box 8.8.1**

**Solid waste management realities and conundrums**

**Solid waste accumulation** in the Big and Little Lotus catchments is an issue of serious concern. It reflects two different aspects – dumping of waste by city residents and the failure of the City to provide an effective waste removal service that addresses the needs of the community in the catchment, often scaled well above the population size originally modelled or assumed by the City in its infrastructure planning.

**Dumping** of solid waste along and within the Big Lotus River in particular is largely confined to areas that are accessible for wheelie bins, vehicles and trollies – that is, river channels and other areas adjacent to road crossings. Day (2024) suggested on the basis of discussions with some community leaders, that dumping of solid waste by residents is influenced *inter alia* by the following factors:

- Many residents have no access to transport to take large waste items (mattresses, couches) to waste disposal sites;
- The City does not take away builder's rubble or waste that does not fit into wheelie bins;
- It is difficult for women and children to put waste into high-standing skips;
- Many homes have large numbers of people residing in them and the weekly waste collection service that is offered by the City is inadequate for the volume of waste generated;
- The confined spaces in which many residents live mean that storage of waste over a week between waste collection cycles creates untenable conditions in the home – and results in waste needing to be disposed of more frequently, especially if it is malodorous (e.g. used nappies).

Discussions with City officials in the present project highlighted issues affecting effective collection of solid waste as including:

- The City's existing by-laws do not allow for collection of items such as rubble and large items;
- Theft and vandalism of infrastructure;
- High levels of gangsterism in many areas, resulting in unsafe working conditions for municipal workers, and hence avoidance of areas where workers might be robbed or shot;
- A culture of tolerance for littering and the disposal of solid waste in streets and open spaces in many areas.

These seemingly intractable issues need to be addressed. The inclusion of the Zeekoe Catchment in the MMP for Reducing Pollution and Solid Waste in Catchments and Rivers (Work Stream 6 in the MMP) is an important one, and its actual implementation should be tracked going forwards.

### **8.8.3 River water quality through the catchment – condition and trajectory**

**Figures 8.8.1-8.8.4** present summary annual water quality data for orthophosphate (as PO<sub>4</sub>-P), free ammonia (NH<sub>3</sub>) and *E. coli* data, with actual analyses as outlined in **Section 3.8.14** of this report. The data are presented spatially, on a per-site basis.

Read in conjunction with catchment-level data presented in **Section 5**, these figures show that, for the Big and Little Lotus Rivers (i.e. the priority catchment areas) that drain into Zeekoevlei:

- **Orthophosphate enrichment** was pervasive in the Zeekoevlei Sub-catchment over the assessed reporting periods, with inflows from the Big and Little Lotus Rivers always well within the Unacceptable levels for orthophosphates, and with >25% increases in orthophosphate concentrations over the 2024 reporting period, at sites in both river systems, as well as in the upper reaches of Zeekoevlei itself, near the mouth of the Big Lotus River (ZEV2S);
- Median data for LR06 (Woodlands Channel into the Big Lotus River) and LR07 were both in the Unacceptable range, but showed no substantial year-on-year change;
- The only monitored stormwater channel entering Zeekoevlei was represented by POC01, located in an artificial, vegetated channel that receives stormwater from parts of the Schaapkraal agricultural and peri-urban areas as well as from parts of Pelican Park. The orthophosphate data show Unacceptable enrichment in this channel as well, correlating with high (i.e. Unacceptable) *E. coli* concentrations (see **Figure 8.8.4**) and suggesting that sources of nutrient loading might include periodic sewage overflows;
- The above spatial data underscore the continued hypertrophic condition of Zeekoevlei itself, with these nutrients promoting in-lake algal growth and occasional blue-green algal blooms, which contribute to the build-up of organic material on the (shallowing) vlei bottom; ongoing in-lake nutrient cycling; and the need for dredging of organic sediments from the vlei, currently being implemented by the City;
- **Dissolved oxygen** concentrations, used here also as an indirect measure of CODs and BODs that exceed the treatment capacity of the waterbody, highlight:

- Poor conditions in the upper catchment upstream of the N2 (LR02), where mainly light industrial activities and road runoff contribute to in-stream flows that move slowly through a shallow, often stagnant channel, liable to low oxygen concentrations as a result of heating and organic decomposition;
- Critically low DO in the river reaches at the monitoring point downstream of Gugulethu (LR03), reflecting high loads of black- and grey water runoff with high CODs from the upstream area. These low DO concentrations are unlikely to have been able to sustain any but the most pollution-tolerant aquatic biota, and even in the absence of canalisation, would not support functioning riverine ecosystems of any viable quality. **This has relevance for river rehabilitation efforts in these reaches – without serious attention to water quality issues, meaningful river rehabilitation will fail;**
- Median DO concentrations in the Big Lotus River improved with distance downstream, ranging from Target to Poor, until just upstream of Zeekoevlei (LR08) where median DO was in the Unacceptable range, and had deteriorated compared with the 2023 reporting period. Low DO at the latter site probably derives from inflows from the Riemvasmaak / Phumlani informal settlement immediately upstream (east of Buck Road) as well as from pump station overflows in the area and backing up of flows from Zeekoevlei in this part of the channel during high water periods;
- Median DO concentrations in the Little Lotus River lay within the target range in the lower river reaches, indicating a system that, while subject to periodic sewage inflows (as shown by *E. coli* data), did not have the high organic load of the Big Lotus River, and had CODs and BODs within the limits of assimilation. Nevertheless, median DO concentrations in the river were in part influenced by very high DO concentrations at times, indicative of high diurnal photosynthesis rates associated with hypertrophic conditions, and potentially also associated with (unmeasured) very low concentrations at night;
- Median **free ammonia** (NH<sub>3</sub>) concentrations fell in the Unacceptable category for all sites on the Big Lotus River in the 2024 reporting period and moreover showed deterioration compared with the 2023 reporting period. These data reflect low oxygen availability in parts of the river, compared with organic loading. Organic loading clearly derived largely from raw sewage inflows, as indicated by (geometric) mean ***E. coli*** concentrations in the Unacceptable range throughout the Big and Little Lotus River catchments, and with data from all sites showing deterioration compared with concentrations over the previous reporting period;
- Median free ammonia concentrations in the Little Lotus River (represented by LR10 only) fell within the Poor range, suggesting lower risks of ammonia toxicity and a system that might lend itself more to aquatic rehabilitation efforts. Median data for the 2024 reporting period did however show deterioration in this variable compared with the previous reporting period;
- Data for the Woodlands Canal also showed *E. coli* concentrations at Unacceptable levels, suggesting a degradation in this part of the catchment over the past few years;

Overall, the data described above reflect a catchment subject to high levels of inflow from backyard and informal settlements, as well as a high (and increasing) frequency of sewage and pump station overflows – **Figure 5.2.10** in **Section 5.2** shows that the Zeekoevlei Sub-catchment had the fifth highest frequency of pump station overflows in the city in the 2024 reporting period and the upper catchment shows as a “hotspot” for sewage spills, as indicated by C3 reporting (see **Figure 5.2.16**).

Interestingly, no individual pump stations from the Zeekoe Catchments appeared among the ten worst performing pump stations, plotted in **Figure 5.2.11**, suggesting that the catchment is impacted by a wider array of pump stations, each with fewer spills, causing these two sub-catchments to have notably high total pump station failure counts.

#### **8.8.4 Focus areas of the City’s current remediation programmes**

This section has been informed mainly by discussions with the City’s Stormwater Planning Region (acting) manager for the Southern Region (Mr L. Abdulla) and his team during the course of this project, and by the



draft (2025) PASAP and TAP for the catchment.

The most serious issues affecting water quality in the Big and (to a lesser extent) the Little Lotus Rivers comprise **raw sewage** and **solid waste**. Sewage passes into watercourses from formal and informal settlements; stormwater flows; sewage pump station overflows; sewer manholes and failed sewer lines.

As noted in Section 8.1.2, these issues are however controlled by other line departments, with CSRM regional managers and their teams, as well as the City's BMB, being at the receiving end of failed systems, and accountable for polluted watercourses and the ecological and other impacts of this pollution, while often being powerless to effect change at source.

The Zeekoe Catchment has however been included in the Priority Catchments of the MPP's newly formed Work Stream 6 (Reducing pollution and solid waste in catchments and rivers) (see Section 7.2.2). A waste programme is currently being formulated for this catchment, and should be available for reporting on progress in the next Inland Water Quality Report (2025 reporting period). This catchment is already a priority catchment in terms of sanitation and inland water quality.

The following measures have been included in City planning and/ or implementation projects, with a specific focus on improving water quality in this priority catchment:

- Planning activities:
  - C40 CFF FUNDING was sourced by the City to drive the development of recommendations for the terms of reference and mandates for the planned Zeekoe Catchment Management Forum (ZKCMF) – the ZKCMF was established in July 2024;
  - C40 CFF funding was also obtained for investigations to identify opportunities within the Big and Little Lotus River catchments for non-structural interventions and green infrastructure (GI), including sustainable drainage systems (SuDS) and nature-based solutions (NbS) – this project was completed in April 2024 (Turpie et al 2024), and included conceptual recommendations for GI and NbS interventions in both the Little and the Big Lotus River catchments;
  - Development of the draft Zeekoe Catchment PASAP and its associated TAP for the catchment – both of these documents have undergone major revision since the last annual Inland Water Quality Report (Day et al 2024a).
    - The **PASAP** (January 2025) includes considerably more detail; more specific references to problem areas in the catchment; timelines for interventions, ranging from immediate (within one year) to long term (> 9 years); and detailed mapping of stormwater infrastructure, sewage pump stations and sewer lines. It focuses on the following four key measures to achieve a measurable improvement in water quality, namely:
      - **Solid Waste Management**
        - Significantly increase the frequency and volume of solid waste removal at source.
        - Establish sufficient formal solid waste collection centres, swop-shops, or recycling facilities
      - **Wastewater Management**
        - Divert known sources of effluent currently entering the Big and Little Lotus Canal, to sewers.
        - Improve sewage and stormwater services for informal and backyard settlements.
        - Enhance short-term storage of effluent at all sewage pump stations, especially those near the False Bay Nature Reserve (FBNR) and Big and Little Lotus canals.
        - Implement existing plans for upgrading the Cape Flats Wastewater Treatment Works (WWTW) and rehabilitating and upgrading sewers infrastructure in the catchment.

- **Stormwater and Sewer Infrastructure Improvements**
  - Eliminate incorrect grey/black water connections to stormwater infrastructure and correctly route them to the sewer system.
  - Investigate and mitigate sources of pollution in the Big Lotus River.
  - Maintain and upgrade the existing low-flow diversion in Springfield Road.
  - Assess the integrity of the main CF2 Sewer line
- **Pollution Monitoring and Incident Response**
  - Establish additional routine monitoring points between the N2 and Govan Mbeki Road downstream of Jakes Gerwel Drive
  - Develop a comprehensive pollution tracking system that leads to active intervention measures
  - Form an inter-departmental task team on water quality improvement.
  - Link the PASAP to Standard Operating Procedures (SOP) for responding to sewage pollution incidents.

Since the above measures all concern impacts that affect stormwater but do not derive from stormwater, it is clear that the required **measurable** improvement in water quality will only be achievable if the PASAP implementation is prioritized across transverse departments and branches within the W&S Directorate, as well as between Directorates (W&S, Urban Waste Management and Spatial Planning & the Environment Directorates).

- The **TAP** (still in draft form and under development in June 2025) is a succinct, action-based plan that lists specific interventions aimed at known pollution hotspots within the catchment. Differentiating it from other TAPs in the City is the assignment of direct responsibility for specific actions to named officials, from a variety of Directorates, Departments and Branches;
- The TAP also assigns timelines that range between Medium term (< 12 months) and Long term (> 12 months);

Discussions with the (acting) Southern Region stormwater manager, Mr L. Abdulla, indicated that implementation of the Zeekoe catchment TAP will form a pilot project within the City, driven by engagement between the W&S and Spatial Planning and the Environment Directorates at ED level, to ensure that funding and workstream priorities are aligned with its effective implementation.

- Meeting the requirements of DEADP Directives:
  - Following significant sewage overflows into the sub-catchment in 2021, recommendations were made for a number of remedial interventions both within the Zeekoe Catchment and in Zeekoevlei itself, to address the impacts of significant ongoing long term pollution of these watercourses. These measures were outlined in a five part plan presented to the City in 2022 (see Day et al 2023). The City was subsequently Directed by DEADP to implement these measures. These included:
  - Remediation of water quality in Zeekoevlei through implementation of some of the required measures is included in Work Stream 4.2 of the MPP on Sanitation and Inland Water Quality (**Section 7.2.2** and **Table 7.2.1**). To date:
    - Dredging of Zeekoevlei has commenced, with the (medium term) disposal of organic sediments from Zeekoevlei allowed for in one of the former maturation ponds in the FBNR, and a ten year time frame for its disposal of elsewhere, ideally through beneficial re-use;
    - Funding has been set aside by the City for:
      - Upgrading of the Zeekoevlei and Rondevlei weirs to allow for deeper draw-down of the former and the passage of estuarine fish up the Zeekoe Canal into both of these, and commencement of the Zeekoevlei Weir upgrade is planned for September 2025;

- Other interventions
  - At the time of writing this report, three new waste interceptors had been installed in the Big and Little Lotus River catchments, at Duinefontein Road and Springfield Road (Big Lotus River) and at 5<sup>th</sup> Avenue (Little Lotus River) – the interceptors were undergoing design adjustments, to allow them to withstand heavy flows. Once in operation, these waste interceptors will bring the total to five in the Zeekoevlei catchment. The new interceptors (fences) will be managed by the CSRМ;
  - Liaison with The Litter Boom Project, resulting in this NGO providing two full-time staff members, who focus on ongoing removal of solid waste from the Big Lotus River downstream of Duinefontein Road – this hands-on approach is proving highly effective;
  - Ongoing focused strategic cleaning of sewers in the southern part of the catchment (downstream of Strandfontein Road) by Waste Water Conveyance (Region 1) – this is a pro-active response to reduce sewer blockages and overflows into the stormwater system, previously reported on in Day et al (2024);
  - Ongoing repairs to sewer bulk infrastructure – these should start to yield results in reduced spill frequency and risk;
- Communications, liaison and training:
  - The CSRМ engages actively with the City's BMB and community activists including the Friends of Zeekoevlei and Rondevlei (FOZR) in working together for solutions to problems of litter and pollution in the downstream environment. These include litter clean-ups and monitoring and management of litter fences;
  - Expansion of the River Warden Programme:
    - The primary objective of the River Warden Programme is to enhance ecosystem health in the City's catchment areas, by championing the eradication of invasive plant species, rehabilitation activities along waterways and litter collection and removal – this programme could also open up opportunities for improved river pollution surveillance and reporting; alien weed clearing. At present, it is focused only on areas within the City's Reserves. In the Big and Little Lotus catchments, these comprise the Edith Stephens Nature Reserve and the receiving environment, Zeekoevlei, in the FBNR. The programme provides short-term jobs and training to the river wardens (see **Table 7.2.1** in Section 7.2)



**Photo 8.8.5**  
**Newly constructed litter fence on the Big Lotus River (one of five litter fences as of June 2025).**  
Photo: CSRМ



**Photo 8.8.6**  
**Solid waste collected from Big Lotus River (June 2025) – ongoing daily collection by The Litter Boom Project, in collaboration with the City.**  
Photo: CSRМ



**Photo 8.8.7**

**Deployment of a long-arm excavator in Zeekoevlei to remove water hyacinth (March 2025), when extended pollution events prevented safe manual removal over several weeks**

Photo: Mr S. Jacobs, FOZR



**Photo 8.8.8**

**Early testing and establishment of the floating suction dredger on Zeekoevlei, May 2025. Photo: Mr S.**

Jacobs, FOZR

### **8.8.5 Inputs from the Zeekoe Catchment Management Forum**

The ZKCMF was established in July 2024, and is a relatively new forum, with a small but growing membership. The forum runs general meetings, at roughly twice-yearly intervals, but the main work of the forum is carried out by structured working groups, currently comprising a pollution abatement working groups, and alien clearing working group, an information assimilation working group, a communications working group and a special interest watercourse rehabilitation working group, for individual projects in the catchment, that could contribute to improved catchment condition and biodiversity conservation.

Strengths of the Forum include an active and engaged (acting) CSRSM regional manager (Mr L. Abdulla, CSRSM) as well as invested and enthusiastic community members, including Friends groups such as FOZR and Friends of Ottery Wetlands, as well as the Princess Vlei Forum. Other forum participants are driving proposed rehabilitation projects in the PHA, including the Lotus Stormwater Wetland Rehabilitation Project, which has yet to gain traction.

Issues that affect the efficacy of the Forum include the slow turn-around time by City departments regarding relatively simple interventions such as the design and installation of waste interceptor fences; delays in awarding of City funding for external agencies such as The Litter Boom Project, making commitment to solid waste removal projects in the catchment difficult; and difficulties in achieving effective communication lines with different Directorates and their various Departments and Branches, regarding planned interventions (and their timing) to address key problems. This makes communication within the Forum difficult, and risks flagging energy and support from Forum members.

Establishing effective communication lines between the Forum and the City's Directorates is a key issue, and requires the development of mutual trust and an understanding of working towards a common goal, to unlock synergies between the City's Directorates and the public and private partnerships that the Forum seeks to unlock.

### **8.8.6 Recommendations**

The main water quality issues in the Big and Little Lotus River derive primarily from poor provision of solid waste management and provision of adequate sanitation to manage sewage and grey water produced in inadequately serviced areas. Fecal pollution is a threat to the health and dignity of local communities in the Big Lotus catchment, as well as to users of Zeekoevlei and the beaches along the False Bay coastline adjacent to the Zeekoe canal outlet. Nutrients and other chemical pollutants associated with this water impact



important downstream inland aquatic ecosystems (Zeekoevlei).

In this context, the following measures are recommended, which require co-operative buy-in across multiple City departments and branches, if there is to be any measurable improvement in water quality in the Big and Little Lotus River catchments, and by implication, in Zeekoevlei downstream:

- Urgent implementation of the catchment TAP – this requires buy-in across multiple Directorates, and the planned collaboration at ED level, to reach agreement on deliverables and KPIs for different line items in the TAP (Section 8.8.4) is strongly supported. A risk in the TAP's assignment of responsibility for different tasks to named individuals rather than official roles, is that staff turn-over may quickly outdate the TAP, leaving some items void;
- Significantly increased focus on the frequency and volume of removal of solid waste at source – this is a complex issue and requires the focused attention of the Urban Waste Management Directorate. The inclusion of the Zeekoe Catchment among the priority catchments for Work Stream 6 in the MPP is strongly supported. Pollution hot-spots have been identified in the catchment, with input from the ZKCMF. These include large-scale accumulation of solid waste in the open channel past the Riemvasmaak informal settlement east of Buck Road – covering over of this channel, to limit access for dumping, accompanied by provision of regular cleansing and waste removal services, is strongly recommended;
- Attention to addressing existing known effluent discharges into the Big Lotus Canal, by diversion into sewers or alternative off-channel treatment (e.g. with package plants):

Known significant point source inflows are visible in the Big Lotus River at:

- The culvert downstream of Duinefontein Road, bringing untreated effluent from the Sweet Home informal settlement – this is the largest known point-source pollution stream into the Big Lotus River;
- Klipfontein Road culvert – this includes runoff from the Barcelona informal settlement, just downstream of the N2;
- The culvert at NY5 Street, downstream of the cemetery in Gugulethu;
- A culvert entering the river at NY3 Road, also in Gugulethu;
- Inflows from the Riemvasmaak informal settlement east of Buck Road (Lotus River area);

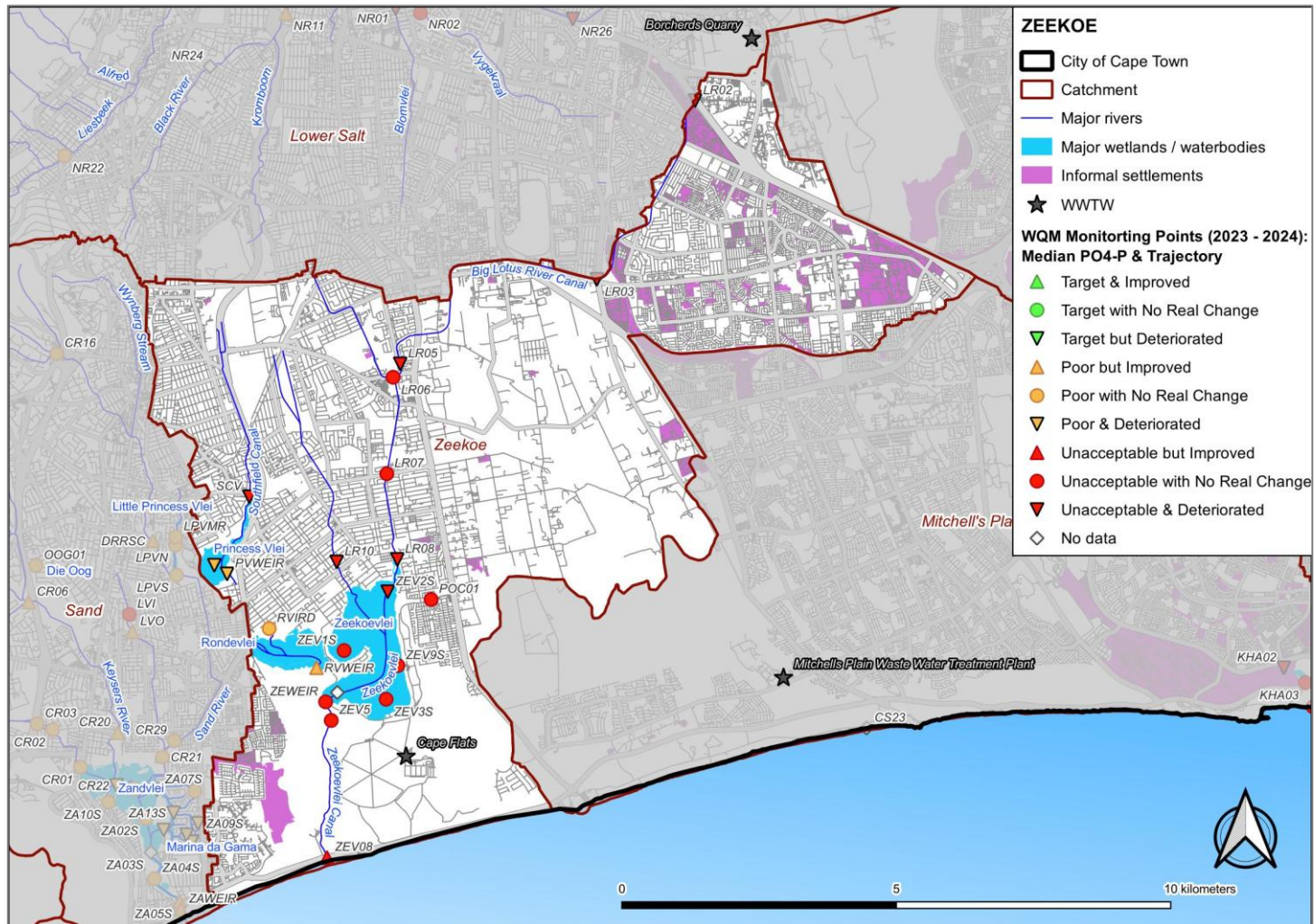
While diversion of polluted stormwater to sewer has been analysed as a generally unfeasible intervention for the City (Lukhozi 2025), the Big Lotus River Sub-catchment already includes low flow diversions to the WWTW, via the Springfield Road diversion. Since dry weather inflows into the Big Lotus River from the Sweet Home area appear to be concentrated flows of raw sewage and grey water, it is arguable that the existing low-flow diversion would be more effective if it was switched to allow for the diversion of the concentrated Sweet Home waste stream, rather than the current diversion of just a small proportion of this waste downstream, in a dilute form. **Urgent investigation of this approach is recommended.**

- A focus on interventions to provide solid waste collection and recycling opportunities, as well as sewage and stormwater servicing to the rapidly expanding informal and backyard settlements in the area;
- A focus on provision of improved bunding and short-term storage of effluent at all sewage pump stations, but particularly those abutting the FBNR and the Big and Little Lotus River canals;
- Pro-active maintenance attention to the multiple pump stations within the catchment, given that by far the most failures in the 2024 reporting period were attributed to electrical and mechanical issues (see **Figure 5.2.13** in Section 5.2);
- A change in the City's regional structure, so as to align with hydrological (major river) catchments, rather than with the current stormwater, sewage reticulation and urban waste management regions, none of which relate to surface runoff and do not facilitate strategic pollution abatement at a catchment level;
- Improved communication with the FBNR PAAC and the ZKCMF regarding planned interventions and their timeframes, to improve awareness among local interested and affected communities regarding City efforts to combat pollution, and challenges therein;
- Consideration of recommendations for the inclusion of Green Infrastructure and Nature-based Solution (NbS) in parts of the catchment, as per Turpie et al (2024), but bearing in mind the water quality constraints

to the efficacy of such measures in some parts of the catchment;

- Inclusion of additional monitoring points between the N2 and Govan Mbeki Road downstream of Jakes Gerwel Drive, to allow identification of point-source pollutants between these points.

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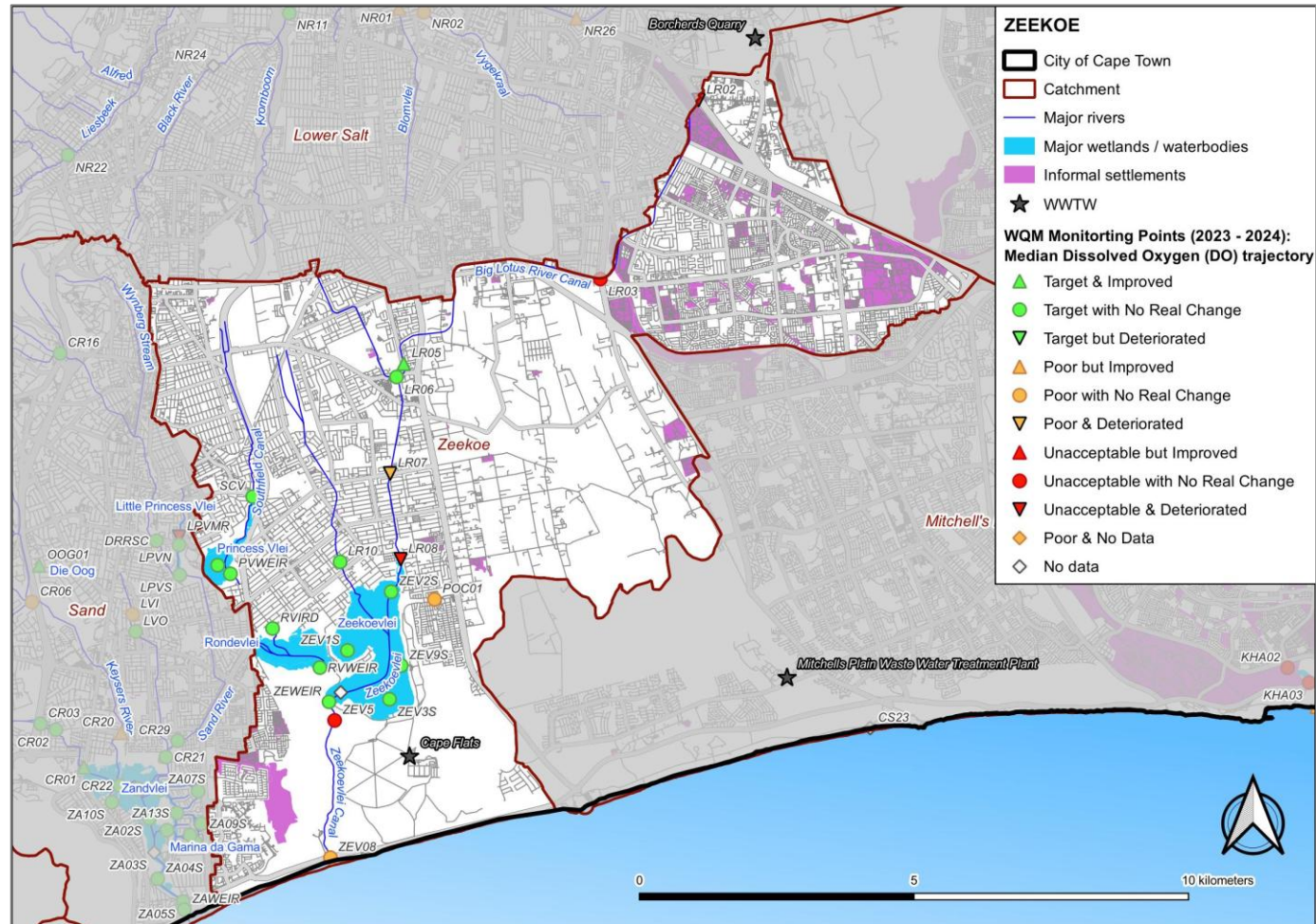


**Figure 8.8.1**

Median annual orthophosphate phosphorus (PO4-P) data, focusing on the ZEEKOE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14



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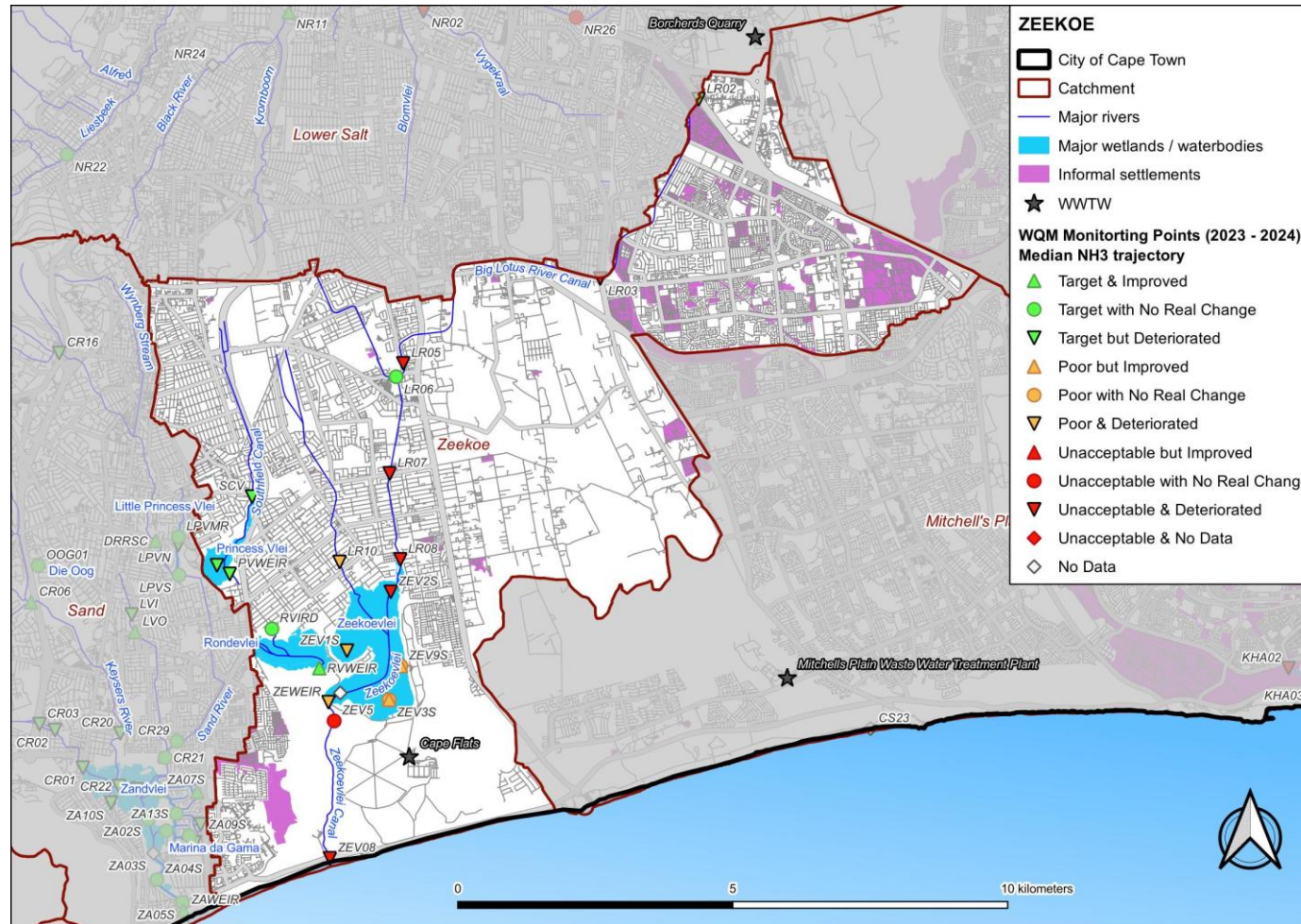


**Figure 8.8.2**

Median annual dissolved oxygen (DO) data, focusing on the ZEEKOE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14

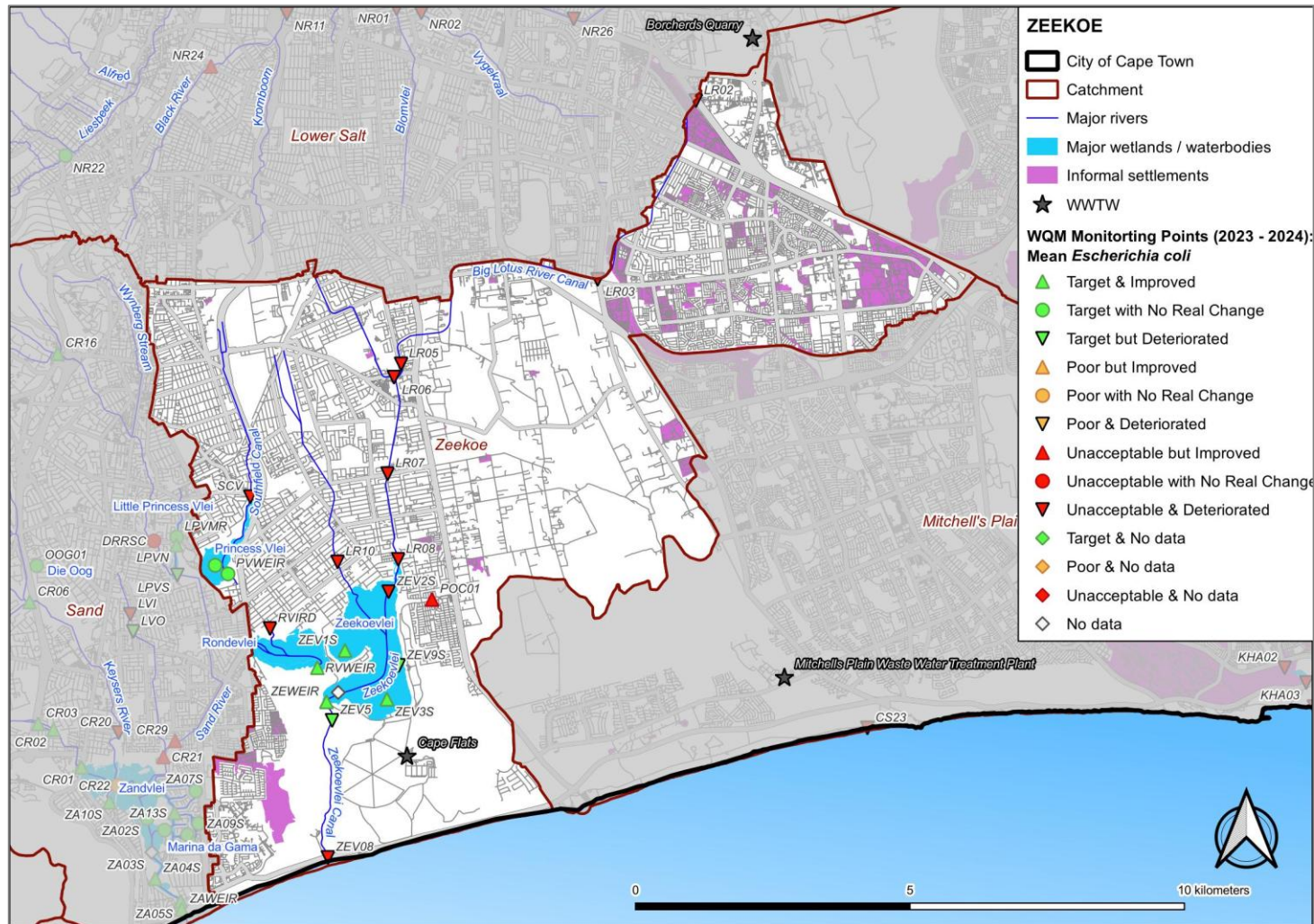


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**Figure 8.8.3**  
Median annual free ammonia (NH3) data, focusing on the ZEEKOE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14

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**Figure 8.8.4**

Mean *E. coli* (Geometric means) data, focusing on the ZEEKOE Sub-catchment. Data coded as to level of change in the 2024 reporting period, compared with the 2023 reporting period. Trajectory calculations explained in Section 3.11.14



## 8.9 What of non-priority catchment areas?

As emphasized in previous annual Inland Water Quality reports, effective catchment management measures that prevent the pollution of the City's waterways and downstream receiving environments are as important in non-priority catchments as in priority catchments. The priority catchments addressed in this report include, with the exception of the Sand Sub-catchment (see Section 8.7), most of the worst-performing, most problematic catchments in Cape Town. Missing from these is however arguably the Sir Lowry's Pass River catchment, which ought also to be included as an additional priority catchment. This system has severe upstream pollution issues, stemming at least in part from poor servicing of expanding backyard and informal settlements. In its reaches downstream of the T2, the City has commenced with a major river works project (the Sir Lowry's Pass River re-alignment project), which will result in channelisation of the river to provide space for floodplain development.

If water quality problems from upstream sewage infrastructure and the Sir Lowry's Pass Village persist, the required ecological mitigation measures that made this project ecologically acceptable at EIA phase will not be realised.

The remaining sub-catchments were, at least over the reporting periods considered here, in generally better condition from a water quality perspective. It is, however, very important that water quality in these systems does not deteriorate, and should ideally improve further. For this reason, it is strongly recommended that ongoing attention be paid to data for key indicative water quality parameters from sites in these systems, and any persistent (i.e. more than two consecutive months, or once-off but large-scale) deterioration in any of the monitored variables should be followed up by pollution tracking to identify likely pollution sources, followed up with interventions to address identified issues.

Such deterioration has been noted for the Silvermine and, to a lesser degree, the Lourens Catchments in the 2024 reporting period (see Section 5) and one of the important recommendations made in this report is for further investigation and preventative interventions in these catchments (Section 9.4.9).

Input from local residents, Friends Groups, Catchment Management Forums and other organisations relating to water quality concerns and known pollution 'hotspots' should be facilitated by the City.

## 8.10 Key take-away points

The following key points emerge from the above discussions:

- The most serious issues affecting water quality in the Cape Town's rivers and wetlands comprise **solid waste and sewage**, and the passage of the latter into watercourses by way of dry-weather flows from settlements; stormwater flows; sewage pump station overflows; sewer manholes and failed sewer lines. These issues are controlled by other line departments, but CSRM regional managers and their teams are often at the receiving end of failed reticulation, WWTW and solid waste management systems, and thus are accountable for polluted watercourses and the ecological and other impacts of this pollution, while being powerless to effect change at source.
- All of the City's priority catchments include runoff from informal settlements with poor access to sewerage systems. This means that water quality in stormwater systems is in many areas compromised, to levels where standard application of SUDS and other stormwater quality polishing / improvement approaches are unlikely to be effective – the Sand Catchment is the exception to this, but even this includes small areas of informality and some suburbs with extensive backyard dwellers.
- Solid waste in the sewerage system is a major contributor to blocked sewers and pump stations, resulting in added watercourse pollution – the passage of inappropriate waste into sewers via toilets or manholes is an issue that cuts across all sectors of Cape Town's communities, regardless of income, although the problem materials themselves differ. Addressing this issue through significantly ramped-up solid waste collection and educating communities in all areas as to the impacts of foreign material in sewerage systems is strongly recommended.
- The City's current regional stormwater management system results in some catchments extending

across two or more Stormwater Planning Regions. This means that in some cases, river catchments are managed by two or more CSRМ regional managers, making integration of projects and responsibilities unwieldy, and accountability for catchment condition difficult to achieve.

- Similarly, sewerage reticulation activities are also not carried out on a (river) catchment basis – this again means that efforts in one part of a reticulation zone may be negated by a lack of co-ordination with upstream reticulation managers, or by different strategies and levels of effort in different areas.
- While progress has been made in many catchments, and in priority catchments in particular, with regard to the development of PASAPs and increasingly detailed TAPs, discussions with regional stormwater management teams highlighted the importance of ensuring buy-in from transverse City Directorates or branches outside of CSRМ (who develop the TAPs), to ensure that the required interventions are feasible and, if not, to ensure that feasible alternatives are identified and incorporated into the TAPs, along with assigned (and agreed-on) responsibilities, to ensure that implementation of the TAPs has support across the multiple City Directorates for which the S&IWQP MMP has relevance.
- In areas not subject to high levels of sewage-impacted stormwater, the City is encouraged to implement or require implementation of SUDS-type interventions and implement pollution tracking when water quality deterioration is detected. These measures will help to maintain the current relatively good status of water quality in these catchments, which comprise:
  - The Silvermine Catchment
  - The Lourens Catchment
  - The Schusters Catchment and
  - The Liesbeek River and its tributaries within the Lower Salt Sub-catchment;
  - Parts of the Sand Catchment.
- The City's re-activation of the planned LUW projects in the Sand Catchment (as of the first quarter of 2025) is strongly supported in this report, as a vehicle to achieve measurable water quality improvement from catchment-scale interventions in moderately impacted catchments, carried out in combination with pollution abatement strategies such as sewer and pump station upgrades and repairs.



## 9 CONCLUSIONS AND RECOMMENDATIONS

### 9.1 Overview of water quality in rivers and other monitored water bodies

This report focused on the City's water quality data for the 2023 and 2024 reporting periods, against a baseline of data from the previous three years (2020 to 2022 reporting periods). Other data such as rainfall data, sewage pump station overflow data, WWTW effluent quality data and sources of information gathered from City officials, Catchment Management Forum Chairs and others regarding planned interventions to address water quality going forwards have also been considered, and drawn into various discussions in the report. This has made for a long, and in places technical, report. Its key findings and recommendations have however been pulled out relatively simply in this section, and will be summarised for broader public consumption in the planned Summary Water Quality Document for the 2023 and 2024 reporting periods.

**Table 9.1** provides a very high level summary of water quality condition and trajectory in all of the City's catchments, over the past five years. The table compares median data for all sites in each catchment, between 2024, 2023 and the 2020-2022 reporting periods, and presents trajectory using arrowed symbols, with trajectory calculated as per Section 3.11.14. Note that the summary nature of the table means that particularly poorly (or better) performing parts of catchments are not accurately reflected in the data, and data for individual sites, included in Table B2 (Appendix B), provide more site-specific summaries. Moreover, *E. coli* data are presented as geometric means, and not as median data (see Section 3.11.12).

The table does however clearly highlight (as do the more detailed analyses presented in this report) that **the most problematic and pervasive water quality issue almost throughout the City's monitored rivers and other watercourses was (and remains) orthophosphate enrichment**. No real improvement was evidenced in data from the 2024 reporting period, where 77% of "flowing" (river / stormwater) samples were rated "Unacceptable" (hypertrophic) and median orthophosphate concentrations lay well above the hypertrophic threshold for this variable in all catchments save the Lourens and Silvermine Catchments.

Hypertrophic conditions in aquatic ecosystems, and slow-flowing or standing water systems in particular, contributed towards ecosystem deterioration as a result of *inter alia* rapid growth of aquatic and emergent vegetation, requiring on-going control; accumulation of organic material from decaying algae and other material in standing water bodies, including some of the recreational vleis. These were in turn also often associated with knock-on socio-economic and human health impacts, such as vlei closures due to high microcystin concentrations (Zeekoevlei) and high costs of vlei dredging and plant clearing.

Compounding problems with the monitoring and management of phosphorus contamination in the City's waterbodies were problems with the data themselves, in that the City has been unable to analyse samples for total phosphorus since December 2022, and the equipment used for the analysis of orthophosphate has a relatively high detection limit, above the threshold for "Poor". **This means that early identification of deteriorating water quality in few better -performing catchments such as the Silvermine and Lourens Catchments, is not possible.**

Not only was orthophosphate enrichment a problem throughout most of the City's catchments, but the data in **Table 9.1** further suggest that there was substantial deterioration (>25% year-on-year increase) in this critical variable in some of the catchments (Lower Salt, Mosselbank and Soet). With regard to the City's standing waterbodies, these were also characterized by very low **N:P ratios**, conducive to dominance by blue-green algae (Cyanobacteria). This was evidenced in **chlorophyll-a** data for standing waterbodies, with only 35 to 40% of samples lying within the Target range for this variable in the 2023 and 2024 reporting periods. The most problematic systems, where the risk of algal blooms would have been high during the 2024 and previous reporting periods considered were Zeekoevlei, Princess Vlei and Wildevoelvlei. Despite these data and although blue-green algal blooms were clearly present on numerous occasions over the 2023 and 2024 reporting periods, the only recreational vlei in which **microcystin toxins** were recorded at concentrations of any concern in the 2024 reporting period concern was Rietvlei, where a single sample was rated as of Medium risk.

Nutrient enrichment in many areas stemmed from variously treated sewage effluent discharges and inflows

of raw sewage and grey water, mainly from informal settlements. This means that these flows were also often associated with high chemical and biological oxygen demand, reflecting in some systems having very low levels of dissolved oxygen to support desirable aquatic life. The worst hit of the assessed systems considered in this study comprised Milnerton Lagoon, the Soet Catchment, Zoarvlei and the highly contaminated Mitchell's Plain and Mew Way detention ponds. All assessed standing water bodies were however at times and in places affected by low DO that would have affected their suitability as habitats for moderately sensitive taxa.

Summary *E. coli* data presented in **Table 9.1** highlight how problematic raw sewage was, across the City's waterbodies, with 60% of river samples rated Unacceptable in the 2023 and 2024 reporting periods. Standing water bodies were generally less impacted, and data showed that 80% of standing water sites were in the Acceptable range for *E. coli*. Non-compliance was, moreover, driven by a few sites only (the Mitchell's Plain and Mew Way ponds for example had zero compliance over the 2024 reporting period). Lower levels of *E. coli* in standing waterbodies are often driven by dilution within the system as well as by extended exposure to sunlight, which breaks down *E. coli* (but not the nutrients and other pathogens associated with raw sewage).

Of concern is the fact that the data show a marked increase in both the frequency and the magnitude of sewage contamination of Cape Town's rivers between 2020 and the 2023 and 2024 reporting periods, with 2024 showing a similar proportion of sites falling within the "Unacceptable" range compared with 2023 but with a higher proportion of these showing an increased magnitude of exceedance of the Unacceptable threshold. Increasing frequency of *E. coli* concentrations in the Unacceptable range were noted in the usually best-performing Silvermine and Lourens Catchments, and these are flagged as particular concerns in these generally least-polluted systems, which are assumed to still have high ecological sensitivity to nutrient enrichment.

The above notwithstanding, while data show that all of the City's recreational water bodies periodically posed risks to human health during the 2023 and 2024 reporting periods, they were however largely in an Acceptable condition, conducive to their safe recreational use. Milnerton Lagoon was however mostly in an Unacceptable condition, and its use for recreation would have posed likely risks to human health most of the time – for this reason, the lagoon has in fact been closed by the City for recreation for several years.

Water quality in Cape Town's rivers, canals and stormwater systems ("flowing systems") was generally much poorer than in standing waters, largely because, with the exception of the monitored Mew Way and Mitchell's Plain detention ponds, the monitored standing water systems are generally not direct recipients of inflows of raw sewage and grey water, which makes its way into these systems via rivers and canals, and there is thus some dilution effect within the standing waterbodies as well as some natural amelioration through plant uptake and sedimentation.

**Table 9.1**

High level summary of water quality condition and trajectory in all of the City's catchments, over the past five years. Data comprise medians for all sites (flowing and standing water bodies) in each catchment, between 2024, 2023 and the 2020-2022 reporting periods. Trajectory shown with arrowed symbols – "up arrow" means improving; "down arrow" means deteriorating. Only changes >25% reflected (as per Section 3.11.14). Colours as per Table 3.1 and 3.3.

| Catchment    | 2020 to 2022  |       |                 |      | 2023          |       |                 |      | 2024          |       |                 |      |
|--------------|---------------|-------|-----------------|------|---------------|-------|-----------------|------|---------------|-------|-----------------|------|
|              | <i>E.coli</i> | PO4-P | NH <sub>3</sub> | DO   | <i>E.coli</i> | PO4-P | NH <sub>3</sub> | DO   | <i>E.coli</i> | PO4-P | NH <sub>3</sub> | DO   |
| Bokramspruit | 26,726        | 0.199 | 0.037           | 7.75 | 12,400        | 0.173 | 0.018           | 7.70 | 42,933        | 0.181 | 0.017           | 5.90 |
| City         |               |       |                 |      |               |       |                 |      | 8,217         |       |                 |      |
| Diep         | 3,687         | 1.225 | 0.022           | 6.20 | 1,486         | 0.565 | 0.014           | 6.90 | 2,328         | 0.541 | 0.023           | 6.40 |
| Eerste       | 10,608        | 2.315 | 0.064           | 4.95 | 9,271         | 1.700 | 0.042           | 6.00 | 35,079        | 1.9   | 0.0765          | 5.80 |
| Else         | 421           | 0.010 | 0.001           | 6.30 | 276           | 0.014 | 0.001           | 7.45 | 356           | 0.05  | 0.001           | 7.20 |
| Elsieskraal  | 1,529         | 0.040 | 0.005           | 8.25 | 1,460         | 0.067 | 0.004           | 8.70 | 932           | 0.05  | 0.005           | 8.00 |
| Hout Bay     | 6,599         | 0.033 | 0.001           | 8.80 | 5,006         | 0.050 | 0.001           | 8.70 | 3,971         | 0.05  | 0.001           | 9.15 |
| Kuils        | 41,012        | 1.400 | 0.043           | 6.60 | 28,519        | 1.525 | 0.045           | 7.10 | 150,247       | 1.6   | 0.1065          | 4.90 |
| Lourens      | 491           | 0.020 | 0.001           | 9.60 | 455           | 0.041 | 0.001           | 9.25 | 742           | 0.05  | 0.0005          | 9.40 |
| Lower Salt   | 124,866       | 2.539 | 0.134           | 4.90 | 99,736        | 1.456 | 0.166           | 4.20 | 252,065       | 2.16  | 0.145           | 5.05 |
| Mosselbank   | 13,335        | 1.400 | 0.044           | 5.50 | 5,566         | 1.200 | 0.017           | 5.80 | 3,539         | 1.6   | 0.026           | 5.30 |
| M'Plain      | 970,287       | 1.250 | 0.197           | 3.91 | 176,063       | 1.038 | 0.204           | 3.40 | 713,589       | 1.255 | 0.219           | 4.15 |
| Muizb        |               |       |                 |      |               |       |                 |      | 578           |       |                 |      |
| Noordhoek    | 727           | 3.701 | 0.739           | 7.58 | 239           | 4.327 | 0.615           | 6.90 | 91            | 3.195 | 0.1235          | 7.75 |
| Sand         | 918           | 0.047 | 0.003           | 8.70 | 561           | 0.050 | 0.004           | 8.60 | 541           | 0.05  | 0.005           | 8.60 |
| Schusters    | 561           | 0.049 | 0.001           | 5.90 | 256           | 0.050 | 0.001           | 5.95 | 156           | 0.05  | 0.00075         | 7.25 |
| Silvermine   | 234           | 0.015 | 0.001           | 8.45 | 157           | 0.033 | 0.001           | 8.70 | 754           | 0.05  | 0.0005          | 7.80 |
| SLPass       | 1,260         | 0.105 | 0.001           | 8.50 | 1,472         | 0.100 | 0.001           | 9.00 | 8,439         | 0.116 | 0.007           | 8.65 |
| Soet         | 381,612       | 2.021 | 0.404           | 3.40 | 419,003       | 2.445 | 0.252           | 3.85 | 848,327       | 3.71  | 0.744           | 3.00 |
| Sout         | 500           | 4.400 | 0.001           | 5.20 | 658           | 6.000 | 0.001           | 5.60 | 212           | 4.8   | 0.001           | 6.70 |
| Zeekoe       | 3,746         | 0.496 | 0.046           | 6.40 | 1,637         | 0.521 | 0.093           | 8.25 | 2,788         | 0.613 | 0.09            | 8.10 |

## 9.2 Identification of key pollution sources

Key sources of pollution in Cape Town's inland watercourses have been highlighted in previous annual inland water quality reports and remain similar over the 2023/2024 reporting periods. While there are many activities and landuses that contribute to cumulative water quality degradation in the City, the following are considered by far the most significant, and unless they can be addressed or their impacts mitigated, there is little likelihood that the City will be able to effect meaningful and measurable improvement in water quality in most of its managed sub-catchments.

These comprise:

- Inflows of treated effluent from the City's WWTWs:** These inflows comprise by far the largest source of pollution into the City's watercourses. This is because these discharge continually into inland watercourses, with a total volume of approximately 508 ML/day. Many of the major WWTWs did not treat effluent to anywhere close to general limits for Chemical Oxygen Demand (Potsdam, Cape Flats, Macassar and Klipheuwel WWTWs) and other parameters and even where they did, the volumes of effluent produced and the resultant loading of effluent into naturally seasonal river systems meant that these systems effectively comprised almost wholly effluent at least at times of the year, with little to no dilution from natural river water. COD data indicate that the most poorly performing WWTWs in this regard feed into the following river aquatic ecosystems:
  - o Eerste River estuary (Macassar WWTW);
  - o Black River and Salt River canal (Athlone and Borchard's Quarry WWTWs);
  - o Diep River estuary and Milnerton Lagoon (Potsdam WWTW);
  - o Zeekoe canal (Cape Flats WWTW); and

- Mosselbank River (and lower Diep River) (Klipheuwel WWTW) – note however that the effluent volume from this system was relatively low, so downstream loading was not marked).

Of the above, the impacts of the Potsdam and Macassar WWTWs on their downstream systems are considered particularly significant, as these WWTWs directly impact on what were largely functional estuarine habitats. In the case of Potsdam, poor and deteriorating effluent quality has been shown to have contributed largely to the collapse of this estuary and its once-important nursery for juvenile fish (Rose et al 2023).

Although the Cape Flats, Athlone and Borchard's Quarry WWTWs essentially now feed into canalised artefacts of urban drainage, these systems nevertheless play important roles in Cape Town's urban society and poor effluent quality both actively detracts from the value of the areas through which they pass, and has significant ecological costs – for example, the potential for estuarine fish to migrate up the Zeekoe Canal into the False Bay Nature Reserve – a Ramsar wetland of international importance – is compromised by large volumes of effluent outflows, often of very poor quality (Day et al 2022 and Clark and Gammon 2022). Similarly, the Black River accumulates organic sludges from upstream inflows of *inter alia* treated effluent, with CODs well above the capacity of this system to effect aerobic decomposition.

Improved performance in some WWTWs was however apparent in both loading and effluent quality data, in particular at the Zandvliet WWTW following its major upgrade in 2023.

Many other contaminants (pathogens, heavy metals, contaminants of emerging concern (CECs) (e.g. food additives, pharmaceuticals, and natural and synthetic hormones) are largely unquantified in the City's waste streams but are increasingly recognised as likely to pose significant ecological and /or human health threats.

Downstream water quality impacts may also be exacerbated by the unintended consequences of effluent disinfection. Where chlorination is used to disinfect effluent with high total ammonia concentrations, persistent potentially toxic chloramines may be formed and passed into downstream receiving water bodies. Thus WWTWs that perform well with regard to their *E. coli* data as a result of effective on-site chlorination, may in fact be contributing significantly to downstream pollution as a result of chloramine discharges.

Finally, it is noted that high concentrations of phosphorus in effluent from all WWTWs were apparent in final effluent data, despite compliance with regulated general limits. These limits are just under two orders of magnitude greater than the hypertrophic thresholds for aquatic ecosystems, and where treated effluent comprises the main water source in river systems, it is not surprising that phosphorus enrichment and its consequences is the major water quality constituent affecting Cape Town's inland waters from an ecological and management perspective.

Since sewer and WWTW capacity is cited by the City (and endorsed in Lukhozi 2025) as a reason that low-flow diversions of contaminated water to sewer are not feasible, urgent attention must be paid to dramatically increasing sewage conveyance and treatment capacity in catchments that are affected, or are likely to be affected, by informal and/or backyard settlements. This issue should be reflected in all planned future sewer, pump station and WWTW upgrades. Catchments most affected at present include (in no order) the Sout (Atlantis area), Diep, Lower Salt, Hout Bay, Sir Lowry's Pass, Kuils, Zeekoe and Mitchell's Plain Catchments.

## **2. Episodic overflows from sewage pump stations and surcharging manholes:**

A major, but episodic rather than perennial, source of raw sewage into the City's catchments is from the sewer system, with overflows occurring from blocked or malfunctioning pump stations; sewer manholes (because of sewer or pump station blockages); or as a result of sewer pipeline collapse /failure.

Over the 2023 and 2024 reporting period, a total of 875 pump station failures were recorded, including three catastrophic, 31 major, and 116 moderate pump station failures, with the other spills considered



minor to insignificant. It is possible (from the on-the-ground experience of the project team) that not all pump stations are recorded, particularly minor events or those that are out of the public eye. However, of the three catastrophic spill events, two were in the Diep catchment - Koeberg Road and Table View East pump stations (the third was at the Dalebrook pump station and sewage ran directly into the sea). The Koeberg Road pump station accounted for more than double the number of spills of any other pump station in the City. Given the volume of flows handled at this pump station, this is of particular concern for the Diep River Estuary.

The Diep sub-catchment was thus by far the most impacted by pump station failures, accounting for 19.6% of all failures in the two-year period assessed. These failures were largely the result of pump overloads, overheating, electrical failure, and clogging by rags. It is affected by pump overloads more than any other catchment, as a result of the failure of infrastructure to keep up with urban growth in this sub-catchment.

In general, electrical failure and rags caused the most major spills across the City;

Stormwater ingress, mechanical failure, electrical failure, and pump overloads were the most common causes of moderate spills;

Overall, the data show that mechanical and electrical failures are widespread issues affecting pumpstations in all catchments;

The top five most affected sub-catchments (Diep, Lower Salt, Kuils, Mitchells Plain and Zeekoe Catchments) accounted for 54% of all pump station failures in 2023-2024, while the Silvermine, Muizenberg, Hout Bay, Eerste, Sir Lowry's and Llandudno Catchments each accounted for < 1% of pump failures.

An often over-looked side effect of pump station failure into watercourses is its effect on the ability of the City and its service providers to carry out important maintenance activities in rivers and wetlands, including removal of solid waste and alien clearing, without risking major health impacts.

Attention to providing back-up generators / inverters to under-performing pump stations in the Lower Salt catchment is supported by pump station failure data, as is the need for improved filtration of solid waste from pump stations upstream of wet wells throughout the City but in the Diep, Lower Salt, Zeekoe and Kuils catchments in particular.

### **3. Runoff of grey- and blackwater from informal settlements and areas with high levels of backyard settlements:**

This is a pervasive issue affecting many of Cape Town's catchments, but particularly the Diep, Zeekoe, Kuils, Sir Lowry's Pass and Noordhoek Catchments, where in summer such flows, along with treated effluent in some areas, can account for almost all of river flows through affected catchments.

These highly contaminated waste streams not only constitute a severe health risk for children and other residents of local communities who live, play and have to cross through these areas, but they can also have significant impacts on water quality in downstream receiving river and wetland environments, which do not have the assimilative capacity for such long-term pollutant loading. Such inflows can negate any benefits of river rehabilitation activities in affected reaches.

Lukhozi (2025) assessed the feasibility of low flow diversions to sewer, and concluded that these measures are not feasible without major infrastructure upgrades. However, since raw sewage and grey water all stem from "allowed" development, some level of treatment is required, whether by way of localised package treatment plants or the diversion of low flows to WWTW precincts for more secure but separate treatment by way of package plants or other technology.

### **4. Accumulations of large volumes of solid waste and illegal dumping of waste**

Accumulated solid waste characterises many areas of the City's open spaces, roadways and pavements. Much of this waste enters watercourses, where it may contribute harmful pollutants to

aquatic ecosystems (e.g. cans containing oil and other toxins; used nappies and other organic waste) or block stormwater drains and channels. When solid waste is disposed of into the sewer system, it can block sewers and clog pumps at sewage pump stations, precipitating pump failure and overflows.

This issue stems largely from inadequate solid waste collection, compared with the volume of waste generated. The problem is concentrated in less affluent areas, and exacerbated by issues such as:

- Often confined spaces in shacks for hygienic refuse storage between collection periods;
- Lack of alternative options for the disposal of solid waste that is not accommodated by existing City waste disposal services (e.g. large objects such as couches and mattresses and rubble, that are not collected by the City);
- A culture of littering, dumping and waste in many communities;
- Poor compliance with and enforcement of bylaws around dumping and littering
- Limited access to recycling centres in some areas.

A focus on removal of solid waste from the most-impacted catchments before it enters sewerage or stormwater systems would considerably reduce knock-on water quality effects caused by blockages in sewers and pump stations, as well as reduce the cost of removal of solid waste from watercourses.

At the same time it is noted that a major contributor to sewer overflows in more affluent suburbs is the disposal of “wet-wipes” and sanitary products into the sewers via toilets – and this practice is also of major concern and not driven by limitations in service delivery.

### 9.3 Responses by the City to water quality issues

The above findings are not new and the MPP for Sanitation and Inland Water Quality as well as the WQIP (see **Section 7**) all recognise and reference the urgent need to address these complex issues. In particular, the committed investment in WWTW infrastructure refurbishment, upgrades and innovation (e.g. Zandvliet WWTW upgrades and the (currently in progress) Potsdam WWTW upgrades) and upgrading of major (and minor) sewer reticulation networks should, once on-line, contribute towards increasing separation of sewage from stormwater systems including Cape Town’s rivers, wetlands and estuaries.

Increased attention to collection of data that allows informed decision-making is evident in the increasing availability of, and improving quality of data for sewage pump station failures and their causes, as well as in the development of the inland water quality dashboard, allowing informed planning around catchment-level water quality interventions.

The City is also investing in other projects to redress aquatic ecosystem impacts stemming from a long history of catchment-scale pollution and other impacts such as canalization and wetland loss. Investment in dredging of accumulated organic waste in Zeekoevlei is an important step towards addressing the knock-on impacts of catchment-scale pollution, while lowering of the weirs of Zeekoevlei and Rondevlei are investments that will reduce on-going management costs and effort in these important systems in the future.

Addressing water quality in the City’s watercourses does however require strategic, co-ordinated and complementary inputs from multiple Directorates, Branches and Departments. This is complicated by the fact that these often have very different mandates and responsibilities.

An important initiative by many of the City’s Directorates and their department and branch officials over the past few years has been a significant improvement in communication with the general public regarding water quality issues and interventions to address them. While more could be done in this regard at a catchment level, the improvement in communications and acknowledgements of system failures and their causes to stakeholders should, over time improve public trust in City data, reporting and associated decision-making. The City’s spearheading the formation of Catchment Management Forums for several of Cape Town’s major catchments should, if actively engaged with, further help to drive City-public-private partnerships.

## 9.4 Key recommendations from this report

Recommendations to address water quality at a municipal level in a city where water quality is severely compromised could constitute a study on its own, and incorporate measures from major interventions to best practices that should result in water quality improvement if rolled out at scale. This section rather highlights the key interventions and/ or activities that stem from this assessment. Given that the issues affecting Cape Town's water quality remain similar to those of the previous inland report, it is not surprising that many of the recommendations remain the same, although some new recommendations have been made and a number of the recommendations previously made have already been implemented by the City (see Sections 2.8 and 2.9).

Upfront it must be stated that until the pervasive issues of pollution from WWTWs, inflows of raw sewage and grey water from informal settlements and backyard dwellings, and solid waste impacts can be addressed, it is unlikely that there will be a significant turn-around in water quality in many areas.

### 9.4.1 Addressing pollution from major WWTWs

The following recommendations and comments apply to this key water quality determinant, which affects water quality in at least parts of nine of the City's major catchments:

- The planned and progressing major capital investment by the City in upgrading of its WWTWs, sewer reticulation and solid waste collection systems is strongly supported, and the fast-tracking of the Potsdam WWTW upgrades and repairs in particular;
- Upgrading the capacity / licensed treatment of WWTWs in catchments with existing and rapidly expanding informal settlements and with high numbers of backyard dwellers should be prioritised, since water quality in these catchments will be difficult to improve meaningfully while raw sewage flows unabated into them. These catchments comprise: the Diep (already undergoing upgrades of Potsdam WWTW); the Zeekoe; the Kuils and the Mosselbank Catchments. These catchments moreover still retain elements of natural aquatic ecosystem function and include important downstream wetlands, estuaries and /or floodplain wetlands;

In the short-term, attention should however be paid to improving the management of existing WWTWs, many of which show very poor levels of compliance with regard to important variables such as COD, TSS, *E. coli* and performance has deteriorated at many of the City's WWTWs over the past few years. The inclusion in the MMP (Section 7) of the recent appointment of new project managers for WWTW upgrades is likely to contribute positively to this issue, while ongoing attention needs to be paid to ensuring the availability of spare parts.

With regard to phosphorus treatment by the City's WWTW, although the City's WWTWs were usually fairly compliant in terms of General Effluent Limits, these limits are very high from an ecological perspective. **It is recommended that measures to further reduce final effluent concentrations should be prioritised by the City for WWTWs that discharge into rivers that feed into important vleis, coastal lakes or estuaries, and contribute to algal and other plant blooms; and an increase in organic sludges from algal growth.** Reduced loading from these WWTWs would reduce both the ecological (and knock-on recreational and economic) costs of degraded aquatic ecosystems in urban areas, but also result in reduced management costs, in terms of clearing of invasive aquatic vegetation such as water hyacinth as well as reeds and the need for river and vlei dredging. Priority catchments should be the Diep (Milnerton Lagoon); Zeekoe (Rondevlei, Zeekoevlei and Princess Vlei), and the Kuils Catchments.

Note that phosphorus reduction does also need to be achieved at the City's WWTWs upstream of their final effluent release points – schemes to encourage the use of low orthophosphate detergents at a City level could be effective, and if financial incentives were attached (e.g. if phosphorus-free detergents are subsidised) there could be wide uptake across all economic and social sectors of the City.

Finally, it is recommended that the City's W&S Directorate should compile a dashboard, similar to that developed for inland water quality data, in which to publish weekly final effluent water quality and discharge

volumes from all of its WWTWs. This would improve reporting transparency; allow for the ready identification of improving or deteriorating WWTWs; and ideally improve management accountability as well.

#### **9.4.2 Addressing pollution from informal settlements and suburbs with high levels of backyard settlement**

This is a critical issue, and many of the Cape Town's rivers and wetlands are highly polluted by sewage and domestic effluent that rightfully belongs in the sewers, for conveyance to WWTWs for treatment. Unfortunately, because in practice this effluent flows in channels into rivers, it is often regarded by Wastewater and Reticulation officials as a stormwater problem. **It is not.**

This report recommends that:

- Stormwater Regions identify all major untreated effluent streams into watercourses at a catchment level, and quantify the discharges to allow for informed planning;
- Treatment of these waste streams must be provided by W&S, either by low-flow diversion to sewers and thence WWTWs, or by way of package treatment plants, established either along the effluent conveyance line before it reaches the river, or through the establishment of package plants at WWTWs themselves, to increase treatment capacity, while allowing for improved security and more ready management access;
- The diversion of effluent streams to sewer or treatment upstream of their passage into watercourses should be prioritized, over attempts to divert whole rivers or parts of their low flows to sewers, where the effluent quality is diluted and the flows are greater;
- Major existing waste streams into important inland watercourses comprise at least:
  - Diep River (Milky Way outlets (diversion works planned); Erica Road outfall (already being diverted to sewer));
  - Kleine Stink River (effluent streams from Doornbach and Du Noon – diversion of the Kleine Stink River proposed, to reduce its exposure to effluent and allow effluent diversion to sewer and enhanced treatment ponds (Lukhozi 2024);
  - Big Lotus River (major effluent stream from the Sweet Home and other informal settlements, with no intervention yet planned; multiple smaller effluent streams in the upper catchment);
  - Hout Bay River (effluent streams from Imizamo Yethu informal settlements, some of which are currently diverted to sewer under outflow conditions)
  - Major inflows into the Noordhoek wetlands from Masiphumelele informal settlements.

The above recommendations around diversions of flow or active treatment should be considered and included in short-to-medium term planning, with treatment of existing residents in Cape Town being prioritized over new developments.

- From a planning perspective, it is recommended that all new high-density, low cost housing planned for the City should be required to be serviced with adequately sized sewers, pump stations and available WWTW capacity to account for the probable four-fold increase in population size once additional backyard dwellings are included – inclusion of this recommendation would impact on nationally determined housing subsidy allocations, and could require additional funding from municipal budgets;
- It is further recommended that the City should consider the introduction of policies to require toilet cisterns in all new developments to be minimum-sized to reduce flow volumes to WWTWs.

The rapid and uncontrolled expansion of informal settlements in many areas of the City also needs to be addressed. Addressing this issue falls outside of the scope of this report but remains highly relevant to water quality concerns.



### **9.4.3 Addressing sewage overflows from pump station failure**

**Section 5.2.3** highlights the fact that the main reasons for pump station overflows, at least over the 2023 and 2024 reporting period, appeared to be rooted in mechanical and equipment failure, stormwater ingress, and pump-tripping as a result of rags and solid waste, noting that “rags” includes both rags and items such as “wet wipes”, prevalent in many more affluent suburbs. The first of these suggest poor maintenance of many of the City’s sewers over the past decades, resulting in pipes that are prone to stormwater ingress. Discussions with the City’s Pump Station

The following measures are recommended:

- Ensuring the availability of crucial spare parts; pro-active maintenance; and strategic upgrading of pump stations – these measures are all now included in the MPP for this Work Stream (Section 7), along with important upskilling of staff to allow in-house pump repairs and maintenance, and the MPP interventions outlined for this Work Stream in Table 7.1 are fully supported;
- Pump stations that fail frequently should be prioritized for repairs and upgrades, that take account of the main causes of failure – discussions with relevant Stormwater Regional Managers have highlighted the reductions in pump failures in some areas of the Kuils and Sand Catchments where additional pumps and back-up generators or inverters were installed in problem pump stations;
- Education campaigns are urgently required across the City, to highlight the effects of disposal of inappropriate material into toilets, and how this effects service delivery;
- Close liaison with the City’s Urban Waste Management Directorate is strongly recommended, with data for pump station failure as a result of solid waste ingress being used to help identify pollution hotspots and focal points for education, as well as for increased frequency of solid waste collection, where this is an issue driving the disposal of waste items into sewers.
- Pump station upgrades should include allowance for upstream sediment and solid waste traps, additional bunding as well as inclusion of grids / grates to reduce ingress by foreign objects, which clearly play a role in periodic pump station failure. The present inclusion of single grids that leave wet wells and pumps vulnerable to clogging during routine grid clearing should be re-visited and a dual grid system (or other innovative approaches) implemented instead.
- A change in the current institutional culture regarding the reporting of pump station failure is required. At present, pump station surcharges are regarded as a ‘failure’, not just of the pump station, but also of its operator. As a result, many shorter-duration spills, particularly in pump stations out of the public eye, go unreported. This issue needs to be addressed in a creative manner.

### **9.4.4 Reducing the passage of solid waste into stormwater systems and watercourses**

This report was compiled shortly after the Urban Waste Management Directorate was assigned to a sixth Work Stream in the MPP, namely “Reducing pollution and solid waste in catchments and rivers”.

The interventions included in **Table 7.1** for this Work Stream are supported by this report. However, the following additional measures are recommended or emphasized here:

- Since the objective of the new Work Stream is to improve water quality in catchments and rivers, it is important that its activities be planned and implemented on a catchment basis as well – traditionally, Urban Waste Management is planned and managed on a street plan basis. Better tracking of improved outcomes can be achieved if efforts are catchment-centered;
- Collection of solid waste must be upscaled in the City to reduce the high levels of waste that accumulate in many areas and blow, wash or are dumped into the stormwater system, from where their removal is costly and recycling is difficult. Sub-catchments that are particularly prone to the build-up of solid waste include the Soet, upper Sir Lowry’s Pass, lower Kuils, Lower Salt, Diep, lower Hout Bay, north-eastern Sand and upper Zeekoe sub-catchments;

- The frequency of solid waste collection at source should be increased in the above areas so that collection outstrips the rate of solid waste accumulation. Innovative approaches such as the “Swap shop” recommended for roll-out in the Soet Sub-catchment and already piloted in some parts of Cape Town should be considered for broader implementation, as such approaches add value to waste – Section 8 noted that this programme is under-resourced, with only one trailer at present. Funding for additional resources should be considered or explored with outside partners;
- The planned roll-out of waste interceptor fences in several of Cape Town’s watercourses that are most afflicted by solid waste is strongly supported, with the proviso that:
  - As far as possible, these interceptors are placed as close as possible to known solid waste hotspots in the catchment, rather than being located at the downstream end of the catchment, by which organic sediments have built up in plastic and other waste and waste removal is more difficult and expensive, as well as having contributed to a long section of river degradation;
  - Interceptor fences must be designed appropriately for their intended use and location – they need to be resistant to vandalism and theft and able to collect large volumes of solid waste without posing flood risks;
  - Learnings from existing fences (e.g. Fisherman’s Walk fence on the Big Lotus River) should be considered in designing new fences;
  - More agility is required to implement such structures effectively and efficiently – the three interceptors placed in the Zeekoe Catchment took almost nine months from concept to construction, allowing many tonnes of waste to pass downstream in the interim;
  - Adequate allowance must be made for the maintenance of these structures (removal of waste) and, importantly, their clearing by Urban Waste Management teams (Cleansing), noting that vandalism of bagged solid waste left overnight on river banks in some areas calls for daily collection of bagged material;
  - Public-Private Partnerships with organisations including The Litter Boom Project and others should be encouraged, to spread the load of the enormous task of freeing the City’s watercourses up from their current solid waste loads and its impacts;
- Covering over some canalized systems has been suggested as a measure to reduce the incidence of dumping of large items of solid waste into these systems. In general, covering over of rivers is not supported from an aquatic ecosystems or water quality perspective. Closed canals / piped systems tend to be characterized by high ammonium concentrations, with low oxygenation reducing nitrification rates and increasing potential ammonia toxicity. A covered canal is also a regressive step in the transition towards a “water sensitive city”. However, it is recognized that in some areas, pollution of local canals is extremely high and seemingly unlikely to be relieved in the near future. There may be better arguments for such measures in these systems – however, given that improved urban waste management is promised in Work Stream 6 of the MPP, canal covering should be seen as a last resort, and only after efforts at waste reduction and management;
- In order to accelerate the uptake of potentially game-changing products such as the CRDC SA: <sup>20</sup>RESIN8 CRDC product presented to the Section 80 WQWW&CE (29 November 2024), it is recommended that the City actively pursues mechanisms to increase the uptake of green building aggregate such as this in its own construction projects (for example, the roll-out of IRT lanes) and explore ways to encourage the private sector to adopt these products as well.

#### **9.4.5 Making changes in stormwater and sewerage reticulation management structures**

An important recommendation from both this and previous Inland Water Quality reports is for a change in the City’s regional management structures, across both sewerage reticulation areas and stormwater planning

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<sup>20</sup> RESIN8 comprises an (approved for construction) concrete aggregate, with up to 20% recycled plastic (Avenant 2024).

regions, so as to align management areas and responsibilities with hydrological (major river) catchments, rather than with the current stormwater (see **Section 2.7**) and sewage reticulation regions, which do not relate to surface runoff and do not facilitate strategic pollution abatement at a catchment level, since different regional managers and their teams have responsibility for different parts of the catchment, meaning that they lack ownership.

#### **9.4.6 Fast-tracking implementation of PASAPs and TAPs**

PASAPs and associated TAPs have been developed for several areas of the City to date, including all Priority Catchments.

It was noted in compilation of the present report that these have been developed to considerably more detail than previous versions, with proposed timelines for many interventions having shifted from "Long Term" to timeframes reflecting a greater urgency. Some of the TAPs also go further, in assigning specific responsibility for different line items, meaning that there will be greater accountability for tasks. This is noted as an important step forwards.

However, reaching the point of TAP sign-off appears slow, and hindered by the need for transversal engagement across different Directorates, Departments and Branches, often with different budget priorities. It is recommended that these issues be addressed at a high level in the Directorates, to drive more rapid sign-off and implementation.

It is also recommended that the TAPs include measurable outcomes / targets and time frames, against which effort and impact can be measured.

Additional PASAPs should moreover be compiled and implemented for other key pollution hotspots, including the lower Kuils River, the upper Sir Lowry's Pass River, the upper Sand River through Retreat and the Diep River sub-catchments, outside of the areas managed by the Diep River Estuary Management Plan.

#### **9.4.7 Changing targets for interpreting sewage contamination in water quality data**

The City has a 60% target for meeting Acceptable *E. coli* Risk levels in any sub-catchment. This low target seems counter-productive and it is strongly recommended that a target of 100% Acceptable samples would be more appropriate. This is particularly so because many of the City's citizens are regularly exposed to contact with water in watercourses that are not managed for recreational use. This recommendation is carried through from the previous Inland Water Quality Report.

#### **9.4.8 Targets for interpreting other water quality parameters**

Reporting on other water quality constituents also at times uses the 60% "target". In terms of ecological reporting, this is not a useful threshold and it would be more informative simply to comment on changes in the proportion of samples in the Unacceptable Category over years or between Catchments.

#### **9.4.9 Conservation of existing sub-catchments in relatively good condition**

Water quality data reported on in this document highlighted the fact that some sub-catchments / parts of catchments were in a generally good condition (i.e. target thresholds for key ecological and human health variables were usually met).

These sub-catchments (the Silvermine, Lourens, (upper) Hout Bay and parts of the Sand sub-catchments, as well as the Liesbeek River sub-catchment of the Salt River Catchment), should be safeguarded, with attention paid to addressing any sources of periodic pollutant inflows.

Such an approach would at least ensure that these systems remain in relatively good condition, particularly as none of them receive WWTW effluent, and only the Hout Bay sub-catchment receives significant runoff from poorly serviced informal settlements.

This report noted with concern however that the frequency of sewage contamination had increased over the past two reporting periods in both the Lourens and the Silvermine Catchments, with the latter also showing an increase in orthophosphate concentrations at least at times in the 2024 reporting period. It is assumed

that these relate to periodic (low level) sewer overflows into the Lower Silvermine River. More recent data for these catchments should be investigated with urgency, and sources of low-level pollution should be identified and addressed with urgency.

#### **9.4.10 Conservation of remnant floodplains and their wetlands**

Few of the City's rivers today retain floodplain wetlands in good condition. The most important remnants today comprise those along the Diep River, downstream of the railway line crossing; the Kuils River (Nooiensfontein wetland and surrounding floodplain; uninhabited wetlands downstream of the N2) and the lower Eerste River (downstream of the N2). These areas in particular should be safe-guarded by the City as critically important systems from both a biodiversity / habitat protection perspective, but as importantly from the perspective of increasing the City's resilience to floods and flooding, particularly in the light of climate change projections. From a water quality perspective, such an approach would also avoid the devastating permanent and largely unmitigable impacts of sewage and grey water pollution that would be associated with the alternative likely establishment of unserviceable settlements in these low-lying flood-prone areas.

#### **9.4.11 Prioritisation of LUW programme implementation**

The LUW programme is a forward-thinking potentially far-reaching programme that offers the City opportunities to effect measurable change in river condition and function at scale. Once implemented, projections and experience of similar approaches in eThekweni Municipality suggest (Mc Donald 2024) that the economic gains per catchment, including avoided costs such as flood damage, and benefits such as increased property value and provision of public amenity, readily outweigh implementation costs.

The catchment approach also offers other strengths, in allowing more holistic management of watercourses. For example, attention to the systematic removal of water hyacinth at a catchment scale offers a much more efficient approach to effecting long term plant control than the narrow approach of focusing operations on repeat clearance of single vleis or river sections, which at best achieve short-term maintenance.

The re-funding of the LUW Programme in mid 2025 is strongly supported, particularly in the Sand Catchment, where generally better water quality in many parts of the catchment mean that rehabilitation impacts are less likely to be over-ridden by upstream water contamination impacts, and measurable improvement may reasonably be expected over time.

#### **9.4.12 Changes to the City's water quality monitoring programme**

The recommendations made in this section relate specifically to changes that would improve the efficacy of the current City water quality monitoring programme in being able to inform water quality data interpretation, water quality management and water quality improvement policy and implementation.

##### **9.4.12.1 New sample sites**

CSRMS have included an additional 65 monitoring points to the routine monitoring programme (see Section 3.6). These are intended to:

- Include more holistic representation of water quality across the City's watercourses (i.e. ambient water quality monitoring), whereas the existing programme has traditionally been skewed towards pollution hotspot areas, selected to track and mitigate pollution;
- Complement planned river flow measurements at selected sites, thus allowing for the calculation of pollution loads;
- Provide additional data in some watercourses to allow better pollution tracking and identification of point-source inflows.

An important point regarding the above is that comparison of long-term data with more recent data at a catchment level becomes complex, as it will not be clear whether change (improvement or degradation) reflected in data reflects real change, or simply the inclusion of better or worse-performing sites.

There are two work-arounds to this issue, and both are recommended, namely:



1. There should be more emphasis in reporting on changes in individual sites than at a catchment level generally – such changes could be reflected by site per catchment, as currently done for Priority Catchments in Section 8;

2. Sites should also be coded as to whether they represent (at a baseline point) highly degraded, moderately degraded or least impacted sites, and assessed in these separate categories per catchment.

An additional waterbody that should be included in the City's water quality programme is the **Paardevlei Wetland** (Lourens Catchment). The vlei has water quality data going back to 2012 (e.g. Day 2014), at varying frequencies, and these should ideally also be incorporated into the City's database. At the time of writing this report, wetland was in the process of being incorporated (through Government Gazette) into the City's managed Nature Reserves.

#### **9.4.12.2 Water quality variables**

Monitoring of the following additional variables is recommended (as per previous reporting):

- **Orthophosphate phosphorus** analyses must be carried out to lower detection limits than the current 0.1 mg P/L. A return to previous analytical methods that allowed for detection limits of <0.01 mg P/L is strongly recommended, if changes in phosphorus pollution trajectory is to be adequately tracked;
- Analyses for **total phosphorus** must be re-commenced as a matter of urgency;
- At existing or new sampling points downstream of all WWTWs that discharge effluent into rivers, vleis or estuaries:
  - Chloramine and COD testing in receiving waters downstream of WWTWs;
  - Heavy metal analyses, with heavy metals to be determined based on sub-catchment land use characteristics – given the costs of such analyses, heavy metal analysis could be carried out infrequently (e.g. annually), with a view to identifying systems where some metals may be accumulating in concentrations of concern;
- At all existing inland recreational water bodies, where *E. coli* counts are currently analysed, Enterococci testing should be allowed for as well, with a view to moving from *E. coli* to enterococci testing over time and providing alternative data against which to check *E. coli* data.

The 2020 Inland Water Quality report recommended that intestinal enterococci should be monitored in inland water bodies. This was based on a recommendation in WHO (2003) and was reiterated in WHO (2021).

Although the SSB included intestinal enterococci monitoring in data used in the 2023 Inland Water Quality Report, this monitoring was subsequently discontinued. This appears to be a decision in part relating to the fact that most of the City's historical microbiological data base includes *E. coli* and not enterococci data; to the costs and other ramifications of attaining laboratory certification for these analyses; and to the costs of essential duplication of both datasets, over an extended period, to allow a switch from one methodology to another.

However, the opportunity costs of not including enterococci analysis with routine analysis of at least recreational water bodies are as follows:

- The SSB's inland water quality monitoring programme becomes progressively outdated compared with global standards;
- There are no alternative datasets with which to assess the magnitude and associated human health risks of sewage pollution into water bodies – this is particularly important, given the recent (2021-2022) history of the SSB's poor laboratory performance with regard to *E. coli* analyses (see Section 3.8.8).
  - This report recommends that enterococci analyses should be provided for, along with *E. coli* analyses, at least in recreation water bodies
- Assessment of the City's water bodies for a suite of Contaminants of Emerging Concern (CECs) should also be carried out by CSR, even if only on an occasional basis, to provide context to CEC data to be produced during planned monitoring of coastal waters in the vicinity of the City's coastal waste

water outfalls.

#### **9.4.13 Improving understanding of strengths and weaknesses of different *E. coli* analyses**

In terms of reporting on *E. coli* data in this report, the changes in analytical approaches and the significant differences between the SSB's Colilert and the independent laboratory's MF methodologies mean, further, that it is difficult to use data over the present five year monitoring period usefully, with major changes in technology that have not included detailed comparative assessments of differences between the two.

The great discrepancy in results presented in the CSRM (2024) report suggests that this issue requires serious and urgent attention. The use of multiple accredited laboratories for split sample testing using both MF and Colilert technologies is strongly recommended to inform analysis and interpretation of data for this critical variable.

#### **9.4.14 Reporting water quality data**

The system for reporting of *E. coli* and other bacteriological data must be standardized to allow for better statistical analyses of these data. It is important that data reflecting samples that have not been analysed to an actual count are at least taken as close to that number as possible, through multiple laboratory dilutions, facilitated by the Colilert system currently being used by SSB. In particular, ">" annotation should not be used to reflect counts that are less than the threshold for Unacceptable. Moreover, in highly polluted watercourses, data simply reflecting ">x", where x is above the Unacceptable limit but still relatively low relative to the actual degree of pollution, such data do not allow pollution tracking or the identification of likely zones of increasing contamination.

During discussions with SSB and CSRM in the present project, it was suggested that these issues could be dealt with by formalizing an analysis protocol that requires standard dilution of all river samples to by  $10^{-2}$  and  $10^{-4}$ . This would allow analysis of *E. coli* concentrations between 100 and 24 196 000.

Recreational vleis are currently analysed to dilutions of  $10^{-1}$ ,  $10^{-2}$  and  $10^{-4}$ .

#### **9.4.15 Water quality data availability**

The City's allowance in early 2022 for open public access to water quality data from its routine monitoring programme through the City data portal is fully supported. The useability of this database has moreover been significantly enhanced through the development of the Water Quality Dash Board, which was launched in late 2024 and has proved a valuable resource for many CSRM regional managers, who use it to inform pollution tracking and policing interventions (subject in some of the more polluted areas to the constraints highlighted above).

#### **9.4.16 The need to link water quality data to pollution control interventions**

The City's routine water quality monitoring produces an extensive ongoing dataset. However, without using these data to trigger further investigations or to design and carry out specific interventions to address sources of pollution or police identified polluters, the City is simply producing a record of water quality deterioration. It is recommended that targeted short-term pollution tracking projects should also be set up in all of the priority sub-catchments, and the findings of these programmes used to design appropriate interventions, with a view to using water quality data to make sound management decisions and interventions.

It is important that such data are not included in the routine monitoring dataset, or they will skew the data towards sites in very poor condition, monitored at a high frequency.

#### **9.4.17 Improvements in data quality or data availability from other City datasets**

##### **9.4.17.1 Flow data**

Water quality data on their own do not allow calculations of loading on downstream ecosystems. This means that the impact of high concentrations from small discharge sources may be over-estimated, while significant impacts resulting from large discharges of less polluted effluent may be missed.

CSRM is currently investigating which sites would best lend themselves to monitoring of both flow and water quality. Flow measurement approaches could be technology-driven with recording devices, or (more practically) carried out using depth measurements at controlled areas (e.g. culverts), where the cross-section can be surveyed and discharge curves calculated.

Given financial constraints as well as the likelihood that instrumentation would be stolen or vandalised in some areas, it is suggested that a combination of these approaches might be most practical.

##### **9.4.17.2 Capturing pump station and CE3 spill data per catchment**

Capturing of data for sewage pump failures is a very useful resource, the quality and usefulness of which has improved dramatically over the last few years. In this report, it is used for helping to understand when, where and at what scale, different parts of the catchment have been impacted by these events and to assist in interpretation of water quality data. More importantly however, the data allow for informed decision-making and planning around the specific challenges, maintenance requirements and vulnerabilities of different pump stations, to guide repair and maintenance effort.

Further separation of some reporting categories might assist in this. For example, the term "rags" is used to include a range of items, including wet wipes, which are increasingly being identified as a major cause of blockages in more affluent areas. Grouping with rags suggests however an indigent community problem, and loses the opportunity to drive behavioral change among wet wipe users. Similarly, electrical failure, mechanical failure and pump tripping could usefully identify where these are as a result of blockage from solid waste or sediment, versus equipment failure from lack of maintenance or expertise.

#### **9.5 Inland Water Quality Reporting**

The present Terms of Reference for and format of the Inland Water Quality Report make for extensive reporting that details watercourse change and condition with regard to a range of key water quality variables. In order to simplify water quality reporting, and make its outputs more accessible to wider non-technical audiences, it is recommended that the City updates its (2013) Ecological and Recreational Use Water Quality Indices, and use these in annual reporting instead of the current format. The Indices output a single rating per water sample (A-F), which is based on consideration of the concentrations and condition thresholds of the full range of variables considered individually here.

The Technical Manual for these indices, outlined in Day et al (2013) would provide a starting point for this approach.

#### **9.6 Role of residents in improving water quality in Cape Town's watercourses**

Finally -it must be stressed that water quality in Cape Town's watercourses is not determined solely by the City's interventions. Residents also need to play a role in reducing sources of pollution into watercourses. Key focal areas include.

- Responsible disposal of waste, by binning, bagging or recycling it
- Reducing the volume of waste produced by thoughtful purchasing and attention to reuse and recycling of waste
- Reducing organic waste by composting
- Disposing of polluted water into the sewer and not the stormwater system thus dirty household wastewater, swimming pool backwash, bin washing water and other polluted water should be disposed of in the sink or toilet so that it enters the sewer network and travels to WWTWs for treatment,

rather than the stormwater system . Remember that water passed onto the road network enters the stormwater system

- Urgent reporting of sewage spills or sewage pump overflows in any areas to the City's "Report a fault" (C3 notification) system by phoning 0860 103 089 or going online to: [www.capetown.gov.za/servicerequests](http://www.capetown.gov.za/servicerequests).
  - Regular cleaning out of restaurant grease traps, as a build-up of fats in the sewer system is a major cause of blockages and sewer overflows.
1. Washing vehicles on soft, porous surfaces such as grass or sand from where the greywater gets absorbed into the soil, rather than on paved areas from where polluted water will flow directly into the stormwater system.
  2. Disposing of used oil, paint and other products that contain harmful chemicals at City-approved drop-off facility, and not into the stormwater system or sewer network.
  3. Using eco-friendly products in gardens and for cleaning vehicles. When it rains, chemicals in fertilisers, pest control and cleaning products end up in the stormwater system, harming our rivers, streams, wetlands and the ocean.
  4. Making a concerted effort to use low-orthophosphate detergents and other products, wherever possible, to help reduce the orthophosphate load on rivers, vleis and wetlands, and to help transition Cape Town towards a phosphorus-free city;
  5. Getting involved – join your Catchment Management Forum or local Friends Group.



## 10 REFERENCES

- Avenant, A. 2024. RESIN8 - The Concrete Solution to Plastic Waste. Presentation to the Section 80 WQWW&CE (November 2024).
- Bernascon, B., Volponi, G. and Bonadonna, L. 2006. Comparison of three different media for the detection of E. coli and coliforms in water. Water Science & Technology Vol 54 No 3 pp 141-145 IWA Publishing.
- Brown, C. and Magoba, R. 2009. Rivers and Wetlands of Cape Town. WRC report TT 376/08. Pretoria
- Buckalew, D.W., Hartman, L.J., Grimsley, G., Martin, A.E. and Register, K.M. 2006. A long-term study comparing membrane filtration with Colilert® defined substrates in detecting fecal coliforms and Escherichia coli in natural waters. Journal of Environmental Management. Volume 80, Issue 3, 2006, Pages 191-197, ISSN 0301-4797,
- Catchment, Stormwater and River Management (CSRM). 2025. Update Report: Review of Inland Water Quality Sampling Points. April 2025. Report by N. Garcia. CSRM Branch. City of Cape Town.
- City of Cape Town (City). 2021. Zandvlei waterbody open to the public. Media release, 1 October 2021. Available: <https://www.capetown.gov.za/Media-and-news/Zandvlei%20waterbody%20open%20to%20the%20public>
- City of Cape Town (City). 2023a. Decision-making to partially close, close or reopen each of the City's recreational vleis located within Protected Areas: Zeekoevlei, Zandvlei and Rietvlei. System and Procedure (S&P).
- City of Cape Town (City). 2023b. Pollution Abatement Strategy and Action Plan (PASAP) for the Soet River catchment. Internal report by the CSRM for the City of Cape Town.
- City of Cape Town and Infinity Environmental. 2021. Diep River Estuarine Management Plan
- City of Cape Town. 2022. Infrastructure report. December 2022. [https://www.investcapetown.com/wp-content/uploads/2023/02/35076-City-Mayors-Infrastructure-Report\\_FA-interactive.pdf](https://www.investcapetown.com/wp-content/uploads/2023/02/35076-City-Mayors-Infrastructure-Report_FA-interactive.pdf)
- Clark, B.M. and Gammon, E. 2022. False Bay Nature Reserve Rehabilitation Plan. Specialist Study on Fish. Draft Report. 17 pp. Clark BM. 2018. RDM Study for Rietvlei/Diep Estuary. Report prepared by Anchor Environmental Consultants as part of the Reserve Determination and Resource Quality Objectives process for the Berg Water Management Area.
- Colenbrander, D. 2023. Coastal Management Update Report. City Report of August 2023 to the Section 79 Portfolio Committee - Spatial Planning and Environment
- Cooke, G.D., Welch, E.B., Peterson, S. and Nichols, S.A. 2005. *Restoration and management of lakes and reservoirs*. Third Edition. Taylor & Francis, Boca Raton.
- Dallas, H.F., Day J.A., Musibono, D.E., and Day, E.G. (Liz). 1998. Water quality for aquatic ecosystems: tools for evaluating regional guidelines. WRC Report No. 626/1/98. Water Research Commission, Pretoria, South Africa.
- Day, E. (Liz). 2023. Draft Maintenance and Management Plan for the Asanda Village Wetland Park. Report to the City of Cape Town.
- Day, E. (Liz). 2024. The proposed dredging of Zeekoevlei: Specialist aquatic ecosystems impact assessment. Report to Infinity Consulting for the City of Cape Town.
- Day, E. (Liz) and Clark, B. 2012. Development of a Water Quality Index and Related Reporting Tools and Information for Inland and Coastal Waters of the City of Cape Town: Review and evaluation of existing local and international water quality indices. Consulting report prepared for the City of Cape Town.
- Day, E. (Liz), Clark, B., van Eeden, D., Rose, J. 2022. False Bay Nature Reserve Sewage Spill Rehabilitation and Action Plan: Volume 1: Assessment Report.
- Day, E. (Liz), Ollis, D., Ngobela, T., Rivers-Moore, N. 2020. Water Quality of Rivers and Open Water bodies in the

City of Cape Town: Status and Historical Trends, with a Focus on the Period April 2015 to March 2020. Technical Report to the City of Cape Town by Liz Day Consulting (Pty) Ltd.

- Day, E. (Liz), Ollis, D., Stock, S., Wilson, I. and Matthews, S. 2023. City of Cape Town Inland Water Quality Report for the period April 2020 to March 2022 (2020 and 2021 Reporting Periods). Technical Report to the City of Cape Town by Liz Day Consulting (Pty) Ltd.
- Day, E. (Liz), Ollis, D., Day, M. and Wilson, I. 2024a. City of Cape Town Inland Water Quality Report for the period October 2021 to September 2023 (2022 and 2023 Reporting Periods). Technical Report to the City of Cape Town by Liz Day Consulting (Pty) Ltd.
- Day, E. (Liz), Smyth, T., and Rose, J. 2024b. *Monitoring and Assessment of the Efficacy of Instream Aeration in the Diep River Estuary in Cape Town*. Report prepared by Liz Day Consulting & Infinity Environmental for the City of Cape Town.
- Day, E. (Liz), Dorse, C., Dorse, S., Bell, J., Rose, J., Smyth, T., van Schalkwyk, F., and Murgatroyd, O. 2024c. *City of Cape Town Wetland Report*. Prepared for the City of Cape Town, December 2024. Infinity Environmental & Liz Day Consulting Report 19065-01.
- de Wit, M., Van Zyl, H., Crookes, D., Blignaut, J., Jayiya, T., Goiset, V., Mahumani, B. 2009. Investing in Natural Assets. A business case for the environment in the City of Cape Town. 10.13140/RG.2.1.1013.3847.
- Department of Environmental Affairs (DEA). 2012. South African Water Quality Guidelines for coastal marine waters. Volume 2. Guidelines for recreational use.
- Department of Water Affairs and Forestry (DWAF). 1996a. South African Water Quality Guidelines (second edition), Volume 7: Aquatic Ecosystems.
- Department of Water Affairs and Forestry (DWAF). 1996b. South African Water Quality Guidelines (second edition), Volume 2: Recreational Use.
- Department of Water Affairs and Forestry (DWAF). 2002. South African National Water Quality Monitoring Programmes Series National Eutrophication Monitoring Programme. Implementation Manual.
- Department of Water Affairs and Forestry (DWAF). 2003. Water Quality Management Series, Sub-Series No. MS 8.2. A Guide to Conduct Water Quality Catchment Assessment Studies: In Support of the Water Quality Management Component of a Catchment Management Strategy. Edition 1. Pretoria.
- Department of Water Affairs and Forestry (DWAF). 2006a. Resource Directed Management of Water Quality: Management Instruments. Volume 4.2: Guideline for Determining Resource Water Quality Objectives (RWQOs), Allocatable Water Quality and the Stress of the Water Resource. Edition 2. Water Resource Planning Systems Series, Sub-Series No. WQP 1.7.2. ISBN No. 0-621-36793-1. Pretoria, South Africa.
- Department of Water Affairs and Forestry (DWAF). 2006b. Water Resource Planning Systems Series. SUB-SERIES NO. WQP 1.7.2. Resource Directed Management of Water Quality. Management Instruments. Volume 4.2. Guideline for Determining Resource Water Quality Objectives (RWQOs), Allocatable Water Quality and the Stress of the Water Resource. August. 2006. Edition 2. Pretoria
- Department of Water Affairs and Forestry (DWAF). 2011. Planning level review of water quality in South Africa. Resource directed management of water quality. Department of Water Affairs, Pretoria.
- Department of Water and Sanitation (DWS). 2018. Determination of Water Resources Classes and associated Resource Quality Objectives in Berg Catchment: Outline of Resource Quality Objectives. Report. Project Number WP10987. DWS Report No: RDM/WMA9/00/CON/CLA/0218
- Department of Water Affairs and Forestry (DWAF). 2008. Methods for determining the water quality component of the Ecological Reserve. Report prepared for Department of Water Affairs and Forestry, Pretoria, South Africa by P-A Scherman of Scherman Consulting.
- Department of Water Affairs and Forestry (DWAF). 2006b. Resource Directed Management of Water Quality: Management Instruments. Volume 4.3: Guideline on Monitoring & Auditing for Resource Directed Management of Water Quality. Edition 2. Water Resource Planning Systems Series, Sub-Series No. WQP 1.7.3. ISBN NO. 0-621-36796-6. Department of Water

Affairs and Forestry, Pretoria, South Africa.

- Geist, D.R., Linley, T.J., Cullinan, V. and Deng, Z. 2013. The effects of total dissolved gas on chum salmon fry survival, growth, gas bubble disease, and seawater tolerance. *North American Journal of Fisheries Management*. 33(1):200-15.
- Gerrans, L. 2022. Mayor's Priority Programme: Sanitation and Inland Water Quality. June 2022 report to the Section 79 Portfolio Committee - Spatial Planning and Environment  
[https://resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/Know\\_Your\\_Coast\\_2021\\_Report.pdf](https://resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/Know_Your_Coast_2021_Report.pdf)
- ICE Group PTY (LTD). 2009. Diep River Water Quality Study for City.
- Infinity Environmental, 2023a. Remediation Planning for Recreational Water bodies in Cape Town: Specialist Assessments to inform proposed dredging of the Flamingo Vlei section of Table Bay Nature Reserve: Part 1: Status quo report.
- Infinity Environmental, 2023b. Remediation Planning for Recreational Water bodies in Cape Town: Specialist Assessments to inform proposed dredging of the Flamingo Vlei section of Table Bay Nature Reserve: Part 2: Assessment Report.
- Jackson, V.A., Pause, A. N., Odendaal, J. P. and Khan, W., 2009. Investigation into metal contamination of the Plankenbrug and Diep Rivers, Western Cape, South Africa. *Water SA* 35(3):289-29.
- Jackson, V.A., Pause, A. N., Odendaal, J. P. and Khan, W., 2009. Investigation into metal contamination of the Plankenbrug and Diep Rivers, Western Cape, South Africa. *Water SA* 35(3):289-29.
- Kadlec, R.H. 2019. *Treatment Marshes for Runoff and Polishing* (1st ed.). CRC Press.  
<https://doi.org/10.1201/9780429451935>
- Killick, M. 2024. Capital Programme for Wastewater Treatment Plants. City Report of March 2024 to the Section 80 Committee: Water quality and wetlands
- Know Your Coast. 2021.
- Lukhozi. 2022. Background Information Document: Liveable Urban Waterways in the Sand catchment. Prepared by Lukhozi Consulting Engineers (Pty) Ltd, June 2022. Available: <https://lukhozi.co.za/documents/>
- Lukhozi. 2023. Hout Bay Catchment Pollution Abatement Comprehensive Study. Report No. 1699/04/01: Revision No. 00, June 2023. Prepared by Lukhozi Consulting Engineers for City of Cape Town: Stormwater and River Management Directorate.
- Lukhozi. 2024. **Error! Reference source not found.. Contract Ref. Error! Reference source not found.. Error! Reference source not found.. Error! Reference source not found..** Report to the City of Cape Town: CSRM Branch.
- Lukhozi. 2025. City-wide low-flow stormwater-to-sewer diversion study (Phase 1b). Contract Ref. 194c/2020/21, Works Project No. Csrn-008. Feasibility Study: Phase 1b Report. Report No. 1699/08/02: Revision No. 1. January 2025. Report to the City of Cape Town.
- Malan, H.L. and Day, J.A., 2005. *Wetland water quality and the Ecological Reserve* (p. 214). Pretoria: Water Research Commission.
- Mc Donald, A. 2024. Liveable Urban Waterways Programme. March 2024. City report to the Section 80 Committee: Water quality and wetlands
- McBride G. and Payne, G. 2009. *Hazen Percentile Calculator*. URL: <https://environment.govt.nz/assets/Publications/Files/hazen-percentile-calculator-2.xls> Accessed: 15/04/2023
- McDonald, A. 2025. The Liveable Urban Waterway Programme. Report to the MPP. May 2025.
- Millard, N.A.H. and Scott, K.M.F., 1954. The Ecology of South African Estuaries: Part VI: Milnerton Estuary and

- the Diep River, Cape. Transactions of the Royal Society of South Africa, 34(2), pp.279-324.
- Ollis, D.J., Snaddon, C.D., Job, N.M. and Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.
- Petersen, C., Volschenk, M., Siebritz, R. and Hoosain, N. 2022. An Assessment of the Hout Bay Catchment in the City of Cape Town. SSB Report No: SSB202210-01, October 2022. Scientific Services Branch, City of Cape Town: Water & Sanitation Department.
- River Health Programme (RHP). 2003. State-Of-Rivers Report: Diep, Hout Bay, Lourens And Palmiet River Systems. Department Of Water Affairs And Forestry, Pretoria.
- River Health Programme (RHP). 2005. State of Rivers Report: Greater Cape Town's Rivers. Department of Water Affairs and Forestry, Pretoria.
- Rose, J., Clark, B., & Armitage, M. 2023b. Zandvlei Estuarine Management Plan. Report by Anchor Environmental & Infinity Environmental for the City of Cape Town.
- Rose, J., Hojem, G., Basson, G., Day, E. (Liz), Clark, B., Winter, K. 2023. Water Quality Remediation Plan for the Milnerton Lagoon.
- Rose, J., van Schalkwyk, F., Smyth, T., Gilmour, K., and Day, E. 2025a. *Report on Water Quality Monitoring in the Milnerton Lagoon in November and December 2024*. Report prepared by Infinity Environmental for the City of Cape Town.
- Rose, J., van Schalkwyk, F., Smyth, T., and Bawuli, A. 2025b. *Report on Water Quality Monitoring in the Milnerton Lagoon on 5 February 2025*. Report prepared by Infinity Environmental for the City of Cape Town.
- Smith, F. 2005. Environmental Advisory Report for the sewage pollution impacting the Kuils River: Environmental Compliance Notice to the City of Cape Town
- Smith, F. 2025a. Pollution Impacting The Soet River, Strand: Report Of A Visual Inspection Conducted By Environmental Compliance On 17 March 2025. Internal Report To The City Of Cape Town.
- Smith, F. 2025b. Environmental Compliance. Escalation Notice: In terms of the Procedure for the Remediation and Escalation of Environmental Non-Compliance – City Manager Directive 10 of 2021. Sewage pollution impacting the Kuils River: Report of visual inspections conducted by Environmental Compliance on 13 February 2025 and 01 April 2025.
- UNESCO. 1983. Algorithms for computation of fundamental properties of seawater. *UNESCO Technical Papers in Marine Science* 44:1-55.
- Vogel RM (2020). The geometric mean? *Communications in Statistics - Theory and Methods*. DOI: 10.1080/03610926.2020.1743313.
- World Health Organisation. 2003. Guidelines for safe recreational water environments. Volume 1, Coastal and fresh waters. Geneva, Switzerland. 219pp ISBN 92 4 154580 1 (NLM classification: WA 820
- World Health Organisation. 2021. Guidelines on Recreational Water Quality. Volume 1: Coastal and Fresh Waters. Geneva: World Health Organization; 2021. License: cc BY-NC-SA 3.0 IGO.
- Wright, K. 2023. Zandvlei Update. A shifting System. . City report to the Section 80 Committee: Water quality and wetlands.



## APPENDIX A: WATER QUALITY SAMPLING SITES AND MONITORING RECORD

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**Table A1**  
**Frequency of samples collected per site in each sub-catchment for the 2020 to 2024 reporting periods**

| Subcatchment | Site code | Type           | Location                                                                 | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|-----------|----------------|--------------------------------------------------------------------------|------|------|------|------|------|
| Bokramspruit | BOK02     | River dataset  | Bokramspruit River upstream of Slangkop Road                             | 9    | 15   | 12   | 13   | 12   |
|              | BOK03     | River dataset  | Bokramspruit River a short distance d/s of Flamingo Rd                   | 10   | 13   | 12   | 12   | 11   |
| City         | CN06B     | River dataset  | Rocklands stormwater pipe discharge                                      |      |      |      |      | 8    |
|              | CN16B     | River dataset  | Saunders Rocks stormwater discharge                                      |      |      |      |      | 23   |
|              | CN17A     | River dataset  | Three Anchor Bay stormwater pipe discharge at rocks (left from top) - A  |      |      |      |      | 24   |
|              | CN17B     | River dataset  | Three Anchor Bay stormwater pipe discharge at rocks (centre) - B         |      |      |      |      | 4    |
|              | CN17C     | River dataset  | Three Anchor Bay stormwater pipe discharge at rocks (right from top) - C |      |      |      |      | 24   |
|              | CN17E     | River dataset  | Three Anchor Bay stormwater pipe discharge at rocks (west of subway) - E |      |      |      |      | 11   |
|              | CN24      | River dataset  | Graaff's Pool stormwater 1 discharge                                     |      |      |      |      | 8    |
|              | CN25      | River dataset  | Graaff's Pool stormwater 2 discharge                                     |      |      |      |      | 7    |
|              | CN26      | River dataset  | Graaff's Pool stormwater 3 discharge                                     |      |      |      |      | 19   |
|              | CN27      | River dataset  | Bakoven stormwater discharge                                             |      |      |      |      | 24   |
|              | CN28      | River dataset  | Camps Bay stormwater discharge                                           |      |      |      |      | 7    |
|              | CN33      | River dataset  | Bakoven stormwater next to pump station                                  |      |      |      |      | 24   |
| Diep         | MAC       | Standing water | Rietvlei in front of Milnerton Aquatic Club                              | 22   | 27   | 51   | 44   | 51   |
|              | MCC       | River dataset  | Milnerton Canoe Club (Diep River)                                        | 17   | 27   | 26   | 18   | 22   |
|              | MOS05     | River dataset  | Diep River u/s Mosselbank River confluence                               | 6    | 13   | 10   | 9    | 7    |
|              | PEV1      | Standing water | Zoarvlei (south end) at corner of Vrystraat and Grey St                  | 16   | 26   | 24   | 26   | 26   |
|              | PEV2      | Standing water | Zoarvlei (centre) at Wemmys road footbridge                              | 11   | 16   | 18   | 27   | 13   |
|              | RTV01     | River dataset  | Diep River at Blauwberg Road bridge                                      | 42   | 67   | 71   | 72   | 62   |
|              | RTV02     | Standing water | Rietvlei at jetty                                                        | 20   | 35   | 28   | 29   | 30   |

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| Subcatchment | Site code | Type           | Location                                                     | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|-----------|----------------|--------------------------------------------------------------|------|------|------|------|------|
|              | RTV03     | River dataset  | Stormwater canal from Theo Marais Park (Montagu Gardens)     | 17   | 26   | 25   | 27   | 27   |
|              | RTV04     | River dataset  | Stormwater channel from Bayside Mall (into Rietvlei)         | 14   | 26   | 29   | 27   | 28   |
|              | RTV04_DS  | River dataset  | Stormwater channel from Bayside Mall d/s of Blaauwberg Rd    |      |      |      | 1    |      |
|              | RTV04_US  | River dataset  | Stormwater channel from Bayside Mall u/s of Blaauwberg Rd    |      |      |      | 1    |      |
|              | RTV05     | River dataset  | Outlet from Rietvlei at Otto du Plessis Drive bridge         | 20   | 56   | 63   | 67   | 60   |
|              | RTV06     | River dataset  | Diep River downstream of N7 road bridge                      | 7    | 26   | 21   | 25   | 25   |
|              | RTV08     | River dataset  | Duikersvlei Stream u/s of confluence with Theo Marais canal  | 13   | 27   | 24   | 27   | 26   |
|              | RTV09     | River dataset  | Diep River estuary at Woodbridge Island (Loxton Rd)          | 19   | 29   | 29   | 32   | 26   |
|              | RTV10     | River dataset  | Diep River estuary at mouth                                  | 22   | 29   | 29   | 31   | 27   |
|              | RTV11     | River dataset  | Diep River d/s of Potsdam WWTW                               | 43   | 69   | 71   | 72   | 61   |
|              | RTV12     | River dataset  | Canal d/s confluence TM & Duikersvlei                        | 19   | 28   | 23   | 28   | 27   |
|              | RTV14     | River dataset  | Stormwater channel next to Bayside Mall d/s of Blaauwberg Rd | 10   | 11   | 24   | 24   | 24   |
|              | RTV17     | Standing water | Water Sport Area middle; Rietvlei                            |      | 1    | 21   | 28   | 27   |
|              | RTV18     | River dataset  | Rietvlei north of island opp Broad Rd                        | 7    | 12   | 26   | 29   | 26   |
|              | RTV19     | Standing water | Rietvlei north west near Bayside Canal inlet                 | 4    | 3    | 24   | 27   | 31   |
|              | RTV22     | River dataset  | Railway bridge near container yard                           |      |      |      | 2    | 26   |
|              | RTV34     | Standing water | NOT KNOWN                                                    |      |      |      | 3    |      |
|              | RTV35     | Standing water | NOT KNOWN                                                    |      |      |      | 3    |      |
|              | RTV36     | Standing water | NOT KNOWN                                                    |      |      |      | 3    |      |
|              | RTV37     | Standing water | NOT KNOWN                                                    |      |      |      | 3    |      |
|              | RTVBUOY1  | Standing water | Rietvlei Water Body@Bouy1                                    | 5    | 5    | 28   | 27   | 32   |
|              | RTVBUOY2  | Standing water | Rietvlei Water Body@Bouy2                                    | 5    | 13   | 29   | 27   | 32   |
|              | RTVBUOY4  | Standing water | Rietvlei Water Body@Bouy4                                    | 5    | 12   | 29   | 27   | 30   |
|              | RTVBUOY6  | Standing water | Rietvlei Water Body@Bouy6                                    | 5    | 12   | 29   | 27   | 30   |

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| Subcatchment | Site code            | Type           | Location                                                     | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|----------------------|----------------|--------------------------------------------------------------|------|------|------|------|------|
|              | RV_SCOT              | Standing water | Northern shore- Scotto Hide - right side of boardwalk        |      |      |      | 1    |      |
|              | THEO_MARAIS_D_STREAM | River dataset  | 100m d/s of TM Park STW system                               | 13   | 19   | 22   | 29   | 26   |
| Eerste       | EK08                 | River dataset  | Kuils River d/s of Baden Powell Drive bridge                 | 58   | 60   | 64   | 61   | 60   |
|              | EK11                 | River dataset  | Kuils River d/s of Zandvliet discharge (dirt road bridge)    | 58   | 60   | 64   | 61   | 60   |
|              | EK12                 | River dataset  | Eerste River u/s of Macassar WTW (d/s of Kuils confluence)   | 61   | 62   | 61   | 60   | 60   |
|              | EK13                 | River dataset  | Eerste River on N2 Freeway (u/s of Kuils confluence)         | 9    | 12   | 12   | 12   | 12   |
|              | EK15                 | River dataset  | Kleinvlei canal                                              | 9    | 12   | 12   | 12   | 12   |
|              | EK17                 | River dataset  | Eerste River estuary                                         | 61   | 63   | 61   | 60   | 58   |
|              | EK18                 | River dataset  | Moddergatspruit River at Macassar Rd                         | 8    | 12   | 11   | 12   | 10   |
| Else         | GC02                 | Standing water | Glencairn vlei centre - at concrete berm                     | 12   | 12   | 12   | 14   | 12   |
| Elsieskraal  | ANG01                | Standing water | Angelier Park upper dam near Van Riebeeckshof Rd             | 12   | 12   | 12   | 15   | 13   |
|              | ANG02                | Standing water | Angelier Park lower dam near Van Riebeeckshof Rd             | 9    | 12   | 9    | 15   | 11   |
|              | DOOR01               | Standing water | Doordekraal Dam at large stormwater outlet on Angelier Stre* | 11   | 12   | 11   | 13   | 13   |
|              | DOOR03               | Standing water | Doordekraal Dam at south end next to dam wall                | 12   | 12   | 12   | 15   | 13   |
|              | ELS_GW               | River dataset  | Elsieskraal River near Grandwest and Goodwood Station        | 9    | 12   | 12   | 12   | 12   |
|              | ELS08                | River dataset  | Elsieskraal River at Nightingale Way                         | 9    | 12   | 12   | 12   | 12   |
|              | ELS10                | River dataset  | Elsieskraal at Carl Cronje Rd                                | 8    | 8    | 11   | 12   | 12   |
| Hout bay     | DR01                 | River dataset  | Hout Bay River at Princess St                                | 13   | 12   | 13   | 12   | 12   |
|              | DR02                 | River dataset  | Hout Bay River at Victoria Road                              | 13   | 13   | 12   | 12   | 12   |
|              | DR04                 | River dataset  | Hout Bay River at Longkloof Rd                               | 10   | 13   | 12   | 12   | 12   |
|              | DR05                 | River dataset  | Hout Bay River estuary                                       | 12   | 12   | 12   | 12   | 12   |
|              | DR06                 | River dataset  | Disa River at Bethal Rd                                      | 10   | 12   | 12   | 12   | 12   |
|              | HB11                 | River dataset  | Yacht Club stormwater discharge                              |      |      |      |      | 4    |
| Kuils        | EK03                 | River dataset  | Bottelary River at Amandel Rd                                | 9    | 12   | 12   | 10   | 6    |
|              | EK04                 | River dataset  | Kuils River at Carinus street bridge                         | 56   | 59   | 61   | 60   | 59   |
|              | EK05                 | River dataset  | Kuils River in canal u/s of Stellenbosch Arterial Rd         | 9    | 11   | 12   | 12   | 12   |



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| Subcatchment | Site code | Type           | Location                                                     | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|-----------|----------------|--------------------------------------------------------------|------|------|------|------|------|
|              | EK09      | River dataset  | Kuils River d/s Belville WWTW discharge at Rietvlei Rd       | 56   | 59   | 61   | 60   | 59   |
|              | EK19      | River dataset  | Kuils River d/s R300 off old bridge                          | 9    | 12   | 12   | 12   | 12   |
|              | EK20      | River dataset  | River d/s of Scottsdene WWTW                                 | 49   | 50   | 46   | 51   | 61   |
|              | KHA01     | Standing water | Pond in Site C on Mew Way                                    | 9    | 12   | 10   | 11   | 12   |
| Lourens      | LOU01     | River dataset  | Lourens River at Vergelegen Estate                           | 12   | 14   | 12   | 12   | 11   |
|              | LOU02     | River dataset  | Lourens River in P.O.S., Hillcrest Rd                        | 9    | 14   | 12   | 12   | 11   |
|              | LOU03     | River dataset  | Lourens River at Main Rd - Somerset West                     | 9    | 14   | 12   | 12   | 11   |
|              | LOU04     | River dataset  | Lourens River at Broadway Rd                                 | 9    | 14   | 12   | 12   | 11   |
|              | LOU05     | River dataset  | Lourens River on Beach Road                                  | 12   | 14   | 12   | 12   | 11   |
|              | LOU06     | River dataset  | Lourens River in Lourensford Estate at "Red Bridge"          | 9    | 14   | 11   | 12   | 11   |
|              | LOU08     | River dataset  | Lourens River between Old Bridge and Main Rd Bridge          | 9    | 14   | 12   | 12   | 11   |
|              | LOU13     | River dataset  | Stormwater outlet from wetland on Vergelegen Rd              | 5    | 7    | 5    | 7    | 2    |
| Lower salt   | ELS08     | River dataset  | Elsieskraal River at Nightingale Way                         | 9    | 12   | 12   | 12   | 12   |
|              | NR01      | River dataset  | Blomvlei Canal at Koodoo Street u/s of Vygekraal River conf* | 10   | 12   | 11   | 12   | 12   |
|              | NR02      | River dataset  | Vygekraal River at Cornflower Street u/s of Blomvlei Canal * | 10   | 12   | 12   | 12   | 12   |
|              | NR03      | River dataset  | Vygekraal River u/s of Athlone WTW                           | 36   | 12   | 11   | 12   | 12   |
|              | NR04      | River dataset  | Vygekraal River d/s Athlone WTW                              | 13   | 12   | 11   | 12   | 12   |
|              | NR06      | River dataset  | Black River at Raapenberg Road bridge                        | 10   | 12   | 12   | 13   | 12   |
|              | NR07      | River dataset  | Black River on Footbridge to Alexandra Institute             | 10   | 12   | 12   | 12   | 12   |
|              | NR08      | River dataset  | Liesbeek River downstream of Lake weir opp. Hartleyvale      | 10   | 12   | 12   | 12   | 11   |
|              | NR09      | River dataset  | Salt River Canal at Voortrekker Road bridge                  | 10   | 12   | 12   | 12   | 12   |
|              | NR10      | River dataset  | Salt River Canal at Marine Drive Bridge - Paarden Eiland     | 13   | 12   | 12   | 12   | 12   |
|              | NR11      | River dataset  | Black River in Rdbosch Golf Course                           | 9    | 12   | 11   | 12   | 12   |
|              | NR15      | River dataset  | Jakkalsvlei Canal at N2                                      | 58   | 61   | 61   | 54   | 60   |
|              | NR16      | River dataset  | Langa Canal on N2                                            | 9    | 12   | 12   | 12   | 12   |
|              | NR17      | River dataset  | Kalksteenfontein Canal nr Netreg Stn                         | 10   | 12   | 11   | 12   | 12   |

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| Subcatchment | Site code | Type           | Location                                         | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|-----------|----------------|--------------------------------------------------|------|------|------|------|------|
|              | NR22      | River dataset  | Liesbeek River on Paradise Road                  | 9    | 12   | 10   | 11   | 12   |
|              | NR24      | River dataset  | Black River at Sandown Road                      | 8    | 9    | 9    | 5    | 3    |
|              | NR25      | River dataset  | Vygekraal d/s of Athlone WWTW at Jan Smuts Drive | 34   | 14   | 12   | 12   | 12   |
|              | NR26      | River dataset  | Kalksteen Canal at corner Robert Subukwe and N2  | 59   | 61   | 60   | 54   | 60   |
| Mosselbank   | MOS01     | River dataset  | Maastricht Canal u/s WWTW                        | 58   | 67   | 68   | 62   | 58   |
|              | MOS02     | River dataset  | Maastricht Canal d/s WWTW                        | 56   | 67   | 68   | 61   | 58   |
|              | MOS03     | River dataset  | Mosselbank trib d/s Fisantkraal                  | 8    | 20   | 19   | 12   | 12   |
|              | MOS04     | River dataset  | Mosselbank River u/s Diep River confluence       | 10   | 13   | 11   | 11   | 12   |
|              | MOS06     | River dataset  | Mosselbank River nr Klipheuwel                   | 6    | 8    | 9    | 9    | 11   |
|              | MOS07     | River dataset  | Mosselbank River u/s Fisantekraal WWTW           | 36   | 48   | 42   | 55   | 58   |
|              | MOS08     | River dataset  | Mosselbank River d/s Fisantekraal WWTW           | 41   | 47   | 44   | 55   | 57   |
|              | MOS09     | River dataset  | Mosselbank tributary d/s Fisantkraal settlement  | 9    | 18   | 16   | 8    | 10   |
| M'plain      | CS23      | Standing water | Mitchell's Plain West STW Drain                  | 21   | 27   | 22   | 13   | 24   |
|              | CS24      | Standing water | Mitchell's Plain East STW Drain                  |      |      | 1    |      |      |
|              | KHA02     | Standing water | Canal inlet to detention pond near litter device | 10   | 12   | 10   | 11   | 12   |
|              | KHA03     | Standing water | Detention pond near outlet on Baden Powell Drive | 10   | 12   | 10   | 11   | 12   |
|              | KHA04     | River dataset  | Outlet from Khayelitsha stormwater system to sea | 12   | 12   | 10   | 11   | 12   |
| Muizb        | CS01B     | River dataset  | Kalk Bay Harbour Beach stormwater discharge      |      |      |      |      | 17   |
|              | CS26      | River dataset  | Bailey's Cottage stormwater discharge            |      |      |      |      | 23   |
| Noordhoek    | WV02      | Standing water | Centre of EAST vlei                              | 12   | 14   | 12   | 13   | 13   |
|              | WV05      | Standing water | Centre of WEST vlei                              | 12   | 14   | 12   | 13   | 11   |
|              | WV08      | Standing water | Wildevleivlei mouth to sea                       | 9    | 12   | 9    | 12   | 11   |
| Sand         | CR01      | River dataset  | Westlake River cnr Main and Chenel Roads         | 8    | 12   | 14   | 14   | 12   |
|              | CR02      | River dataset  | Westlake River at Orange St - Kirstenhof         | 4    | 2    | 14   | 14   | 11   |
|              | CR03      | River dataset  | Westlake River Altenburg Rd - Kirstenhof         | 4    | 3    | 11   | 12   | 12   |
|              | CR04      | River dataset  | Westlake River in Pollsmoor Prison grounds       | 1    | 4    | 7    | 7    | 6    |
|              | CR05      | River dataset  | Westlake River at Steenberg Rd                   |      | 3    | 9    | 11   | 12   |

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| Subcatchment | Site code | Type           | Location                                                     | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|-----------|----------------|--------------------------------------------------------------|------|------|------|------|------|
|              | CR06      | River dataset  | Prinskasteel River in greenbelt off Lismore Rd (close to M3) | 9    | 11   | 11   | 10   | 12   |
|              | CR16      | River dataset  | Diep River at Alphen Rd in canal d/s of CR15                 | 5    | 12   | 11   | 12   | 12   |
|              | CR20      | River dataset  | Keysers River at Military Rd                                 | 11   | 14   | 11   | 12   | 12   |
|              | CR21      | River dataset  | Sand River at Oudevlei Road (d/s conf Langvlei & Sand)       | 12   | 12   | 11   | 12   | 12   |
|              | CR22      | River dataset  | Downstream of Westlake and Keysers River nr railway line     | 10   | 13   | 8    | 9    | 9    |
|              | CR29      | River dataset  | Sand River at Coniston Rd (u/s of litter trap)               |      | 2    | 11   | 12   | 12   |
|              | CS22      | River dataset  | Muizenberg Station stormwater discharge                      |      |      |      |      | 24   |
|              | DRRSC     | River dataset  | Diep River at Roscommon Road                                 | 9    | 12   | 12   | 13   | 13   |
|              | LPVMR     | River dataset  | Mocke River inflow to Little Princessvlei                    | 9    | 12   | 12   | 15   | 13   |
|              | LPVN      | Standing water | Little Princessvlei - north                                  | 9    | 12   | 12   | 47   | 50   |
|              | LPVS      | Standing water | Little Princessvlei - south                                  | 12   | 12   | 12   | 49   | 51   |
|              | LVI       | River dataset  | Langvlei - canal at vlei inlet                               | 9    | 12   | 12   | 46   | 50   |
|              | LVO       | Standing water | Langvlei - vlei outlet                                       | 12   | 12   | 12   | 45   | 50   |
|              | OOG01     | Standing water | Die Oog at Midwood Avenue, Bergvliet                         | 8    | 12   | 12   | 17   | 13   |
|              | PV03      | Standing water | Princessvlei - centre                                        | 11   | 13   | 11   | 49   | 50   |
|              | PVWEIR    | Standing water | Princessvlei near outlet weir                                | 10   | 12   | 11   | 49   | 51   |
|              | SCV       | River dataset  | Southfield Canal at Victoria Road                            | 10   | 13   | 11   | 14   | 10   |
|              | ZA01S     | Standing water | Zandvlei - north, surface                                    | 18   | 28   | 29   | 28   | 26   |
|              | ZA02S     | Standing water | Zandvlei - centre (opp Imperial Yacht Club), surface         | 21   | 27   | 29   | 29   | 28   |
|              | ZA03S     | Standing water | Zandvlei- south (opposite Playwaters), surface               | 5    | 13   | 2    | 1    |      |
|              | ZA04S     | Standing water | Outlet channel - midway to mouth, surface                    |      | 10   | 24   | 26   | 25   |
|              | ZA05S     | Standing water | Outlet channel near Royal Road bridge, surface               | 10   | 14   | 28   | 27   | 27   |
|              | ZA06S     | Standing water | South entrance to Marina da Gama canals, surface             | 1    | 2    | 17   | 20   | 8    |
|              | ZA07S     | Standing water | North entrance to Marina da Gama canals, surface             | 3    | 5    | 18   | 22   | 8    |
|              | ZA08S     | Standing water | Marina da Gama canal near "The Anchorage", surface           | 14   | 14   | 26   | 26   | 26   |
|              | ZA09S     | Standing water | Marina da Gama canal, surface                                | 10   | 13   | 24   | 26   | 26   |
|              | ZA10S     | Standing water | Westlake Wetland opposite Rutter Rd (old WLW)                | 12   | 13   | 24   | 25   | 26   |

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| Subcatchment | Site code | Type           | Location                                                     | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|-----------|----------------|--------------------------------------------------------------|------|------|------|------|------|
|              | ZA11S     | Standing water | Marina da Gama canal East Lake (old BM20), surface           | 10   | 12   | 24   | 26   | 26   |
|              | ZA12S     | Standing water | Marina da Gama canal Baalen Way (old BM22), surface          | 10   | 15   | 26   | 27   | 26   |
|              | ZA13S     | Standing water | Marina da Gama canal Park Island Bridge (old BM23), surface  | 12   | 21   | 27   | 27   | 26   |
|              | ZAWAIR    | Standing water | Zandvlei outlet channel at Rubble Weir, surface              | 14   | 11   | 29   | 27   | 26   |
| Schusters    | SCH02     | River dataset  | Schusters River at Schusterskraal Reserve entrance           | 7    | 10   | 12   | 10   | 11   |
|              | SCH04     | River dataset  | Pound canal (stormwater)                                     | 4    | 10   | 6    | 8    | 9    |
| Silvermine   | FHC       | River dataset  | Fish Hoek stormwater culvert discharge                       |      |      |      |      | 18   |
|              | FHLH      | River dataset  | Fish Hoek lighthouse stormwater discharge                    |      |      |      |      | 6    |
|              | SIL02     | River dataset  | Silvermine River near Sunbird Environmental Centre           | 7    | 12   | 12   | 13   | 13   |
|              | SIL04     | River dataset  | Silvermine River a wooden bridge near Winkle Rd - Clovelly   | 6    | 8    | 7    | 8    | 11   |
|              | SIL06     | River dataset  | Silvermine River at Bridge on Main Rd, Clovelly              | 12   | 13   | 12   | 13   | 12   |
|              | SRE       | River dataset  | Silvermine River East stormwater discharge                   |      |      |      | 9    | 12   |
|              | SRW       | River dataset  | Silvermine River West stormwater discharge                   |      |      |      | 9    | 13   |
| Slpass       | SIR01     | River dataset  | Sir Lowrys Pass River at Wedderwill Farm                     | 9    | 13   | 12   | 13   | 49   |
|              | SIR02     | River dataset  | Sir Lowrys Pass River d/s N2                                 | 9    | 12   | 12   | 13   | 49   |
|              | SIR03     | River dataset  | Sir Lowrys Pass River at Gustrouw Rd                         | 8    | 10   | 11   | 29   | 41   |
|              | SIR04     | River dataset  | Sir Lowrys Pass River (original river channel) at Dolphin Rd | 3    | 5    | 3    | 8    | 8    |
|              | SIR05     | River dataset  | Sir Lowrys Pass River (original river channel) Hendon Park   | 12   | 12   | 11   | 12   | 11   |
|              | SIR06     | River dataset  | Sir Lowrys Pass River d/s of WWTW (diversion canal)          | 58   | 60   | 60   | 58   | 54   |
|              | SIR07     | River dataset  | Sir Lowrys Pass River at Hibiscus Rd (diversion canal)       | 12   | 12   | 11   | 12   | 8    |
|              | SIR08     | River dataset  | NEW SITES NOT KNOWN                                          |      |      |      | 2    |      |
|              | SIR09     | River dataset  | NEW SITES NOT KNOWN                                          |      |      |      | 2    |      |
| Soet         | SOE02     | River dataset  | Soet River u/s of Greenways Rd                               | 11   | 14   | 11   | 13   | 12   |
| Sout         | SOU01     | River dataset  | Sout River at R27                                            | 56   | 63   | 52   | 56   | 63   |
|              | SOU02     | River dataset  | Sout River at Otto du Plessis Drive                          | 12   | 13   | 12   | 13   | 12   |
| Zeekoe       | LR02      | River dataset  | Lotus River on (N2) 500m from Airport Approach Rd            | 9    | 12   | 15   | 12   | 12   |



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| Subcatchment | Site code | Type           | Location                                                                        | 2020 | 2021 | 2022 | 2023 | 2024 |
|--------------|-----------|----------------|---------------------------------------------------------------------------------|------|------|------|------|------|
|              | LR03      | River dataset  | Lotus River at corner Duinefontein and Lansdowne Roads                          | 9    | 12   | 16   | 12   | 12   |
|              | LR05      | River dataset  | Lotus River at entrance to Council Depot on Old Strandfonte*                    | 9    | 12   | 16   | 12   | 12   |
|              | LR06      | River dataset  | Woodlands Canal at New Ottery Road (near Ottery Hypermarket)                    | 7    | 11   | 14   | 12   | 12   |
|              | LR07      | River dataset  | Lotus River at Klip Road                                                        | 9    | 12   | 16   | 12   | 12   |
|              | LR08      | River dataset  | Lotus River at Fisherman's Walk bridge (just u/s of vlei bo*)                   | 14   | 14   | 16   | 13   | 12   |
|              | LR10      | River dataset  | Little Lotus River at Eighth Avenue                                             | 12   | 12   | 15   | 12   | 12   |
|              | LR19A     | River dataset  | Lotus River Channel at Buck Road                                                |      |      | 1    |      |      |
|              | LR19B     | River dataset  | Lotus River DS of PS and DS of Buck Rd Channel                                  |      |      | 1    |      |      |
|              | LR20A     | River dataset  | Lotus River LHS pipe below bridge                                               |      |      | 1    |      |      |
|              | LR20B     | River dataset  | Lotus River RHS pipe below bridge                                               |      |      | 1    |      |      |
|              | POC01     | River dataset  | Phillipi stormwater outlet upstream site                                        | 11   | 13   | 11   | 12   | 16   |
|              | RVIRD     | River dataset  | Italian Rd canal leading to Rondevlei                                           | 8    | 12   | 15   | 10   | 12   |
|              | RVWEIR    | Standing water | Rondevlei at weir                                                               | 11   | 6    | 12   | 12   | 10   |
|              | ZEV08     | River dataset  | Zeekeovlei canal mouth at Baden Powell drive                                    |      |      | 3    | 19   | 21   |
|              | ZEV10     | Standing water | NOT KNOWN                                                                       |      |      |      | 1    |      |
|              | ZEV11     | Standing water | NOT KNOWN                                                                       |      |      |      | 1    |      |
|              | ZEV1S     | Standing water | Zeekoevlei Home Bay in front of Zeekoevlei Yacht Club                           | 12   | 20   | 29   | 26   | 19   |
|              | ZEV2S     | Standing water | Opposite inlet of Big Lotus River                                               | 13   | 18   | 27   | 20   | 11   |
|              | ZEV3S     | Standing water | Zeekoevlei in front of Cape Peninsula Aquatic Club                              | 16   | 21   | 31   | 27   | 24   |
|              | ZEV4S     | Standing water | SW corner pprox. 200m from weir                                                 | 11   | 8    | 19   | 8    |      |
|              | ZEV5      | River dataset  | At cut-off drain outfall to Zeekoe outlet canal                                 | 10   | 12   | 15   | 22   | 24   |
|              | ZEV9S     | Standing water | Zeekoevlei Eastern shore near stormwater outlet (picnic area at traffic circle) |      | 25   | 29   |      | 26   |
|              | ZEWEIR    | Standing water | Zeekoevlei near weir                                                            | 1    | 17   | 27   | 33   | 27   |

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**Table A2**  
**List of new sites with their associated location description and catchment (data from CSRM 2025).**

| Catchment    | Site Code | System         | T              | 1st year of data | Location                                                                                        | PLNG_RGN |
|--------------|-----------|----------------|----------------|------------------|-------------------------------------------------------------------------------------------------|----------|
| Zeekoe       | LR04      | Canal          | River dataset  | 1990             | Lotus River at Govan Mbeki Road                                                                 | Southern |
| Zeekoe       | LR09      | Canal          | River dataset  | 1991             | Little Lotus River at Klip Road (near Montagues Gift Road)                                      | Southern |
| Salt         | NR19      | Canal          | River dataset  | 1982             | Vygekraal River downstream of Elsieskraal but upstream of Black River                           | Southern |
| Salt         | ELS04     | Canal          | River dataset  | 1997             | Elsieskraal River on Chelsea Street                                                             | Northern |
| Diep         | PEV3      | Vlei & Wetland | Standing water | 1988             | Zoarvlei at Bancroft Street                                                                     | Central  |
| Bokramspruit | BOK01     | River          | River dataset  | 2000             | Bokramspruit River upstream of Aries Street                                                     | Southern |
| Soet         | SOEAH11   | Canal          | River dataset  | 2012             | Soet River in open concrete channel, corner of Broadlands Road - next to Pryde Group            | Eastern  |
| Soet         | SOEAH06   | Canal          | River dataset  | 2011             | Soet River in concrete channel - in front of BP garage corner of N2 and Hlathi Road             | Eastern  |
| Soet         | SOEAH12   | Canal          | River dataset  | 2014             | Soet River in open channel near Erf 32524 (Combined channel 20 metres downstream of confluence) | Eastern  |
| Soet         | SOEAH10   | River          | River dataset  | 2012             | Soet River in open channel Erf 7810 next to Onverwacht Road                                     | Eastern  |
| Diep         | MOSAH11   | River          | River dataset  | 0                | Concrete water structure on farm Bakoor Jakkalsdraai                                            | Northern |
| Diep         | MOSAH03   | River          | River dataset  | 2012             | Radio Street just off R304 at Klipheuwel                                                        | Northern |
| Salt         | ELS11     | Canal          | River dataset  | 2017             | Elsieskraal River at N2 Bridge                                                                  | Central  |
| City         | CEN01     | River          | River dataset  | 2024             | Platteklip Stream at corner of Homeleigh and Capel Road, Vredehoek                              | Central  |
| City         | CEN02     | River          | River dataset  | 2024             | Kasteelpoort River at 21 Fulham Road, Bakoven                                                   | Central  |
| City         | CEN03     | River          | River dataset  | 2024             | Little Glen Playground at end of 1st Crescent Street, Camps Bay                                 | Central  |
| Lourens      | DTP01     | Detention Pond | Standing water | 2024             | Detention Pond at Poinsettia Park, Pyracantha Street, Somerset West                             | Eastern  |
| Lourens      | LOU14     | River          | River dataset  | 2024             | Lourens River off the N2 and Old Paardevlei Road                                                | Eastern  |
| Eerste       | STREAM01  | River          | River dataset  | 2024             | Stream opposite 3 Berghowe Road, Helderberg Village                                             | Eastern  |
| Lourens      | GLT01     | River          | River dataset  | 2024             | Geelsloot Stream on Jakaranda Street, Parel Vallei, Somerset West                               | Eastern  |
| Eerste       | STREAM02  | River          | River dataset  | 2024             | Stream between the Huntsman and Acorn Creek on R102                                             | Eastern  |
| Diep         | DIEP12    | River          | River dataset  | 2024             | Diep River adjacent to Old Malmesbury Road                                                      | Northern |

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|        |       |                |                |      |                                                                                      |          |
|--------|-------|----------------|----------------|------|--------------------------------------------------------------------------------------|----------|
| Eerste | BOP_1 | Detention Pond | Standing water | 2024 | Botfontein pond inlet                                                                | Northern |
| Eerste | BOP_2 | Detention Pond | Standing water | 2024 | Botfontein pond outlet                                                               | Northern |
| Eerste | BOP_3 | Detention Pond | Standing water | 2024 | Botfontein pond 3                                                                    | Northern |
| Eerste | BOP_4 | Detention Pond | Standing water | 2024 | Botfontein pond 4                                                                    | Northern |
| Diep   | SAP_1 | Detention Pond | Standing water | 2024 | Sandringham pond South Western inflow                                                | Northern |
| Diep   | SAP_4 | Detention Pond | Standing water | 2024 | Sandringham pond central outflow                                                     | Northern |
| Diep   | SAP_3 | Detention Pond | Standing water | 2024 | Sandringham pond minor inflow                                                        | Northern |
| Diep   | SAP_2 | Detention Pond | Standing water | 2024 | Sandringham pond North inflow                                                        | Northern |
| Eerste | EK27  | River          | River dataset  | 2024 | Bottelary river upstream confluence                                                  | Northern |
| Eerste | EK28  | River          | River dataset  | 2024 | Botterlary river at Botterlary Road (upstream point)                                 | Northern |
| Salt   | ELS32 | Dam            | Standing water | 2024 | Plattekloof Dam at Meyboom Avenue in Plattekloof                                     | Northern |
| Salt   | ELS33 | Dam            | Standing water | 2024 | Dam downstream of Kanonberg Dam on Riesling Street                                   | Northern |
| Salt   | ELS34 | Dam            | Standing water | 2024 | Welgemoed Dam in Tygerberg Nature Reserve                                            | Northern |
| Salt   | ELS35 | River          | River dataset  | 2024 | De Kock Street at bend of M16                                                        | Northern |
| Eerste | EK31  | River          | River dataset  | 2024 | Kuils River at end of Eikenhout Avenue, Bellville                                    | Northern |
| Salt   | ELS37 | River          | River dataset  | 2024 | Elsieskraal River, off Van Riebeeckshof Road, just before Doordekraal Dam at bridge  | Northern |
| Diep   | MOS12 | River          | River dataset  | 2024 | Mosselbank River near County Fair farm on R304                                       | Northern |
| Eerste | EK29  | River          | River dataset  | 2024 | Kuils River at Fairtrees public open space, at bridge on Ibis Street                 | Northern |
| Eerste | EK30  | River          | River dataset  | 2024 | Off Bottelary Road at Hazendal Farm, Kuilsriver                                      | Northern |
| Sout   | DG03  | River          | River dataset  | 2024 | Donkergat River, downstream of Wesfleur WWTW discharge point, off Brakkefontein Road | Central  |
| City   | CEN04 | River          | River dataset  | 2024 | Camps Bay Stream, opposite 26 Shanklin Crescent at Shanklin Crescent Park            | Central  |
| City   | CEN05 | River          | River dataset  | 2024 | Diepsloot Stream at footbridge of the Glen near Camps Bay Retreat, Camps Bay         | Central  |

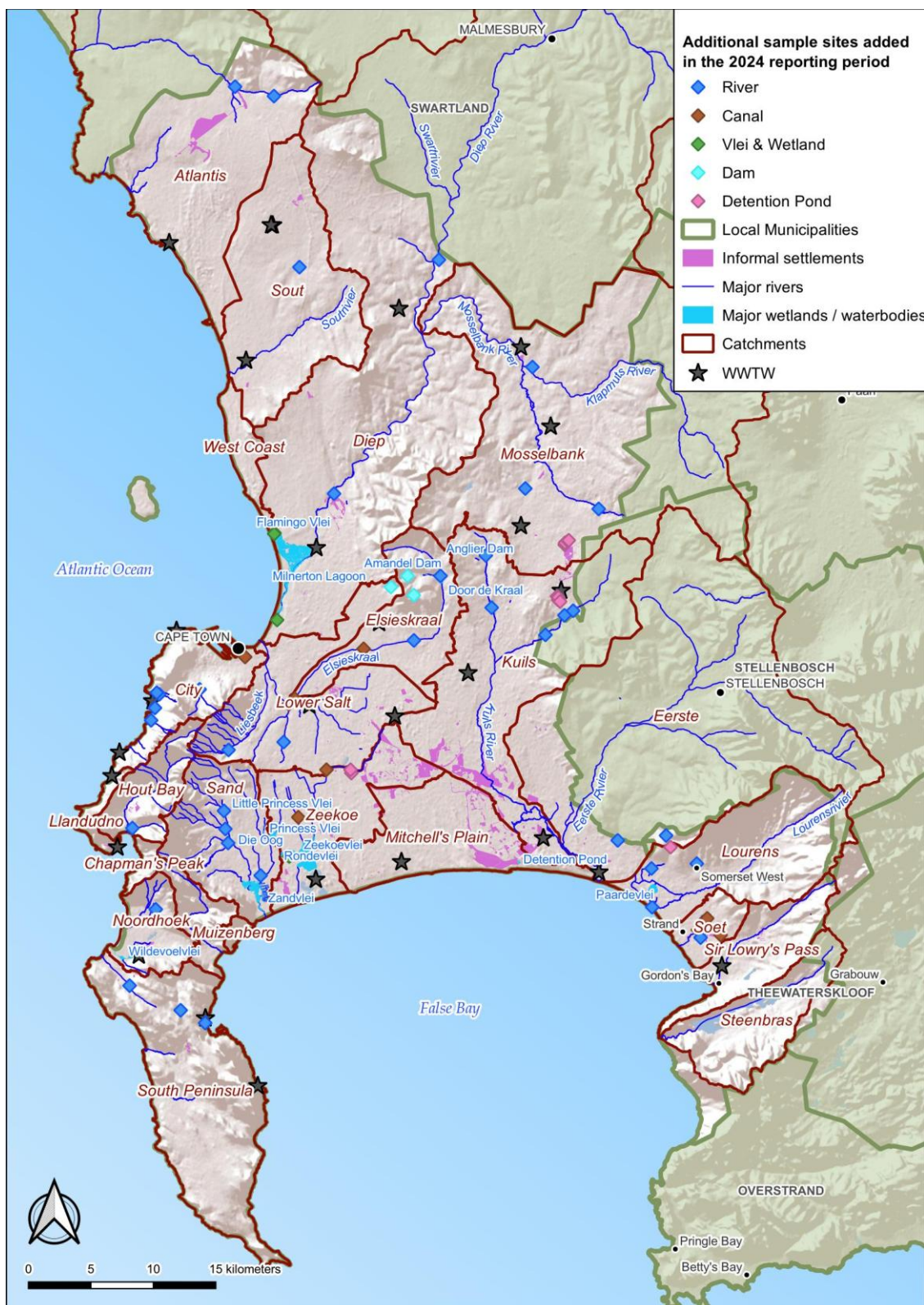
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|         |        |                |                |      |                                                                                        |          |
|---------|--------|----------------|----------------|------|----------------------------------------------------------------------------------------|----------|
| Atls    | MOD02  | River          | River dataset  | 2024 | Louwskloof River, tributary of Modder River downstream of Mamre town                   | Central  |
| Diep    | RTVD5  | Vlei & Wetland | Standing water | 2024 | Dolphins edge pan, Rietvlei - North                                                    | Central  |
| Diep    | RTVD1  | Vlei & Wetland | Standing water | 2024 | Dolphins edge pan, Rietvlei - South                                                    | Central  |
| City    | NR30   | Canal          | River dataset  | 2024 | Near truck stop, Nereide Street, Woodstock                                             | Central  |
| Diep    | RTV38  | River          | River dataset  | 2024 | Upstream of Malibongwe Drive                                                           | Central  |
| Lourens | LOU15  | River          | River dataset  | 2024 | Just before confluence with Lourens River, near pump station on Beach Road, Strand     | Eastern  |
| SPen    | GC08   | River          | River dataset  | 2024 | Brooklands Road, Noordhoek. Upstream of Brooklands Water Treatment Plant               | Southern |
| Sand    | CR31   | River          | River dataset  | 2024 | Downstream of Grootboschkloof and Pagasvlei Stream at end of Willow Road               | Southern |
| Salt    | NR31   | River          | River dataset  | 2024 | Access from M5, 400m before exit 15 to Racecourse Road off ramp                        | Southern |
| Nhoek   | BWS01  | River          | River dataset  | 2024 | Brookwood Stream on Noordhoek Main Road                                                | Southern |
| Sand    | CR32   | River          | River dataset  | 2024 | Prinskasteel River, Sweet Valley Vineyard Estate at end of Lismore Avenue              | Southern |
| Sand    | CR33   | River          | River dataset  | 2024 | Spaanschemat River at Spaanschemat Road                                                | Southern |
| HBay    | BKR01  | River          | River dataset  | 2024 | Baviaanskloof River on Baviaanskloof Road at bridge                                    | Southern |
| Salt    | NR32   | River          | River dataset  | 2024 | Liesbeek River at Kirstenbosch Drive                                                   | Southern |
| Zeekoe  | ESDP01 | Detention Pond | Standing water | 2024 | Edith Stephens Nature Reserve pond inlet on Jakes Gerwel Drive (first pond)            | Southern |
| Zeekoe  | ESDP02 | Detention Pond | Standing water | 2024 | Edith Stephens Nature Reserve pond outlet on Govan Mbeki Road (middle pond)            | Southern |
| Sand    | LVC    | River          | River dataset  | 2024 | Langvlei canal before confluence with Sand River                                       | Southern |
| Zeekoe  | RVS    | Vlei & Wetland | Standing water | 2024 | Main waterbody at Jack Winterbottom bird hide, Rondevlei Nature Reserve                | Southern |
| SPen    | SMT01  | River          | River dataset  | 2024 | Palace Hill Road, Simon's Town                                                         | Southern |
| Atls    | MOD01  | River          | River dataset  | 2024 | Louwskloof River, tributary of Modder River upstream of Mamre town, on Dassenberg Road | Central  |



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**Figure A1**

Locations of new water quality sampling points, established in late 2024, to be included in the 2024/2025 water quality report

## APPENDIX B: THRESHOLD VALUES USED IN DATA INTERPRETATION

### B1 Thresholds for the interpretation of ecosystem condition

The City of Cape Town is included in the Berg Catchment and many of its watercourses have been assigned specific Resource Quality Objectives (RQOs) through the Berg Classification (see **Section 3.5**). It is thus important that the rating ranges and rating terminology used in assessments of the City water quality data should align with those of the Berg RQOs, and be readily referenceable to these gazetted requirements. This approach also ensures that any ecological categorisation of water quality for the City aligns to the categories of water quality condition employed at a national level in South Africa and in particular to the methods for determining the water quality component of the Ecological Reserve for rivers. These methods, used in the Berg Classification of DWS (2018), are referred to as Resource Directed Measures (RDM) and assign estuaries and river reaches or systems to a range of water quality categories, which are aligned to categories used in the assessments of Present Ecological State (PES).

The range of values included in these categories have been variously described as Natural to Poor or<sup>21</sup>Ideal to Unacceptable (DWAf 2011), and ranked A to F. They can be semi-quantified in terms of percentage deviation from natural (reference) conditions, with 100% scores indicating completely natural conditions, and scores of 0 representing extreme (complete) change from natural conditions with respect to water quality (DWAf 2008). They are compared in **Table B1**. In the previous City inland water quality report (Day et al. 2020), a simpler approach, with fewer but still comparable categories was utilised, for ease of interpretation by a wide range of users. The rating scale included in **Table B1** was thus adopted, with its ratings of Good, Fair, Poor and Unacceptable, with the desired threshold (break point) being "Fair".

**Table B1**  
**Relationship between Present Ecological State (PES) water quality categories A-F and scores, showing % deviation from natural conditions, as defined in DWAf (2008) for river Water Quality Resource Directed Measures, as well as the rating categories and their simplified interpretation, compared with the Ideal to Unacceptable categories used in DWAf (2021) and the Berg RQOs.**

| This project:                 |                                                               | DWS Ecological Categories (PES) / RDM terminology         | PES% score range | DWAf (2011)  |
|-------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|------------------|--------------|
| City Water Quality Categories | Interpretation of City Water Quality Categories – this report |                                                           |                  |              |
| GOOD                          | TARGET                                                        | A: Natural / no change                                    | 90-100%          | Ideal        |
|                               |                                                               | B: Largely natural, with few modifications / small change | 80-89%           |              |
| FAIR                          | TARGET                                                        | C: Moderately modified / moderate change                  | 60-79%           | Acceptable   |
| POOR                          | POOR                                                          | D: Largely modified / large change                        | 40-59%           | Tolerable    |
| UNACCEPTABLE                  | UNACCEPTABLE                                                  | E: Seriously modified / serious change                    | 20-39%           | Unacceptable |
|                               |                                                               | F: Critically modified / extreme change                   | 0-19%            |              |

<sup>21</sup> **Ideal** – the use of water is not affected in any way; 100% fit for use by all users at all times; desirable water quality (TWQR); **Acceptable** – slight to moderate problems encountered on a few occasions or for short periods of time; **Tolerable** – moderate to severe problems are encountered; usually for a limited period only; and **Unacceptable** – water cannot be used for its intended use under normal circumstances at any time (DWAf 2006)

Rating ranges differentiate between standing water bodies (in this case, the main recreational vleis and dams included in the City's inland monitoring programme) and flowing water systems (that is, rivers), with different variables and sometimes concentrations applicable to different watercourse types, as identified in **Tables B2** and **B3**.

In the previous (2020 and the 2023) City Water Quality Reports, orthophosphate concentrations were used as a measure of both flowing and standing water phosphorus enrichment. In the present report, total phosphorus concentrations are, instead, used to evaluate standing water phosphorus enrichment (**Table B3**), based on the threshold values provided by DWAF (2002) and reiterated in the DWAF (2011) guidelines for lakes and dams. The 2020 RQOs for dams in the Berg catchment erroneously use the same orthophosphate phosphorus thresholds for dams and rivers, whereas the use of total phosphorus concentrations is a more useful measure for standing water systems such as vleis, lakes and dams (Cooke et al 2005).

**Table B2**  
**Rating ranges for variables considered in this assessment of water quality in City Rivers**

| City Water Quality Categories (CWQC) | Interpretation of CWQC | <sup>22</sup> PO <sub>4</sub> -P<br>mg P/l | <sup>16</sup> TIN<br>mg N/l                                                | <sup>16</sup> DO<br>mg/l | <sup>23</sup> N:P | <sup>17</sup> NH <sub>3</sub><br>mg/l |
|--------------------------------------|------------------------|--------------------------------------------|----------------------------------------------------------------------------|--------------------------|-------------------|---------------------------------------|
| GOOD                                 | TARGET                 | ≤ 0.015<br>(oligotrophic)                  | ≤ 0.70<br>(oligotrophic - mesotrophic)                                     | >7                       | >25               | ≤ 0.007                               |
| FAIR                                 |                        | > 0.015 - 0.025<br>(mesotrophic)           | >0.70-1.00<br>(mesotrophic)                                                | >6-7                     |                   | > 0.007 -0.015                        |
| POOR                                 | POOR                   | > 0.025- 0.125<br>(eutrophic)              | >1.00 -4.00<br>(mesotrophic -eutrophic)                                    | >4 -6                    | 10-25             | > 0.015-0.1<br>(chronic toxicity)     |
| UNACCEPTABLE                         | UNACCEPTABLE           | > 0.125<br>(hypertrophic)                  | > 4.00<br>(eutrophic - concentrations > 10mg/L classified as hypertrophic) | ≤ 4                      | < 10              | > 0.1<br>(acute toxicity)             |

**Table B3**  
**Rating ranges for variables considered in this assessment of water quality in City Vleis and Dams**

| City Water Quality Categories (CWQC) | Interpretation of CWQC | <sup>24</sup> TOTAL PHOSPHORUS<br>mg P/l | <sup>25</sup> TIN<br>mg N/l | <sup>19</sup> DO<br>mg/l | <sup>26</sup> N:P | <sup>20</sup> NH <sub>3</sub><br>mg/l | RUNNING MEAN ANNUAL CHL-A<br>µg/l |
|--------------------------------------|------------------------|------------------------------------------|-----------------------------|--------------------------|-------------------|---------------------------------------|-----------------------------------|
| GOOD                                 | TARGET                 | ≤ 0.015<br>(oligotrophic)                | ≤ 0.7                       | > 7                      | >25               | ≤ 0.007                               | ≤ 5                               |
| FAIR                                 |                        | > 0.015 – 0.047<br>(mesotrophic)         | >0.7 -1                     | >6-7                     |                   | > 0.007 -0.015                        | >5 - 10                           |
| POOR                                 | POOR                   | >0.047 - 0.130<br>(eutrophic)            | >1.0-4.0                    | >4 -6                    | 10-25             | > 0.015-0.1<br>(chronic toxicity)     | > 20 - 30                         |
| UNACCEPTABLE                         | UNACCEPTABLE           | >0.130<br>(hypertrophic)                 | > 4                         | ≤ 4                      | <10               | > 0.1<br>(acute toxicity)             | > 30                              |

<sup>22</sup> Based on DWAF (2008)

<sup>23</sup> Based on DWAF (1996a) guideline

<sup>24</sup> Based on DWAF (2002)

<sup>25</sup> Based on DWAF (2008)

<sup>26</sup> Based on DWAF (1996a) guideline

## **B2     Thresholds for the interpretation of water quality risks to recreational users**

### **B2.1    General**

**Human health risk ratings** for *Escherichia coli* data were also based on those used in the Berg RQOs study. Day et al. 2020 used an expanded version of these thresholds, to identify examples of extreme exceedance of these thresholds (as developed by the City in routine reporting), as shown in **Table B4**, while Microcystin toxin thresholds were based on those included in the City's Recreational Use Water Quality Index. These are slightly more conservative than those used in WHO (2021).

The ratings include both full contact (i.e., swimming) and intermediate contact (e.g. canoeing, sailing) for *E. coli*.

Note however that, given issues around reporting of ">" data over the 2020 reporting period, in the present report, the expanded range of values was not utilised. It has been included in this appendix for future possible application.

### **B2.2    Microbial indicators**

The most frequent adverse health outcome associated with exposure to water contaminated with fecal material is enteric illness (WHO 2021).

Historically, two different bacterial indicators have been used as a measure of the risk posed by the presence of pathogens in water - fecal coliforms and *Escherichia coli*, both typically reported as the number of organisms (or colony forming units / cfu ) present per 100 ml of water .

**Fecal coliforms** are a group of bacteria that include genera (such as *Escherichia*) that are able to survive in the guts of animals (including humans) and also occur in their faeces.

***Escherichia coli*** (abbreviated *E. coli*) is a species of fecal coliform bacteria that is commonly found in the lower intestine of warm-blooded organisms (birds and mammals). Most *E. coli* strains are harmless, but some can cause serious food poisoning in humans. Their presence in the water is used as an "indicator" of fecal contamination of avian or mammalian origin, and therefore are indicative of other pathogens that may be present in faeces.

While fecal coliforms (including *E. coli*) are still considered to be good indicators of the presence of other pathogens in freshwater, research over the last 10 years has shown that fecal coliforms tend to die off faster than other pathogens in seawater, and can result in an underestimate of the risk to beach bathers when only fecal coliform concentrations are monitored. As a result, microbial assessments of coastal waters has shifted to measurements of **intestinal enterococci** as an indicator of public health risks. Worldwide, there has been a general shift to the use of intestinal Enterococci as a standard indicator of public health risks in inland recreational water bodies as well (WHO 2003; 2018; 2021; Australian Government National Health and Medical Research Council 2008).

**While there are guidelines for the interpretation of *E. coli* in waters used for full contact recreation (e.g. EU guidelines), most authorities who do consider intermediate contact uses now have begun to rely on intestinal Enterococci guidelines.**

In South Africa, DWAF (1996b) provides guidelines for both Full Contact and Intermediate Contact recreational use. Of these, the former are based on non-exceedance of maximum ***E. coli*** concentrations, noting that there is "insufficient information for the development of criteria for *E. coli* in water used for intermediate contact recreation purposes" while the latter are based on non-exceedance of maximum **fecal coliform** bacteria concentrations.

The City's historical inland water quality database includes both fecal coliform and *E. coli* data.



However, all current water microbial assessments include only *E. coli* data<sup>27</sup>. This means that evaluations of the implications of these data for human health must be carried out on the basis of *E. coli* concentrations alone. Accordingly, the City generally interprets the suitability of its inland waters for recreational purposes according to an adaptation of the intermediate contact South African Water Quality Guidelines for Recreational Use (DWAF 1996b) – see **Table B4**. A limitation of this guideline, when used with *E. coli* data alone, however, is that it potentially under-estimates risk, in that *E. coli* concentrations make up just one component of the total fecal bacterial count.

**Table B4**  
**Generic water quality limits for Recreational Use: Intermediate Contact.**  
**Fecal coliforms**

Values extracted from DWAF (2006) as used in Berg RQOs

| GRADE          | FECAL COLIFORM COUNT (INCLUDING <i>E. COLI</i> ) <sup>1</sup> |
|----------------|---------------------------------------------------------------|
| TARGET (IDEAL) | ≤ 1 000 CFU/100 ML                                            |
| ACCEPTABLE     | 1 001-2 500 CFU/100 ML                                        |
| TOLERABLE      | >2 500-4000 CFU/100 ML                                        |
| UNACCEPTABLE   | >4000 CFU/100 ML                                              |

**Table B5**

Approach to assessment of microbial data in this study, based on DWAF (1996b) and the Berg RQOs and applied to *E. coli* concentrations as per City's *E. coli* specific target for full contact recreation, as per DWAF (1996b). The table below indicates additional ranges for *E. coli* beyond the "Unacceptable" threshold, to indicate very high levels of pollution in some cases.

| GRADE                                                                 | FECAL COLIFORM COUNT (INCLUDING <i>E. COLI</i> ) <sup>1</sup> |
|-----------------------------------------------------------------------|---------------------------------------------------------------|
| TARGET FOR MAXIMUM ACCEPTABLE RISK FOR <u>FULL CONTACT RECREATION</u> | ≤ 400 <sup>28</sup> CFU/100 ML \                              |
| ACCEPTABLE <u>RISK INTERMEDIATE CONTACT</u>                           | ≤ 2 500 CFU/100 ML                                            |
| TOLERABLE RISK - INTERMEDIATE CONTACT                                 | > 2 500-4000 CFU/100 ML                                       |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT                              | >4000 CFU/100 ML                                              |

| "UNACCEPTABLE" CATEGORIES | INDICATIVE <i>E. COLI</i> RANGE (COUNT/100ML) | COMMENT / STRATEGIC MANAGEMENT RESPONSE                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LEVEL 1                   | 4001 – 10 000                                 | <ul style="list-style-type: none"> <li>WQ trends in this range may be reflective of general urban diffuse runoff rather than a major point source of pollution</li> <li>Address using stormwater / catchment management measures.</li> <li>Ensure sewer spill responses are adequate and timely.</li> <li>Continue to monitor to determine if additional pollution abatement intervention is necessary.</li> </ul> |
| LEVEL 2                   | 10 001 – 100 000                              | <ul style="list-style-type: none"> <li>WQ trends in this high range are likely indicative of chronic pollution possibly from multiple source/s.</li> <li>If results are in this range for a single month / only during the rainy season it is possible that catchment wash-off (first flush) or surcharging sewers were causal</li> </ul>                                                                          |

<sup>27</sup> This was due to a change in microbial analytical methodology (media change) where there is no longer a presumptive fecal coliform count followed by a confirmatory count for *E. coli*. Instead, the *E. coli* count is determined immediately after incubation (see Day et al. 2020).

<sup>28</sup> The concentrations of bacteria in water is usually expressed as numbers of colony-forming units (cfu) per 100 ml, which is a measure of the number of viable cells in a particular sample, where a colony represents an aggregate of cells derived from a single progenitor cell

| "UNACCEPTABLE" CATEGORIES | INDICATIVE <i>E. COLI</i> RANGE (COUNT/100ML) | COMMENT / STRATEGIC MANAGEMENT RESPONSE                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           |                                               | <p>factors.</p> <ul style="list-style-type: none"> <li>Transversal approach to pollution abatement is necessary.</li> <li>Extra budget may be required.</li> </ul>                                                                                                                                                                                                                            |
| LEVEL 3                   | > 100 000                                     | <ul style="list-style-type: none"> <li>WQ <u>trends</u> in this extreme range likely indicate chronic ongoing pollution from multiple sources &amp;/or extreme incidents.*</li> <li>Urgent management intervention to address the source/s of contamination.</li> <li>Transversal approach to pollution abatement is necessary.</li> <li>Significant funding likely to be required</li> </ul> |

Enterococci data were interpreted using the same thresholds used by the City for its coastal enterococci evaluations, which are drawn from the national guidelines of DEA (2012) WHO (2021) confirm that the same thresholds can be applied to both marine and inland (fresh) waters.

Guidelines for the interpretation of single sample data have been used in this report for compliance type reporting. These guidelines are provided in DEA (2012) as well. The latter report does note however that single sample interpretation is not ideal, as it does not allow reasonable determination of Risk for water users. However, in the present reporting context, it does allow evaluation of suitability of water for intermediate contact use over a number of sampling periods.

One of the issues also highlighted in this report was that of repeated sampling of sites where sewage spills have taken place or are suspected. This results in multiple potentially highly contaminated water samples, the data from which can skew Hazen assessments of long-term data, by increasing the 90<sup>th</sup> and 95<sup>th</sup> percentiles considerably. Such issues need to be considered carefully in the interpretation of long-term data with high potential event-driven variability.

**Table B6**  
**Approach to assessment of microbial data (intestinal enterococci counts)**  
**Percentile data calculated using the Hazen Method**

Water quality categories as used in the City's Coastal Water Quality Reporting<sup>29</sup>  
Single sample ratings from DEA (2012)  
See **Appendix B** for derivation of threshold values.

| Interpretation                                    | Descriptor in Coastal Water Quality Reporting | Estimated risk of illness per exposure <sup>2</sup> | Enterococci (cfu/100 ml)               | Enterococci (cfu/100 ml) - for single samples |
|---------------------------------------------------|-----------------------------------------------|-----------------------------------------------------|----------------------------------------|-----------------------------------------------|
| TARGET                                            | EXCELLENT                                     | < .9%<br>Gastrointestinal Illness (GI) risk         | < 100<br>(95 <sup>th</sup> percentile) |                                               |
| ACCEPTABLE RISK INTERMEDIATE CONTACT              | GOOD                                          | <5%<br>Gastrointestinal Illness (GI) risk           | < 200 (95 <sup>th</sup> percentile)    | ≤240                                          |
| TOLERABLE RISK - INTERMEDIATE CONTACT             | SUFFICIENT                                    | <8.5%<br>Gastrointestinal Illness (GI) risk         | < 185 (90 <sup>th</sup> percentile)    | 240 – 380                                     |
| UNACCEPTABLE RISK - INTERMEDIATE CONTACT– LEVEL 1 | POOR                                          | >8.5%<br>Gastrointestinal Illness (GI) risk         | ≥ 185<br>(90 <sup>th</sup> percentile) | >380                                          |

<sup>29</sup> (<https://www.capetown.gov.za/explore%20and%20enjoy/nature-and-outdoors/our-precious-biodiversity/coastal-water-quality>)

<sup>2</sup> 'Exposure' defined as 10 minutes of swimming with three head immersions

### **B2.3 Microcystin toxins**

Cyanobacteria (or blue-green algae) are a common and naturally occurring component of most recreational water environments (WHO 2021). They are of potential public health concern because some types may under certain circumstances produce toxins that can have a harmful effect on recreational water users.

The City of Cape Town also monitors its water bodies for microcystin toxins. The thresholds for interpretation shown in Table B6 are used by the City, and were developed for use in its Recreational Water Quality Index (Day and Clark 2012). These thresholds are based on the WHO (2003) guidelines for full and intermediate contact recreation. Note that WHO (2021) provides an updated GV Recreation ( $GV_{RECREATION}$ ) Threshold of 24 ug/L for microcystins, below which recreational water use should be within acceptable risk limits. This suggests that the Medium Risk values in **Table B7** are slightly conservative

**Table B7**  
**Water quality grades and corresponding threshold concentrations for Microcystin toxins for inland waters adopted for this project. Guideline levels are based on those published by the WHO (2003).**

| Interpretation                     | Microcystin Toxin Concentration |
|------------------------------------|---------------------------------|
| <b>TARGET (ACCEPTABLE)</b>         | <b>≤ 20 µG/L</b>                |
| <b>MEDIUM RISK (UNACCEPTABLE)</b>  | <b>&gt;20- 30 µG/L</b>          |
| <b>HIGH RISK (UNACCEPTABLE)</b>    | <b>&gt;30-40 µG/L</b>           |
| <b>EXTREME RISK (UNACCEPTABLE)</b> | <b>&gt;40 µG/L</b>              |

## APPENDIX C: SUMMARY VALUES FOR KEY VARIABLES



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**Table C.1**

Summary data for key variables per sub-catchment for reporting periods 2020-2022, 2023 and 2024. All sites included.

Data presented as median values for all variables except *E. coli*, for which data are presented as geometric means. Up arrows indicate improvement; down arrows indicate deterioration; dash indicates no change since the previous reporting period. "Change" means ≥25% change.

| Catchment    | 2020 to 2022   |       |                 |      | 2023           |       |                 |    | 2024           |       |                 |    |
|--------------|----------------|-------|-----------------|------|----------------|-------|-----------------|----|----------------|-------|-----------------|----|
|              | <i>E. coli</i> | PO4-P | NH <sub>3</sub> | DO   | <i>E. coli</i> | PO4-P | NH <sub>3</sub> | DO | <i>E. coli</i> | PO4-P | NH <sub>3</sub> | DO |
| Bokramspruit | 26,726         | 0.199 | 0.037           | 7.75 | 12,400         | ↑     | 0.173           | ↓  | 0.018          | ↑     | 7.70            | ↓  |
| City         |                |       |                 |      |                |       |                 |    | 8,217          | ↓     |                 |    |
| Diep         | 3,687          | 1.225 | 0.022           | 6.20 | 1,486          | ↑     | 0.565           | ↑  | 0.014          | ↑     | 6.90            | ↓  |
| Eerste       | 10,608         | 2.315 | 0.064           | 4.95 | 9,271          | ↓     | 1.700           | ↑  | 0.042          | ↑     | 6.00            | ↓  |
| Else         | 421            | 0.010 | 0.001           | 6.30 | 276            | ↑     | 0.014           | ↓  | 0.001          | ↓     | 7.45            | ↓  |
| Elsieskraal  | 1,529          | 0.040 | 0.005           | 8.25 | 1,460          | ↓     | 0.067           | ↓  | 0.004          | ↓     | 8.70            | ↓  |
| Hout Bay     | 6,599          | 0.033 | 0.001           | 8.80 | 5,006          | ↓     | 0.050           | ↓  | 0.001          | ↓     | 8.70            | ↓  |
| Kuils        | 41,012         | 1.400 | 0.043           | 6.60 | 28,519         | ↑     | 1.525           | ↓  | 0.045          | ↓     | 7.10            | ↓  |
| Lourens      | 491            | 0.020 | 0.001           | 9.60 | 455            | ↓     | 0.041           | ↓  | 0.001          | ↓     | 9.25            | ↓  |
| Lower Salt   | 124,866        | 2.539 | 0.134           | 4.90 | 99,736         | ↓     | 1.456           | ↑  | 0.166          | ↓     | 4.20            | ↓  |
| Mosselbank   | 13,335         | 1.400 | 0.044           | 5.50 | 5,566          | ↑     | 1.200           | ↓  | 0.017          | ↑     | 5.80            | ↓  |
| M'Plain      | 970,287        | 1.250 | 0.197           | 3.91 | 176,063        | ↑     | 1.038           | ↓  | 0.204          | ↓     | 3.40            | ↓  |
| Muizb        |                |       |                 |      |                |       |                 |    | 578            | ↓     |                 |    |
| Noordhoek    | 727            | 3.701 | 0.739           | 7.58 | 239            | ↑     | 4.327           | ↓  | 0.615          | ↓     | 6.90            | ↓  |
| Sand         | 918            | 0.047 | 0.003           | 8.70 | 561            | ↑     | 0.050           | ↓  | 0.004          | ↓     | 8.60            | ↓  |
| Schusters    | 561            | 0.049 | 0.001           | 5.90 | 256            | ↑     | 0.050           | ↓  | 0.001          | ↓     | 5.95            | ↓  |
| Silvermine   | 234            | 0.015 | 0.001           | 8.45 | 157            | ↑     | 0.033           | ↓  | 0.001          | ↓     | 8.70            | ↓  |
| SLPass       | 1,260          | 0.105 | 0.001           | 8.50 | 1,472          | ↓     | 0.100           | ↓  | 0.001          | ↓     | 9.00            | ↓  |
| Soet         | 381,612        | 2.021 | 0.404           | 3.40 | 419,003        | ↓     | 2.445           | ↓  | 0.252          | ↑     | 3.85            | ↓  |
| Sout         | 500            | 4.400 | 0.001           | 5.20 | 658            | ↓     | 6.000           | ↓  | 0.001          | ↓     | 5.60            | ↓  |
| Zeekoe       | 3,746          | 0.496 | 0.046           | 6.40 | 1,637          | ↑     | 0.521           | ↓  | 0.093          | ↓     | 8.25            | ↑  |

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**Table C.2**

Summary data for key variables for all sites for reporting periods 2020-2022, 2023 and 2024. All sites included.

Data presented as median values for all variables except *E. coli*, for which data are presented as geometric means. Up arrows indicate improvement; down arrows indicate deterioration; dash indicates no change since the previous reporting period. "Change" means ≥25% change.

| Type          | Catchment    | Site        | <i>E. coli</i> |        |        | PO4-P        |        |        | NH <sub>3</sub> |        |        | DO           |       |      |
|---------------|--------------|-------------|----------------|--------|--------|--------------|--------|--------|-----------------|--------|--------|--------------|-------|------|
|               |              |             | 2020 to 2022   | 2023   | 2024   | 2020 to 2022 | 2023   | 2024   | 2020 to 2022    | 2023   | 2024   | 2020 to 2022 | 2023  | 2024 |
| River dataset | Bokramspruit | BOK02       | 72898          | 20769  | 171233 | 0.792        | 0.296  | 0.204  | 0.102           | 0.014  | 0.0185 | 8.4          | 7.55  | 5.65 |
|               |              | BOK03       | 9798           | 7032   | 9493   | 0.136        | 0.167  | 0.143  | 0.011           | 0.02   | 0.013  | 7.3          | 7.7   | 5.9  |
|               | City         | CN06B       |                |        | 3264   |              |        |        |                 |        |        |              |       |      |
|               |              | CN16B       |                |        | 23351  |              |        |        |                 |        |        |              |       |      |
|               |              | CN17A       |                |        | 27539  |              |        |        |                 |        |        |              |       |      |
|               |              | CN17B       |                |        | 16485  |              |        |        |                 |        |        |              |       |      |
|               |              | CN17C       |                |        | 88758  |              |        |        |                 |        |        |              |       |      |
|               |              | CN17E       |                |        | 22889  |              |        |        |                 |        |        |              |       |      |
|               |              | CN24        |                |        | 4532   |              |        |        |                 |        |        |              |       |      |
|               |              | CN25        |                |        | 28851  |              |        |        |                 |        |        |              |       |      |
|               |              | CN26        |                |        | 22476  |              |        |        |                 |        |        |              |       |      |
|               |              | CN27        |                |        | 3697   |              |        |        |                 |        |        |              |       |      |
|               |              | CN28        |                |        | 36955  |              |        |        |                 |        |        |              |       |      |
|               |              | CN33        |                |        | 35     |              |        |        |                 |        |        |              |       |      |
|               | Diep         | MCC         | 3677           | 11163  | 7818   |              | 3.76   |        |                 |        |        |              |       |      |
|               |              | MOS05       | 1830           | 2471   | 2190   | 1.5265       | 1.343  | 0.397  | 0.011           | 0.008  | 0.006  | 6            | 5.5   | 7.7  |
|               |              | RTV01       | 1977           | 1134   | 6663   | 2.767        | 2.175  | 1.835  | 0.008           | 0.0055 | 0.009  | 5            | 4     | 4.8  |
|               |              | RTV03       | 20653          | 18015  | 37215  | 0.131        | 0.145  | 0.323  | 0.011           | 0.009  | 0.01   | 6.65         | 6.9   | 5.3  |
|               |              | RTV04       | 59385          | 39881  | 128972 | 0.074        | 0.074  | 0.05   | 0.017           | 0.039  | 0.068  | 8.1          | 7.85  | 8.2  |
|               |              | RTV04_DS    |                | 72700  |        |              |        |        |                 |        |        |              |       |      |
|               |              | RTV04_US    |                | 46110  |        |              |        |        |                 |        |        |              |       |      |
|               |              | RTV05       | 60210          | 157916 | 217165 | 3.2          | 3.545  | 2.8    | 0.104           | 0.4285 | 0.332  | 3.4          | 2.65  | 2.65 |
|               |              | RTV06       | 1680           | 703    | 738    | 2.686        | 1.3855 | 0.95   | 0.009           | 0.0045 | 0.0135 | 3.95         | 6.7   | 5.2  |
|               |              | RTV08       | 6032           | 1565   | 5546   | 0.463        | 0.397  | 0.215  | 0.059           | 0.046  | 0.016  | 6.3          | 6.3   | 6    |
|               |              | RTV09       | 12995          | 34547  | 115481 | 2.69         | 3.184  | 2.3    | 0.12            | 0.26   | 0.145  | 6.8          | 5.3   | 3.6  |
|               |              | RTV10       | 9756           | 17358  | 3398   | 1.905        | 1.958  | 0.679  | 0.095           | 0.144  | 0.03   | 9.1          | 7.05  | 8    |
|               |              | RTV11       | 39888          | 115438 | 237407 | 3.3          | 3.457  | 2.18   | 0.133           | 0.492  | 0.366  | 3.95         | 3.9   | 4.6  |
|               |              | RTV12       | 65086          | 41150  | 164064 | 0.585        | 0.389  | 0.46   | 0.0515          | 0.033  | 0.011  | 5.45         | 6.2   | 4.5  |
|               |              | RTV14       | 30873          | 10182  | 69286  | 0.095        | 0.082  | 0.05   | 0.017           | 0.011  | 0.035  | 5.4          | 4.7   | 4.65 |
|               |              | RTV18       | 35597          | 76946  | 246440 | 3.29         | 3.342  | 2.735  | 0.13            | 0.413  | 0.168  | 3.25         | 4     | 3.4  |
|               |              | RTV22       |                | 2612   | 35547  |              | 1.2245 | 2.45   |                 | 0.001  | 0.101  |              | 5.45  | 3.35 |
|               |              | THEO_MARAIS | 86642          | 118649 | 419600 | 1.625        | 2.824  | 2.64   | 0.0735          | 0.315  | 0.286  | 4.5          | 3.6   | 3.4  |
|               | Eerste       | EK08        | 8200           | 6416   | 159276 | 2.4          | 2.2    | 2.45   | 0.0715          | 0.066  | 0.197  | 1.95         | 2.75  | 2.35 |
|               |              | EK11        | 11513          | 10038  | 133348 | 2.6          | 2      | 2.05   | 0.229           | 0.176  | 0.174  | 3.8          | 5.3   | 4.4  |
|               |              | EK12        | 9795           | 3847   | 35154  | 2.3          | 1.4    | 1.715  | 0.168           | 0.0875 | 0.0815 | 3.6          | 4.25  | 4.25 |
|               |              | EK13        | 1473           | 2083   | 1611   | 0.555        | 0.22   | 0.4335 | 0.002           | 0.0035 | 0.0015 | 8            | 8.05  | 7.35 |
|               |              | EK15        | 117919         | 132062 | 265804 | 0.112        | 0.15   | 0.1835 | 0.073           | 0.046  | 0.127  | 10.7         | 10.65 | 13.1 |
|               |              | EK17        | 28733          | 27514  | 63553  | 3.1          | 2.1    | 2.2    | 0.348           | 0.4305 | 0.214  | 4.6          | 6.25  | 5.1  |
|               |              | EK18        | 2899           | 2819   | 2117   | 0.138        | 0.143  | 0.15   | 0.003           | 0.0055 | 0.006  | 6            | 7.2   | 7.1  |

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| Type | Catchment   | Site   | E.coli       |        |         | PO4-P        |        |        | NH <sub>3</sub> |        |        | DO           |       |       |
|------|-------------|--------|--------------|--------|---------|--------------|--------|--------|-----------------|--------|--------|--------------|-------|-------|
|      |             |        | 2020 to 2022 | 2023   | 2024    | 2020 to 2022 | 2023   | 2024   | 2020 to 2022    | 2023   | 2024   | 2020 to 2022 | 2023  | 2024  |
|      | Elsieskraal | ELS_GW | 58197        | 123344 | 28885   | 0.208        | 0.3225 | 0.172  | 0.166           | 0.064  | 0.0775 | 11.3         | 11.4  | 11.25 |
|      |             | ELS08  | 44384        | 79452  | 28408   | 0.161        | 0.221  | 0.139  | 0.105           | 0.029  | 0.094  | 11.1         | 10.1  | 11.9  |
|      |             | ELS10  | 1599         | 6681   | 5024    | 0.044        | 0.07   | 0.077  | 0.0025          | 0.002  | 0.0095 | 8.5          | 6.45  | 6.75  |
|      | Hout Bay    | DR01   | 48386        | 59683  | 22678   | 0.181        | 0.124  | 0.05   | 0.004           | 0.003  | 0.003  | 2.95         | 5.6   | 5.5   |
|      |             | DR02   | 42683        | 52020  | 35013   | 0.091        | 0.156  | 0.05   | 0.0015          | 0.003  | 0.001  | 4.8          | 6.2   | 8.4   |
|      |             | DR04   | 354          | 125    | 125     | 0.0185       | 0.0335 | 0.05   | 0.0005          | 0.0005 | 0.0005 | 9.75         | 10.3  | 9.45  |
|      |             | DR05   | 26894        | 25496  | 35593   |              | 0.094  |        |                 | 0.002  |        |              | 3.7   |       |
|      |             | DR06   | 420          | 318    | 561     | 0.0175       | 0.0275 | 0.05   | 0.0005          | 0.0005 | 0.001  | 9.4          | 10.3  | 9.7   |
|      |             | HB11   |              |        | 494     |              |        |        |                 |        |        |              |       |       |
|      | Kuilis      | EK03   | 3102         | 583    | 8875    | 2.016        | 2.8    | 2      | 0.019           | 0.0085 | 0.1185 | 5.6          | 4.85  | 5.55  |
|      |             | EK04   | 5982         | 3686   | 16972   | 0.9          | 1.096  | 1.2    | 0.011           | 0.009  | 0.064  | 8.8          | 9.45  | 7.15  |
|      |             | EK05   | 207730       | 469050 | 798590  | 1.975        | 2.1415 | 1.555  | 0.1075          | 0.1835 | 0.2015 | 7.05         | 7.5   | 3.4   |
|      |             | EK09   | 104931       | 210081 | 1542522 | 2.1          | 1.7    | 1.89   | 0.12            | 0.2145 | 0.334  | 7.3          | 7.7   | 5.35  |
|      |             | EK19   | 6232         | 3781   | 2615    | 0.179        | 0.1705 | 0.1395 | 0.001           | 0.008  | 0.006  | 6.7          | 6.65  | 5.15  |
|      |             | EK20   |              | 28804  | 280330  | 1.35         | 2.3    | 2.68   |                 |        | 0.1145 |              |       | 4.9   |
|      | Lourens     | LOU01  | 230          | 206    | 81      | 0.019        | 0.03   | 0.05   | 0.0005          | 0.0005 | 0.0005 | 9.9          | 9.4   | 9.5   |
|      |             | LOU02  | 417          | 204    | 505     | 0.019        | 0.032  | 0.05   | 0.0005          | 0.0005 | 0.0005 | 9.71         | 9.2   | 9.6   |
|      |             | LOU03  | 773          | 591    | 3145    | 0.017        | 0.025  | 0.05   | 0.0005          | 0.0005 | 0.0005 | 9.75         | 9.3   | 9.5   |
|      |             | LOU04  | 1774         | 1987   | 3997    | 0.017        | 0.034  | 0.05   | 0.0005          | 0.0005 | 0.0005 | 9.35         | 9     | 8.9   |
|      |             | LOU05  | 3235         | 3212   | 5637    | 0.033        | 0.058  | 0.05   | 0.001           | 0.001  | 0.001  | 9.1          | 8.6   | 8.9   |
|      |             | LOU06  | 30           | 62     | 39      | 0.021        | 0.043  | 0.05   | 0.0005          | 0.0005 | 0.0005 | 10           | 9.6   | 9.7   |
|      |             | LOU08  | 752          | 827    | 2142    | 0.017        | 0.028  | 0.05   | 0.0005          | 0.0005 | 0.001  | 9.7          | 9.5   | 9.2   |
|      |             | LOU13  | 169          | 252    | 139     | 0.05         | 0.069  | 0.05   | 0.0005          | 0.001  | 0.0025 | 6.05         | 6.7   | 7.2   |
|      | Lower Salt  | ELS08  | 44384        | 79452  | 28408   | 0.161        | 0.221  | 0.139  | 0.105           | 0.029  | 0.094  | 11.1         | 10.1  | 11.9  |
|      |             | NR01   | 364969       | 259750 | 372573  | 0.265        | 0.2645 | 0.338  | 0.0145          | 0.0195 | 0.0225 | 3.2          | 2.95  | 4.45  |
|      |             | NR02   | 266655       | 80997  | 464521  | 0.911        | 1.026  | 0.9935 | 0.129           | 0.126  | 0.159  | 3.85         | 4.5   | 5.3   |
|      |             | NR03   | 733937       | 273130 | 1204508 | 2.1          | 1.888  | 3.415  | 0.188           | 0.241  | 0.1795 | 2.9          | 2     | 2.85  |
|      |             | NR04   | 417054       | 344733 | 1208059 | 2.97         | 2.131  | 2.41   | 0.258           | 0.335  | 0.367  | 3.43         | 2.7   | 4.1   |
|      |             | NR06   | 245341       | 283445 | 911810  | 2.71         | 1.6935 | 2.155  | 0.245           | 0.2655 | 0.2865 | 3.32         | 2.35  | 3.85  |
|      |             | NR07   | 248070       | 201239 | 1002799 | 2.89         | 4.296  | 2.64   | 0.275           | 0.3365 | 0.3745 | 2.4          | 2.5   | 3.25  |
|      |             | NR08   | 2799         | 7938   | 2854    | 0.036        | 0.046  | 0.05   | 0.001           | 0.0025 | 0.0005 | 7.62         | 7.6   | 8.5   |
|      |             | NR09   | 164527       | 275162 | 886389  | 2.55         | 3.466  | 2.77   | 0.229           | 0.289  | 0.3275 | 2.86         | 3.3   | 3.5   |
|      |             | NR10   | 122717       | 139818 | 327376  | 2.255        | 3.6205 | 2.125  | 0.2595          | 0.34   | 0.358  | 6.05         | 5.5   | 5.85  |
|      |             | NR11   | 15869        | 9330   | 12029   | 0.079        | 0.1185 | 0.05   | 0.014           | 0.064  | 0.014  | 11.3         | 12.25 | 11.05 |
|      |             | NR15   | 824003       | 376908 | 1811384 | 4.7          | 3.185  | 5.1    | 0.147           | 0.2455 | 0.1765 | 4.4          | 3.35  | 3.1   |
|      |             | NR16   | 560041       | 276791 | 1283919 | 0.634        | 1.3945 | 1.172  | 0.084           | 0.2095 | 0.085  | 3.9          | 2.4   | 3.95  |
|      |             | NR17   | 264096       | 172603 | 221652  | 0.877        | 0.8945 | 0.4775 | 0.305           | 0.249  | 0.204  | 7.4          | 4.75  | 6.7   |
|      |             | NR22   | 1262         | 2154   | 1733    | 0.036        | 0.05   | 0.05   | 0.0005          | 0.001  | 0.001  | 10.35        | 9.1   | 10    |
|      |             | NR24   | 21243        | 7833   | 5872    | 0.072        |        |        | 0.001           |        |        | 9.9          |       |       |
|      |             | NR25   | 538913       | 407433 | 1661261 | 2.2          | 3.0195 | 2.9    | 0.197           | 0.4345 | 0.3765 | 4            | 4.45  | 3.6   |
|      |             | NR26   | 232182       | 105322 | 1219491 | 5.8          | 3.1435 | 5.15   | 0.11            | 0.1475 | 0.167  | 5.3          | 3.1   | 4.8   |

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| Type | Catchment  | Site  | E.coli       |        |         | PO4-P        |        |        | NH <sub>3</sub> |         |        | DO           |      |      |
|------|------------|-------|--------------|--------|---------|--------------|--------|--------|-----------------|---------|--------|--------------|------|------|
|      |            |       | 2020 to 2022 | 2023   | 2024    | 2020 to 2022 | 2023   | 2024   | 2020 to 2022    | 2023    | 2024   | 2020 to 2022 | 2023 | 2024 |
|      | Mosselbank | MOS01 | 57234        | 16269  | 15468   | 1            | 0.458  | 0.9    | 0.1925          | 0.029   | 0.1535 | 9.95         | 10.5 | 9.5  |
|      |            | MOS02 | 66886        | 22840  | 10483   | 1.02         | 0.8    | 0.939  | 0.09            | 0.0235  | 0.0675 | 7.5          | 7.25 | 5.35 |
|      |            | MOS03 | 14706        | 1519   | 2104    | 0.7175       | 1.0835 | 1.025  | 0.044           | 0.022   | 0.0205 | 4.1          | 3.75 | 4.25 |
|      |            | MOS04 | 2269         | 3216   | 739     | 1.38         | 2.16   | 1.46   | 0.019           | 0.0065  | 0.004  | 5.8          | 6.6  | 5.75 |
|      |            | MOS06 | 8216         | 11160  | 5567    | 1.744        | 2.274  | 3.02   | 0.0125          | 0.012   | 0.0075 | 3.7          | 3.9  | 5.4  |
|      |            | MOS07 | 2783         | 1767   | 787     | 2.477        | 2      | 2      | 0.0125          | 0.0095  | 0.008  | 2.25         | 2.45 | 2.1  |
|      |            | MOS08 | 2328         | 1589   | 1911    | 1.97         | 2.3    | 2.155  | 0.005           | 0.007   | 0.0025 | 5.65         | 5.35 | 4.95 |
|      |            | MOS09 | 18289        | 51312  | 11795   | 14.15        | 8.8625 | 4.015  | 0.186           | 0.185   | 0.0735 | 4.6          | 7.7  | 5.1  |
|      | M'Plain    | KHA04 | 1877073      | 288093 | 2400521 | 1.362        | 1.191  | 1.19   | 0.1995          | 0.223   | 0.2225 | 3.5          | 3.5  | 5    |
|      | Muizb      | CS01B |              |        | 1499    |              |        |        |                 |         |        |              |      |      |
|      |            | CS26  |              |        | 286     |              |        |        |                 |         |        |              |      |      |
|      | Sand       | CR01  | 1866         | 1685   | 719     | 0.068        | 0.0565 | 0.05   | 0.001           | 0.0015  | 0.002  | 6.5          | 4.45 | 7.3  |
|      |            | CR02  | 1925         | 914    | 272     | 0.057        | 0.044  | 0.05   | 0.0005          | 0.00075 | 0.002  | 7.3          | 7.5  | 6.8  |
|      |            | CR03  | 1055         | 1193   | 331     | 0.0605       | 0.05   | 0.05   | 0.0005          | 0.001   | 0.0015 | 7.65         | 8.35 | 6.75 |
|      |            | CR04  | 12959        | 2125   | 18094   | 0.078        | 0.05   | 0.104  | 0.004           | 0.002   | 0.004  | 6.75         | 8.85 | 8.4  |
|      |            | CR05  | 1363         | 175    | 170     | 0.047        | 0.05   | 0.05   | 0.0005          | 0.0005  | 0.001  | 8.3          | 7.6  | 6.9  |
|      |            | CR06  | 718          | 1943   | 624     | 0.152        | 0.117  | 0.05   | 0.0005          | 0.00075 | 0.0005 | 6.6          | 7.35 | 5.8  |
|      |            | CR16  | 1515         | 2105   | 1241    | 0.0385       | 0.05   | 0.05   | 0.0005          | 0.0005  | 0.001  | 9.5          | 9.3  | 9.4  |
|      |            | CR20  | 1830         | 1220   | 35173   | 0.121        | 0.1165 | 0.0845 | 0.0005          | 0.001   | 0.004  | 3.7          | 2.6  | 5.3  |
|      |            | CR21  | 20569        | 25631  | 7204    | 0.06         | 0.05   | 0.05   | 0.008           | 0.007   | 0.006  | 9.9          | 9.2  | 10.4 |
|      |            | CR22  | 944          | 3621   | 3256    | 0.111        | 0.065  | 0.105  | 0.002           | 0.0015  | 0.003  | 7.1          | 5.35 | 6.2  |
|      |            | CR29  | 33790        | 20683  | 9925    | 0.041        | 0.05   | 0.05   | 0.005           | 0.006   | 0.005  | 10.2         | 8.4  | 9.65 |
|      |            | CS22  |              |        | 1178    |              |        |        |                 |         |        |              |      |      |
|      |            | DRRSC | 40877        | 60882  | 51150   | 0.063        | 0.101  | 0.05   | 0.009           | 0.056   | 0.003  | 10.86        | 11.2 | 9.4  |
|      |            | LPVMR | 327          | 593    | 524     | 0.016        | 0.05   | 0.05   | 0.0005          | 0.001   | 0.001  | 5.1          | 4.3  | 3.2  |
|      |            | LVI   | 3990         | 1521   | 8642    | 0.105        | 0.182  | 0.1745 | 0.006           | 0.006   | 0.0085 | 6.3          | 6.9  | 5.4  |
|      |            | SCV   | 40580        | 18955  | 153937  | 0.085        | 0.0825 | 0.168  | 0.008           | 0.003   | 0.012  | 10.1         | 9.9  | 8.95 |
|      | Schusters  | SCH02 | 310          | 197    | 81      | 0.02         | 0.0345 | 0.05   | 0.0005          | 0.0005  | 0.0005 | 5.6          | 6.6  | 7.8  |
|      |            | SCH04 | 1290         | 354    | 346     | 0.245        | 0.263  | 0.235  | 0.001           | 0.001   | 0.003  | 5.95         | 5.15 | 6.5  |
|      | Silvermine | FHC   |              |        | 17459   |              |        |        |                 |         |        |              |      |      |
|      |            | FHLH  |              |        | 1710    |              |        |        |                 |         |        |              |      |      |
|      |            | SIL02 | 79           | 28     | 67      | 0.017        | 0.028  | 0.05   | 0.0005          | 0.0005  | 0.0005 | 9.9          | 9.9  | 9.45 |
|      |            | SIL04 | 371          | 55     | 106     | 0.016        | 0.0455 | 0.05   | 0.0005          | 0.0005  | 0.0005 | 8.6          | 8.7  | 7.6  |
|      |            | SIL06 | 440          | 109    | 217     | 0.012        | 0.029  | 0.05   | 0.0005          | 0.0005  | 0.0005 | 5.6          | 7.65 | 5.8  |
|      |            | SRE   |              | 512    | 808     |              |        |        |                 |         |        |              |      |      |
|      |            | SRW   |              | 1827   | 1169    |              |        |        |                 |         |        |              |      |      |
|      | SLPass     | SIR01 | 2468         | 182    | 345     | 0.041        | 0.047  | 0.05   | 0.0005          | 0.0005  | 0.0005 | 9.6          | 9.8  | 9.2  |
|      |            | SIR02 | 5620         | 12219  | 356163  | 0.068        | 0.087  | 0.28   | 0.001           | 0.002   | 0.026  | 8.8          | 9.4  | 8.2  |
|      |            | SIR03 | 3435         | 2307   |         | 0.0645       | 0.1    | 0.2    | 0.001           | 0.001   |        | 9.2          | 8.95 |      |
|      |            | SIR04 | 214          | 195    | 1228    | 0.044        | 0.059  | 0.2195 | 0.0005          | 0.0005  | 0.058  | 5.1          | 3.15 | 4.7  |
|      |            | SIR05 | 877          | 4285   | 1504    | 0.083        | 0.073  | 0.116  | 0.001           | 0.0005  | 0.012  | 7.9          | 7.4  | 8    |
|      |            | SIR06 | 261          | 884    | 12438   | 0.2          | 0.2    | 0.4    | 0.001           | 0.001   | 0.0295 | 6.5          | 6.8  | 9.35 |
|      |            | SIR07 | 924          | 1801   | 16920   | 0.155        | 0.1705 | 0.1695 | 0.006           | 0.004   | 0.051  | 10.7         | 10   | 10.6 |
|      |            | SIR08 |              | 1553   |         |              | 0.05   |        |                 |         |        |              |      |      |
|      |            | SIR09 |              | 7980   |         |              | 0.05   |        |                 |         |        |              |      |      |
|      | Soet       | SOE02 | 381612       | 419003 | 848327  | 2.0205       | 2.445  | 3.71   | 0.4035          | 0.2515  | 0.744  | 3.4          | 3.85 | 3    |

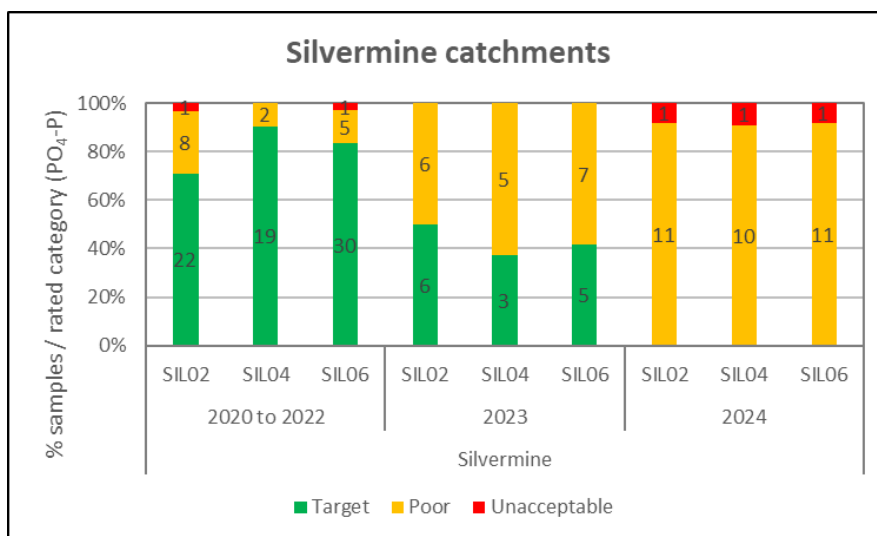
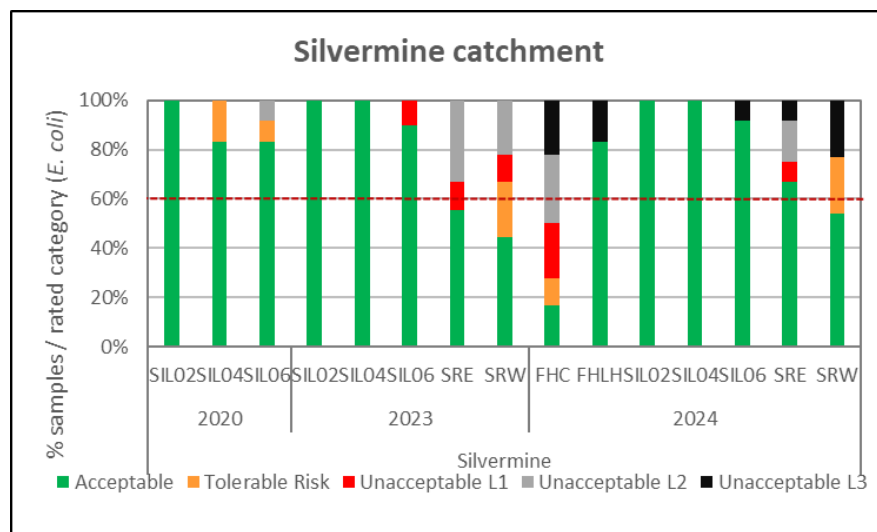


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| Type           | Catchment   | Site     | E.coli       |        |         |   | PO4-P        |        |        |   | NH3          |        |        |   | DO           |      |      |   |
|----------------|-------------|----------|--------------|--------|---------|---|--------------|--------|--------|---|--------------|--------|--------|---|--------------|------|------|---|
|                |             |          | 2020 to 2022 | 2023   | 2024    |   | 2020 to 2022 | 2023   | 2024   |   | 2020 to 2022 | 2023   | 2024   |   | 2020 to 2022 | 2023 | 2024 |   |
| Standing water | Sout        | SOU01    | 266          | 544    | 96      | ↓ | 4.5          | 5.9    | 4.7    | ↓ | 0.001        | 0.0005 | 0.001  | ↓ | 5            | 5.2  | 6.3  | ↓ |
|                |             | SOU02    | 891          | 796    | 468     | ↑ | 3.755        | 6.7495 | 5.645  | ↓ | 0.001        | 0.001  | 0.001  | ↓ | 5.85         | 6.1  | 7.1  | ↓ |
|                | Zeekoe      | LR02     | 13594        | 3283   | 4913    | ↓ | 0.369        | 0.2455 | 0.767  | ↓ | 0.0135       | 0.002  | 0.013  | ↓ | 4.5          | 6    | 4    | ↓ |
|                |             | LR03     | 1115895      | 317102 | 637364  | ↓ | 1.0095       | 0.695  | 0.872  | ↓ | 0.26         | 0.253  | 0.367  | ↓ | 1.2          | 2.7  | 2.2  | ↓ |
|                |             | LR05     | 183963       | 67876  | 367189  | ↓ | 1.1155       | 0.9105 | 1.19   | ↓ | 0.1655       | 0.119  | 0.257  | ↓ | 2.2          | 4.5  | 6.7  | ↑ |
|                |             | LR06     | 6084         | 14028  | 17745   | ↓ | 0.0625       | 0.1625 | 0.129  | ↓ | 0.006        | 0.007  | 0.008  | ↓ | 7.1          | 7.8  | 6.7  | ↓ |
|                |             | LR07     | 210639       | 187109 | 1563075 | ↓ | 1.0215       | 1.1005 | 1.16   | ↓ | 0.162        | 0.1025 | 0.253  | ↓ | 4.45         | 6.85 | 4.1  | ↓ |
|                |             | LR08     | 52901        | 173908 | 900847  | ↓ | 1.07         | 1.0345 | 1.48   | ↓ | 0.148        | 0.1385 | 0.286  | ↓ | 3.5          | 5.7  | 3.8  | ↓ |
|                |             | LR10     | 12670        | 16495  | 36693   | ↓ | 0.049        | 0.1    | 0.132  | ↓ | 0.028        | 0.0165 | 0.041  | ↓ | 10.8         | 10.1 | 10.5 | ↓ |
|                |             | LR19A    |              |        |         |   | 8.439        |        |        |   |              |        |        |   |              |      |      |   |
|                |             | LR19B    |              |        |         |   | 1.839        |        |        |   |              |        |        |   |              |      |      |   |
|                |             | LR20A    |              |        |         |   | 5.558        |        |        |   |              |        |        |   |              |      |      |   |
|                |             | LR20B    |              |        |         |   | 0.562        |        |        |   |              |        |        |   |              |      |      |   |
|                |             | POC01    | 6577         | 6110   | 4477    | ↑ | 0.23         | 0.26   | 0.278  | ↓ | 0.0285       | 0.023  | 0.0225 | ↓ | 5.6          | 5.9  | 6    | ↓ |
|                |             | RVIRD    | 6843         | 2822   | 7289    | ↓ | 0.053        | 0.05   | 0.05   | ↓ | 0.004        | 0.003  | 0.003  | ↓ | 5.9          | 7.4  | 7.5  | ↓ |
|                |             | ZEV08    | 62310        | 85422  | 307208  | ↓ | 3.302        | 4.543  | 2.6    | ↑ | 0.258        | 0.338  | 0.433  | ↓ | 5.2          | 5    | 5.3  | ↓ |
|                |             | ZEV5     | 46           | 5      | 8       | ↓ | 7.04         | 6.863  | 6.02   | ↓ | 0.279        | 0.389  | 0.41   | ↓ | 2.6          | 2.9  | 3.3  | ↓ |
|                | Diep        | MAC      | 265          | 43     | 51      | ↓ | 0.128        | 0.055  | 0.3255 | ↓ | 0.003        | 0.013  | 0.0165 | ↓ | 9.2          | 9.6  | 9.1  | ↓ |
|                |             | PEV1     | 964          | 4063   | 5176    | ↓ | 0.2085       | 0.2195 | 0.4995 | ↓ | 0.01         | 0.006  | 0.016  | ↓ | 5.45         | 3.9  | 4    | ↓ |
|                |             | PEV2     | 305          | 415    | 800     | ↓ | 0.323        | 0.244  | 0.354  | ↓ | 0.001        | 0.0005 | 0.002  | ↓ | 2.4          | 3.2  | 2.3  | ↓ |
|                |             | RTV02    | 160          | 22     | 30      | ↓ | 0.154        | 0.061  | 0.3115 | ↓ | 0.007        | 0.015  | 0.019  | ↓ | 9.1          | 9.5  | 8.85 | ↓ |
|                |             | RTV17    | 48           | 13     | 12      | ↓ | 0.148        | 0.0605 | 0.315  | ↓ | 0.0055       | 0.008  | 0.018  | ↓ | 9.1          | 9.5  | 9.25 | ↓ |
|                |             | RTV19    | 116          | 40     | 52      | ↓ | 0.1425       | 0.064  | 0.325  | ↓ | 0.0045       | 0.011  | 0.017  | ↓ | 8.4          | 9.6  | 8.6  | ↓ |
|                |             | RTV34    |              | 282    |         |   |              |        |        |   |              |        |        |   |              |      |      |   |
|                |             | RTV35    |              | 3716   |         |   |              |        |        |   |              |        |        |   |              |      |      |   |
|                |             | RTV36    |              | 3964   |         |   |              |        |        |   |              |        |        |   |              |      |      |   |
|                |             | RTV37    |              | 2976   |         |   |              |        |        |   |              |        |        |   |              |      |      |   |
|                |             | RTVB00Y1 | 179          | 11     | 26      | ↓ | 0.131        | 0.066  | 0.325  | ↓ | 0.0065       | 0.006  | 0.019  | ↓ | 8.9          | 9.55 | 8.95 | ↓ |
|                |             | RTVB00Y2 | 379          | 15     | 40      | ↓ | 0.14         | 0.054  | 0.323  | ↓ | 0.007        | 0.007  | 0.014  | ↓ | 9.2          | 9.4  | 9    | ↓ |
|                |             | RTVB00Y4 | 341          | 14     | 18      | ↓ | 0.138        | 0.062  | 0.311  | ↓ | 0.005        | 0.007  | 0.016  | ↓ | 9.3          | 9.6  | 8.9  | ↓ |
|                |             | RTVB00Y6 | 394          | 6      | 18      | ↓ | 0.137        | 0.05   | 0.3215 | ↓ | 0.004        | 0.006  | 0.0165 | ↓ | 9            | 9.35 | 8.95 | ↓ |
|                | Eise        | GC02     | 421          | 276    | 356     | ↓ | 0.01         | 0.014  | 0.05   | ↓ | 0.0005       | 0.0005 | 0.001  | ↓ | 6.3          | 7.45 | 7.2  | ↓ |
|                |             | ANG01    | 82           | 82     | 46      | ↑ | 0.005        | 0.0465 | 0.05   | ↓ | 0.002        | 0.001  | 0.002  | ↓ | 7.5          | 9.05 | 6.55 | ↓ |
|                |             | ANG02    | 176          | 126    | 128     | ↓ | 0.005        | 0.015  | 0.05   | ↓ | 0.001        | 0.002  | 0.002  | ↓ | 7.95         | 7.85 | 7.1  | ↓ |
|                |             | DOOR01   | 3568         | 951    | 824     | ↓ | 0.103        | 0.133  | 0.05   | ↑ | 0.004        | 0.0095 | 0.0075 | ↓ | 5.7          | 3.7  | 5.35 | ↑ |
|                | Eisieskraal | DOOR03   | 101          | 115    | 43      | ↑ | 0.012        | 0.008  | 0.05   | ↓ | 0.003        | 0.001  | 0.005  | ↓ | 6.3          | 5.9  | 8.15 | ↑ |
|                |             | KHA01    | 2834180      | 341043 | 3253207 | ↓ | 1.39         | 1.151  | 1.55   | ↓ | 0.153        | 0.124  | 0.195  | ↓ | 1.4          | 1.3  | 2    | ↑ |
|                | M'Plain     | CS23     | 298258       | 43300  | 86316   | ↓ |              |        |        |   |              |        |        |   |              |      |      |   |
|                |             | CS24     | 100001       |        |         |   |              |        |        |   |              |        |        |   |              |      |      |   |
|                |             | KHA02    | 2452245      | 425569 | 3424449 | ↓ | 1.046        | 0.958  | 1.285  | ↓ | 0.201        | 0.157  | 0.248  | ↓ | 4.05         | 3.4  | 3    | ↓ |
|                |             | KHA03    | 2826833      | 275703 | 3021118 | ↓ | 1.3825       | 1.175  | 1.205  | ↓ | 0.173        | 0.217  | 0.1825 | ↓ | 4.25         | 3.1  | 3.2  | ↓ |
|                | Noordhoek   | WV02     | 509          | 223    | 44      | ↑ | 3.681        | 4.1965 | 3.17   | ↓ | 0.991        | 0.7005 | 0.1465 | ↑ | 8.3          | 7.25 | 7.9  | ↓ |
|                |             | WV05     | 418          | 176    | 101     | ↑ | 3.787        | 4.5535 | 3.28   | ↑ | 0.706        | 0.5665 | 0.0935 | ↑ | 6.8          | 6.6  | 7.1  | ↓ |
|                |             | WV08     | 1975         | 348    | 171     | ↑ |              |        |        |   |              |        |        |   |              |      |      |   |

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|      |           |         | E.coli       |       |    |       | PO4-P        |        |        |      | NH3          |      |        |        | DO           |        |    |       |       |    |       |    |
|------|-----------|---------|--------------|-------|----|-------|--------------|--------|--------|------|--------------|------|--------|--------|--------------|--------|----|-------|-------|----|-------|----|
| Type | Catchment | Site    | 2020 to 2022 | 2023  |    | 2024  | 2020 to 2022 | 2023   |        | 2024 | 2020 to 2022 | 2023 |        | 2024   | 2020 to 2022 | 2023   |    | 2024  |       |    |       |    |
|      | Sand      | LPVN    | 197          | 141   | ⬆️ | 96    | ⬆️           | 0.012  | 0.05   | ⬇️   | 0.05         | ⬇️   | 0.001  | 0.001  | ⬇️           | 0.0025 | ⬇️ | 7.4   | 6.6   | ⬇️ | 7.2   | ⬇️ |
|      |           | LPVS    | 897          | 1196  | ⬇️ | 2146  | ⬇️           | 0.0255 | 0.05   | ⬇️   | 0.05         | ⬇️   | 0.0015 | 0.003  | ⬇️           | 0.003  | ⬇️ | 4.48  | 5.4   | ⬇️ | 6.2   | ⬇️ |
|      |           | LVO     | 718          | 226   | ⬆️ | 308   | ⬇️           | 0.0655 | 0.134  | ⬇️   | 0.05         | ⬆️   | 0.0175 | 0.0275 | ⬇️           | 0.013  | ⬆️ | 9     | 9.3   | ⬇️ | 8.5   | ⬇️ |
|      |           | OOG01   | 288          | 159   | ⬆️ | 184   | ⬇️           | 0.009  | 0.05   | ⬇️   | 0.05         | ⬇️   | 0.001  | 0.0075 | ⬇️           | 0.007  | ⬇️ | 7.8   | 6.55  | ⬇️ | 9.4   | ⬆️ |
|      |           | PV03    | 340          | 485   | ⬇️ | 512   | ⬇️           | 0.01   | 0.016  | ⬇️   | 0.05         | ⬇️   | 0.002  | 0.002  | ⬇️           | 0.009  | ⬇️ | 10.2  | 9.1   | ⬇️ | 9.15  | ⬆️ |
|      |           | PVWEIR  | 383          | 468   | ⬇️ | 418   | ⬇️           | 0.005  | 0.019  | ⬇️   | 0.05         | ⬇️   | 0.002  | 0.001  | ⬆️           | 0.008  | ⬇️ | 9.6   | 9     | ⬇️ | 9.15  | ⬇️ |
|      |           | ZA01S   | 1246         | 385   | ⬆️ | 194   | ⬆️           | 0.0405 | 0.0455 | ⬇️   | 0.05         | ⬇️   | 0.009  | 0.004  | ⬆️           | 0.006  | ⬇️ | 9.52  | 9.3   | ⬇️ | 9.35  | ⬇️ |
|      |           | ZA02S   | 646          | 200   | ⬆️ | 210   | ⬇️           | 0.043  | 0.05   | ⬇️   | 0.05         | ⬇️   | 0.0075 | 0.0045 | ⬆️           | 0.005  | ⬇️ | 9.1   | 9.5   | ⬇️ | 9.1   | ⬇️ |
|      |           | ZA03S   | 2324         | 579   | ⬆️ |       |              | 0.03   |        |      |              |      | 0.025  |        |              |        |    | 7     |       |    |       |    |
|      |           | ZA04S   | 1231         | 505   | ⬆️ | 227   | ⬆️           | 0.072  | 0.052  | ⬆️   | 0.05         | ⬇️   | 0.003  | 0.0025 | ⬇️           | 0.003  | ⬇️ | 9     | 9.4   | ⬇️ | 8.8   | ⬇️ |
|      |           | ZA05S   | 520          | 457   | ⬇️ | 247   | ⬆️           | 0.1035 | 0.07   | ⬆️   | 0.05         | ⬆️   | 0.003  | 0.0025 | ⬇️           | 0.002  | ⬇️ | 8.2   | 8.7   | ⬇️ | 7.55  | ⬇️ |
|      |           | ZA06S   | 210          | 251   | ⬇️ | 298   | ⬇️           | 0.021  | 0.038  | ⬇️   | 0.05         | ⬇️   | 0.013  | 0.014  | ⬇️           | 0.011  | ⬇️ | 8.05  | 9.9   | ⬇️ | 9.3   | ⬇️ |
|      |           | ZA07S   | 896          | 259   | ⬆️ | 218   | ⬇️           | 0.026  | 0.037  | ⬇️   | 0.05         | ⬇️   | 0.0065 | 0.014  | ⬇️           | 0.009  | ⬆️ | 9.2   | 10.75 | ⬇️ | 10.45 | ⬇️ |
|      |           | ZA08S   | 213          | 137   | ⬆️ | 90    | ⬆️           | 0.0215 | 0.038  | ⬇️   | 0.05         | ⬇️   | 0.006  | 0.006  | ⬇️           | 0.0075 | ⬇️ | 9.9   | 9.6   | ⬇️ | 8.9   | ⬇️ |
|      |           | ZA09S   | 176          | 121   | ⬆️ | 117   | ⬇️           | 0.0195 | 0.029  | ⬇️   | 0.05         | ⬇️   | 0.0045 | 0.0055 | ⬇️           | 0.007  | ⬇️ | 9.7   | 8.8   | ⬇️ | 9.5   | ⬇️ |
|      |           | ZA10S   | 1069         | 289   | ⬆️ | 213   | ⬆️           | 0.0575 | 0.055  | ⬇️   | 0.05         | ⬇️   | 0.012  | 0.005  | ⬆️           | 0.0085 | ⬇️ | 8.765 | 9.1   | ⬇️ | 9.4   | ⬇️ |
|      |           | ZA11S   | 199          | 114   | ⬆️ | 140   | ⬇️           | 0.023  | 0.033  | ⬇️   | 0.05         | ⬇️   | 0.007  | 0.006  | ⬇️           | 0.007  | ⬇️ | 9.4   | 9.9   | ⬇️ | 9.3   | ⬇️ |
|      |           | ZA12S   | 446          | 293   | ⬆️ | 323   | ⬇️           | 0.023  | 0.045  | ⬇️   | 0.05         | ⬇️   | 0.0035 | 0.01   | ⬇️           | 0.0075 | ⬆️ | 9.8   | 10.9  | ⬇️ | 9.8   | ⬇️ |
|      |           | ZA13S   | 319          | 145   | ⬆️ | 103   | ⬆️           | 0.017  | 0.027  | ⬇️   | 0.05         | ⬇️   | 0.009  | 0.01   | ⬇️           | 0.008  | ⬇️ | 9.2   | 10    | ⬇️ | 9.3   | ⬇️ |
|      |           | ZAWWEIR | 513          | 732   | ⬇️ | 167   | ⬆️           | 0.106  | 0.074  | ⬆️   | 0.05         | ⬆️   | 0.003  | 0.004  | ⬇️           | 0.002  | ⬆️ | 8.4   | 8.9   | ⬇️ | 8.2   | ⬇️ |
|      | Zeekoe    | RVWEIR  | 96           | 422   | ⬇️ | 132   | ⬆️           | 0.077  | 0.101  | ⬆️   | 0.05         | ⬆️   | 0.001  | 0.013  | ⬇️           | 0.009  | ⬆️ | 4.7   | 7.5   | ⬆️ | 8.8   | ⬇️ |
|      |           | ZEV1S   | 421          | 146   | ⬆️ | 69    | ⬆️           | 0.5    | 0.4405 | ⬇️   | 0.3305       | ⬇️   | 0.041  | 0.0495 | ⬇️           | 0.079  | ⬇️ | 10.4  | 11.2  | ⬇️ | 11.55 | ⬇️ |
|      |           | ZEV2S   | 4120         | 15540 | ⬇️ | 46669 | ⬇️           | 0.634  | 0.772  | ⬇️   | 1.14         | ⬇️   | 0.1015 | 0.112  | ⬇️           | 0.289  | ⬇️ | 8.55  | 7.1   | ⬇️ | 7.3   | ⬇️ |
|      |           | ZEV3S   | 468          | 127   | ⬆️ | 95    | ⬆️           | 0.616  | 0.602  | ⬇️   | 0.55         | ⬇️   | 0.051  | 0.115  | ⬇️           | 0.077  | ⬆️ | 9.65  | 8.8   | ⬇️ | 9.7   | ⬇️ |
|      |           | ZEV4S   | 130          | 32    | ⬆️ |       |              | 0.5235 | 0.285  | ⬆️   |              |      | 0.017  | 0.094  | ⬇️           |        |    | 9.4   | 11.3  | ⬇️ |       |    |
|      |           | ZEV9S   | 1128         | 186   | ⬆️ | 550   | ⬇️           | 0.597  | 0.4775 | ⬇️   | 0.484        | ⬇️   | 0.063  | 0.098  | ⬇️           | 0.064  | ⬆️ | 9.6   | 10.45 | ⬇️ | 10.4  | ⬇️ |
|      |           | ZEWEIR  | 823          | 186   | ⬆️ | 129   | ⬆️           | 0.498  | 0.4135 | ⬇️   | 0.315        | ⬇️   | 0.045  | 0.0205 | ⬆️           | 0.057  | ⬇️ | 10.65 | 11.2  | ⬇️ | 11.1  | ⬇️ |

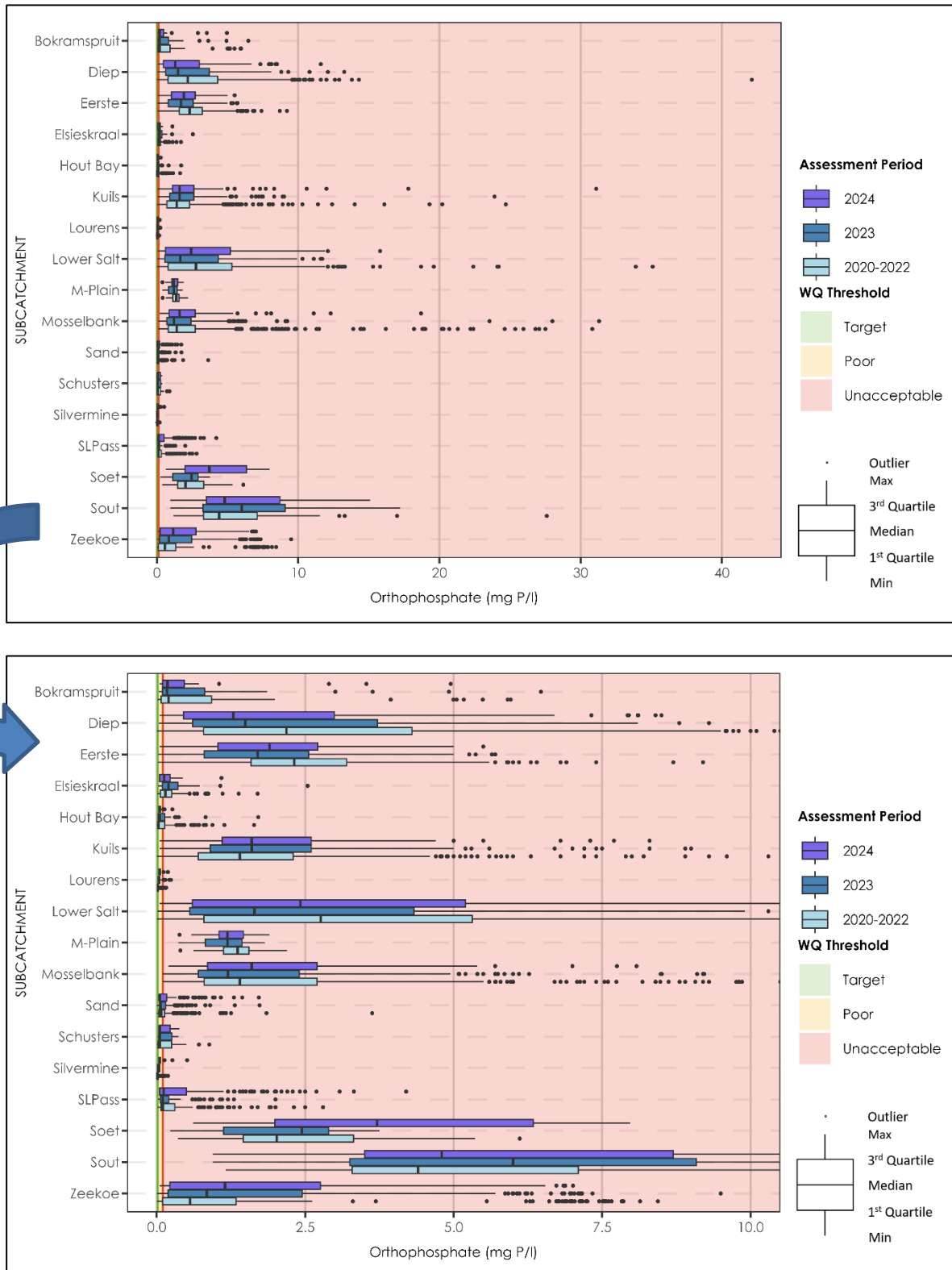


**Figure C1**  
*Escherichia coli* and Orthophosphate data for sites in the Silvermine Catchment, showing additional sites included in past few years (*E. coli* monitoring only).

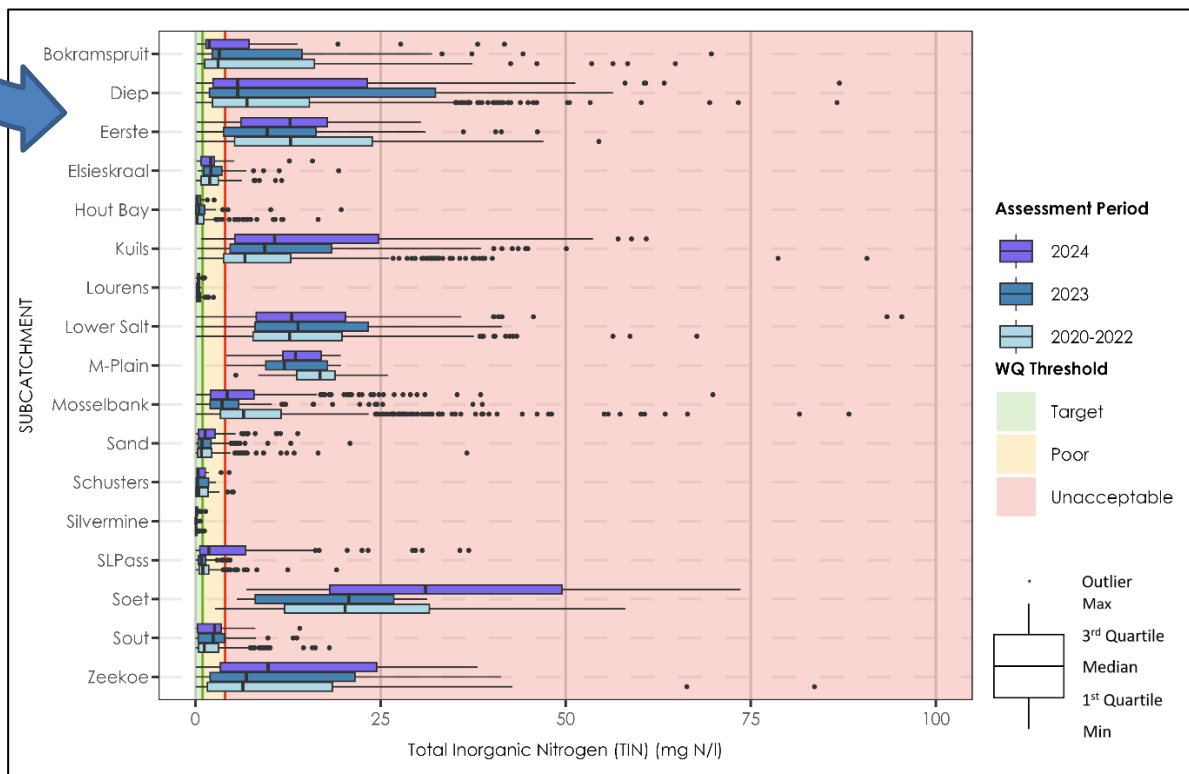
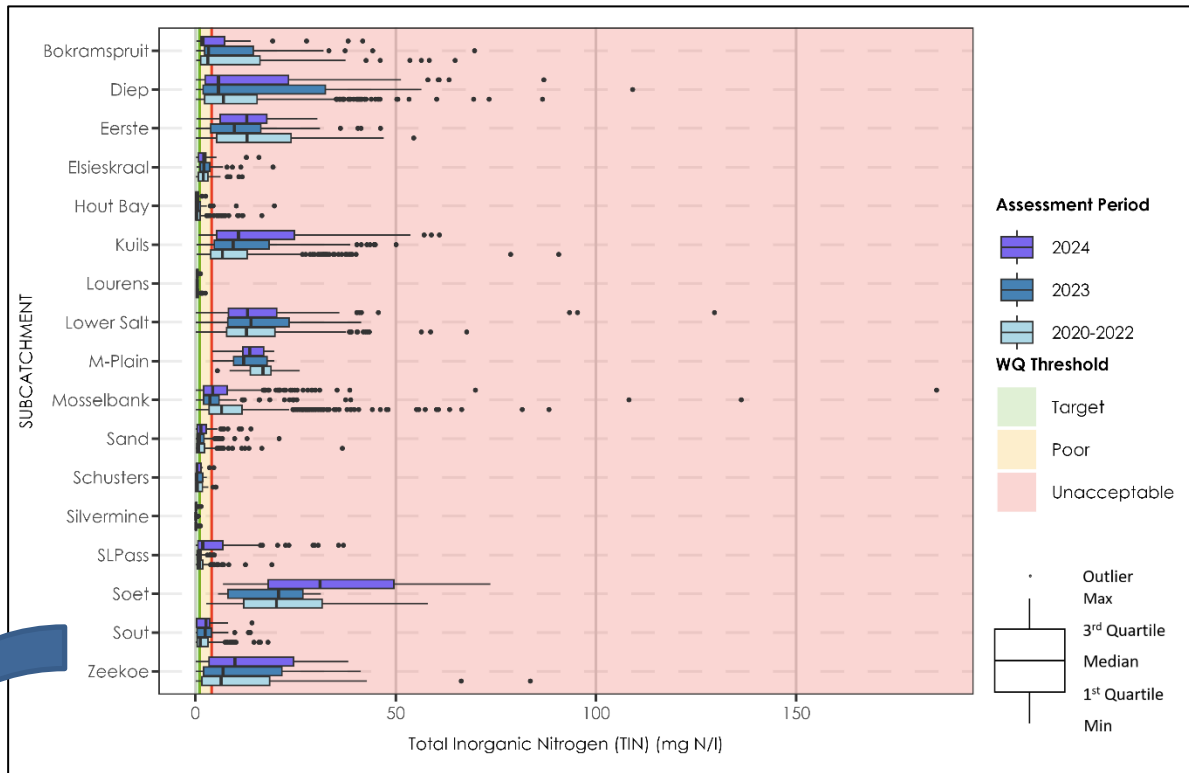
## APPENDIX D: BOXPLOTS OF ANNUAL DATA FOR KEY VARIABLES



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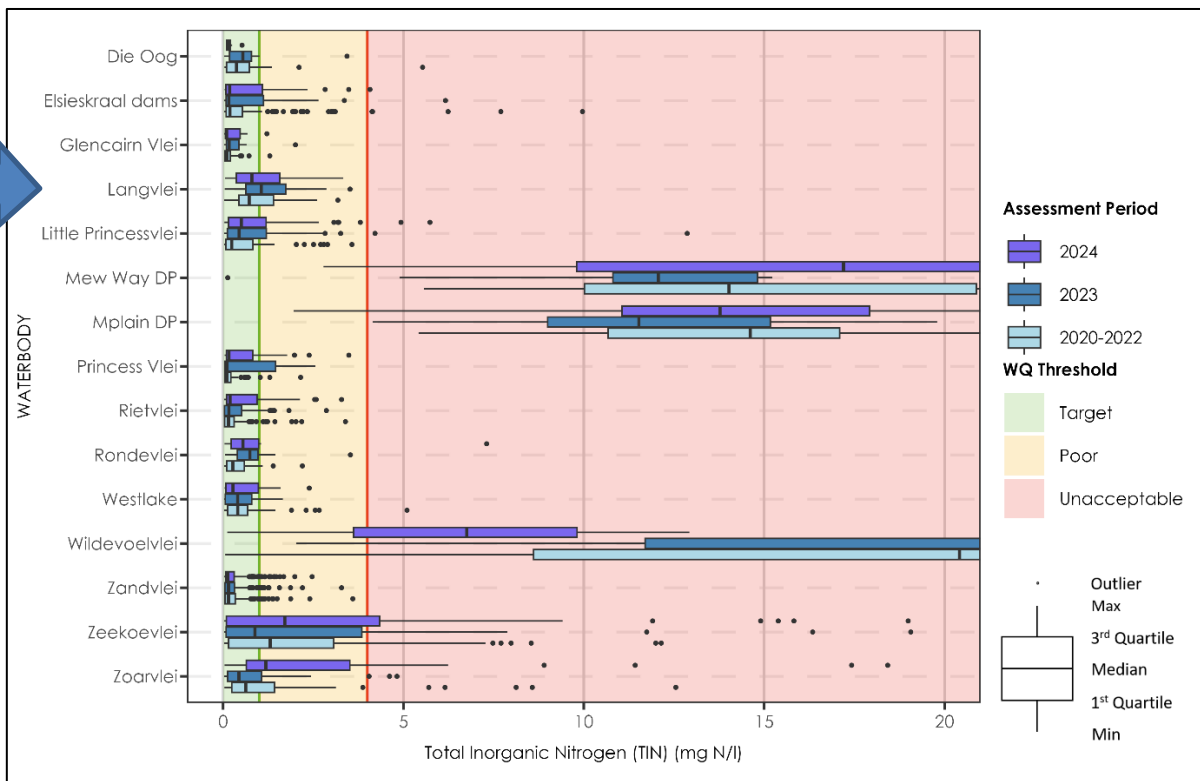
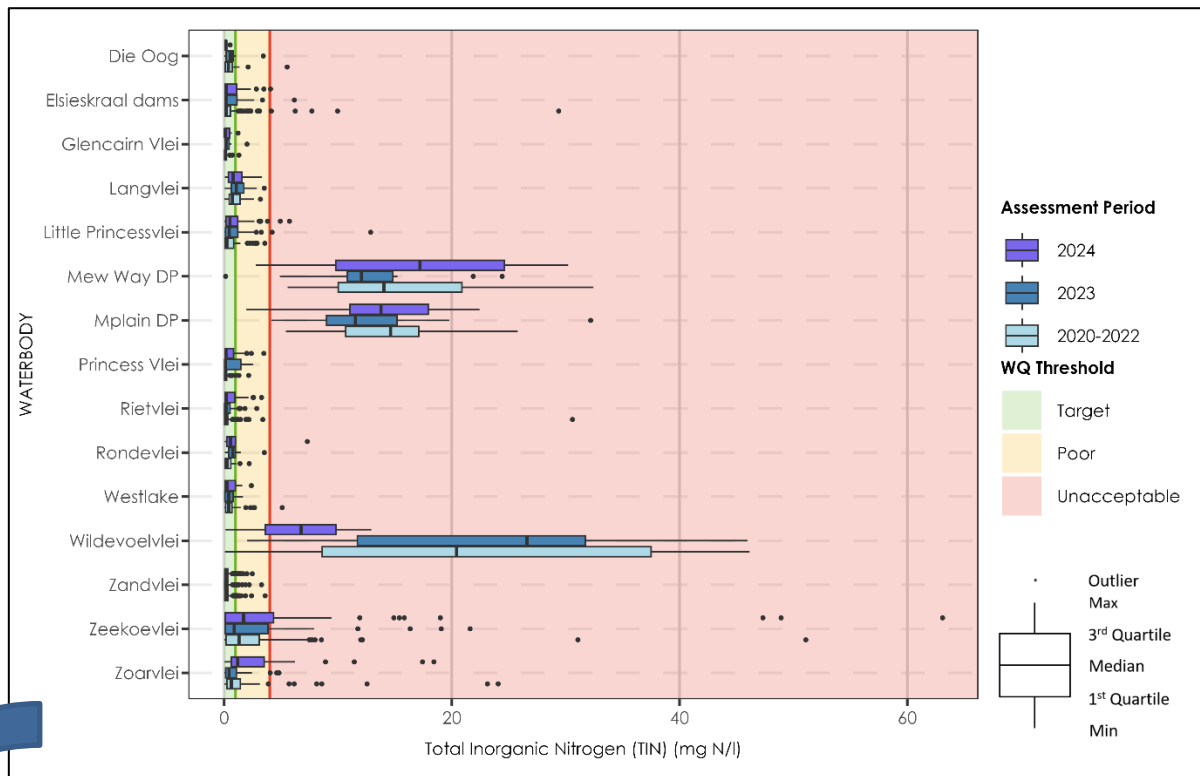


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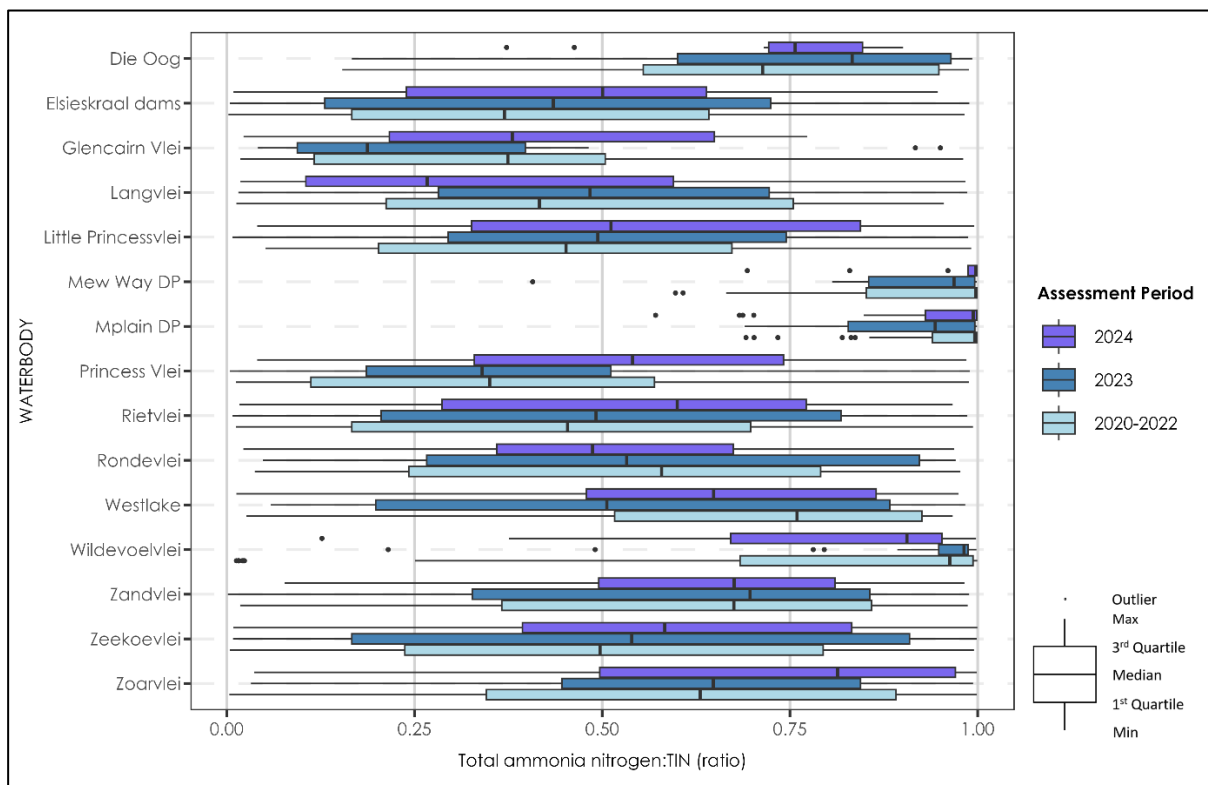
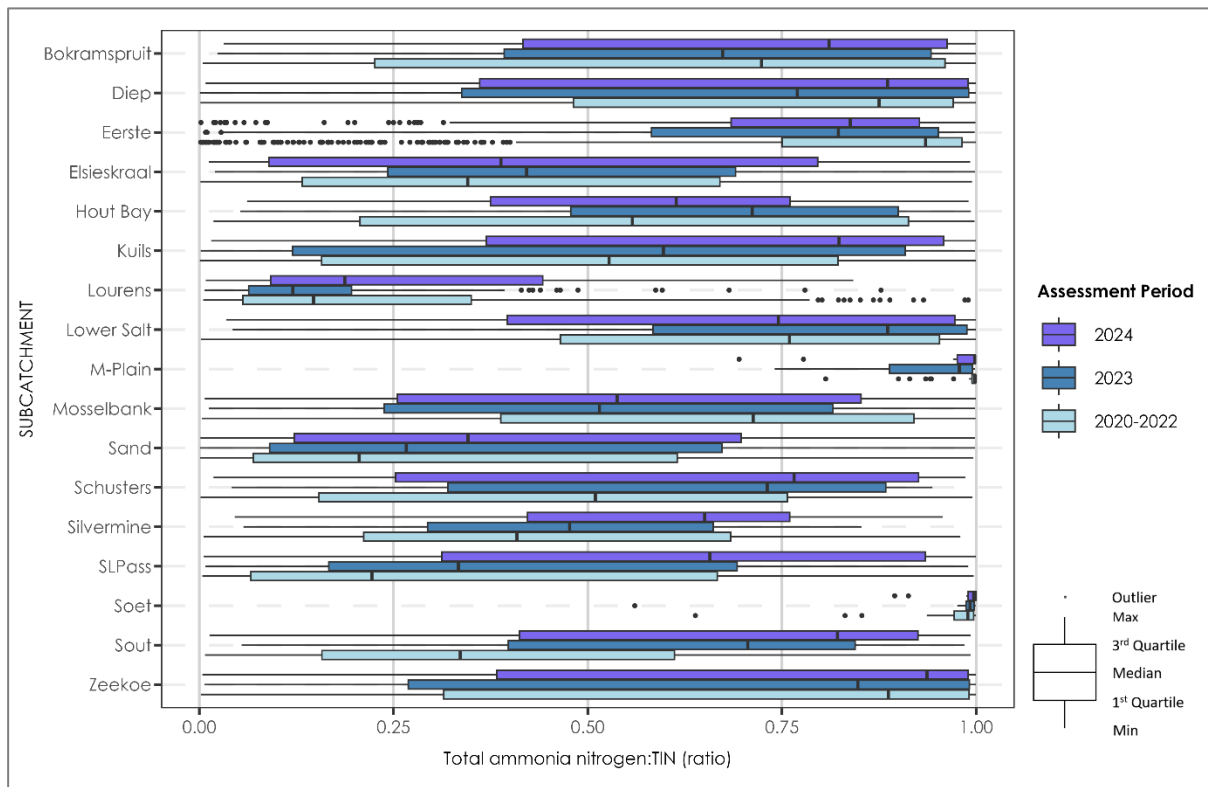
**Figure D2**  
Comparison of Total Inorganic Nitrogen (TIN) data for flowing water systems (rivers and stormwater channels) from the 2024 reporting period with those from 2023 and the previous three years (2020 to 2022) combined. Bottom graph comprises same data as top graph, but shown at different x-axis scale.

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**Figure D3**  
**Comparison of Total Inorganic Nitrogen (TIN) data for standing water systems (vleis, dams and detention ponds) from the 2024 reporting period with those from 2023 and the three years (2020 to 2022) combined. Bottom graph comprises same data as top graph, but shown at different x-axis scale.**

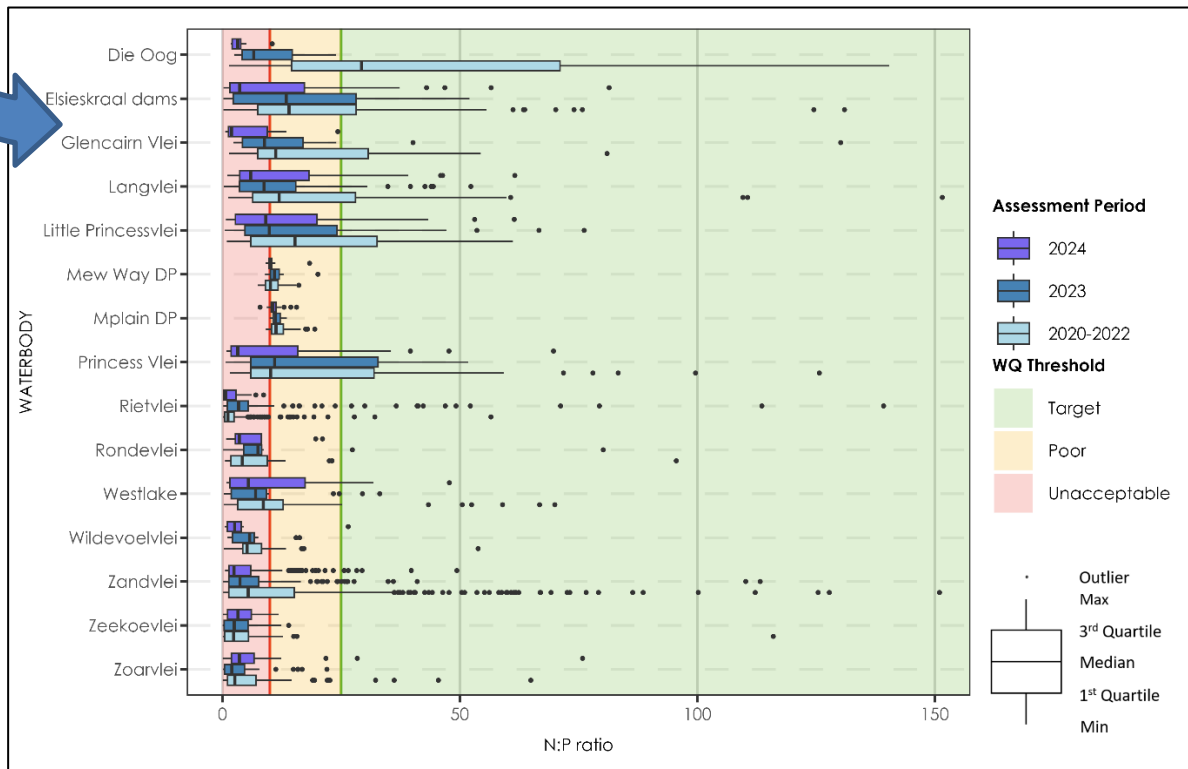
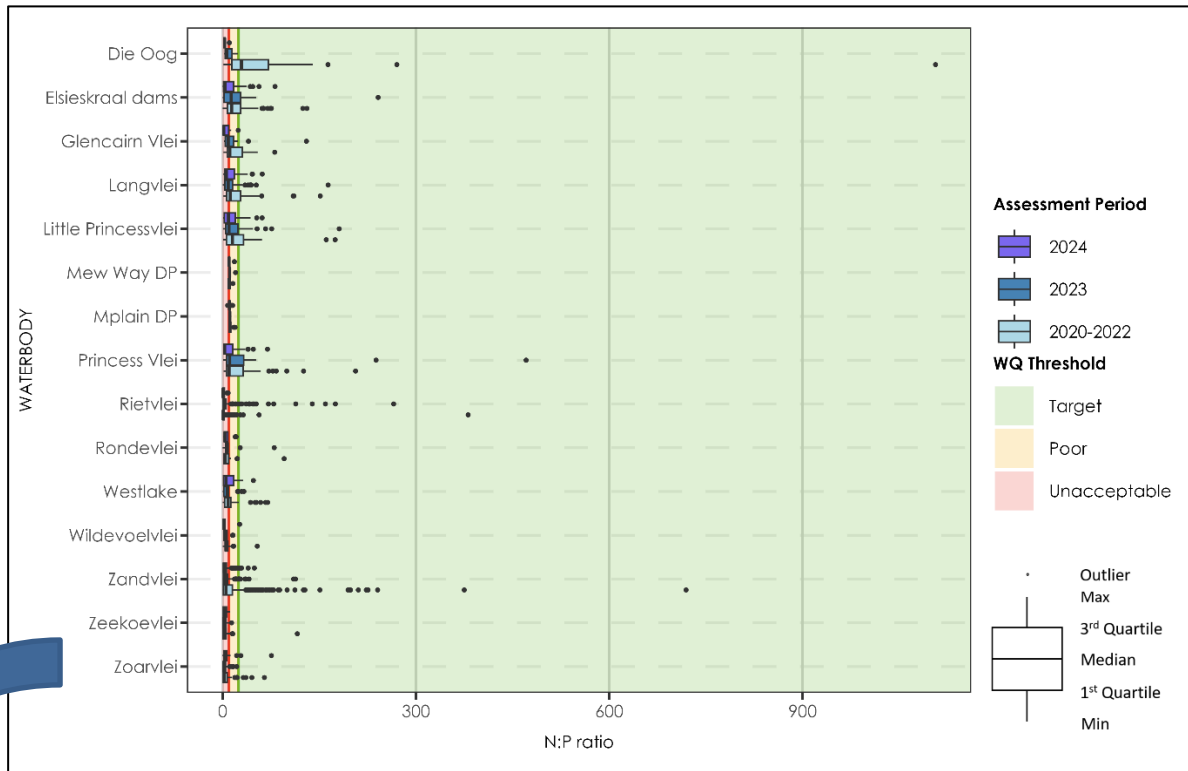
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**Figure D4**  
**Comparison of ratios of total ammonia nitrogen (NH<sub>4</sub>-N) to Total Inorganic Nitrogen (TIN) for flowing systems (rivers and stormwater channels) (top) and standing water systems (vleis, dams and detention ponds) (bottom) from the 2024 reporting period with those from 2023 and the previous three years (2020 to 2022) combined. Bottom graph comprises same data as top graph, but shown at different x-axis scale.**

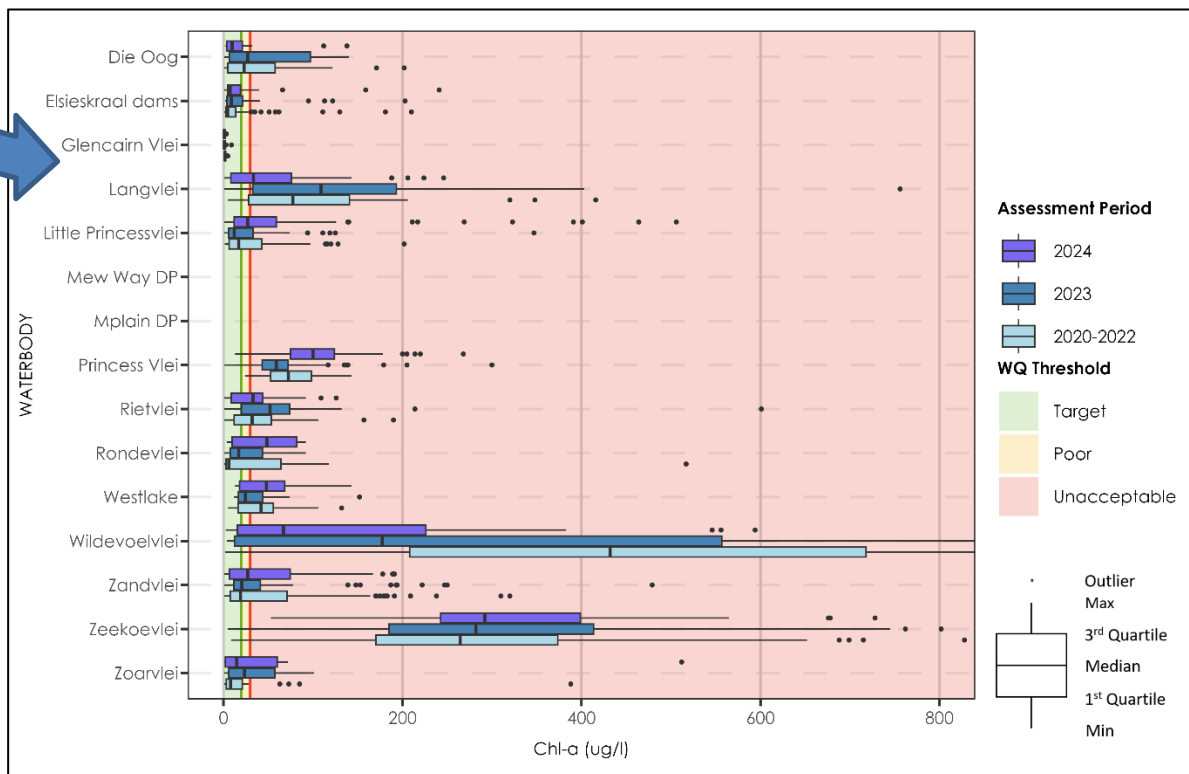
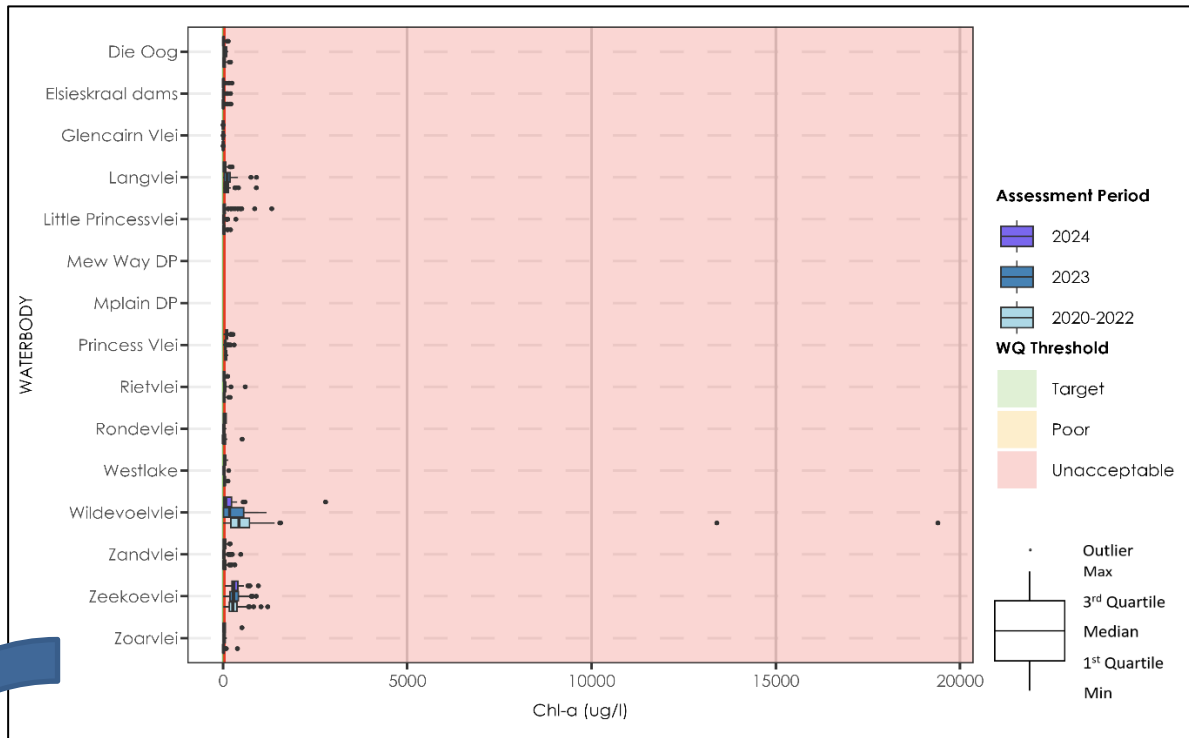


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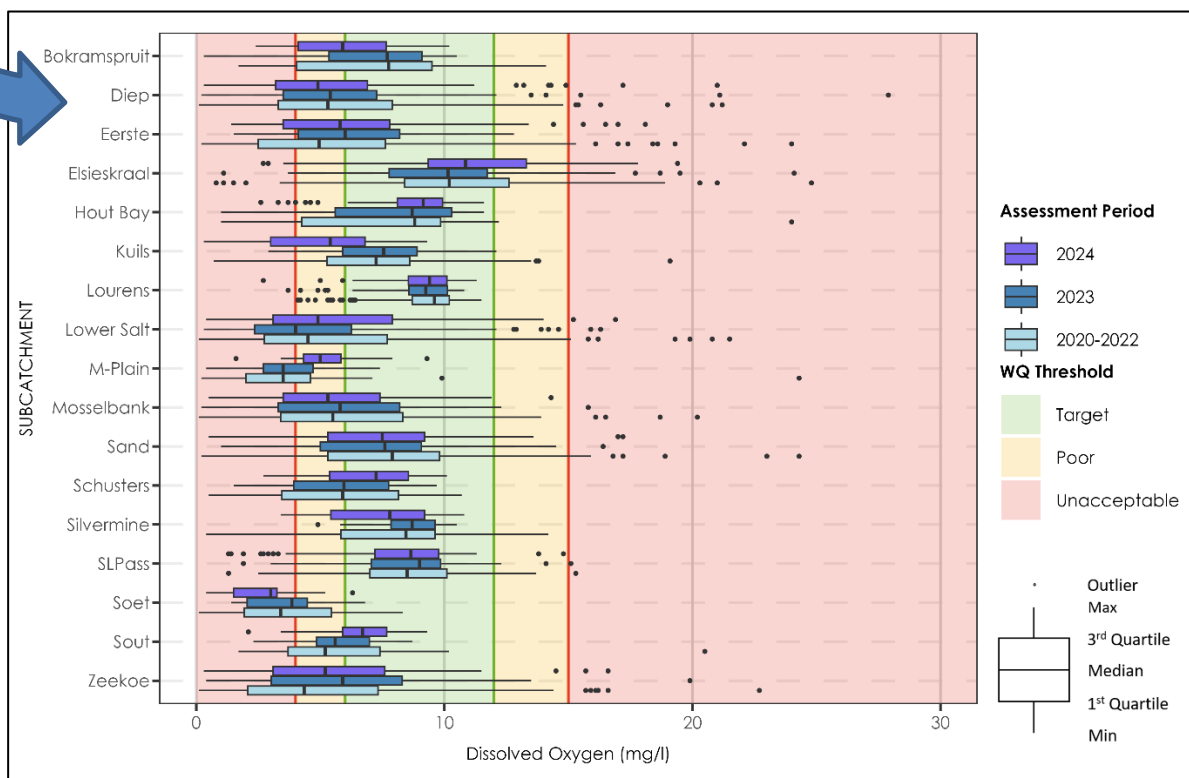
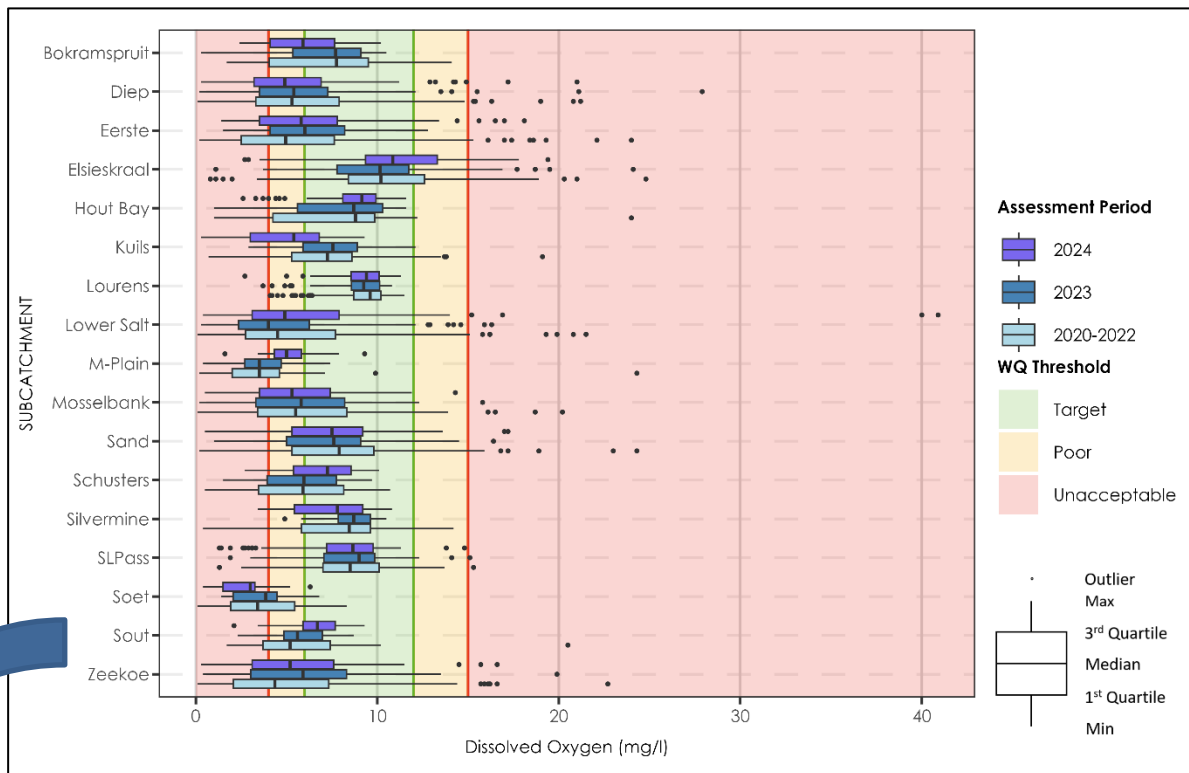
**Figure D5**  
**Comparison of ratios of Total Inorganic Nitrogen (TIN) to orthophosphate (PO<sub>4</sub>-P) for standing water systems (vleis, dams and detention ponds) from the 2024 reporting period with those from 2023 and the previous three years (2020-2022) combined.**  
**Bottom graph comprises same data as top graph, but shown at different x-axis scales.**

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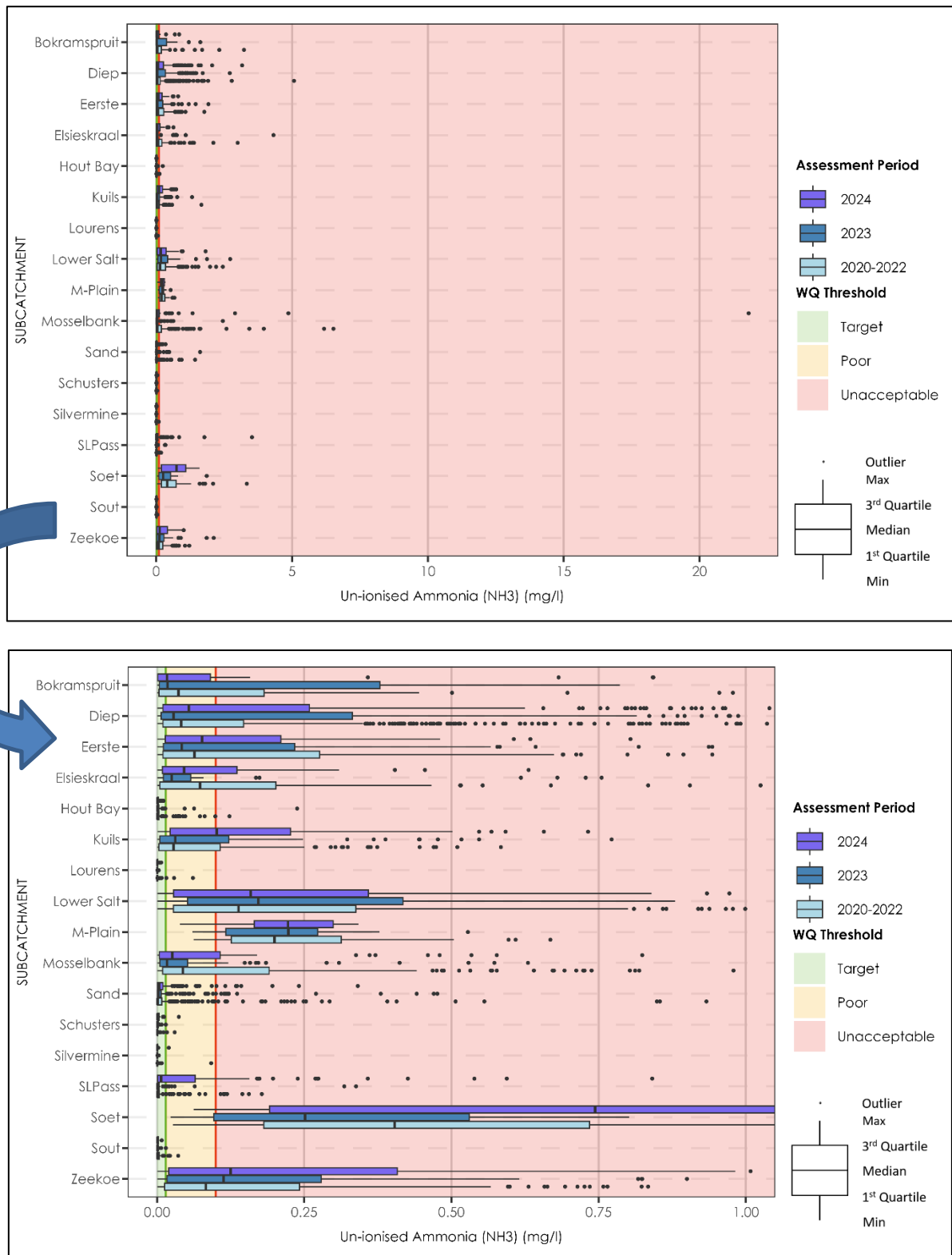
**Figure D6**  
Comparison of chlorophyll-a data for standing water systems (vleis, dams and detention ponds) from the 2024 reporting period with those from 2023 and the previous three years (2020 to 2022) combined. Marked thresholds as per Table 3.2. Closer view (reduced y-axis) shown in bottom figure (arrowed).

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**Figure D7**

**Comparison of Dissolved Oxygen for flowing systems (rivers and stormwater channels) (top) and standing water systems (vleis, dams and detention ponds) (bottom) from the 2024 reporting period with those from 2023 and the previous four years (2020 to 2022) combined.**



**Figure D8**  
Comparison of un-ionised ammonia for flowing systems (rivers and stormwater channels) from the 2024 reporting period with those from 2023 and the previous three years (2020 to 2022) combined. Sub-catchments as shown in Figure 2.1.



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