CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

INLAND WATER QUALITY REPORT

FOR THE PERIOD OCTOBER 2021 TO SEPTEMBER 2023
(2022 AND 2023 REPORTING PERIODS)

MAY 2024
SUMMARY REPORT
Prepared by: Liz Day, Dean Ollis and Ian Wilson

Making progress possible. Together.

Acknowledgements

This summary report was developed from the detailed technical report on the City of Cape Town's inland water quality for the period October 2021 to September 2023.

The report was contracted to Lukhozi Consulting Engineers, who in turn subcontracted the project to Liz Day Consulting (LDC). LDC is a private consulting company specialising in river and wetland assessment, management and rehabilitation.

LDC's team comprised Dr Liz Day (LDC), Mr Dean Ollis (Inland Waters Consultancy), Mr Ian Wilson (Spatial Mapping Solutions) and Mr Michael Day (LDC).

1. FOREWORD

In order to realise the City's vision to become a water-sensitive city by 2040, water quality in our inland water systems needs to be improved for its beneficial use by people and the ecosystems that depend on it. The restoration and protection of our inland waters build resilience and buffer ecosystems against shocks and stresses such as climate change and other disasters. Effective management of our catchments requires forecasting, foresight and anticipatory thinking in order to develop long-term strategic plans, develop scenario planning for probable events, and plan for unforeseen shocks and disturbances to the system. Effective management should also look at public perception of our urban water systems and how people connect to these systems. Bringing the public closer to our inland waters and having the public place value (recreational, aesthetic, ecological, economic) on these systems, while building awareness around the issues related to the management of these systems, will assist in the public management and protection of these systems. This goal of improved inland water quality in Cape Town can only be achieved in partnership with its citizens.

Inland water quality must be monitored and managed in order to assess water quality trends in the catchments, i.e. monitor the ecological health of these systems, identify areas of concern where pollution is evident and use these data to plan for interventions. Whereas this report has revealed areas of concern, the City commits to full transparency around possible causes that need to be addressed from within the organisation through our various programmes and projects; however, we appeal to residents to always keep in mind the role they have to play, and to take on their share of responsibility for ensuring that our inland waters are not further degraded.

This summary booklet "2022/23 Inland Water Quality Report" has been published as a companion to the technical report entitled "Water quality of river and open waterbodies in the city of Cape Town: Status and historical trends with a focus on the period October 2021 to September 2023". The reports have been published to promote transparency and as a spur to action that will improve inland water quality in order to meet the City's goals.

Various programmes have been developed to tackle the issue of pollution in our waterways, and are aimed at improving our inland water quality and ecological health, such as the Mayor's Priority Programme (MPP) for Sanitation and Inland Water Quality (S&IWQ), the Water Quality Improvement Programme for the city's catchments, and the Pollution Abatement and Strategic Plans. The City has recently made significant strides with major projects such as the development of five Liveable Urban Waterways projects and the extension of the Potsdam wastewater treatment works. These kinds of programmes and projects demonstrate the City's commitment and earnestness in working towards cleaning up our urban catchment systems.

In its continued efforts towards improved water quality and service delivery, the City's budget for the Water and Sanitation Department doubled to R4,3 billion in the 2023/24 financial year, with a 95% spend of its R2,385 billion capital budget achieved in the 2022/23 financial year. The 2023/24 budget includes an allocation of R1,8 billion for the upgrade of wastewater treatment plants, R123 million for the refurbishment of pump stations, and R246 million for the replacement of sewer pipes. The City recognises the critical importance of these interventions in ensuring that our inland catchment systems are cleaned up and are able to continue to provide the various services that benefit the people and the ecosystems that depend on it. The proposed 2024/25 capital budget of R5,317 billion for the department further demonstrates the City's undertaking to ensure effective service delivery for its citizens.

The City will continue to monitor and publish data on water quality in our waterways, so that we can measure progress towards our goal. We are committed to making water quality information regarding the state of our urban rivers and vleis more accessible to the public and data more easily available to researchers. Therefore, all of the City's latest inland water quality data and monthly reports are available on the Open Data Portal, which can be accessed at https://odp-cctegis.opendata.arcgis.com/search?q=inland%20water%20quality.

Leonardo Manus

Executive Director: Water and Sanitation
City of Cape Town

CONTENTS

1. INTRODUCTION

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 collectively referred to as its 'inland waters'.

The City has monitored the quality of water in these waterbodies since the 1970s, and its water quality database includes data from both long-term, routine monitoring points and those from ad hoc or project-specific monitoring.

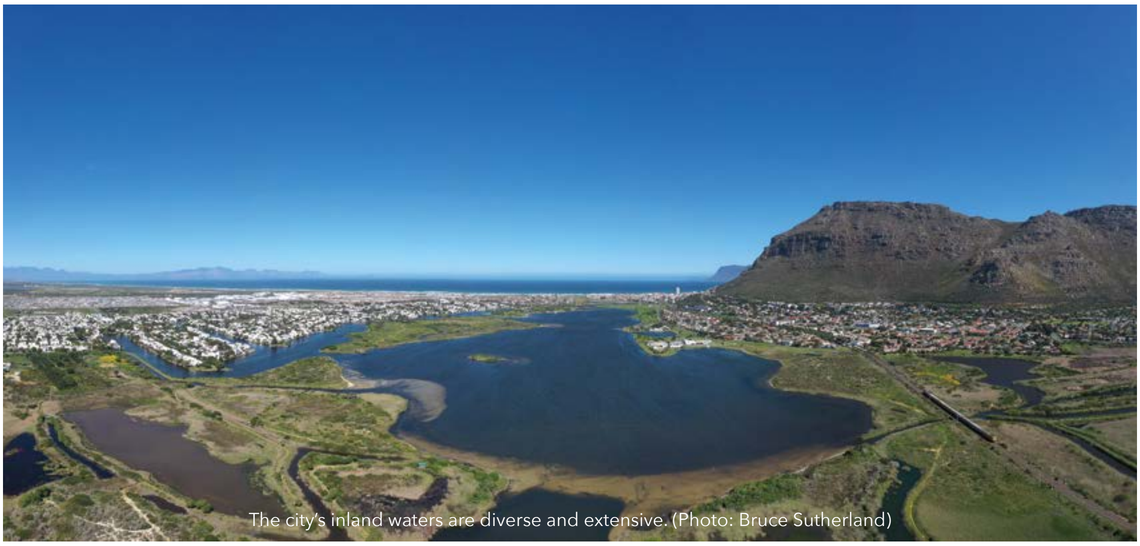
Regular reporting on the results of water quality sampling is required in order to inform both City managers and members of the public or other interested parties about the state of the city's watercourses. Since 2020, the City has periodically appointed independent consultants to assess water quality data for its inland waters, and to write up the results of these assessments in technical documents.

What about coastal water quality?

Coastal waters are also monitored by the City and are reported on separately.

See capetown.gov.za/explore and enjoy/nature-and-outdoors/our-precious-biodiversity/coastal-water-quality

Please see the full technical report, compiled by Liz Day Consulting, for more detailed analyses and summary data.



The city's inland waters are diverse and extensive. (Photo: Bruce Sutherland)

These technical water quality reports were compiled in 2020, 2023 and 2024, and consider inland water quality data up to March 2019, March 2022, and September 2023 respectively. The reports can all be accessed via the City's website by visiting: https://www.capetown.gov.za/Explore%20and%20enjoy/Nature-and-outdoors/Rivers-and-wetlands. The reports deal only with data collected during routine (monthly to two-weekly) monitoring and do not deal with data from projects or once-off sample collections.

The technical water quality reports are large, complex documents that deal in depth with water quality data and its implications for the management and use of the city's inland waterbodies. This summary report has been compiled to present the main findings of the latest water quality report (data from October 2021 to September 2023) in a shortened, non-technical form.

2. CAPE TOWN'S CATCHMENTS AND WATERCOURSES

What is a catchment?

A catchment is an area of land from where all rainfall either flows on the surface or seeps through the soil toward a central low point or an outlet. The catchment is bounded by high-points or watersheds.

Lost watercourses

Most of the streams that drain off Table Mountain and the Twelve Apostles range into the City Bowl and Sea Point/ Camps Bay areas have been piped underground, and pass into Table Bay and the coastline along the Atlantic seaboard as stormwater. The city's Green Point Park makes use of some of this water to supply its artificial wetlands and streams and to irrigate the gardens.

The Plattekloof River is passed under the City Bowl in covered, brick-lined culverts.

2.1. The city's catchments

The city's numerous watercourses drain 17 major catchment areas, including the City Bowl. These are shown in figure 2.1. Some of these areas in fact include a number of relatively small catchments, which are grouped together for management purposes. For example, the 'South Peninsula' catchment is made up of several separate river and wetland systems, such as the Bokramspruit River, the Schuster's River and the Noordhoek wetlands.

Some parts of the city (e.g. the City Bowl) have been so modified by urban development that they have few if any remaining open river channels, with most having been diverted into underground systems. Pollution passing into these systems can, however, still affect coastal water quality. For this reason, water quality in these catchments is monitored at their coastal stormwater outlets at least.

By contrast, the Mitchells Plain catchment 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 extensive hardened surfaces is stored in artificial detention ponds and conveyed to the sea through stormwater pipes and drains.

Not all catchments are monitored by the City. The Atlantis, Steenbras, Llandudno, Chapman's Peak and Muizenberg catchments do not have major rivers or channelled stormwater flow and are not included in the monitoring programme. These catchments have not been colour-coded in figure 2.1 and are not discussed further in this report, although clearly activities in these catchments, as in all catchments, have an impact on the quality of water entering the coastal zone.

The largest of the city's catchments are those of the Diep, Eerste and Salt rivers. In this report, these three catchments have been further divided into 'subcatchments', separating out their major tributaries (hence the Diep and Mosselbank subcatchments; the Kuils and Eerste subcatchments; and the Elsieskraal and Lower Salt River subcatchments).

In fact, a large proportion of the Diep, Mosselbank and Eerste River subcatchments lie outside of the city's boundaries, while many of the smaller rivers also have their origins outside of the urban area, rising high up in the Table Mountain Nature Reserve and on other mountains surrounding much of the city.

Figure 2.1: Cape Town's major subcatchments and watercourses

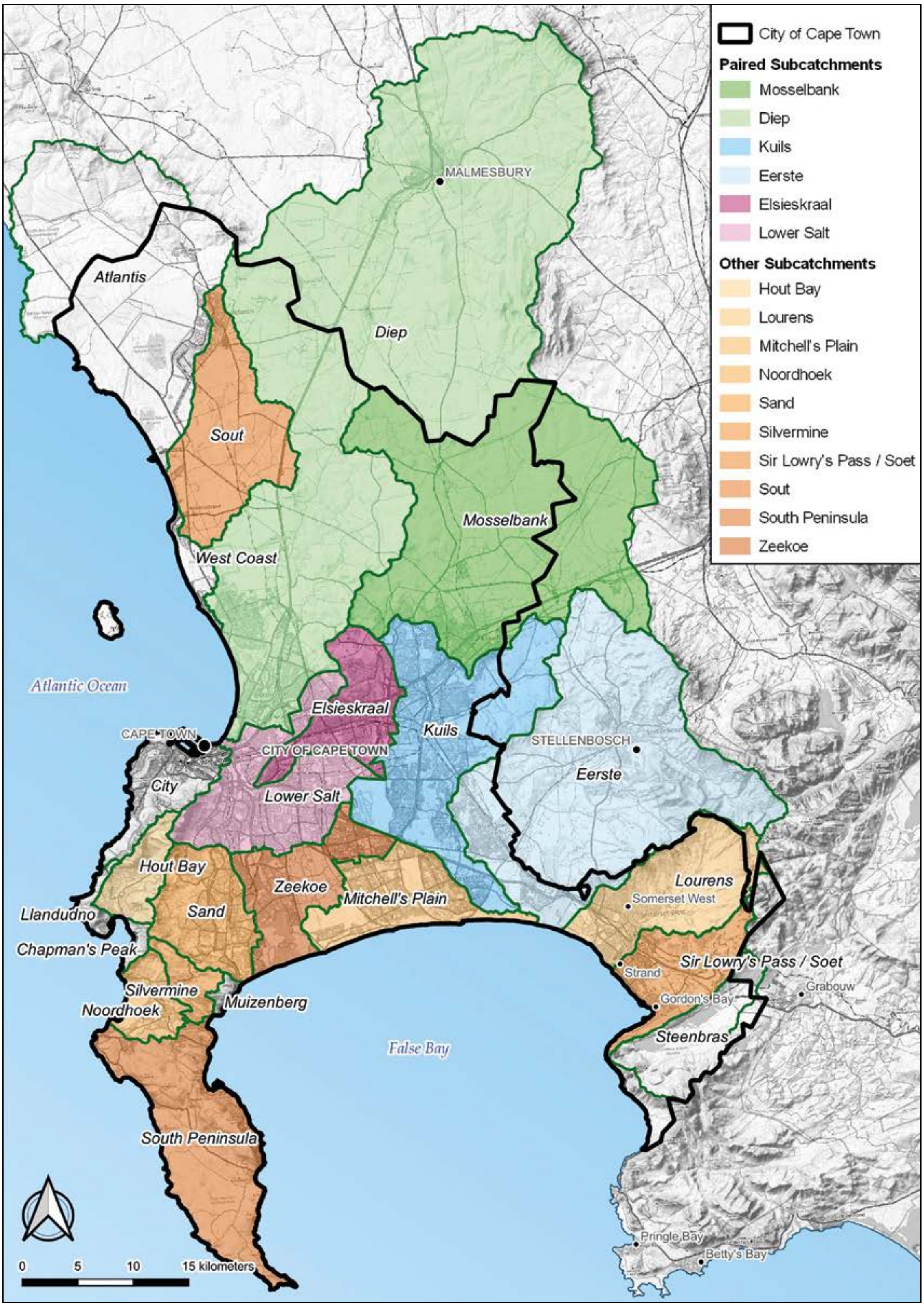
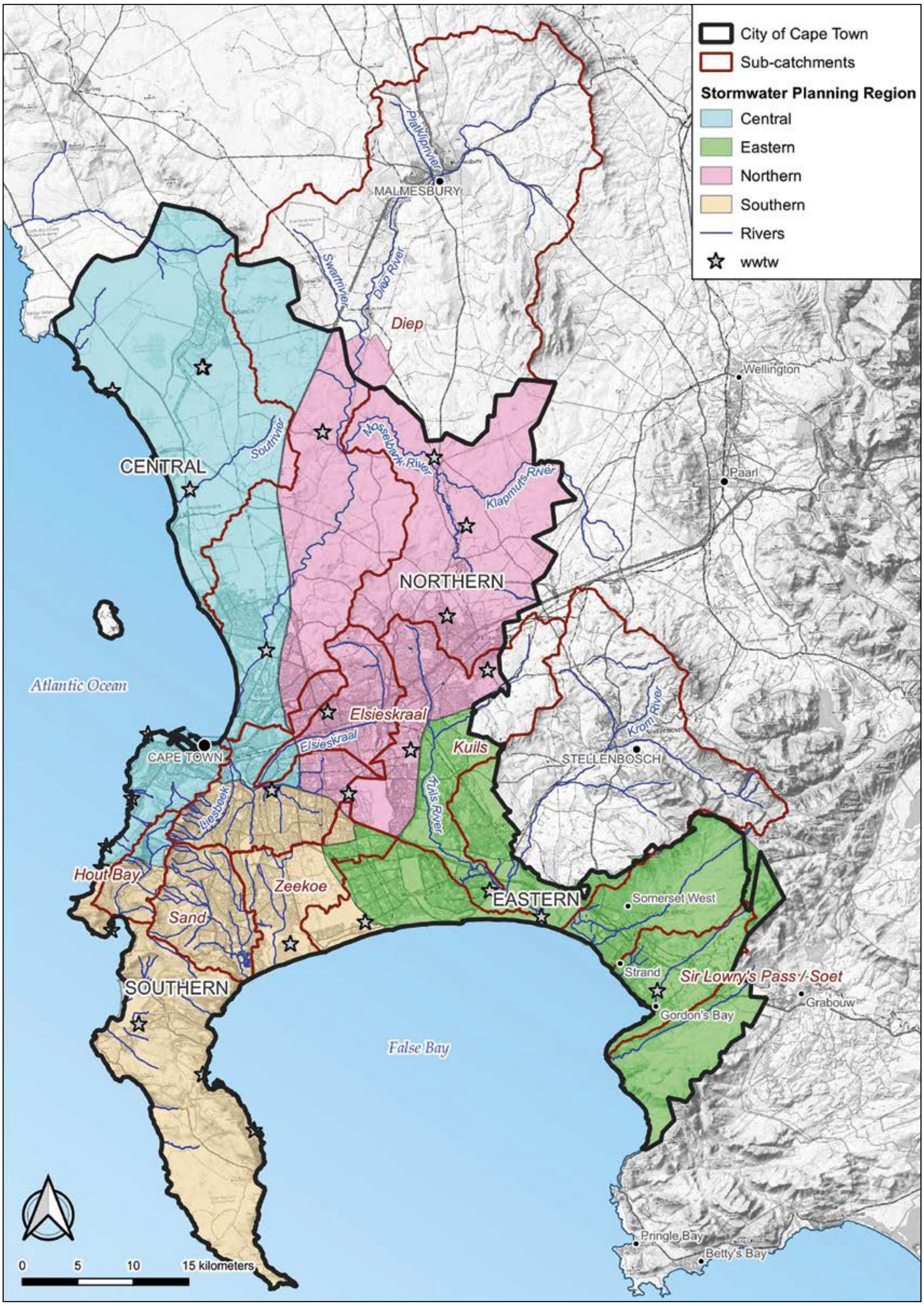


Figure 2.2: Relationship between the city's stormwater planning regions and its river catchments



2.2. The city's 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, namely the northern, southern, eastern and central regions. Each region has a separate manager responsible for stormwater management across the whole region. The stormwater regions do not take account of natural catchment boundaries.

The four stormwater planning regions are shown in figure 2.2.

Stormwater planning regions and Cape Town's citizens

If you have concerns about the condition or management of any watercourse in the city, the manager of that stormwater region should be your first port of call, as follows:

- Southern region: Mr Abdulla Parker (Abdulla.Parker@capetown.gov.za)
- Eastern region: Mr Gerhardt Muller (GehardtRushby.Muller@capetown.gov.za)
- Central region: Mr Ben de Wet (Ben.DeWet@capetown.gov.za)
- Northern region: Mr Johann Terblanche (Johann.Terblanche@capetown.gov.za)

2.3. The ecological importance of urban watercourses

Urban watercourses can provide important aquatic habitats and, in some areas, are of great biodiversity importance. The city lies in the heart of the Cape Fynbos Biome. As a result, some of its aquatic ecosystems support species of plants and/or animals that occur in often highly restricted areas and nowhere else in the world.

Western leopard toad © ?

The western leopard toad (*Sclerophrys pantherina*) is an endangered frog species, restricted to the southwestern Cape region. It spends most of the year in terrestrial areas but breeds in ponds, wetlands and vleis. Its tadpoles remain in the ponds for a few months until they emerge as tiny toadlets. The city includes a number of important breeding sites for this species. (Photo: M. Burger)

Cape pondweed © ?

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 having been infilled or changed to permanently wetted systems as a result of urban drainage. (Photo: T. Stock)

Urban watercourses can also be important corridors of relatively natural habitat through increasingly sterile urban landscapes, and can connect mountain habitats with the coast. Some of Cape Town's rivers run through extensive greenbelts used for walking, running, cycling and riding. These areas provide green lungs in an otherwise hardened urban space. As climate change heats up the urban environment, such greenbelts become increasingly important for cooling. They also provide habitats for many indigenous terrestrial species. Knysna warblers (classed as vulnerable), for example, in thicket on the fringes of some of the riverine greenbelts in Constantia, while caracal are among several indigenous mammal species known to move through and inhabit these corridors, moving between the mountains and lower-lying areas.

What happened to Cape Town's natural watercourses?

Before Cape Town was developed as a major metropolitan centre, the area supported extensive permanent wetlands, identifiable today only by remnant peat deposits; seasonal and/or temporary wetlands that were inundated for a few months of each year only; mainly seasonally flowing and a few permanent (or perennial) rivers; and several estuaries along the Table Bay or False Bay coastlines.

The most significant of the estuaries would have been those of the Eerste, Sand and Diep rivers. Under predevelopment natural conditions, the Diep River Estuary was the combined outlet of the Liesbeek, Black, Salt and Diep River systems, which flowed into Table Bay via a broad wetland marsh in the general region of today's Paarden Eiland (see Brown and Magoba, 2009: https://www.wrc.org.za/wp-content/uploads/mdocs/TT-376-08_Part%201.pdf).

Perennial (i.e. permanently flowing) rivers were those that rose in the mountains, with the main perennial systems being the Silvermine and Else rivers; the main stem and tributaries of the Diep River (Sand River catchment), Keysers and Liesbeek rivers; and the Lourens, Sir Lowry's Pass and Eerste rivers.

Most of the rivers that flowed through the vast, sandy Cape Flats, by contrast, were seasonal and often associated with groundwater-fed wetlands, which would have been inundated when the primary (surface) aquifer rose above the level of surrounding surface depressions. These wetlands supported communities of small crustaceans and insects that were adapted to surviving life in seasonal systems, often using hibernation or diapause strategies, or having eggs able to withstand long periods of dryness.

A long history of urban development has resulted in the complete loss of and/or permanent changes to many of these systems within the city's boundaries. Low-lying seasonal wetlands and rivers have been the most severely impacted, mainly through:

- Drainage and/or infilling of wetlands;
- Diversions, channelisation and canalisation of rivers and valley-bottom wetlands;
- Passage of treated sewage effluent into naturally seasonal rivers, creating perennial, nutrient-enriched systems with different plant and animal communities, different responses to drought and floods, and different management requirements as a result; and
- The creation of canals and drainage channels to lower the water table and/or the floodline to allow development to encroach into naturally seasonally inundated areas, areas with a high water table, and areas prone to flooding (e.g. the Big and Little Lotus rivers in the Zeekoe catchment).

The Bamboesvlei wetlands in Ottery have been drained and their hydrology altered – permanent parts of the once seasonal wetlands are now invaded by bulrush.

3. CHALLENGES IN URBAN WATERCOURSE MANAGEMENT

Urban watercourses require management to protect a city's inhabitants from floods and flooding; to provide amenities such as safe recreational areas; to harness ecosystem services provided by natural aquatic ecosystems; and to safeguard biodiversity. Active management is required, because in most cities, most of the natural drivers that would have sustained rivers and wetlands have been destroyed or controlled by human development. In Cape Town, these natural drivers would have included floods, fire, drought, and grazing and trampling by large herbivores. Together, these kinds of disturbances would have maintained open river channels and wetlands. Without them, rivers and wetlands can be overgrown with reeds and other vegetation that need physical management by the City, and which threaten natural biodiversity.

Urban watercourses generally reflect the condition of their catchments. In Cape Town, as in many other urban areas, water quality has changed considerably from the low-nutrient systems that probably characterised many of its fynbos rivers under natural conditions. Today, many of them are highly nutrient enriched, and these nutrients promote the growth of (often alien) aquatic plants such as water hyacinth (*Pontederia crassipes*).

Watercourse condition, including water quality, can have significant 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, property value has been shown[1] to be enhanced in properties near to well-managed watercourses in good condition. By contrast, those properties located near watercourses that are in poor condition, with high levels of solid waste and litter accumulation, odour or aquatic plant invasion (including algal growth in standing waterbodies), are likely to experience a decline in property value.

Among the most profound issues affecting water quality in Cape Town, as well as in many other urban centres, is the impact of waste. Treated and untreated sewage waste that enters Cape Town's watercourses is a particular cause of problems, as is solid waste.

Under ideal conditions, domestic and industrial sewage effluent is conveyed to wastewater treatment works (WWTW), where it is treated to an acceptable standard and then either released back into the environment (usually into rivers or the sea); reused in industry or for irrigation; or, in some areas, is treated further for human consumption.

In practice, however, the management and treatment of human waste are often fraught with problems, particularly in developing countries.

Key issues relevant to waste management in Cape Town are:

- Informal settlements and backyard dwellings with inadequate or no sanitation, resulting in sewage waste as well as so-called 'grey water' discharges, comprising wastewater from cooking and washing, 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;

1 De Wit, M., Van Zyl, H., Crookes, D., Blignaut, J., Jayiya, T., Goiset, V. and 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.

- 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 in these areas is thus often directly into wetlands and other watercourses, resulting in rapid pollution and degradation of sometimes important seasonal wetlands;
- Repeated sewer leaks and overflows from ageing infrastructure in dense urban areas – these are often older areas, where infrastructure is now failing;
- Overflows from sewers as a result of 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 WWTW 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;
- 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 backwashed from swimming pools into streets or the stormwater system, where it can result in the formation of persistent toxins (e.g. chloramines) in the downstream environment; and
- 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.

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.

Remember

Everything that passes into the stormwater system ends up in the city's watercourses and ultimately passes into the sea.

Cape Town's inland wastewater treatment works (WWTW) account for 95% of the sewage effluent passing into the city's marine ecosystems.

4. THE CITY'S INLAND WATER QUALITY MONITORING PROGRAMME

4.1. 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 using 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 in natural ecosystems.

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.

4.2. Reasons for water quality monitoring 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 waterbodies, including rivers and lakes/vleis. This is important for informing decisions about how to manage the risks that exposure to water may pose to different user groups (for example, are vleis 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 as to 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 catchment managers in strategic planning around where to focus efforts to achieve maximum returns.

In addition, water quality data can be used to 'red-flag' sudden onsets of pollution (caused, for example, by sewage leaks or illegal discharges); inform pollution-tracking efforts along watercourses; and provide evidence for compliance with licensing or permit conditions.

4.3. 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 2018 to September 2023), with an emphasis on data from the period October 2021 to September 2023.

These data are presented in 'reporting periods'. Each reporting period covers water quality data collected from 1 October in one year to 30 September in the following year. The 'naming year' is the year ending in September. Hence the period 1 October 2022 to 30 September 2023 is reporting period 2023.

Public access to water quality data

The City's inland water quality data are available for free to download by anyone from its Open Data Portal [https://odp-cctegis.opendata.arcgis.com/search?q=inland%20water%20quality]. These data include most but not all of the monitored water quality variables from inland and estuary systems.

Figure 4.1 shows the locations of all the current inland routine monitoring points utilised in this study, including sampling points located at major stormwater outfalls along the coast.

A range of chemical, algal and bacterial constituents is measured from water samples collected at these sites and the data are interpreted and reported on internally by the City's Catchment, Stormwater and River Management (CSRM) Branch, and externally in the Inland Water Quality Reports.

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

4.4. 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 (i.e. so-called 'ambient water quality'), the data collected by the City arguably over-emphasise problem areas, and do not provide an overarching view of water quality in the city's rivers and wetlands as a whole.

This issue has been considered by the CSRM, and additional sites, intended to provide a more holistic overview of water quality in the city's watercourses, will be monitored during the course of 2024 and going forward.

4.5. What variables are considered in the Inland Water Quality Report?

Although the City's Scientific Services Branch (SSB) 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 listed below (abbreviations for some variables are shown in brackets):

- Major nutrients
  - Phosphorus in orthophosphates (PO4-P)
  - Phosphorus in total phosphorus (Tot-P)
  - Total inorganic nitrogen (TIN)
- Un-ionised (or 'free') ammonia (NH_3)
- 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 waterbodies that have been classified as estuaries.

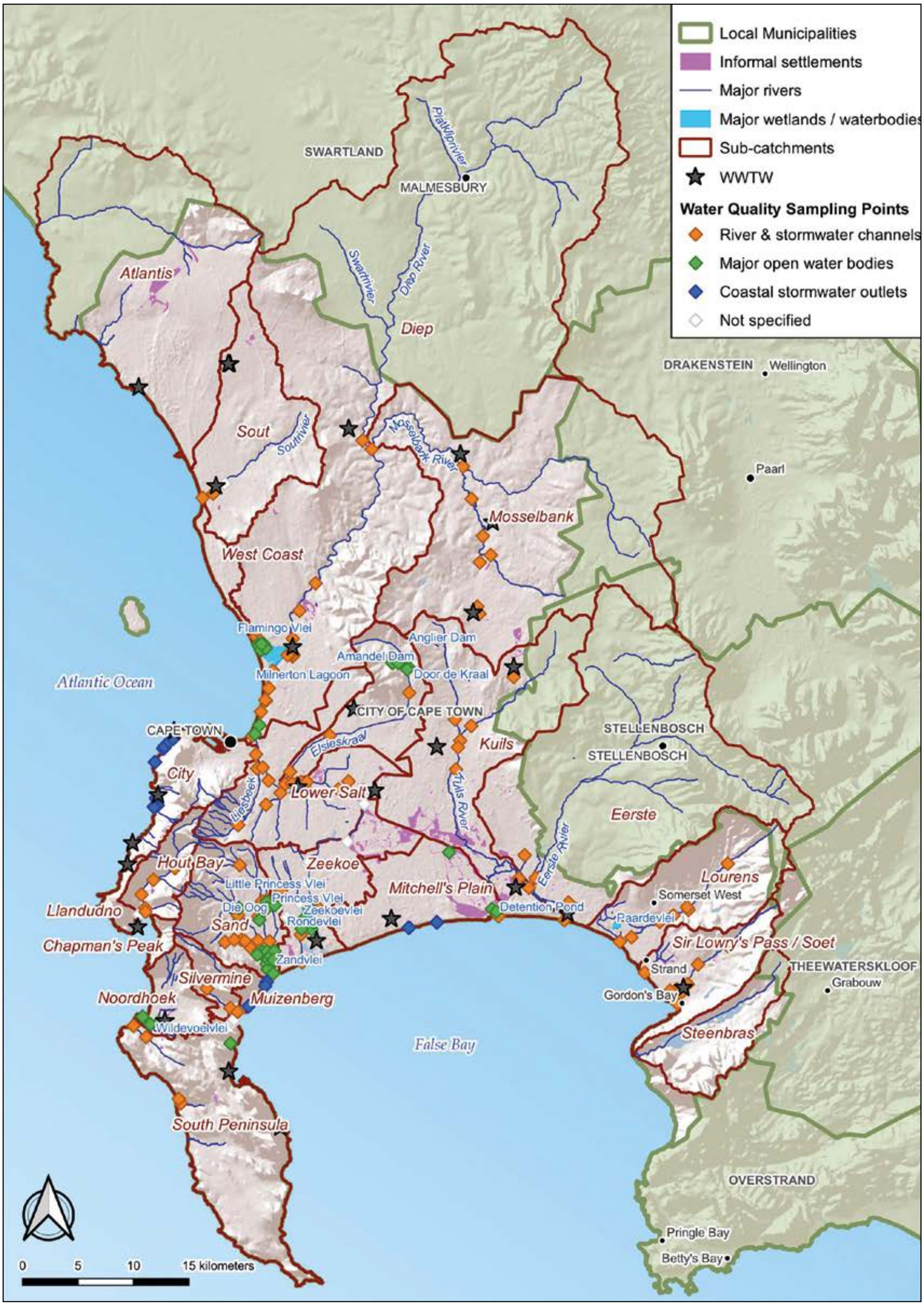
The City's Inland Water Quality Report also considers rainfall data for various monitoring stations across the city. This is because knowing what rainfall has fallen in different parts of the city can help to understand water quality data. Rain can dilute river water, reducing the concentration of pollutants in the water. It can, however, also serve to wash pollutants into the river channels and, in some very polluted catchments, river water quality can be much worse immediately after rainfall, especially early on in the wet season, when months of accumulated pollution can be washed into the rivers.

4.6. What the City’s water quality data do not show

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. The data cannot be used to infer future water quality (for example whether a waterbody will be 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.

Water quality monitoring data also only provide 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, complex herbicides and pesticides or contaminants of emerging concern (CECs) (e.g. hormones and medicinal or other drugs) that may also be present in water.

Figure 4.1: Locations of the City of Cape Town's routine water quality sampling points on river and stormwater channels and canals, standing water systems (vleis and dams) and coastal stormwater pipeline outlets



The Rietvlei waterbody lies in the Table Bay Nature Reserve. © P. Glanville

5. INTERPRETING WATER QUALITY DATA

5.1. Interpreting aquatic ecosystem condition

Tables 5.1 and 5.2 provide ranges in concentrations of key water quality variables from the perspective of what they indicate about ecosystem condition. These thresholds distinguish between flowing water systems (rivers, channels, canals, estuaries) and open water systems (dams, vleis, detention ponds and coastal lakes).

Table 5.1: Rating ranges for variables considered in this assessment of water quality in Cape Town's rivers

CITY WATER QUALITY CATEGORIES (CWQC)	INTERPRETATION OF CWQC	PO4-P mg P/ℓ	TIN mg N/ℓ	DO mg/ℓ	N:P	NH_3 mg/ℓ
GOOD	TARGET	≤ 0,015 (oligotrophic)	≤ 0,70 (oligotrophic, mesotrophic)	> 7	> 25	≤ 0,007
FAIR		> 0,025-0,125 (mesotrophic)	> 0,70-1,00 (mesotrophic)	> 6-7		> 0,007-0,015
POOR	POOR	> 0,025-0,125 (eutrophic)	>1,00-4,00 (mesotrophic -eutrophic)	> 4-6	10-25	> 0,015-0,1 (chronic toxicity)
UNACCEPTABLE	UNACCEPTABLE	> 0,125 (hypertrophic)	> 4,00 (eutrophic concentrations > 10 mg/ℓ classified as hypertrophic)	≤ 4	< 10	> 0,1 (acute toxicity)

Note: PO4-P = phosphate phosphorus; TIN = total inorganic nitrogen; DO = dissolved oxygen; N:P = ratio of TIN:PO4-P; NH_3 = un-ionised ammonia. Note also that the terms 'PO4-P', 'TIN', 'NH_3', etc. are abbreviations and are not the full chemical notation for these variables.

5.2. Interpreting water quality data in terms of risks to human health

Tables 5.3 and 5.4 show the thresholds used to show how risky various waterbodies may have been for people doing activities such as canoeing, fishing, or sailing (called 'intermediate contact' recreational activities). While these people might touch or swallow some water, they are not as likely to as people who swim (termed 'full-contact' recreation).

Two key variables are considered, namely *Escherichia coli* bacteria (an indicator of exposure to raw sewage and other sources of faeces from warm-blooded animals (i.e. birds and mammals)) and microcystin toxin concentrations, associated with cyanobacteria (also called blue-green algae).

> ***Note that the City does not manage any of its waterbodies with the target of their being fit for full-contact recreation. Full-contact recreational use is not considered a realistic target at present.***

Table 5.2: Rating ranges for variables considered in this assessment of water quality in Cape Town's vleis and dams

CITY WATER QUALITY CATEGORIES (CWQC)	INTERPRE-TATION OF CATEGORIES	PO4-P mg P/ℓ	TIN mg N/ℓ	DO mg/ℓ	N:P	NH_3 mg/ℓ	RUNNING MEAN ANNUAL CHL-A µg/ℓ
GOOD	TARGET	≤ 0,015 (oligotrophic)	≤ 0,7	>7	> 25	≤ 0,007	≤ 5
							> 5-10
FAIR		> 0,015-0,047 (mesotrophic)	> 0,7-1	> 6-7		> 0,007-0,015	> 10-20
POOR	POOR	> 0,047-0,130 (eutrophic)	> 1,0-4,0	> 4-6	10-25	> 0,015-0,1 (chronic toxicity)	> 20-30
UNACCEPTABLE	UNACCEPTABLE	> 0,130 (hypertrophic)	> 4	≤ 4	< 10	> 0,1 (acute toxicity)	> 30

Note: TP = total phosphorus; TIN = total inorganic nitrogen; DO = dissolved oxygen; N:P = ratio of TIN:PO4-P; NH3 = un-ionised ammonia; CHL-A = Chlorophyll-a. Note also that the terms 'PO4-P', 'TIN', 'NH_3', etc. are abbreviations and are not the full chemical notation for these variables.

Table 5.3: Guidelines for the interpretation of *Escherichia coli* data

INTERPRETATION	INLAND SYSTEMS FAECAL COLIFORM COUNT (INCLUDING E. COLI)
TARGET FOR MAXIMUM ACCEPTABLE RISK FOR FULL-CONTACT RECREATION	≤ 400 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 cfu/100 mℓ

**cfu = colony forming unit.*

Table 5.4: Guidelines for the interpretation of microcystin toxin data

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

6. WATER QUALITY IN THE CITY'S RIVERS, VLEIS AND DAMS

This section summarises the results of some of the water quality analyses presented in the technical report. It focuses on the 2022 and 2023 reporting periods, and compares these data with data from the 2019 to 2021 reporting periods. Consult the technical report for details on data analysis assumptions, limitations and methodologies and for the full set of analyses and discussion about their implications.

6.1. Assessment of water quality based on nutrient enrichment

6.1.1. The role of nutrients in aquatic ecosystems

All ecosystems need nutrients to support growth. In aquatic ecosystems, the major nutrients are phosphorus and nitrogen, which occur in various forms. These two nutrients play important roles 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.

The Inland Water Quality Report deals only with phosphorus and nitrogen nutrients, which play a major role in determining aquatic ecosystem condition.

6.1.2. Effects of nutrient enrichment on aquatic ecosystems and their management

When aquatic ecosystems have abundant nutrients (particularly phosphorus, in freshwater ecosystems), the rate of aquatic plant growth increases and the kinds of plants that occur in them may also change, to favour fast-growing species. Thus nutrient-enriched systems are often dominated by dense reedbeds in shallow waters, with deeper waters being characterised by floating plants on the surface, where they can access light and nutrients. Blue-green algae (also called cyanobacteria) often prevail in such conditions, because they can access nitrogen from the air. Other non-algal plants (or macrophytes) growing on the water surface comprise fast-growing, generally invasive alien plants such as water hyacinth.

Excessive plant growth can have serious knock-on ecological and management implications, such as:

- Blocking waterways, posing flood risks and affecting recreational activities such as kayaking, rowing and sailing;

Officials from the City's False Bay Nature Reserve remove water hyacinth from Zeekoevlei and other inland waterbodies.

(Photo: S. Jacobs)

- Rapid accumulation of organic sediments in vleis and lakes as a result of die-off of fast-growing plants such as algae, which sink to the bottoms of vleis and lakes, forming thick layers, low in oxygen and sometimes characterised by foul-smelling hydrogen sulfide and methane gases, indicative of decomposing plant material under low oxygen conditions and sometimes linked to fish die-offs as a result of anoxic (no oxygen) conditions; and
- Management costs – the need for ongoing clearing of invasive vegetation and dredging of organic sediments come at a high financial cost.

Defining nutrient status

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). In vleis and lakes, these conditions can translate into the following broad habitat types, where:

- **Oligotrophic** waterbodies typically have clear waters and a rocky or sandy shoreline, and where both planktonic and rooted plant growth are sparse;

Zeekoevlei in the 1920s, prior to enrichment from sewage effluent and its upstream catchment. Source: C. Mileham (in Harding 2000)

Zeekoevlei in 2024 – this hypertrophic waterbody is characterised by blue-green algae, thick organic sediment layers and dense reedbeds.

- **Mesotrophic** waterbodies represent intermediate trophic states between oligotrophic and eutrophic, and often share characteristics between the other two;
- **Eutrophic** waterbodies 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; and
- **Hypertrophic** waterbodies 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 have very high oxygen concentrations due to very high rates of photosynthesis by algae.

6.1.3. Sources of nutrients

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

- Inputs of treated sewage effluent from any of the City's 16 WWTW that discharge into inland watercourses or estuaries – these discharges do not always meet licensing conditions, and even if they do, they still add a lot of nutrients to the water, especially in summer when they make up most of the river flow in some systems;
- Overflows from sewage pump stations and/or low-lying sewer manholes into the stormwater system as a result of load-shedding or sewer line blockages;
- Runoff from catchment areas with high levels of backyard and/or informal settlements, with poor levels of sewage and stormwater servicing;
- 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; and
- In standing water systems (lakes, vleis), decomposing bottom sediments release phosphorus when oxygen levels are low or when they are stirred up by wind or boats.

6.1.4. Phosphorus status of Cape Town's waterbodies: RP 2019 to 2023

Phosphorus data were analysed separately for flowing systems (rivers and Milnerton Lagoon) and standing water systems (vleis, dams and coastal lakes).

For rivers, phosphate data (analysed as phosphorus in ortho-phosphate) showed that phosphorus enrichment remains an issue of great concern, affecting most of Cape Town's monitored rivers and other stormwater systems (see figure 6.1).

Over the 2022 and 2023 reporting periods, phosphate concentrations were well within the hypertrophic (unacceptable) range at most monitored sites in most subcatchments. The Mosselbank, Sout and Soet subcatchments were always enriched to unacceptable levels throughout the monitoring period. The only subcatchments where 20% or more of river water samples were within target in the 2022 and 2023 reporting periods, were the Hout Bay, Silvermine and Lourens subcatchments. All of these showed a marked decrease in the proportion of samples in an acceptable condition over the 2023 reporting period.

Although the technical report does note that median phosphate concentrations did reduce in many subcatchments over the 2023 reporting period, the proportion of samples within an acceptable range reduced by almost half, with just under 80% of all samples lying within the unacceptable range.

Since many of these nutrient-enriched rivers feed into the city's vleis and dams, the impacts of river phosphorus enrichment are passed on to, and magnified within, these standing waterbodies.

For standing water systems (vleis, coastal lakes and dams) where total phosphorus is used as the assessment measure, the data show that all of the city's standing water systems are all highly nutrient-enriched systems. No samples fell within the target range for these systems. These waterbodies are clearly all impacted by a history of inflows from permanently or periodically polluted rivers and stormwater systems. These inflows load these standing waterbodies with nutrients that accumulate over time, both in the water columns themselves, as well as in bottom sediments and living plant material.

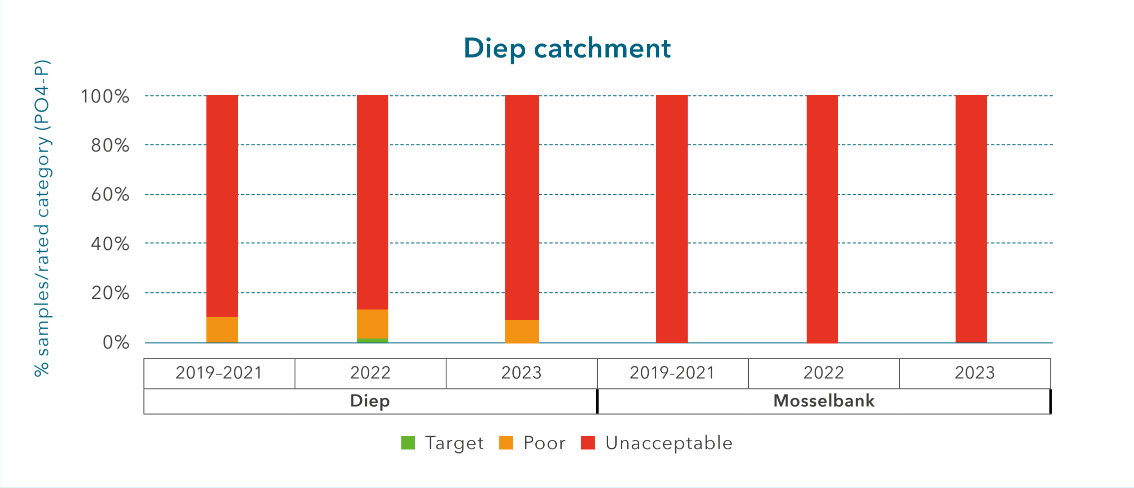
The most consistently phosphorus-enriched waterbodies over the 2022 and 2023 reporting periods comprised Wildevoëlvlei, Zoarvlei, Rietvlei, Zeekoevlei and the Mitchells Plain and Mew Way detention ponds. Glencairn Vlei was the best performing system, with no samples falling into the unacceptable range for this variable.

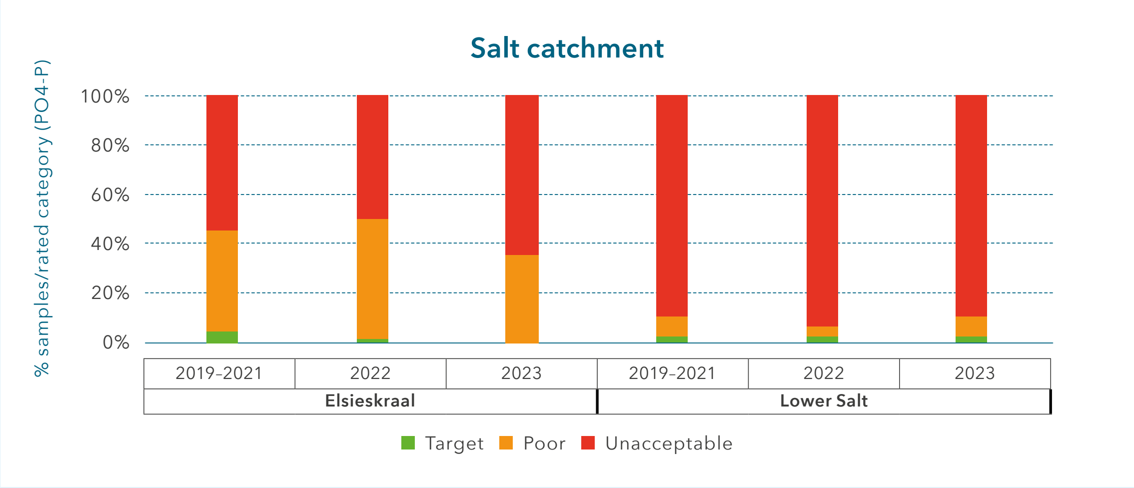
Although clearly phosphorus-enriched above target levels, a reduction in the number of samples falling within the unacceptable range was evident in the 2023 reporting period for Zandvlei, Die Oog and Rondevlei, with Zandvlei and Die Oog both showing long-term improvement compared with data from the 2019 to 2021 reporting periods.

The main sources of phosphorus over the 2022 and 2023 reporting periods were likely to include nutrients from frequent, ongoing or episodic overflows from sewage manholes, pump stations and WWTW, as well as from the city's burgeoning unserviced informal settlements. These causal factors are considered in more detail in the technical report.

The technical report did note with concern the fact that, from January 2023, the City was unable to analyse total phosphorus from any samples, resulting in major gaps in these data between late summer and winter 2023. Moreover, the detection limit for orthophosphate phosphorus also increased by an order of magnitude, also affecting data analyses and interpretation.

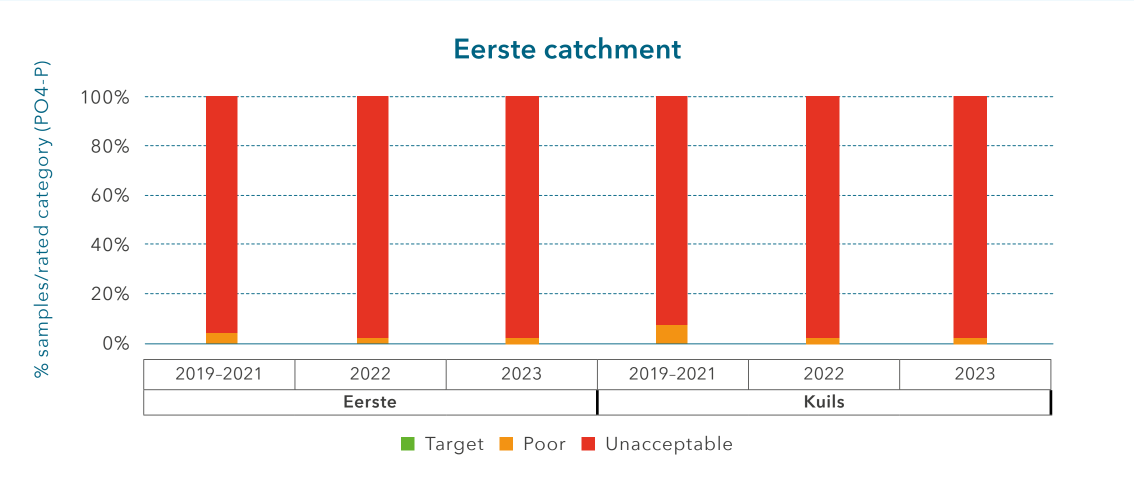
Figure 6.1: Percentage of phosphate (PO4-P) samples falling within each rated category for this variable, per subcatchment

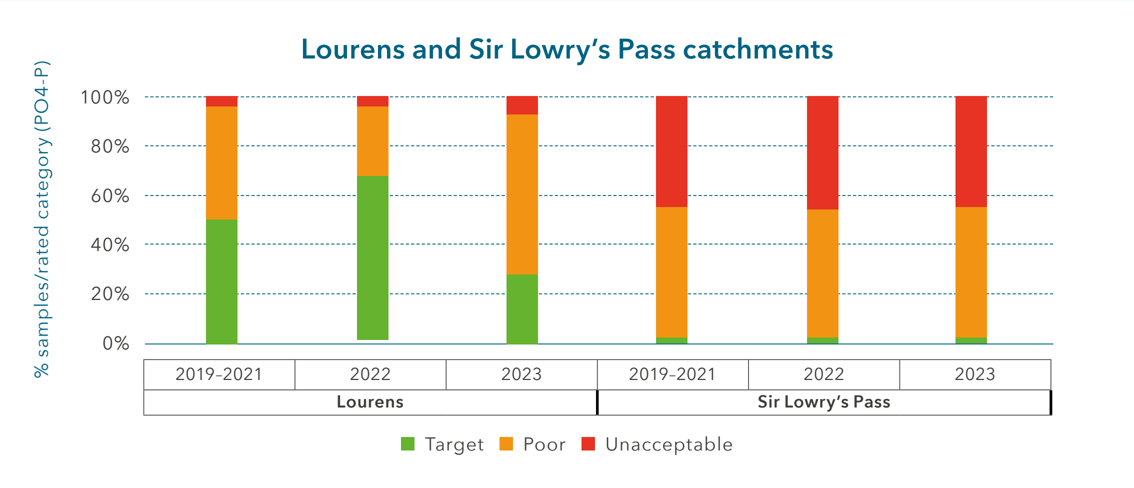




Thresholds for rated categories as defined in table 5.1. Data presented for river/'flowing' water monitoring points. Subcatchments as shown in figure 2.1. Total number of samples considered shown in bars in bottom right plot ('all rivers/stormwater systems').

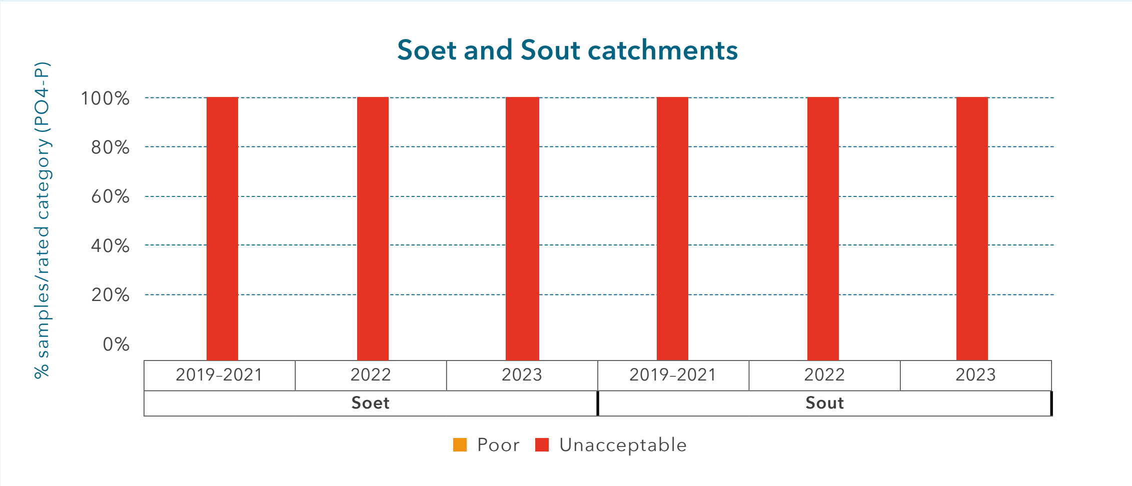
Figure 6.1: Percentage of phosphate (PO4-P) samples falling within each rated category for this variable, per subcatchment (continued)





Thresholds for rated categories as defined in table 5.1. Data presented for river/'flowing' water monitoring points. Subcatchments as shown in figure 2.1. Total number of samples considered shown in bars in bottom right plot ('all rivers/ stormwater systems').

Figure 6.1: Percentage of phosphate (PO4-P) samples falling within each rated category for this variable, per subcatchment (continued)



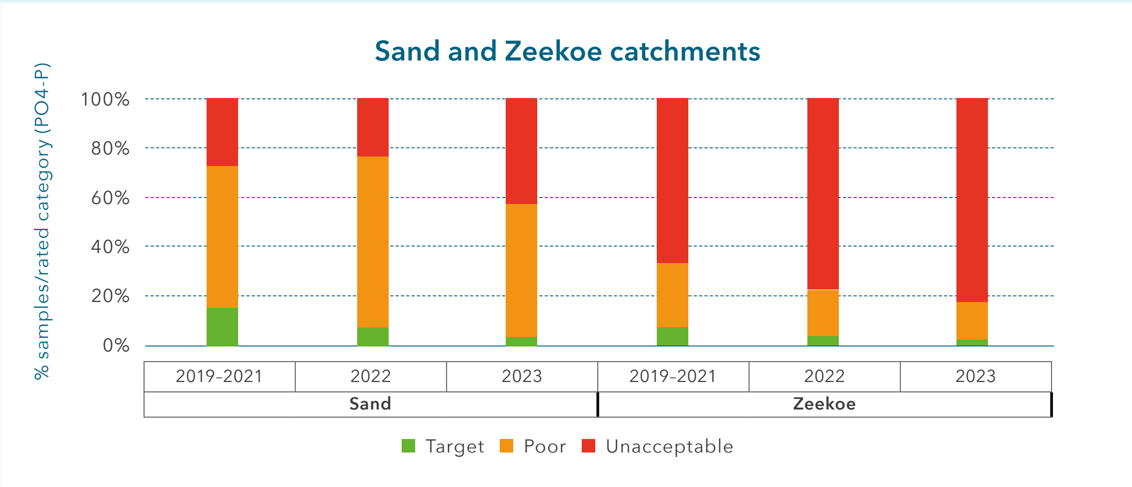


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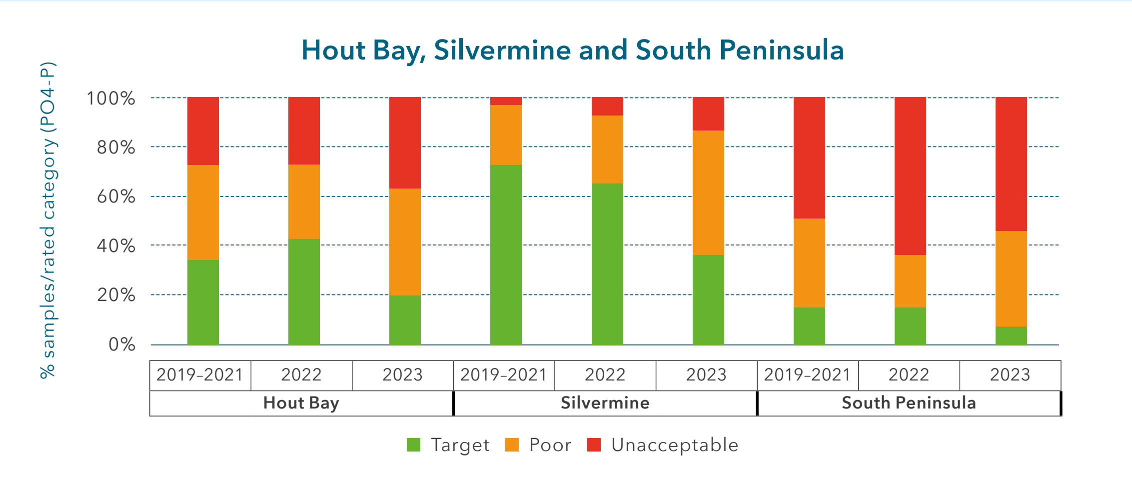
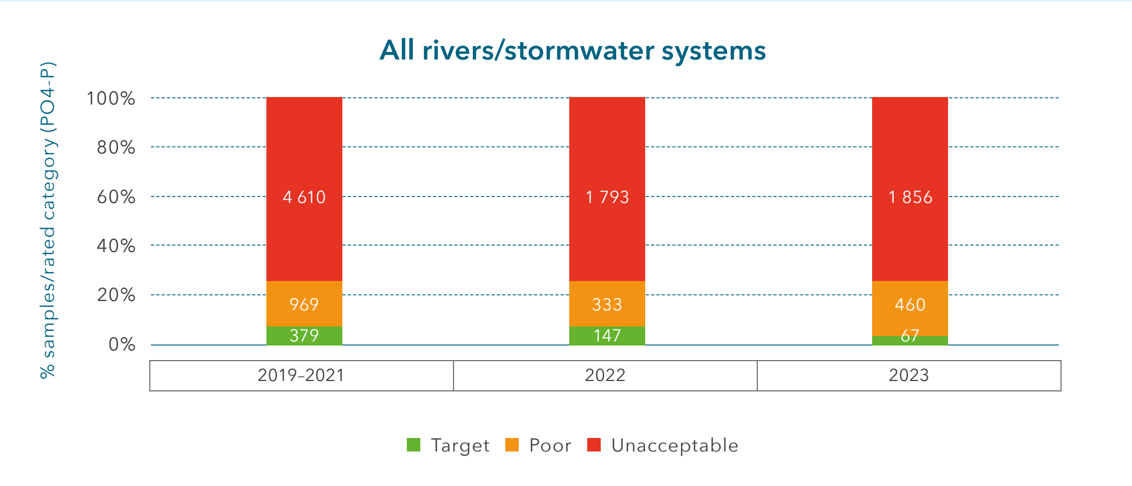
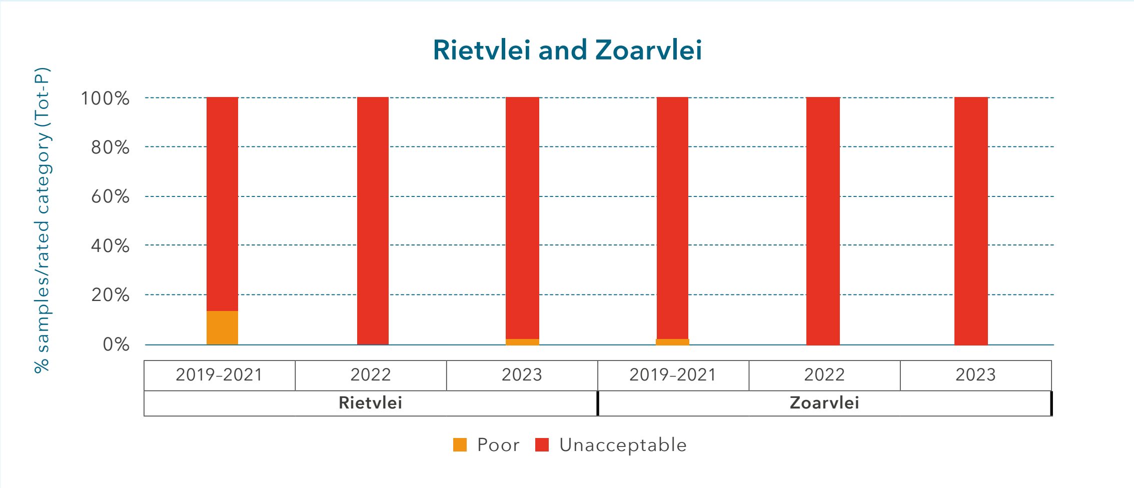
Figure 6.1: Percentage of phosphate (PO4-P) samples falling within each rated category for this variable, per subcatchment (continued)

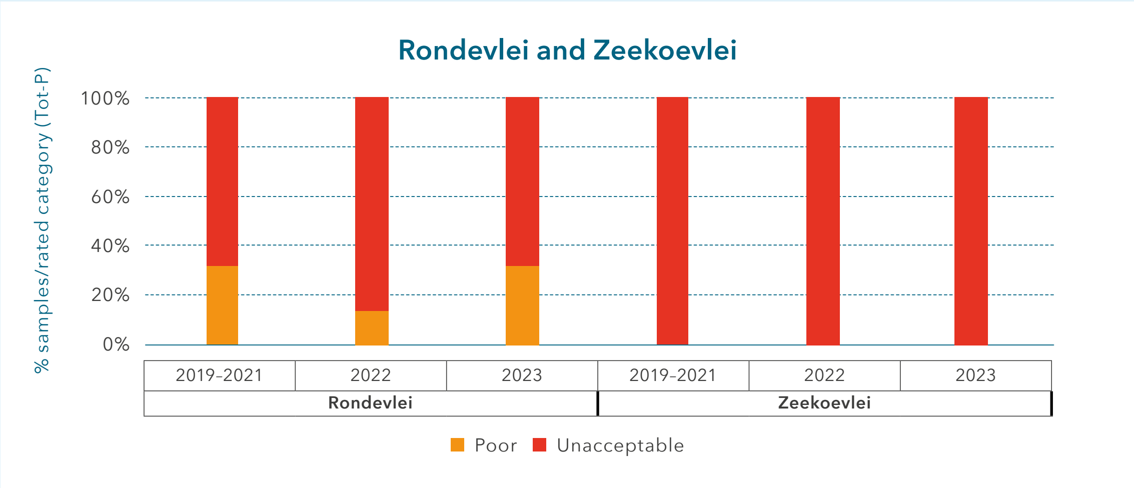




Thresholds for rated categories as defined in table 5.1. Data presented for river/'flowing' water monitoring points. Subcatchments as shown in figure 2.1. Total number of samples considered shown in bars in bottom right plot ('all rivers/ stormwater systems').

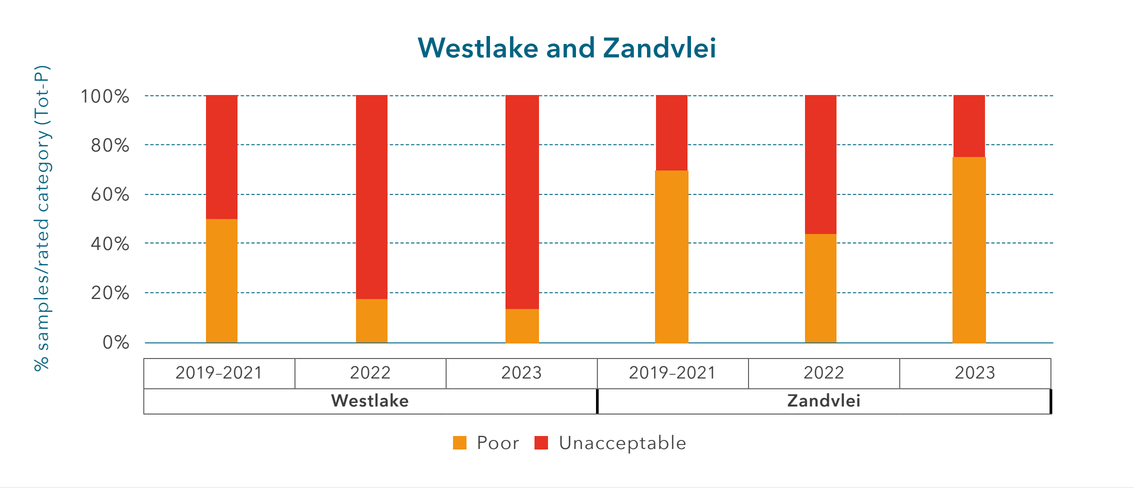
Figure 6.2: Percentage of total phosphorus (Tot-P) samples falling within each rated category for this variable, per monitored standing water system

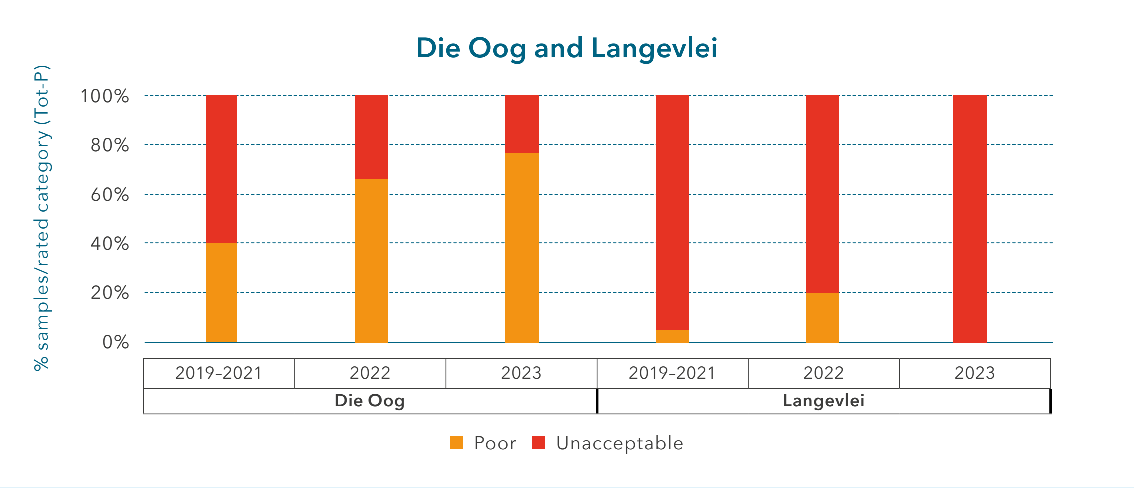




Thresholds for rated categories as defined in table 5.2. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('all standing waterbodies'). Note missing Tot-P data from January 2023.

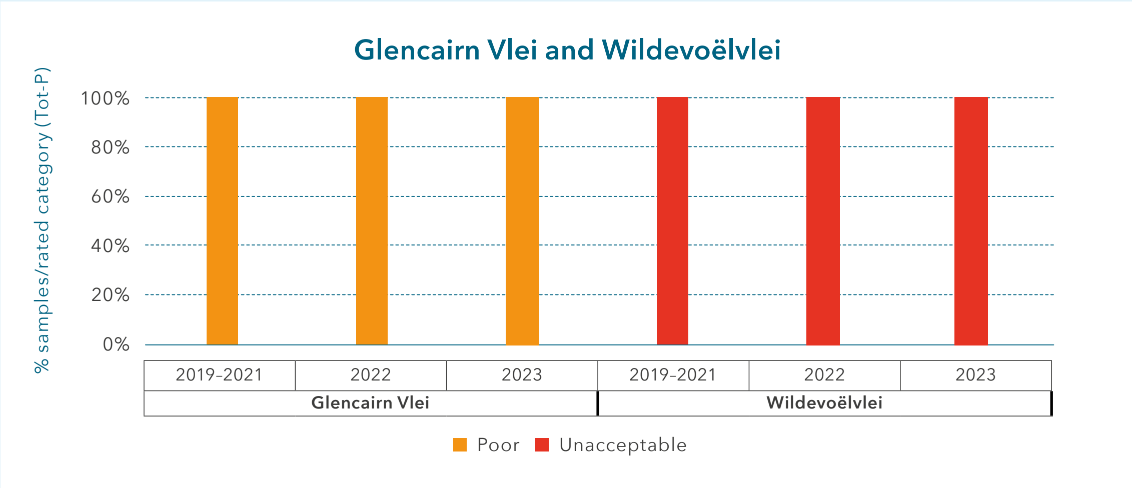
Figure 6.2: Percentage of total phosphorus (Tot-P) samples falling within each rated category for this variable, per monitored standing water system (continued)

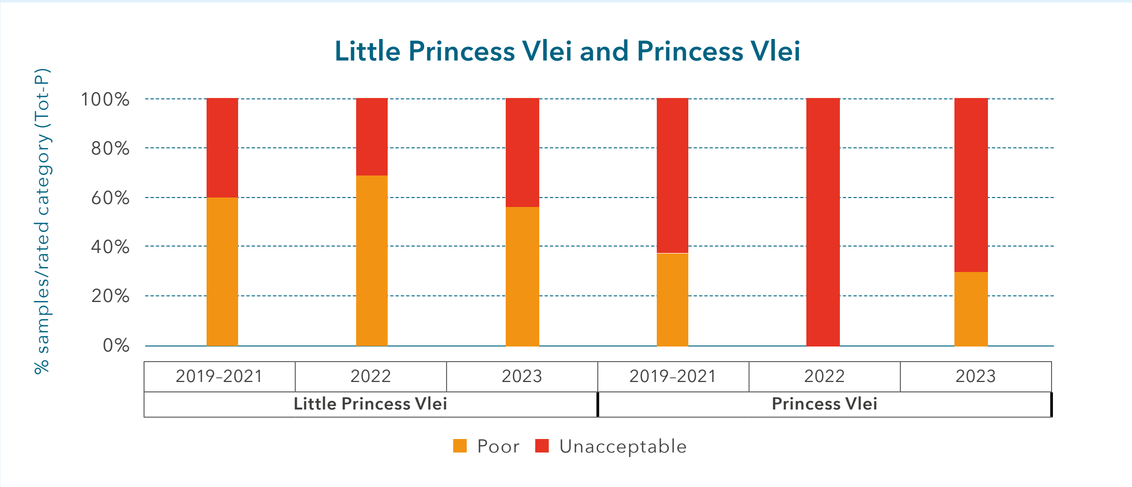




Thresholds for rated categories as defined in table 5.2. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('all standing waterbodies'). Note missing Tot-P data from January 2023.

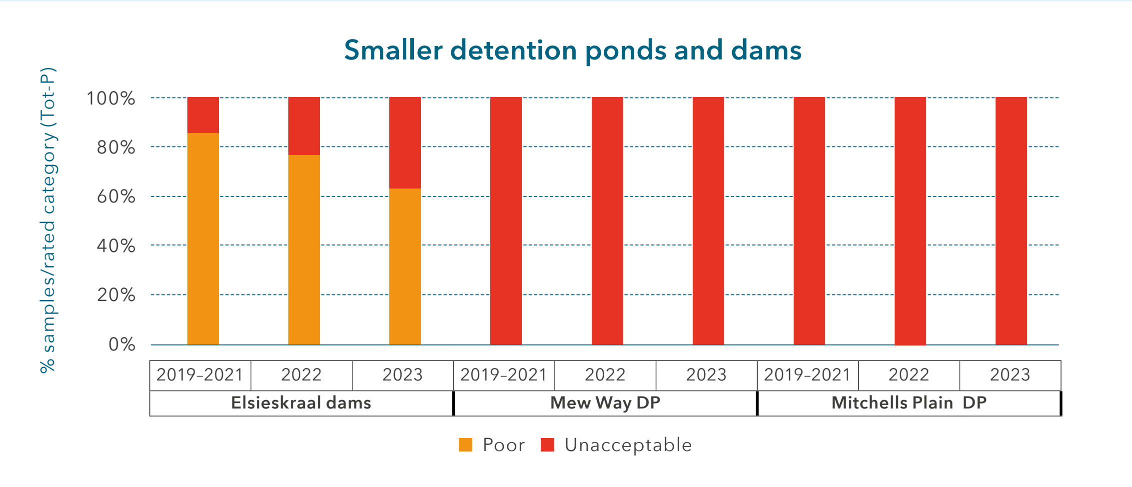
Figure 6.2: Percentage of total phosphorus (Tot-P) samples falling within each rated category for this variable, per monitored standing water system (continued)

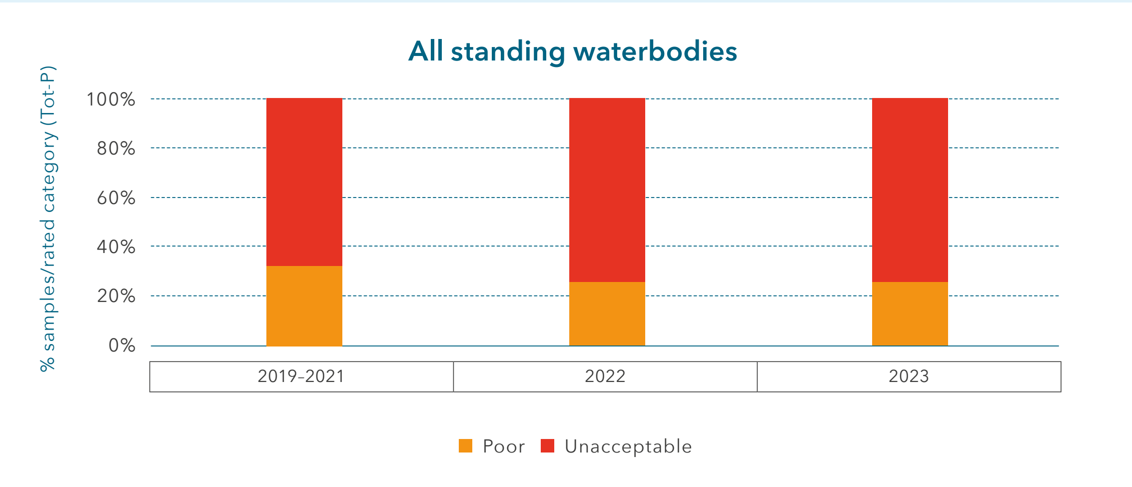




Thresholds for rated categories as defined in table 5.2. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('all standing waterbodies'). Note missing Tot-P data from January 2023.

Figure 6.2: Percentage of total phosphorus (Tot-P) samples falling within each rated category for this variable, per monitored standing water system (continued)





Thresholds for rated categories as defined in table 5.2. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('all standing waterbodies'). Note missing Tot-P data from January 2023.

What is TIN?

TIN is made up of nitrate, nitrite and ammoniacal nitrogen. All three of these components can be toxic to aquatic organisms at certain concentrations. In the Inland Water Quality Report, only ammoniacal nitrogen is considered from a toxicity perspective. This is because it includes ammonia, which can be toxic even at very low concentrations.

The following findings highlight how 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 often characterised by impacted river waters, which reflect in polluted standing waterbodies but where natural processes are usually still able to process nitrogen pollutants.

Rondevlei is part of the False Bay Nature Reserve, a declared Ramsar site.

6.1.5. Nitrogen nutrient status of Cape Town's waterbodies: RP 2019 to 2023

Total inorganic nitrogen (TIN) concentrations were used to assess nitrogen enrichment levels in Cape Town's waterbodies.

While phosphorus is considered more problematic than nitrogen in driving ecosystem responses to eutrophication (e.g. rapid plant growth including algae and reeds), nitrogen enrichment was also at levels of concern in many parts of Cape Town's watercourses over the 2022 and 2023 reporting periods. More than 55% of water quality samples from routinely monitored sites were rated unacceptable with regard to their TIN concentrations, and only 20–21% were within the target range over these periods.

By contrast, over 60% of samples from most of the monitored standing water systems (vleis and dams) fell within the target range for this variable, with some systems performing much better. The exceptions to this were Zeekoevlei, Langevlei, Wildevoëlvlei and the Mew Way and Mitchells Plain detention ponds.

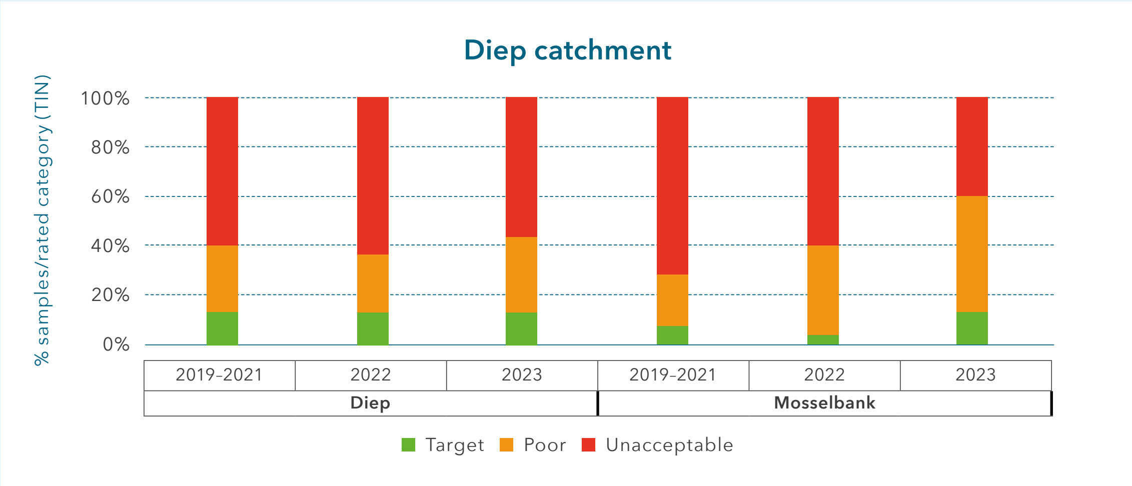
These results suggest that TIN enrichment was less problematic in standing water systems than in rivers and stormwater channels. This finding suggests dilution by a larger waterbody but, more importantly, the ecological impacts of extended residence time, which allow nitrogen uptake, sedimentation and denitrification processes.

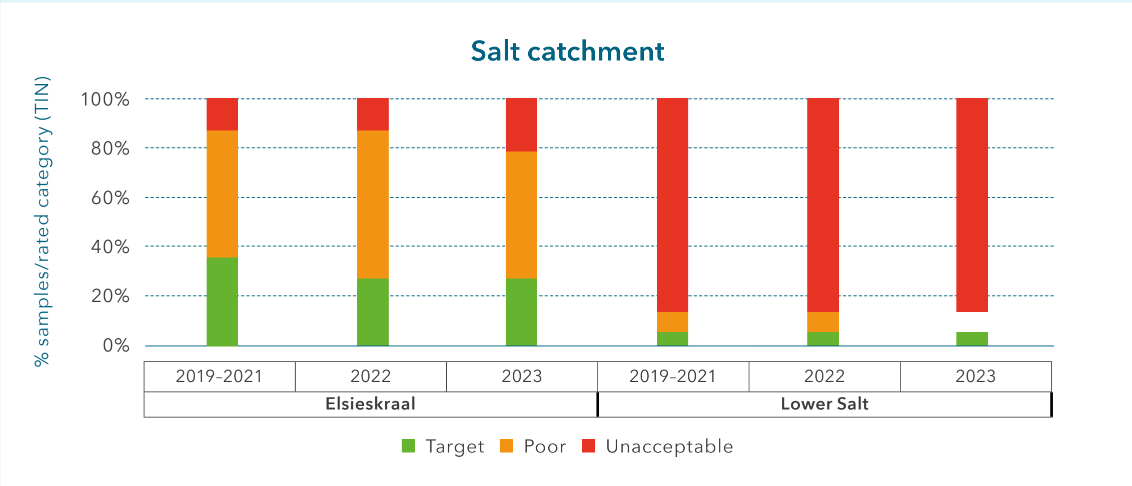
The report also looked at the ratio of nitrogen (in TIN) to phosphorus (in orthophosphates) in various standing waterbodies. These waterbodies were generally characterised by low N:P ratios, in the range most likely for the systems to be dominated by blue-green algae rather than rooted plants or other less problematic algal groups. In particular, very low (and thus problematic) N:P ratios were evident in Wildevoëlvlei, the Mew Way and Mitchells Plain detention ponds, Zeekoevlei, Rondevlei and Zoarvlei (in the 2023 reporting period), suggesting that all of these systems were likely to be affected at least at times by blue-green algal growth.

The ratio of TIN that comprises total ammoniacal nitrogen (NH4-N) is also an important measure. This is because total ammoniacal nitrogen includes a proportion of un-ionised ammonia (NH_3), which can be toxic to some aquatic biota even at low concentrations. Hence its dominance in TIN can reflect problems in ecosystem health (or condition). Generally, the less nutrient-enriched rivers in this study had lower NH4-N:TIN ratios, suggesting that where TIN loads are lower, more efficient nitrification takes place.

Even high proportions of total ammoniacal nitrogen in such systems would still be likely to have very low NH_3 concentrations, which would be unlikely to be harmful.

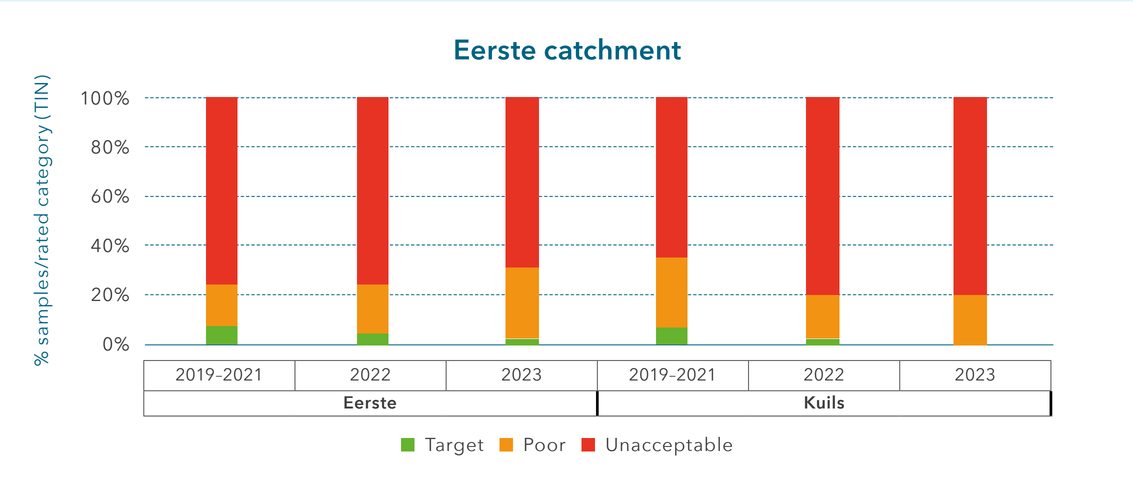
Figure 6.3: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per subcatchment





Thresholds for rated categories as defined in table 5.2. Data for river/'flowing' water monitoring points in each subcatchment. Subcatchments as shown in figure 2.1. Total number of samples considered shown in bars in bottom right plot ('All rivers/stormwater systems').

Figure 6.3: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per subcatchment (continued)



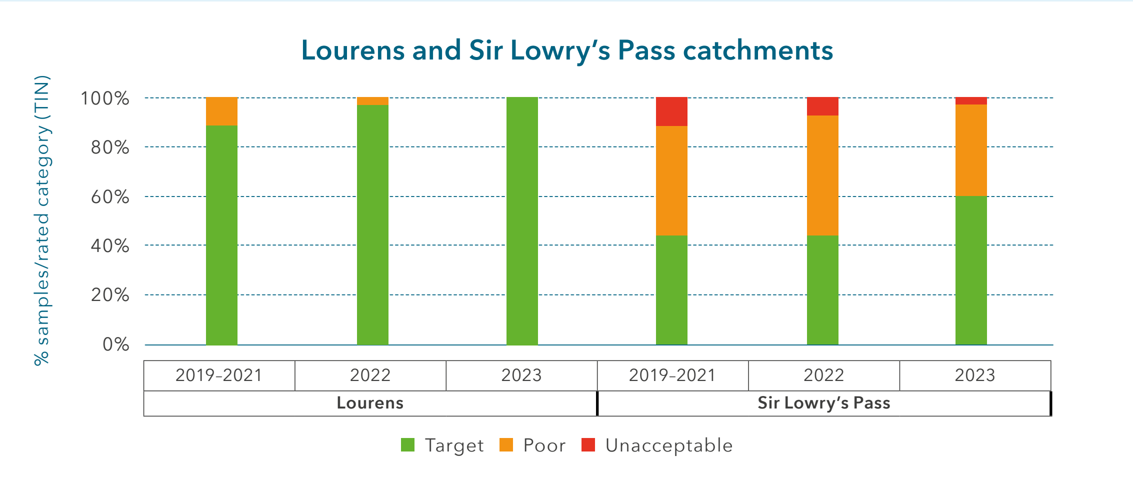


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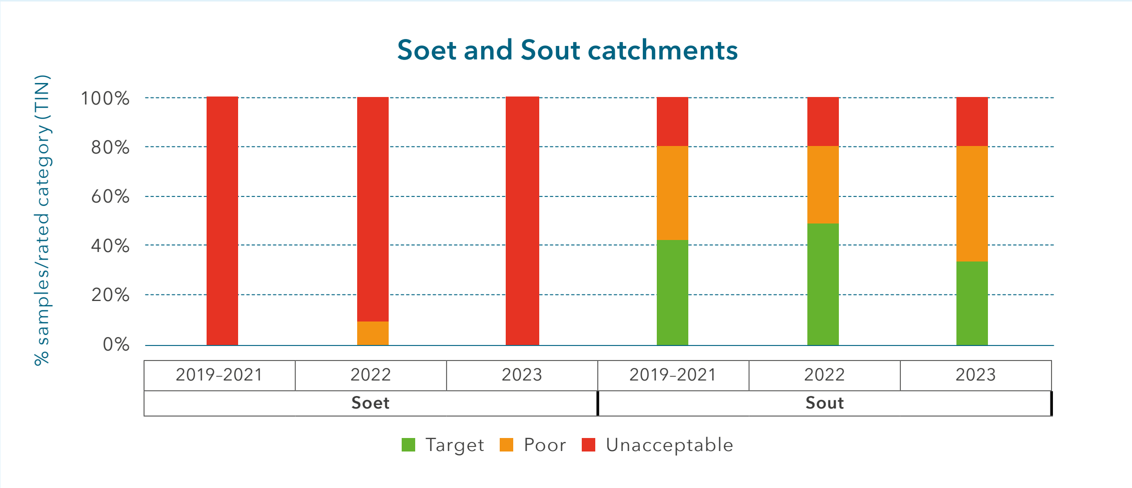
Figure 6.3: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per subcatchment (continued)



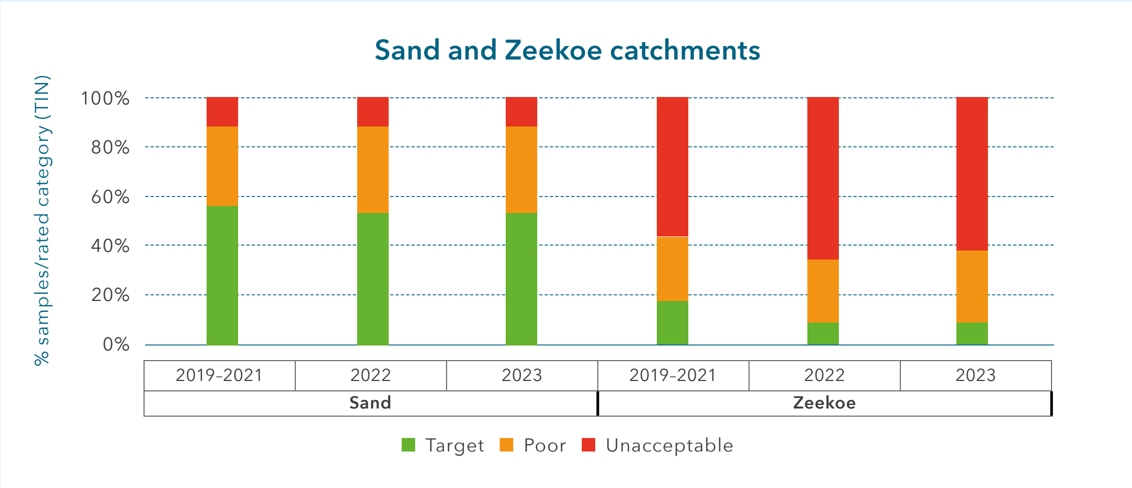


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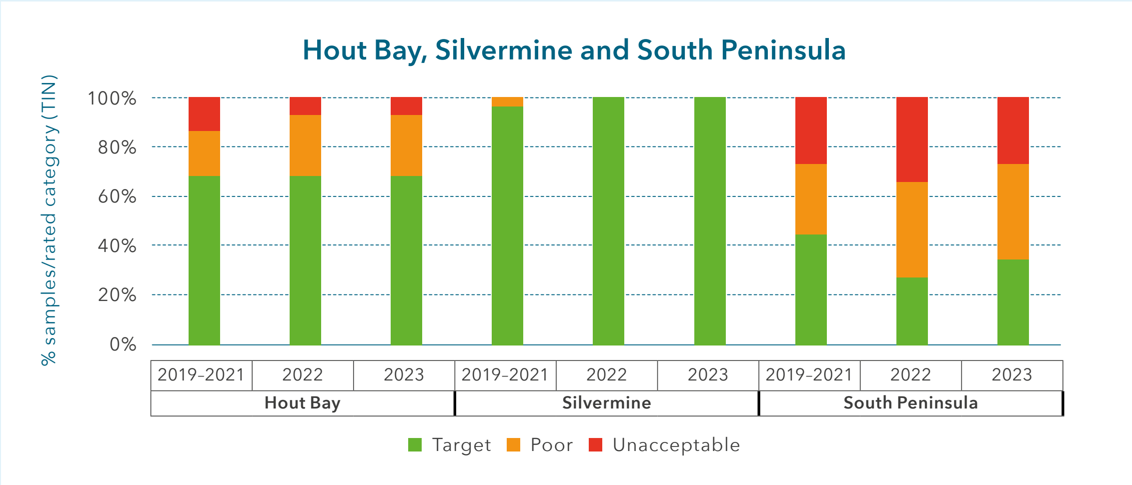
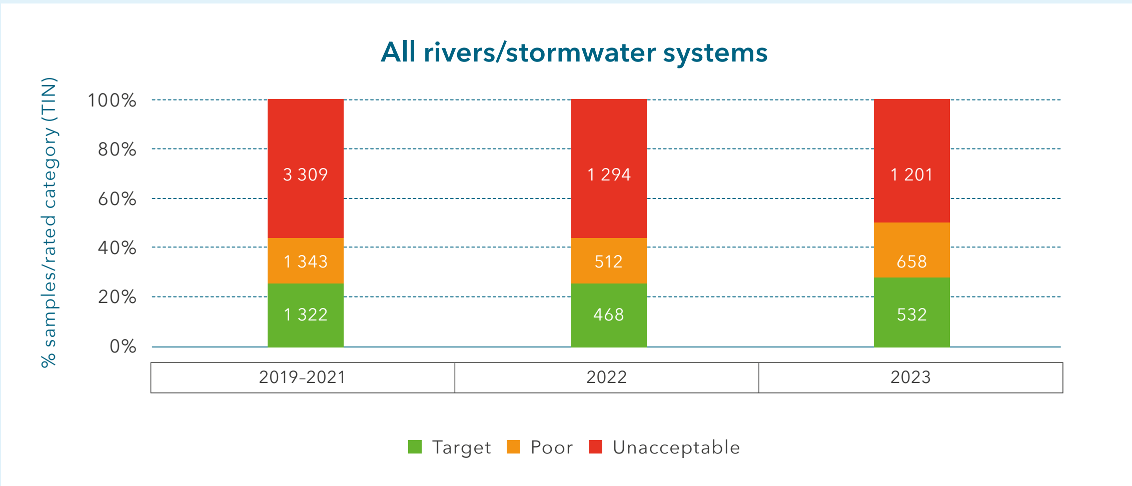
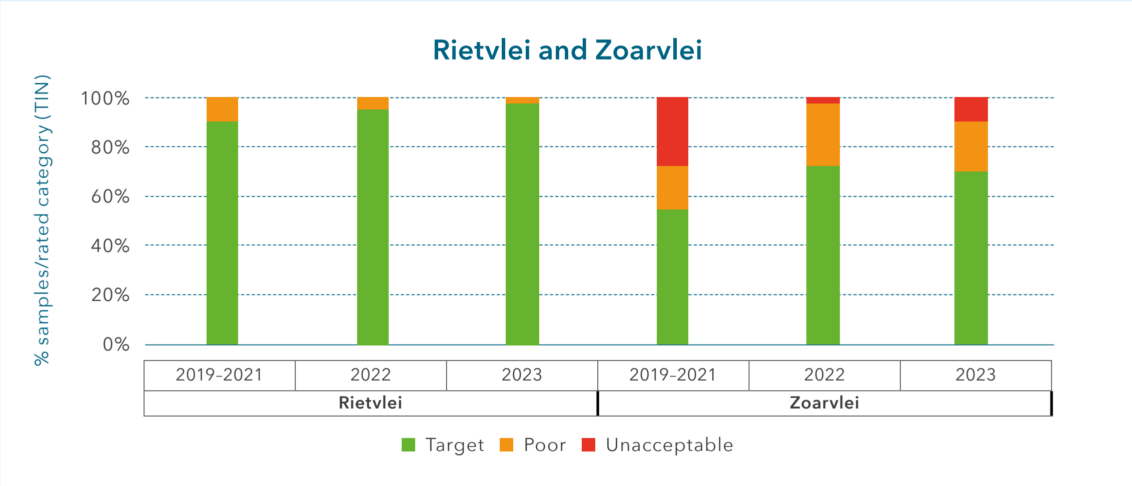
Figure 6.3: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per subcatchment (continued)

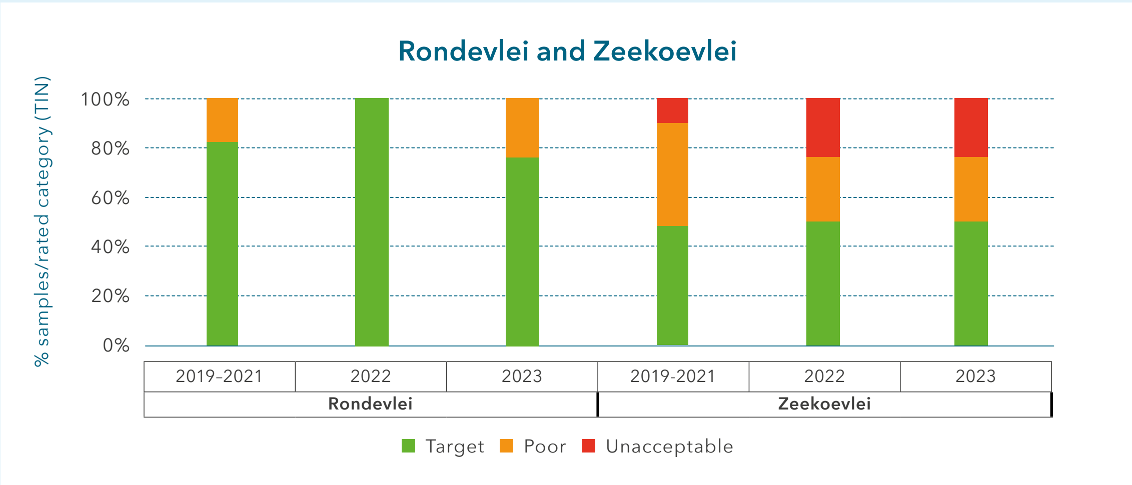




Thresholds for rated categories as defined in table 5.2. Data for river/'flowing' water monitoring points in each subcatchment. Subcatchments as shown in figure 2.1. Total number of samples considered shown in bars in bottom right plot ('All rivers/stormwater systems').

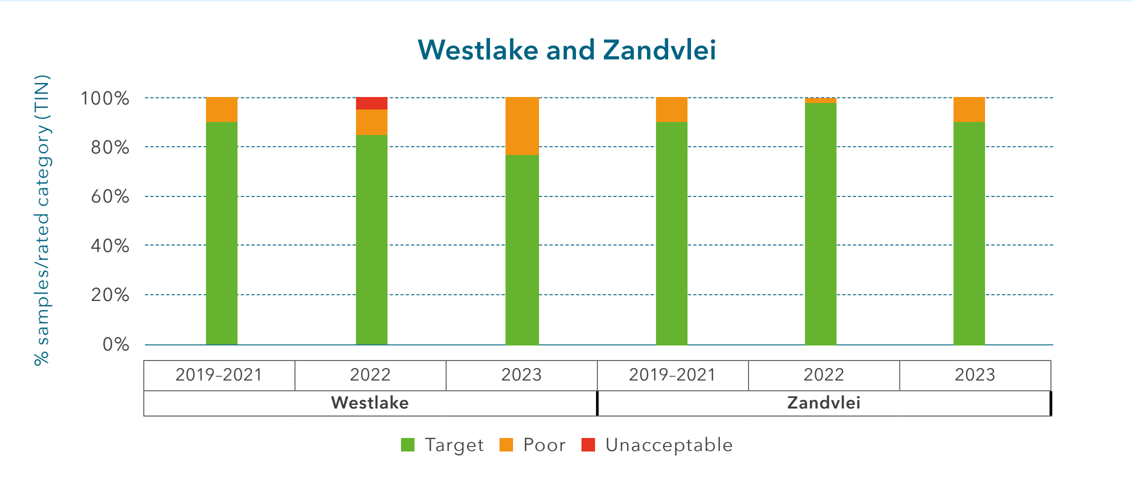
Figure 6.4: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per monitored standing water system





Thresholds for rated categories as defined in table 5.2. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing waterbodies').

Figure 6.4: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per monitored standing water system (continued)



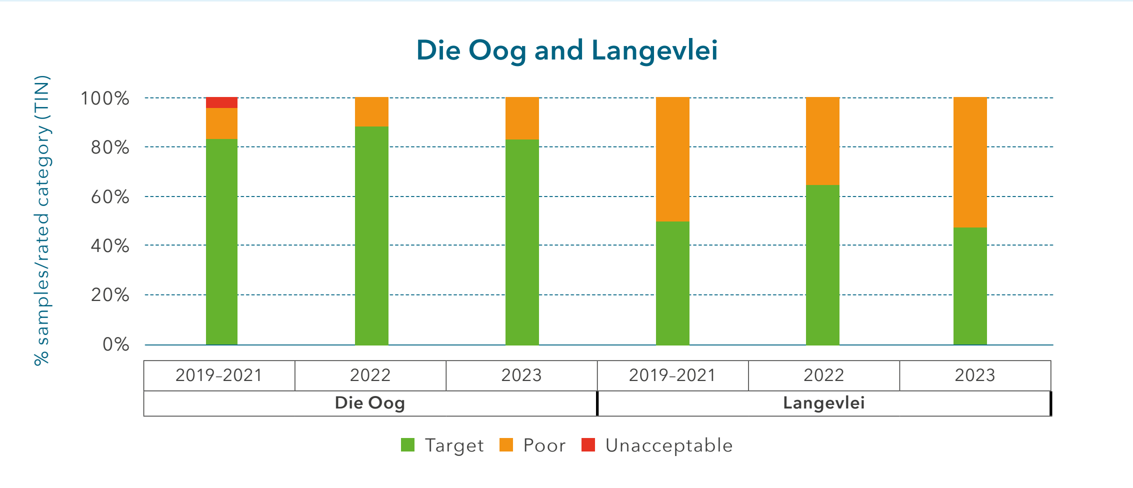


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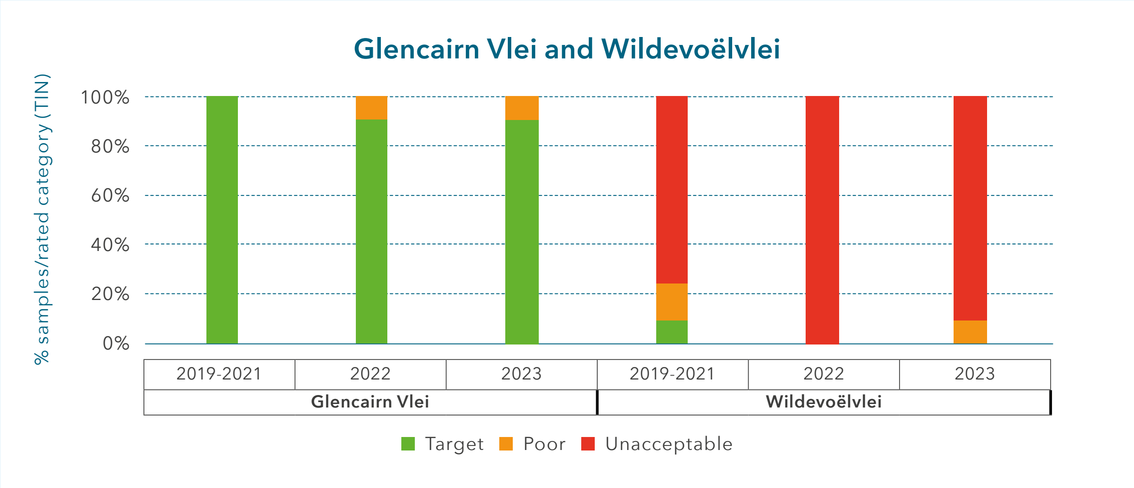
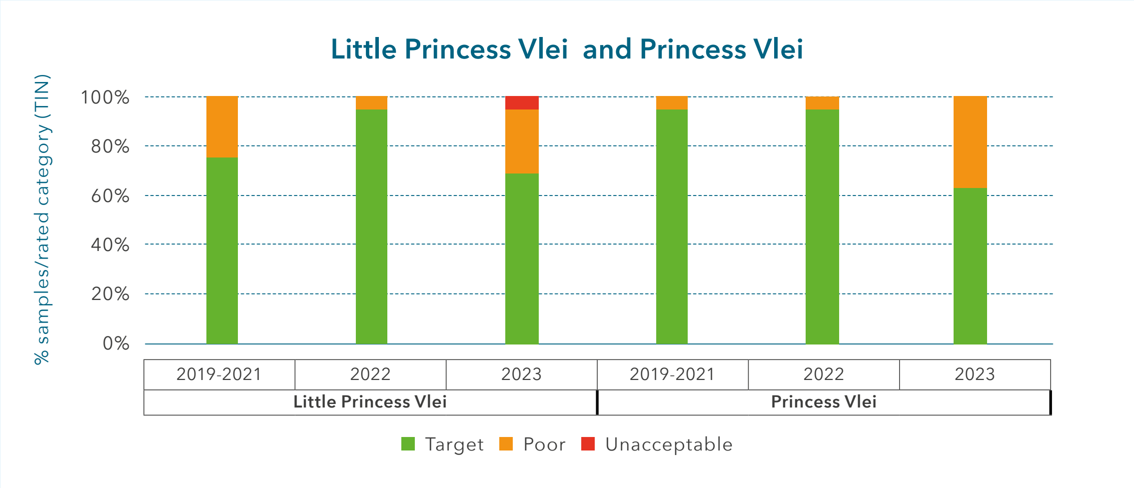
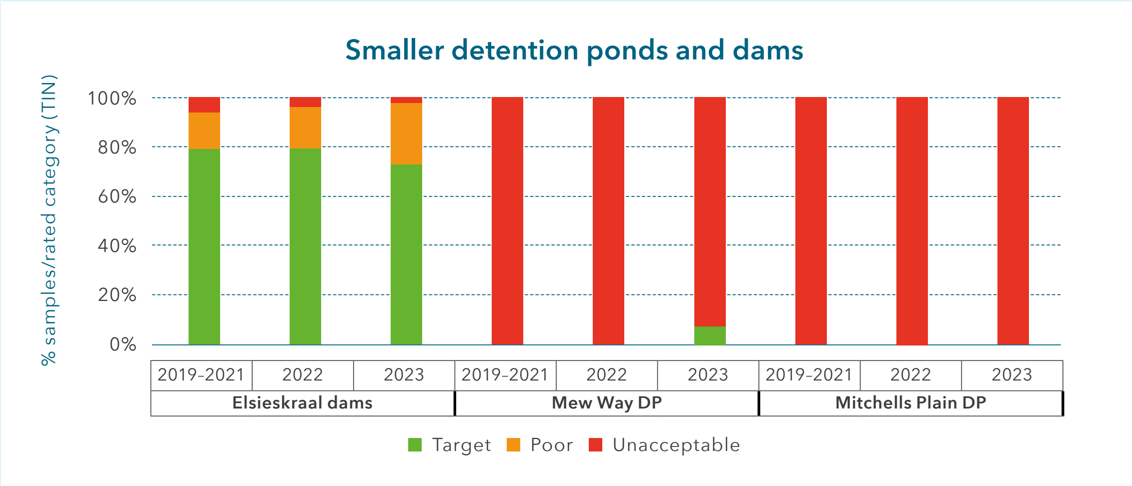
Figure 6.4: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per monitored standing water system (continued)

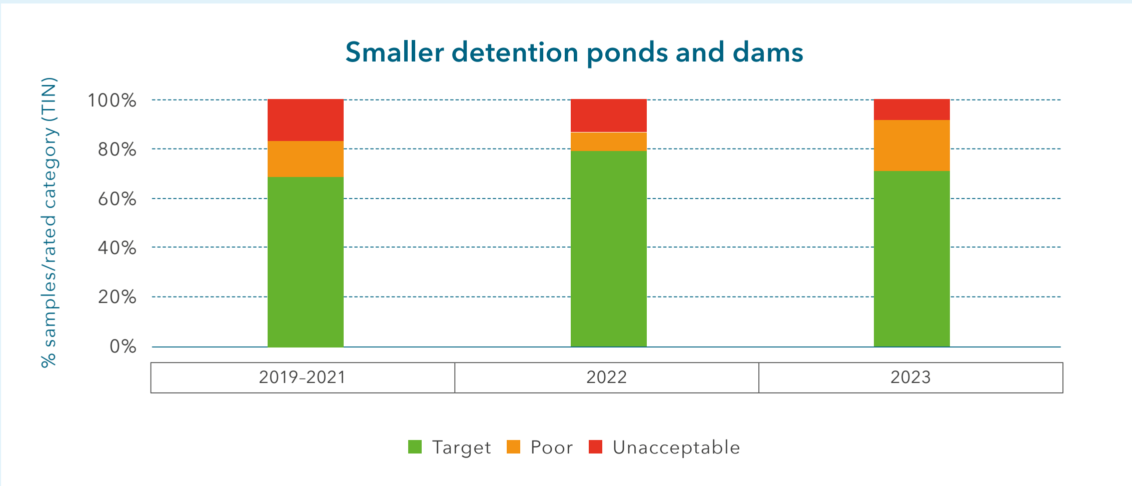




Thresholds for rated categories as defined in table 5.2. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing waterbodies').

Figure 6.4: Percentage of total inorganic nitrogen (TIN) samples falling within each rated category for this variable, per monitored standing water system (continued)





Thresholds for rated categories as defined in table 5.2. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing waterbodies').

6.2. Sewage as a risk to public health

6.2.1. Sources of sewage contamination

The technical report highlighted the following sources of sewage contamination in Cape Town's subcatchments:

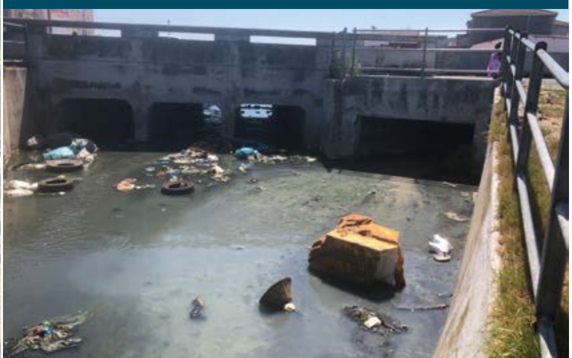
- Periodic sewer blockages and manhole overflows that enter the stormwater system and thus pass into watercourses. Blockages result variously from poor solid waste management (due to multiple factors), overflows as a result of stormwater ingress, vandalism, ageing infrastructure (reflecting a history of poor maintenance effort), and increasing sewage volumes generated from rapidly expanding, largely informal 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, this waste finds its way into the stormwater system and from here into the city's watercourses. The technical report showed that by far the most prevalent causes of damage in the 2022 reporting period were from pump tripping and electrical failures (both 23%) and mechanical failure (17%);
- Load-shedding was the factor that accounted for the fourth highest number of pump station overflows (9%);
- The city has 25 WWTW, 17 of which pass effluent into inland aquatic ecosystems (see figure 6.5), accounting for roughly 95% of the city's total sewage volume of some 542 Mℓ/d;
- 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 faecal waste);
- Runoff from urban areas with high levels of homeless people without alternative waste disposal options;
- Illegal connections of sewers into stormwater systems;
- Formal connections to allow sewers to overflow into stormwater systems (this practice has been discontinued but some systems remain connected);
- Inputs from wildlife (baboons and birds);
- Input from livestock (e.g. feedlots in agricultural areas in and draining into rivers or other watercourses); and
- 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.

In some areas, homeless people use often polluted river water for washing and drinking.

Overflowing sewer manhole,
leading to the Sir Lowry's Pass River.

Polluted runoff in Imizamo Yethu.

Sewage overflows into the Theo Marais channel,
leading to the Milnerton Lagoon
(Diep River subcatchment) as a result of prolonged
failure of the Koeberg pump station (March 2024).



Polluted inflows from informal settlements and
backyard areas into the Big Lotus River,
Gugulethu (Zeekoe subcatchment).

The City’s inland wastewater treatment works – Impacts of treated sewage effluent on Cape Town’s inland watercourses and estuaries

The technical report provides a brief assessment of final effluent data from the City’s inland WWTW over the 2022 and 2023 reporting periods. The report should be assessed for details of data sources and analyses. The report found, though, that only five of the City’s WWTW consistently produced effluent within the Department of Water and Sanitation’s ‘general limits’ for *E. coli*, with most of the other WWTW producing effluent with *E. coli* counts several orders of magnitude higher. Outlets from these WWTW pose significant risks to downstream users in contact with the water.

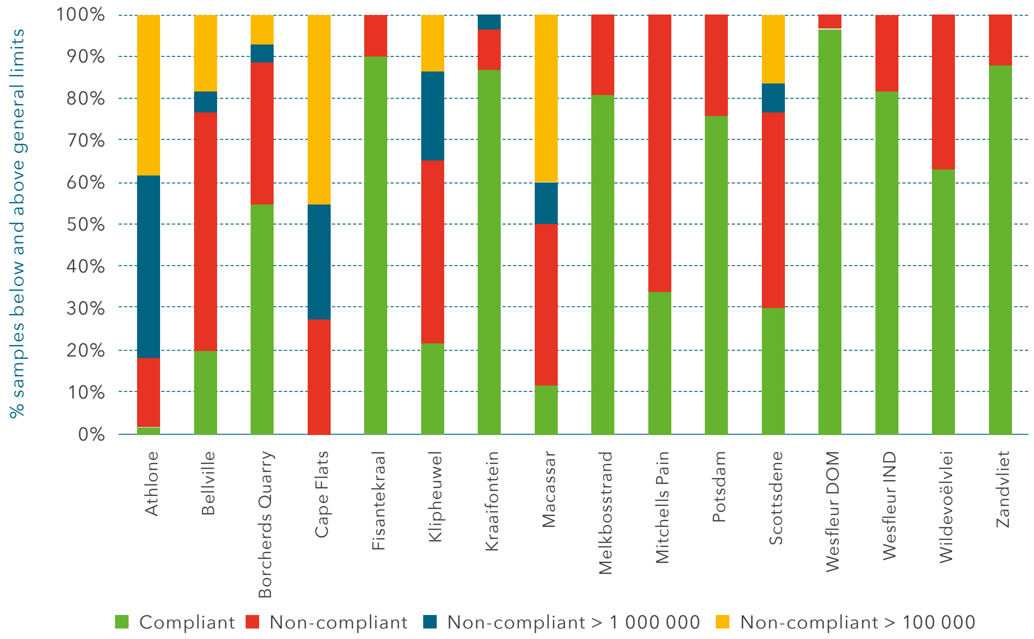
Chemical oxygen demand data were also assessed as a measure of highlighting risk to aquatic ecosystems from high levels of oxygen needed to break down or oxidise chemicals in effluent, which can reduce dissolved oxygen available for aquatic ecosystems. These data indicated that the most poorly performing WWTW in this regard feed into the following river aquatic ecosystems:

- Diep River estuary and Milnerton Lagoon (Potsdam WWTW)
- Black River and Salt River canal (Athlone and Borcherds Quarry WWTW)
- Wildevoëlvlei (Wildevoëlvlei WWTW)
- Zeekoe canal (Cape Flats WWTW)
- 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)
- Eerste River estuary (Macassar WWTW)

Of the above, the impacts of the Potsdam WWTW on the downstream systems are considered the most significant, having contributed largely to the recent collapse of this estuary and its once-important nursery for juvenile fish (Rose et al., 2023). Similarly, the Macassar WWTW, the effects of which are multiplied by inflows from the Bellville, Scottsdene and Zandvliet WWTWs upstream in the catchment, has contributed to the severe degradation of the Eerste River estuary.

Although the Cape Flats, Athlone and Borcherds Quarry WWTW pass effluent into artificial canals and channels, even these systems play important roles in Cape Town’s urban society. Poor effluent quality actively detracts from the value of the areas through which they pass, and has significant ecological costs.

The report did note improved performance in some WWTW (e.g. the recently upgraded Zandvliet WWTW). However, the downstream impacts of many of these WWTW remain significant.

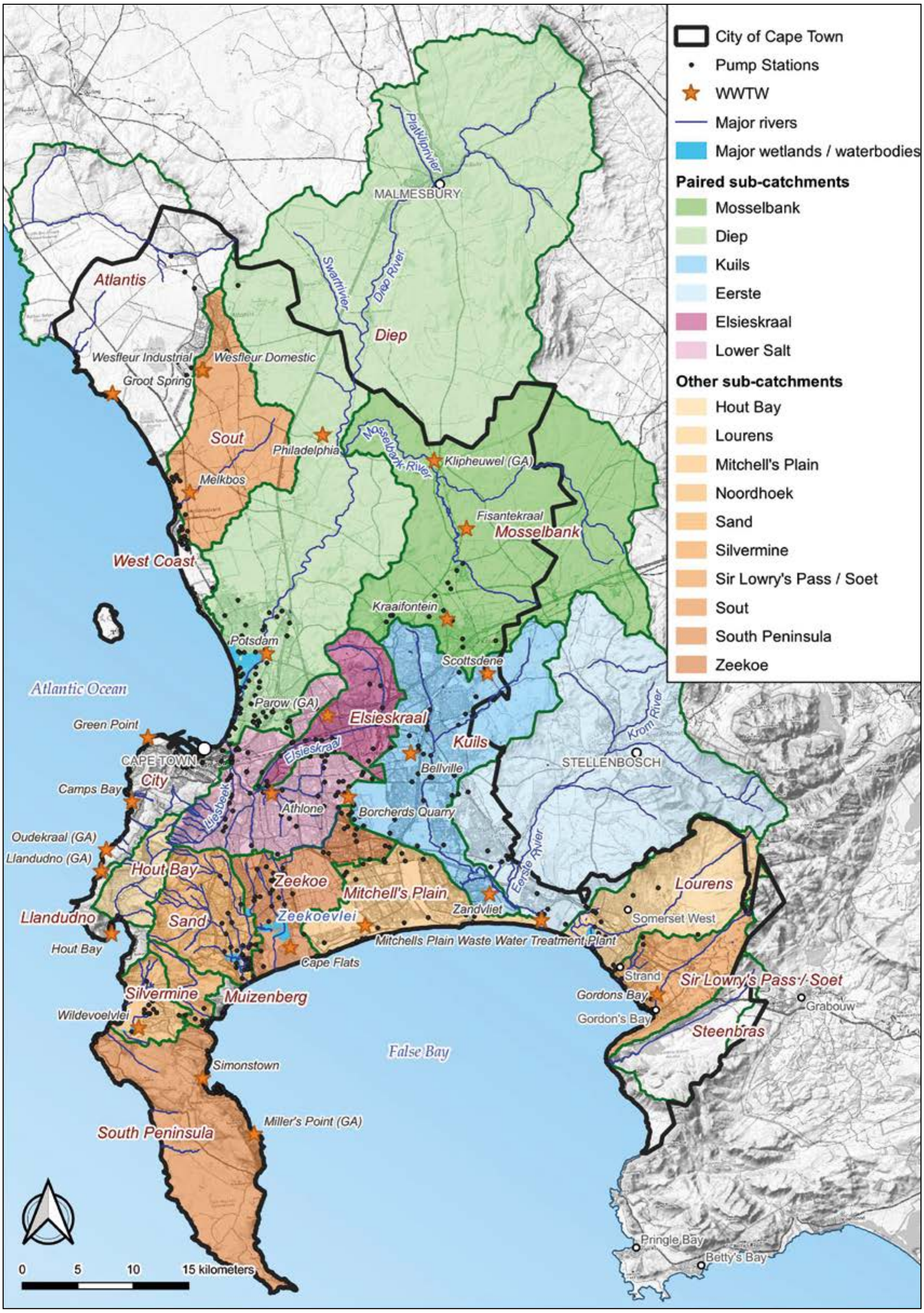


Proportion of samples from the City's various inland WWTW where *Escherichia coli* samples complied with, did not comply with, or highly exceeded general effluent limits (> 100 000 and > 1 000 000 cfu/100 mℓ). 2023 reporting period data.

The technical report recommended that the City should prioritise improving the quality of final effluent from WWTW that discharges 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.

WWTW discharging into the Kuils, Eerste, Mosselbank and Diep rivers in particular should be prioritised, as these river systems retain elements of natural aquatic ecosystem function and include important downstream estuaries and floodplain wetlands. It was further recognised that polluted discharges into other systems do also result in major ecological and human health consequences.

Figure 6.5: Map showing the locations of the City of Cape Town's WWTW and sewage pump stations, in the context of different subcatchments and their rivers and major wetlands



6.2.2. Indicators of sewage contamination

Escherichia coli measurements are used by the City primarily as an indicator of human health risk, where people are exposed to river, vlei, lake or other (non-potable) water sources, particularly where they might swallow it. This is clearly a very important measure in waterbodies that are formally used for recreational purposes such as sailing, rowing, kayaking and fishing. These are categorised as intermediate-contact recreational activities, because they do not usually require full immersion in water for extended periods of time. Other activities such as swimming and diving are classified as full-contact recreational activities, and people swimming or diving would have a much higher likelihood of swallowing larger volumes of potentially contaminated water.

What is *E. coli*?

Escherichia coli (abbreviated *E. coli*) is a species of faecal 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 faecal contamination of avian or mammalian origin, and therefore are indicative of other pathogens that may be present in faeces.

The City does not manage any of its inland waterbodies for full-contact recreational activities. Nevertheless, Cape Town's citizens are exposed to intermediate levels of contact with water across the city, from both formal recreational waterbodies (e.g. Zandvlei, Zeekoevlei, Rietvlei, Milnerton Lagoon and Princess Vlei) as well as from informal contact with many other rivers, stormwater channels, vleis, lakes and detention ponds across the city, from activities such as walking or wading through them or, in some cases, even swimming in them. For this reason, monitoring of, and reporting on, *E. coli* data are carried out to provide information about human health risks linked to both formal intermediate-contact recreational use and other uses resulting in intermediate contact with the city's waterbodies.

In addition to allowing waterbodies to be categorised in terms of risks to human health, the Inland Water Quality Report also uses *E. coli* data to highlight watercourses affected by point-source pollution, 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.

6.2.3. Assessments of *E. coli* data from the city's waterbodies

Reliable *E. coli* data were not available for much of the 2021 and 2022 reporting periods, and the technical report thus included only data for the 2023 reporting period, comparing these with data from the 2019 and 2020 reporting periods. The data (summarised here in figures 6.5 and 6.6), showed that *E. coli* concentrations were far higher in flowing water sites (rivers and stormwater channels) than in standing water systems (vleis, lakes). In fact, 60% of samples from rivers/channels were rated unacceptable, compared with just 19% from assessed standing waterbodies. This pattern reflects extended retention time in standing waterbodies (especially the large vleis), allowing exposure of *E. coli* to ultraviolet (UV) light in sunlight (which kills these bacteria), as well as dilution of point-source inflows in large waterbodies.

Over time, the proportion of flowing water samples rated as unacceptable from a human risk perspective increased over the assessed reporting periods (2019, 2020 and 2023), with data showing increases from 49% unacceptable (2019 dataset) to 59% in the 2023 dataset. These data suggest a deterioration in river water quality over this period with an increase in frequency of significant exposure to sewage.

The most poorly-performing subcatchment was the Soet subcatchment (90-100% unacceptable samples), reflecting a stormwater system fed almost entirely by grey- and blackwater inflows from informal settlements. By contrast, the Silvermine and the Lourens River subcatchments were least impacted by *E. coli* (and by assumption, raw sewage), with > 80% of samples lying within the acceptable range, and explaining in part their generally low levels of nutrient enrichment. Nevertheless, even these generally cleaner subcatchments were impacted at least at times by sources of raw sewage, assumed to relate to overflows from sewer manholes in the lower catchment areas.

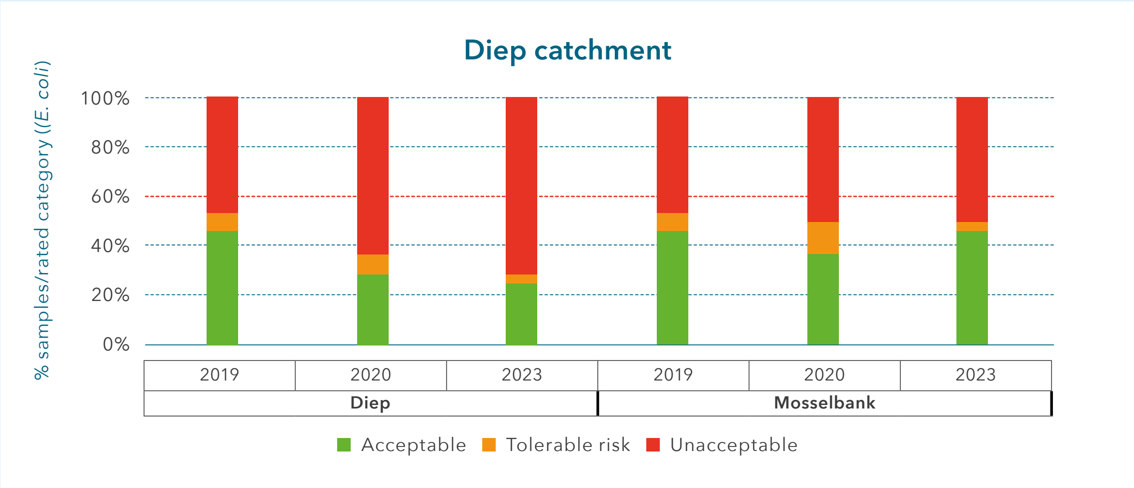
All of the routinely monitored open-water systems in the city, with the exception of the Mew Way and Mitchells Plain detention ponds, showed relatively low levels of sewage pollution, as measured by *E. coli* counts, with > 60% of samples in all systems lying within the acceptable range for *E. coli* during the 2023 reporting period. The managed recreational vleis all showed generally very high levels of compliance in *E. coli* data (< 20% samples rated as unacceptable in the 2023 reporting period, with the exception of Princess Vlei). Increased frequencies of unacceptable ratings were, however, evident in samples from Zeekoevlei and Princess Vlei.

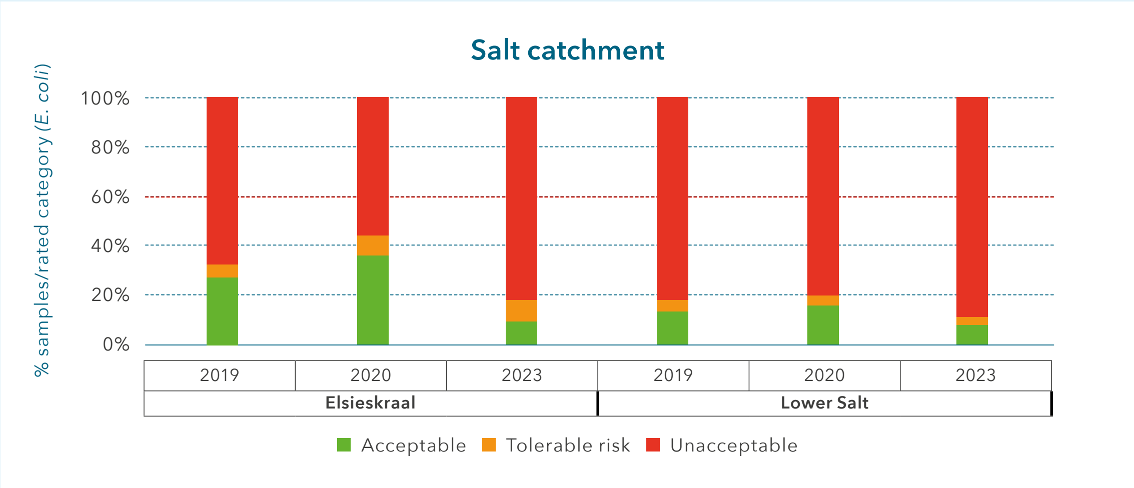
Data for the markedly worst-performing Mew Way and Mitchells Plain detention ponds (100% of samples were rated unacceptable throughout all of the assessed reporting periods) were unsurprising, given that these ponds are fed by black- and greywater discharges from poorly serviced urban areas, where even formal residential areas are prone to frequent manhole and pump station overflows of raw sewage.

The technical report does stress that *E. coli* data are used in the City's monitoring programme as an indicator of sewage contamination. Even if these bacteria are killed by UV light, however, the nutrients, decomposing organic waste and the various pathogens also associated with raw sewage would still remain within the affected waterbodies, where they would be expected to result in various short- to long-term impacts on the fitness for use of the system for both human use and aquatic ecosystems.

Exposure to sunlight kills off *E. coli* bacteria in sewage – but the other water quality impacts (nutrients, solids, other pathogens, etc.) remain, even when *E. coli* data appear innocuous.

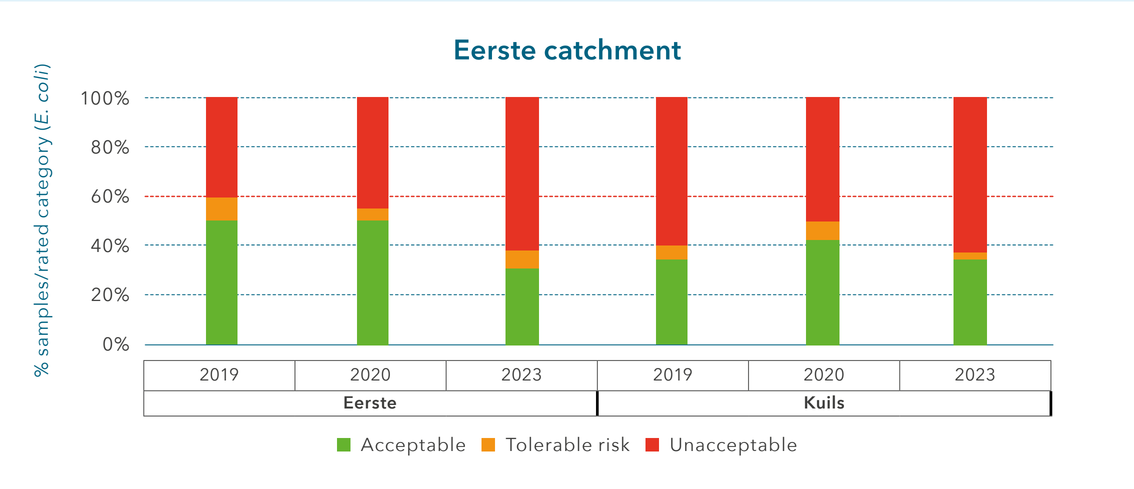
Figure 6.6: Percentage of *Escherichia coli* samples falling within each rated category for this variable, per subcatchment

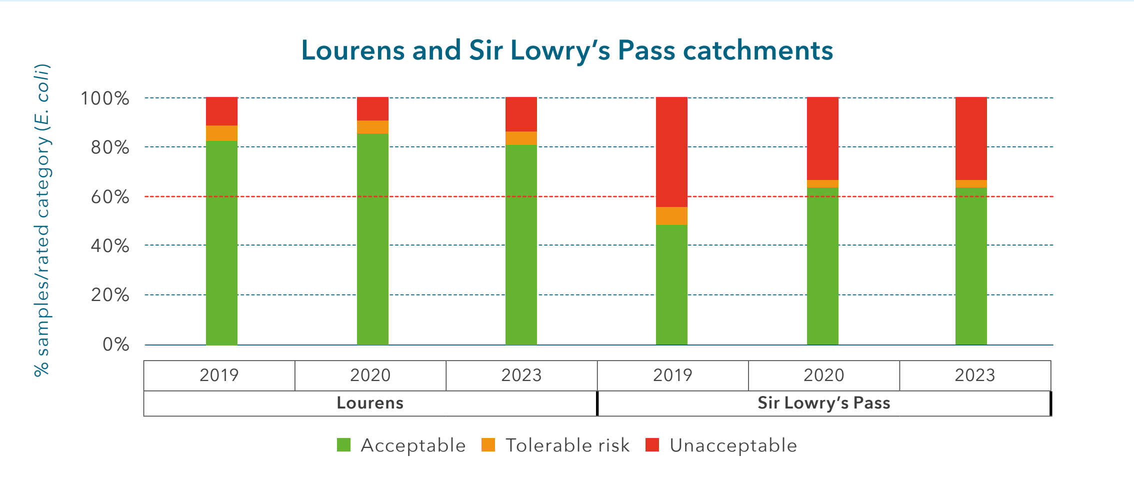




Thresholds for rated categories as defined in table 5.4. Data for river/'flowing' water monitoring points in each subcatchment. Subcatchments as shown in figure 2.1. Note inclusion of city coastal stormwater outlets. Dotted red line indicates City's '60% target' for meeting E. coli targets.

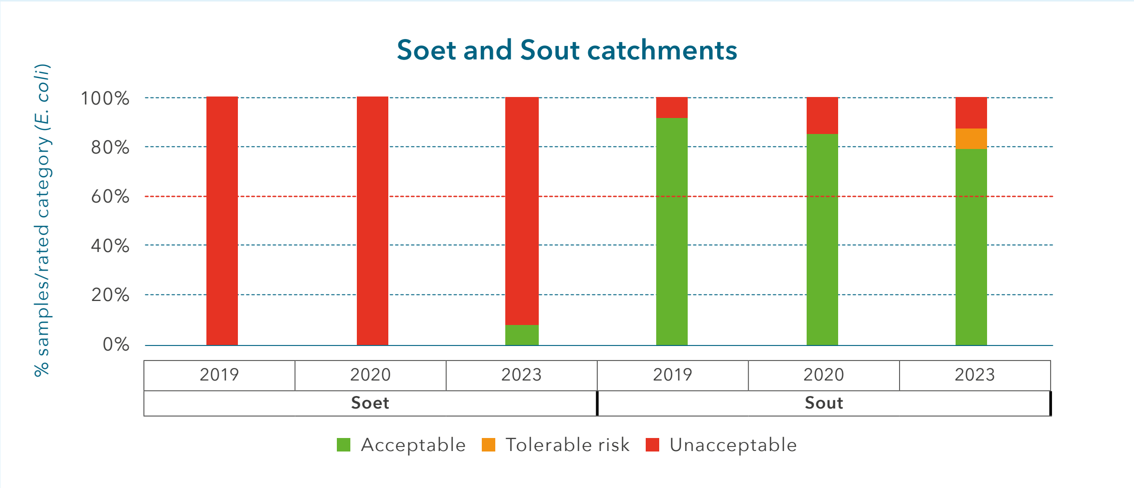
Figure 6.6: Percentage of *Escherichia coli* samples falling within each rated category for this variable, per subcatchment (continued)

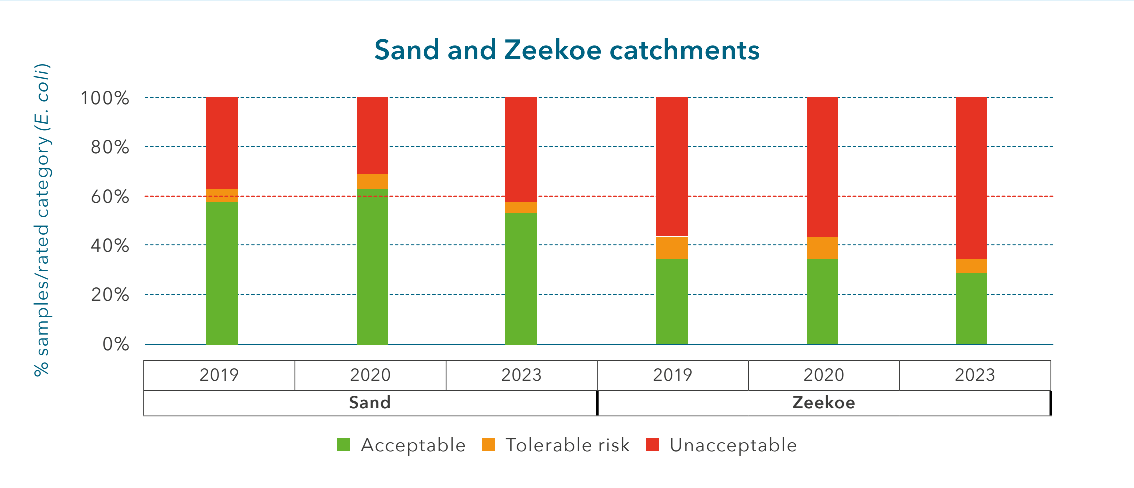




Thresholds for rated categories as defined in table 5.4. Data for river/'flowing' water monitoring points in each subcatchment. Subcatchments as shown in figure 2.1. Note inclusion of city coastal stormwater outlets. Dotted red line indicates City's '60% target' for meeting E. coli *targets.*

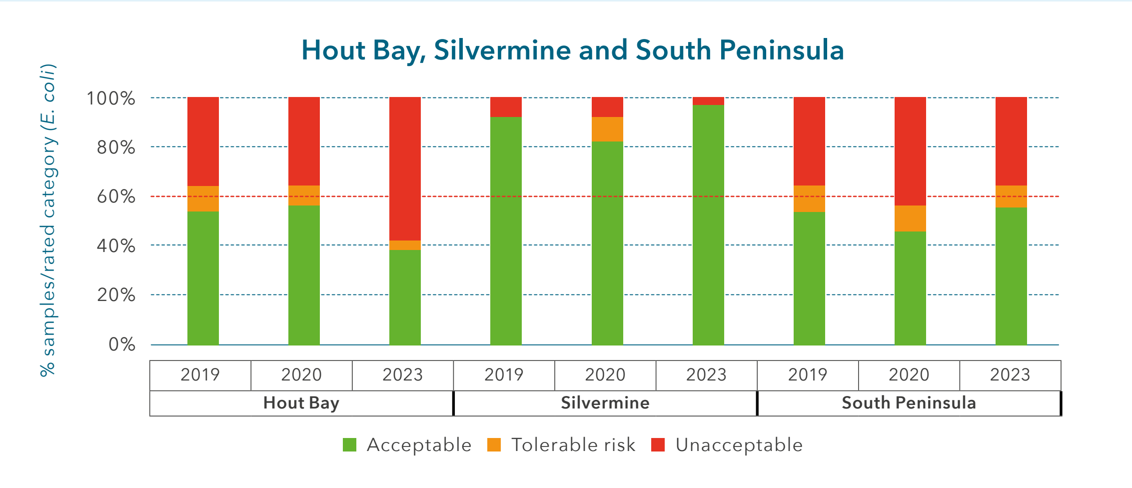
Figure 6.6: Percentage of *Escherichia coli* samples falling within each rated category for this variable, per subcatchment (continued)

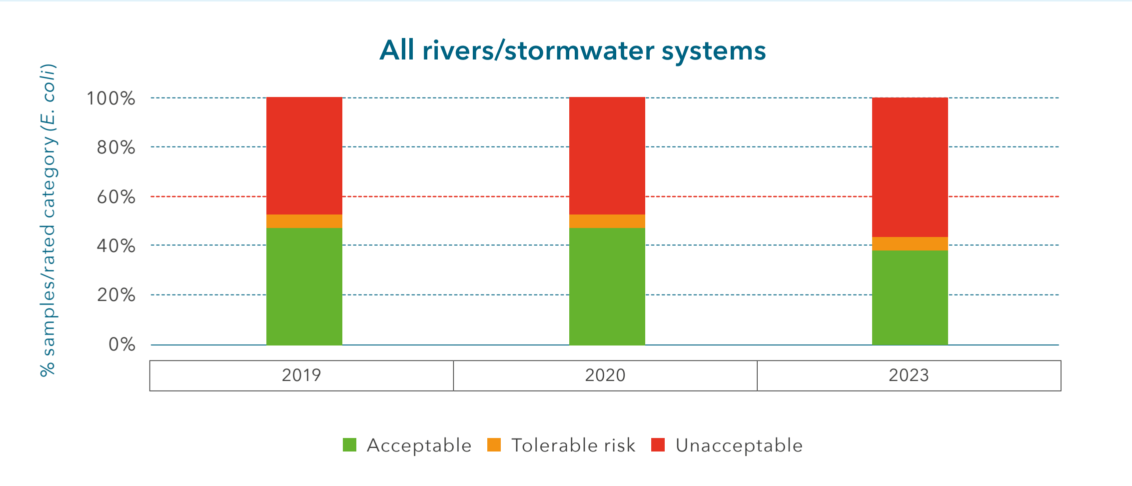




Thresholds for rated categories as defined in table 5.4. Data for river/'flowing' water monitoring points in each subcatchment. Subcatchments as shown in figure 2.1. Note inclusion of city coastal stormwater outlets. Dotted red line indicates City's '60% target' for meeting E. coli targets.

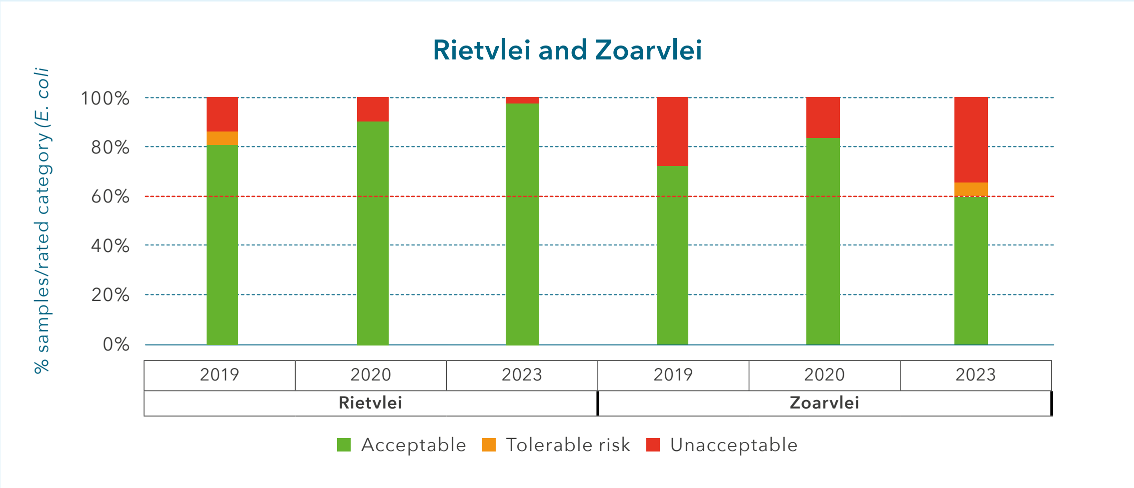
Figure 6.6: Percentage of *Escherichia coli* samples falling within each rated category for this variable, per subcatchment (continued)

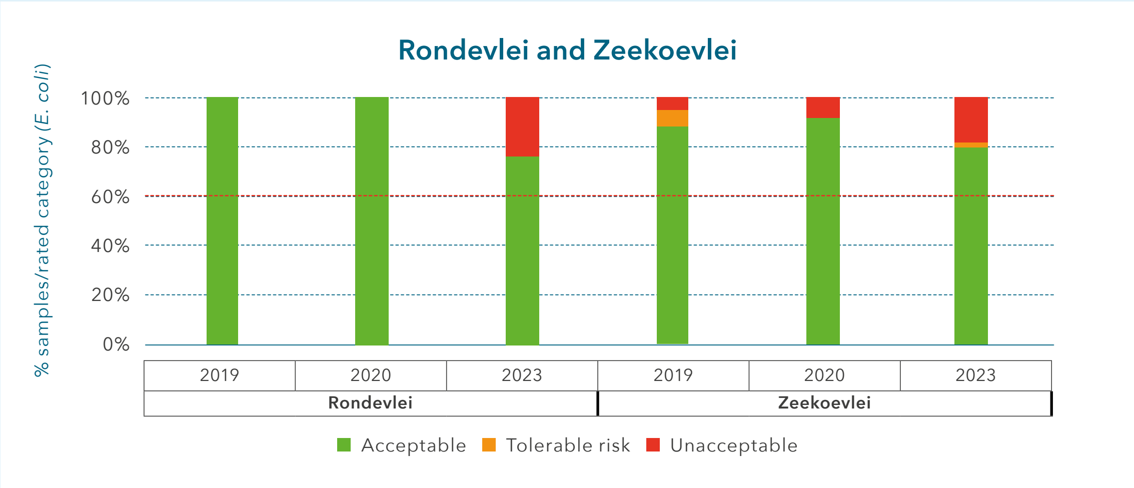




Thresholds for rated categories as defined in table 5.4. Data for river/'flowing' water monitoring points in each subcatchment. Subcatchments as shown in figure 2.1. Note inclusion of city coastal stormwater outlets. Dotted red line indicates City's '60% target' for meeting E. coli targets.

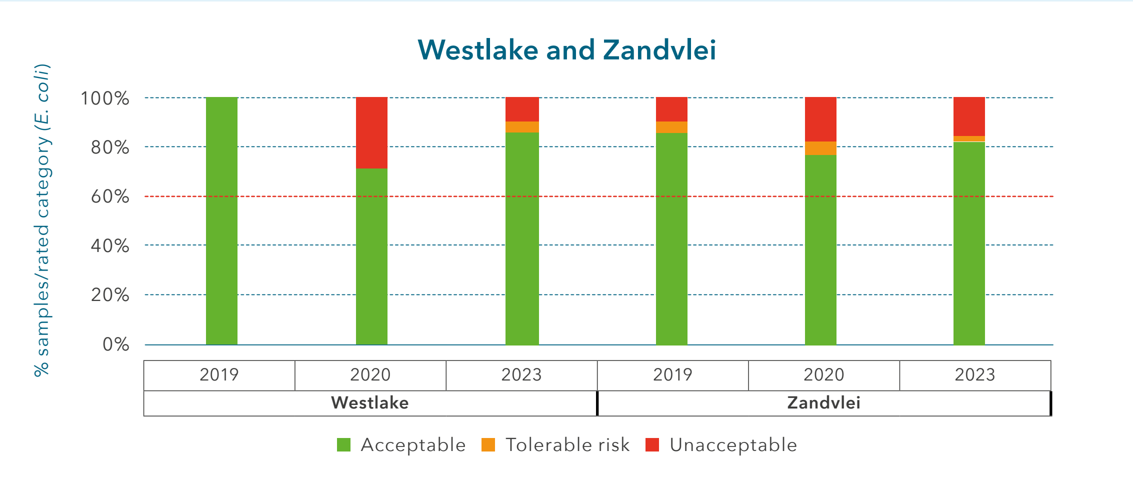
Figure 6.7: Percentage of *Escherichia coli* samples falling within each rated category for this variable

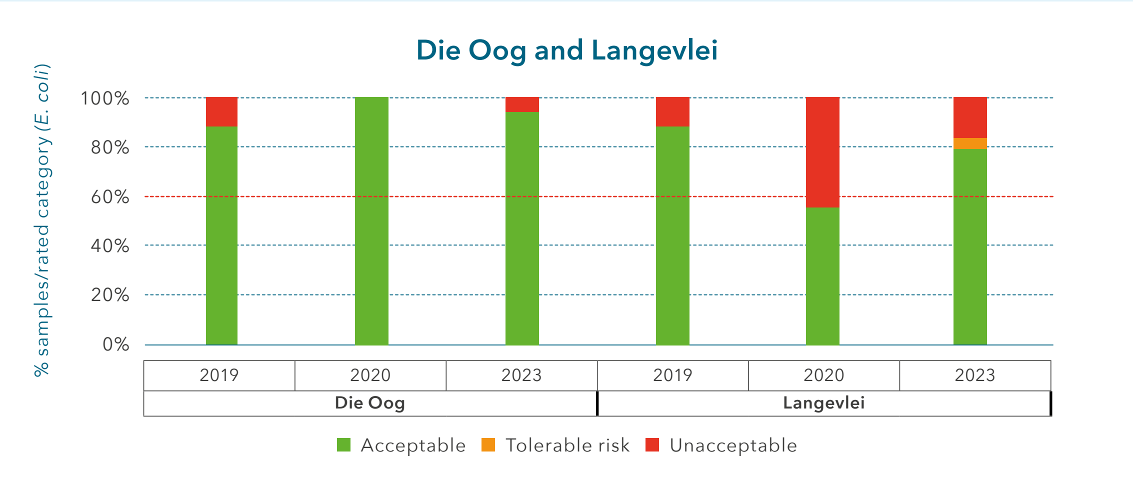




Thresholds for rated categories as defined in table 5.4. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing waterbodies').

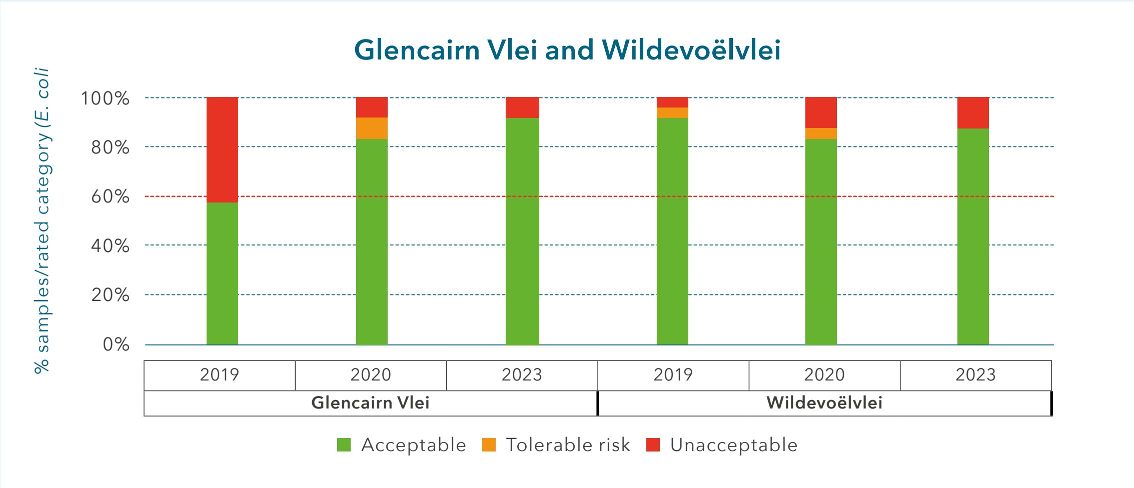
Figure 6.7: Percentage of *Escherichia coli* samples falling within each rated category for this variable (continued)

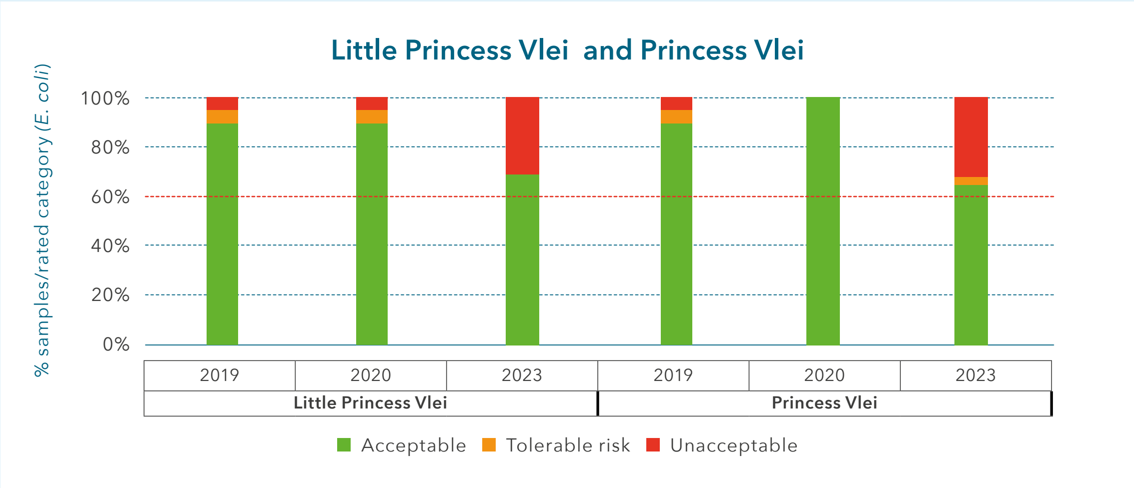




Thresholds for rated categories as defined in table 5.4. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing waterbodies').

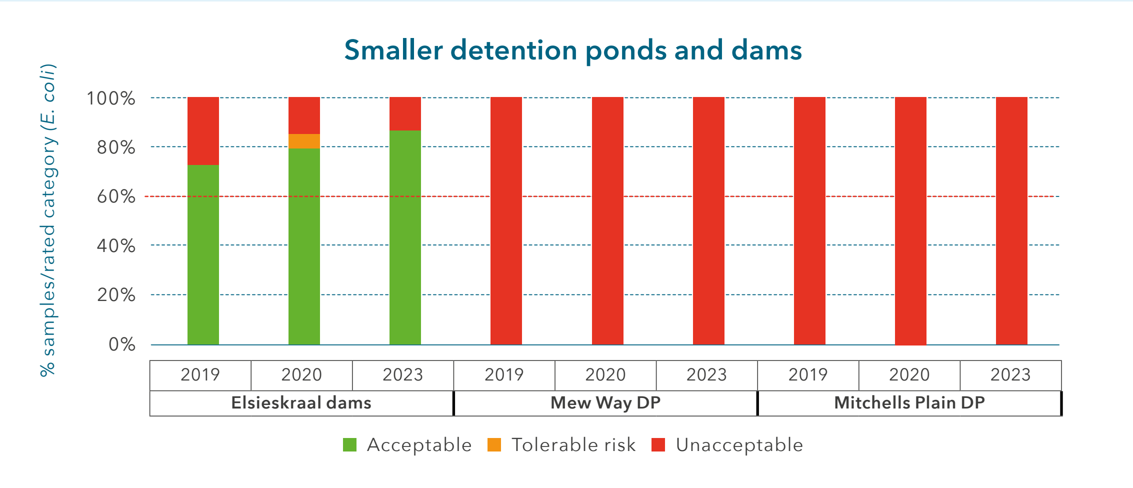
Figure 6.7: Percentage of *Escherichia coli* samples falling within each rated category for this variable (continued)

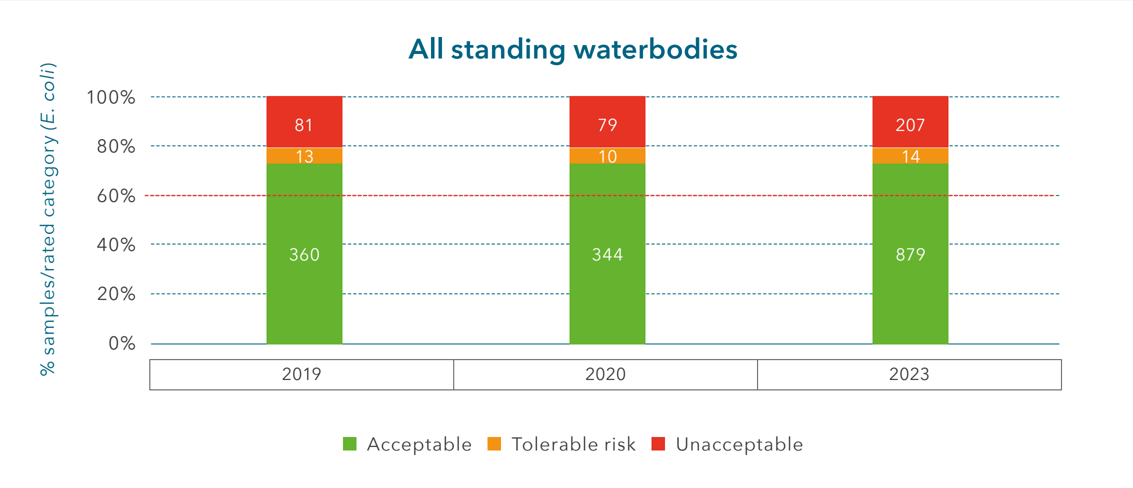




Thresholds for rated categories as defined in table 5.4. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing waterbodies').

Figure 6.7: Percentage of *Escherichia coli* samples falling within each rated category for this variable (continued)





Thresholds for rated categories as defined in table 5.4. Data for sample points in standing waterbodies/vleis and detention ponds. Total number of samples considered shown in bars in bottom right plot ('All standing waterbodies').

6.2.4. *Escherichia coli* data as indicator of risk to human health in the city's formal recreational waterbodies

The technical report focused on how polluted water in the city's main recreational water areas might affect people's health. It looked at the following main waterbodies:

- 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, 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.

6.2.5. Overview of *E. coli* data for individual recreational waterbodies

Summary *E. coli* compliance data (for all sites in each system) are shown in figure 6.8, while the maps in figures 6.9 and 6.10 show (geometric) mean annual data for individual monitoring sites in and near to each waterbody. These are colour-coded to show different levels of risk.

Drawing on these data, the technical report showed that:

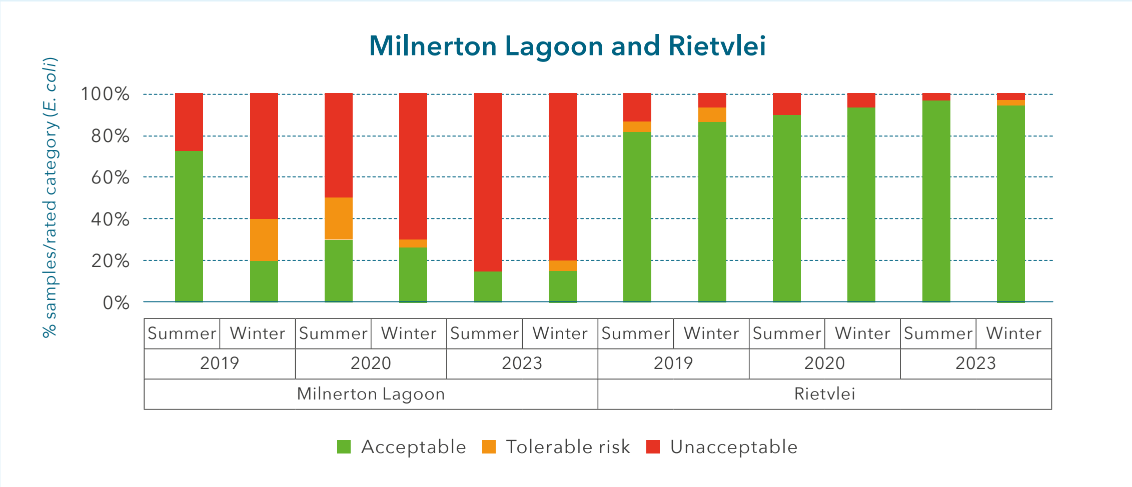
- **Milnerton Lagoon** experienced high levels of raw sewage inflows over all three reporting periods considered, with an increased frequency of estuarine samples rated as unacceptable over the 2023 period. *Escherichia coli* data for Potsdam WWTW do not suggest high bacterial populations in treated effluent from the WWTW, so it is assumed that the main source of *E. coli* comes from the catchment, including informal settlements in Dunoon, Doornbach, Jo Slovo, Phoenix and many other areas in the catchment, some of which entered Milnerton Lagoon via point-source inflows from the Erika Road stormwater outlet during and prior to the 2023 reporting period. The data in fact suggest near-continual inflows of polluted water over the 2023 reporting period, including from failed sewage pump stations.

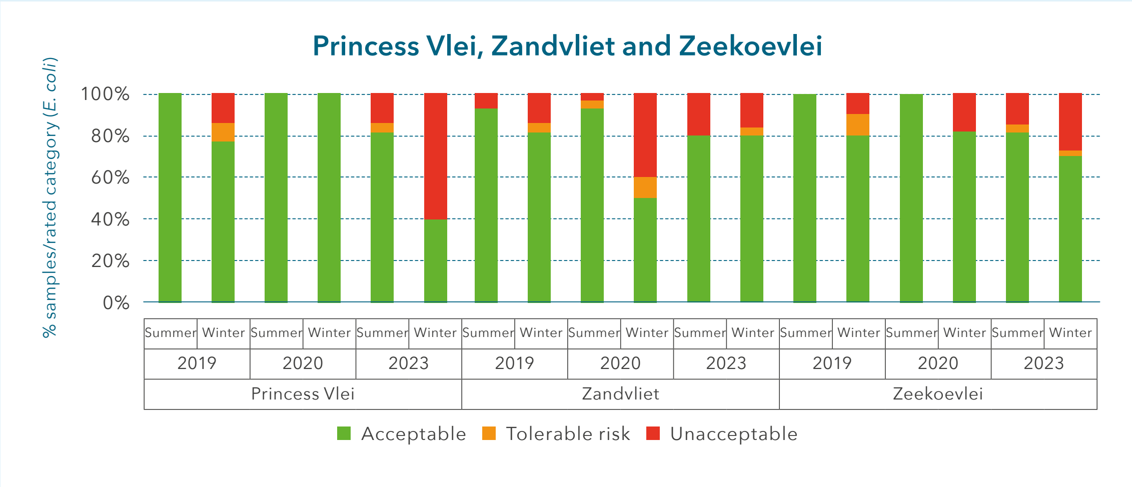
The technical report concludes that, for most of the 2023 reporting period, Milnerton Lagoon was not a safe waterbody for even intermediate-contact recreational use.

- Both **Princess Vlei** and **Zeekoevlei** were also exposed to more frequent raw sewage inflows during the 2023 reporting period than over previous periods (data showed that 45% and 25% of samples from these two vleis, respectively, were rated as unacceptable due to *E. coli* concentrations in winter 2023). They both showed substantial improvement during summer of the same reporting period.
- **Zandvlei** data showed that 15% and 20% of samples were rated as unacceptable over winter and summer respectively in the 2023 reporting period, with these data indicating a recreational system periodically threatened by sewage overflows. Pump stations such as the Raapenberg pump station, near Westlake, was reported as a frequent offender.
- **Rietvlei** appears to have provided a relatively low-risk environment to recreational users, at least from the perspective of exposure to raw sewage. Extended water detention time in the vlei and a generally cleaner catchment area, albeit still affected at times by overflows from pump stations and sewer manholes upstream, would have contributed to these results.

Generally, the data suggest that all of the city's recreational waterbodies periodically posed risks to human health during the 2023 reporting period, 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 risks to human health most of the time.

Figure 6.8: Percentage of *E. coli* samples falling within each rated category for this variable for each recreational waterbody





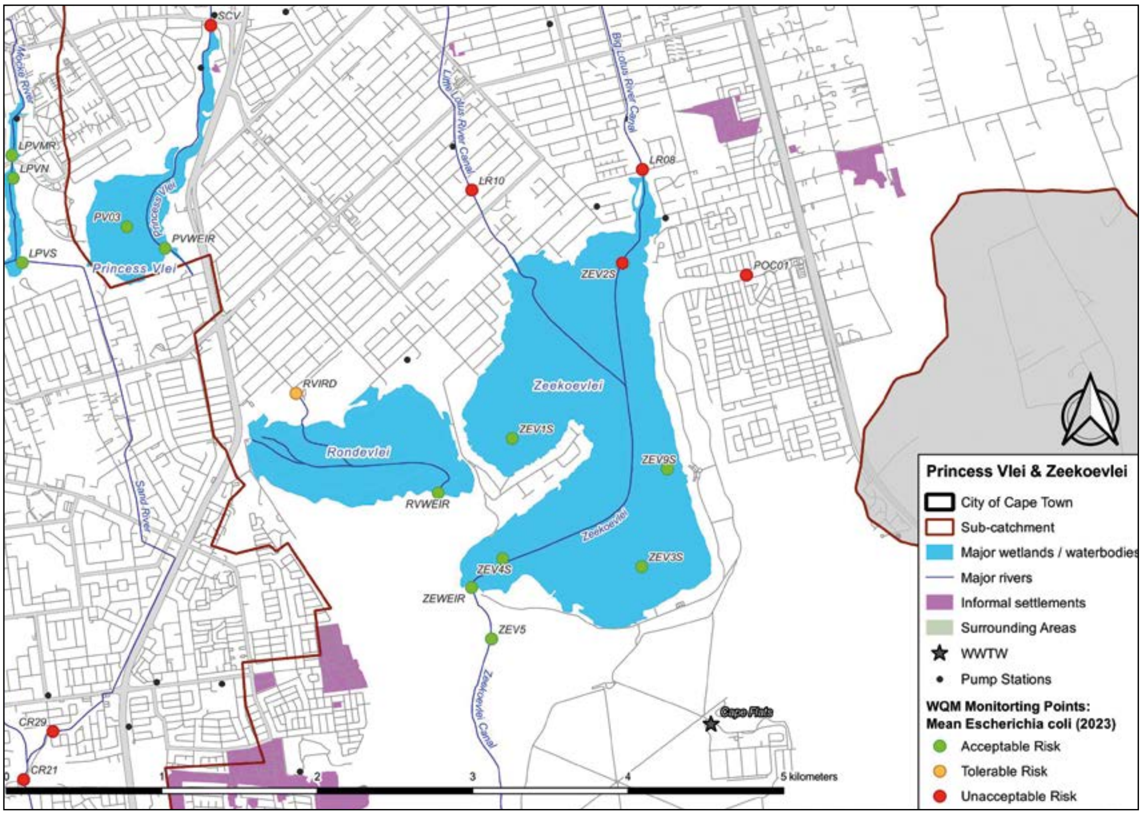
6.2.6. Overview of *E. coli* at individual sites in recreational waterbodies

The (geometric) mean annual *E. coli* concentrations plotted in maps in figures 6.9 and 6.10 illustrate 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). Nevertheless, the data shown in figure 6.8 show that there were times when raw sewage did pose a significant threat to vlei users.
- 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, highlighting the high level of risk associated with recreational use of this part of the vlei.
- 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 Keysers River inflows, near the railway line, and presumed to be impacted by road runoff and periodic sewage manhole overflows).
- Data for watercourses flowing into Zandvlei highlight generally less polluted water entering from the Westlake and Keysers River systems, but more problematic water inflows from the Langvlei and Sand River systems to the north, both of which flow through at least some areas in their lower catchments where there are high levels of solid waste on street and in canals, and where associated sewer blockages and other impacts are likely to be more frequent.
- Mean *E. coli* data for monitored sample points in Rietvlei were all rated as within target range – but the upstream catchment (Bayside channel) was clearly problematic and its mean *E. coli* concentrations were rated as unacceptable.
- **Sample points in Milnerton Lagoon were all rated as unacceptable, and continued as unacceptable upstream as far as Blaauwberg Bridge (RTV01)**, suggesting that the main sources of raw sewage stem from the catchment between Blaauwberg Road Bridge and Otto du Plessis Drive. Data for inflowing canals such as the Theo Marais canal (RTV12) illustrate high levels of raw sewage pollution, probably stemming mainly from overflows from the Koeberg pump station in this area, but also likely to reflect at least occasional overflows from the WWTW into this canal, prior to disinfection with chlorine at the WWTW outlet into the diversion channel upstream of the Theo Marais canal outlet.
- **Water quality was rated as of high risk (unacceptable) throughout the Milnerton Lagoon's reaches, including past the Milnerton Canoe Club, near Woodbridge Island (MCC).**

It is, however, reiterated that summary *E. coli* data are complicated, because in some cases the data include 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 significant sewage spills at times.

Figure 6.9: Colour-coded (geometric mean) annual *E. coli* data, focusing on Princess Vlei, Zeekoevlei and Zandvlei for the 2023 reporting period



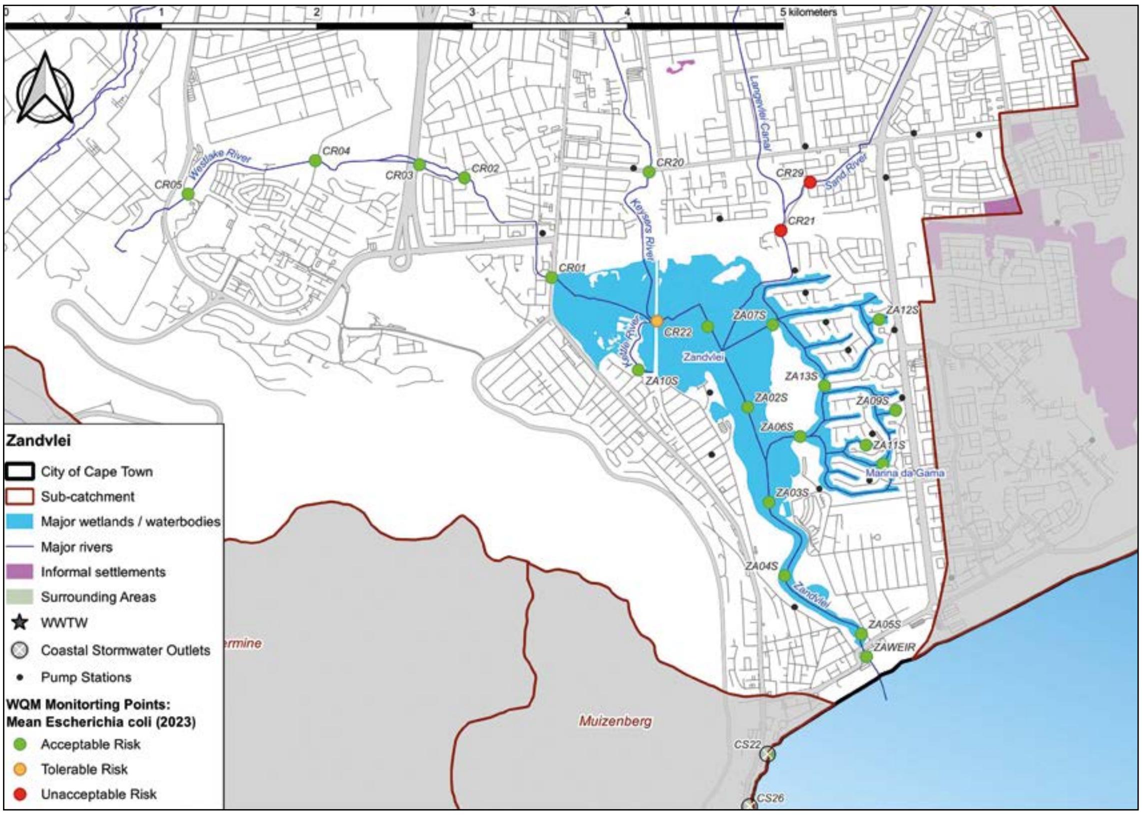
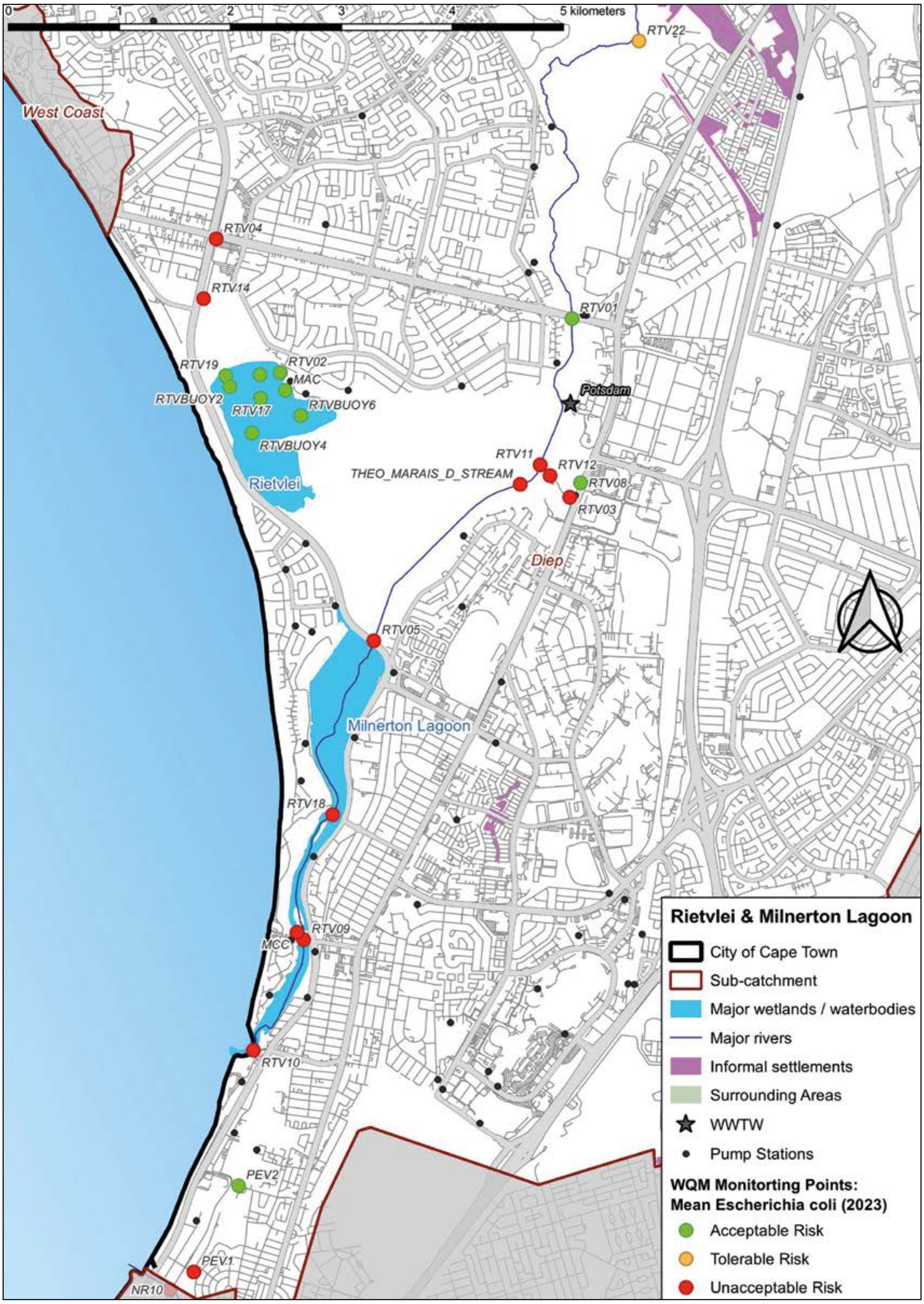

5 kilometers
Zandvlei
City of Cape Town
Sub-catchment
Major wetlands / waterbodies
Major rivers
Informal settlements
Surrounding Areas
WWTW
Coastal Stormwater Outlets
Pump Stations
WQM Monitorting Points:
Mean Escherichia coli (2023)
Acceptable Risk
Tolerable Risk
Unacceptable Risk
Westlake River
Keysers River
Langevlei Canal
Sand River
Zandvlei
Marina da Gama
Muizenberg
CR01
CR02
CR03
CR04
CR05
CR20
CR21
CR22
CR29
ZA02S
ZA03S
ZA04S
ZA05S
ZA06S
ZA07S
ZA09S
ZA10S
ZA11S
ZA12S
ZA13S
ZAWEIR
CS22
CS26

Figure 6.10: Colour-coded (geometric mean) annual *E. coli* data, focusing on Milnerton Lagoon and Rietvlei



6.3. Microcystin toxins from blue-green algae as a risk to human health

6.3.1. Where do microcystin toxins come from?

Cyanobacteria (or blue-green algae) are a common and naturally occurring component of most recreational water environments. They are of potential public health concern because some types may, under certain conditions, produce 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.

Blue-green algae – why the name?

Blue-green algae (also known as cyanobacteria) produce green surface scums under bloom conditions. The algal cells contain a blue pigment, which is mostly visible when algal cells, in bloom conditions, die and release the pigment into the water. This sometimes appears as if turquoise-coloured paint has been spilled into the waterbody.

The City defines a 'bloom' as when cyanobacterial algal cell counts exceed 20 000 cells/m or a visible algal slick is detected.

6.3.2. Microcystin toxin data

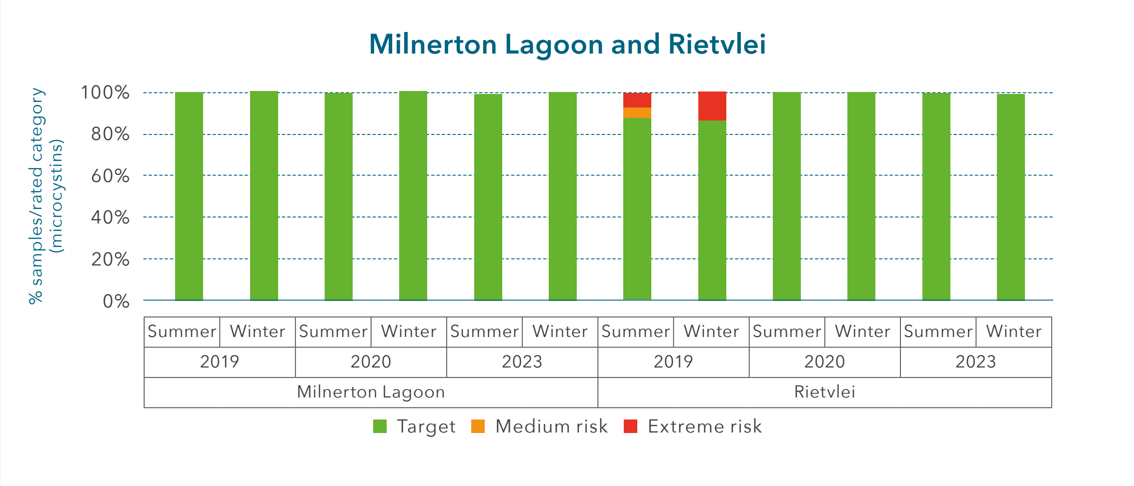
Figure 6.11 presents the results of analyses of water samples from Cape Town's recreational waterbodies for microcystin toxins.

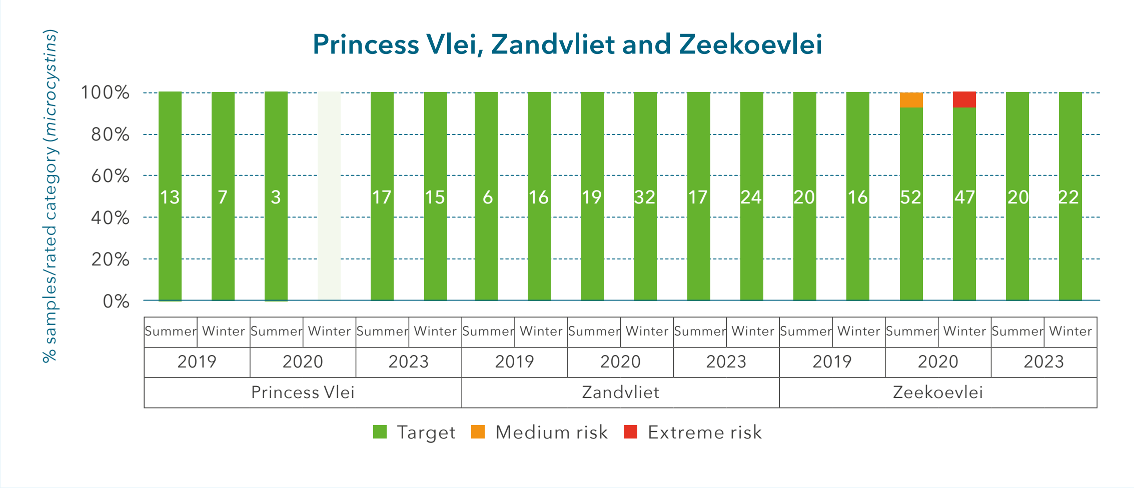
The data show that, although blue-green algal blooms were clearly present on numerous occasions over the 2022 and 2023 reporting periods covered in this report, the only vlei in which microcystin toxins were recorded at concentrations of concern was Zeekoevlei.

This means that, excluding Zeekoevlei's waters, and despite periodic blue-green algal blooms, Cape Town's recreational waterbodies were assumed to be relatively safe for human use over the 2022 and 2023 reporting periods, from the perspective of exposure during intermediate-contact use to microcystin toxins.

Three samples analysed from Zeekoevlei in the 2022 reporting period (two in summer and one in winter) showed microcystin concentrations rated as of medium risk (summer 2022) and extreme risk (winter 2022). This means that recreational users of Zeekoevlei could have been exposed to at least periodic risk of microcystin toxicity. The technical report did, however, note that blue-green algal blooms in Zeekoevlei did not occur as blooms over the whole vlei, but generally comprised isolated blooms, usually confined to sheltered parts of the vlei.

Figure 6.11: Percentage of microcystin samples falling within each rated category for this variable, per recreational vlei





Thresholds for rated categories as defined in table 5.4.

In summary:

- All five of the city's recreational waterbodies have been impacted by high levels of phosphorus enrichment, likely to promote high levels of plant productivity, which in some cases result in algal blooms, some of which are associated with microcystin toxins:
  - Although blue-green algal blooms were clearly present on numerous occasions over the 2022 and 2023 reporting periods, the only vlei in which microcystin toxins were recorded at concentrations of concern was Zeekoevlei.
  - This means that, excluding Zeekoevlei's waters, and despite periodic blue-green algal blooms, Cape Town's monitored recreational waterbodies were assumed to be relatively safe for human use over the 2022 and 2023 reporting periods, from the perspective of exposure during intermediate-contact use to microcystin toxins in water from these systems.
  - Of all of the city's recreational vleis, Zeekoevlei was most affected by algal blooms over the 2022 and 2023 reporting periods, reflecting ongoing nutrient enrichment of this vlei from external sources, exacerbated by the build-up of organic sediments within the vlei, which provide an ongoing source of additional phosphate nutrients, facilitated by low dissolved oxygen availability.

Not included in the assessed recreational waterbodies, due to a lack of water quality data, is a backwater area of the Kuils River in Khayelitsha, from where the Khayelitsha Canoe Club operates. The club's operations are hampered by ongoing land invasion into the wetland park as well as by invasion of open waterbodies by water hyacinth, and poor water quality.

The technical report recommended that the City create an additional routine monitoring point in the reaches of the Kuils River that are used by the canoe club, to provide some information about potential health risks from exposure, at least at times, to polluted waters. This would allow risk mitigation.

Kayaking at the Khayelitsha Canoe Club. Photo: City of Cape Town

7. WATER QUALITY IN THE CITY'S PRIORITY CATCHMENTS

7.1. Cape Town's priority subcatchments

While water quality is recognised as a concern in many of Cape Town's catchments, seven have been identified by the City as particularly problematic. These have been prioritised 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 catchments/subcatchments are:

- The Lower Diep River subcatchment (upstream of Milnerton Lagoon): central and northern stormwater management regions
- The Sir Lowry's Pass and Soet River subcatchments: eastern stormwater management region
- The Lower Salt River subcatchment: northern and central stormwater management regions
- The Kuils and Eerste River subcatchments: eastern stormwater management region
- The Hout Bay River subcatchment: southern stormwater management region
- The Big and Little Lotus Rivers (within the Zeekoe subcatchment): southern stormwater management region
- The Sand catchment (upstream of Zandvlei): southern stormwater management region

The above priority subcatchments 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.

Section 8 of the technical report describes and discusses the main causes and implications of water quality issues in each of the listed priority catchments, and outlines any actual or planned interventions by the City to address these, as well as the major challenges faced in implementing the interventions.

The report also maps changes in various water quality characteristics at different monitoring points across the subcatchment over time, using colour codes to show condition and trajectory of change.

In this summary report, the *E. coli* maps for each priority catchment are presented, together with the key recommendations made for each catchment in the technical report. The photographs below illustrate some of the pressing problems in these areas, which need to form the focus for City management interventions.

Theo Marais channel downstream of inflows from the Koeberg pump station (March 2024).

7.2. Key issues in priority catchments

During discussions informing the technical report, the City's Stormwater Planning Region Management teams identified the following key issues, common to all of these areas:

- Water quality issues in rivers and wetlands are mainly caused by solid waste and sewage from informal settlements, poorly serviced high-density settlements, stormwater flows, sewage pump station overflows, and failed sewer lines.
- Catchment managers are accountable for polluted watercourses, but often powerless to change systems controlled by other City departments and/or branches.
- Pump station failures, inadequate pump capacity and lengthy upgrade processes contribute to continued pollution in important watercourses such as the Diep River and Milnerton Lagoon.
- The Big Lotus River, Zeekoevlei, the Mosselbank River (downstream of Bloekombos settlement), the Diep River and the lower Kuils/Eerste rivers and their wetlands are all examples of watercourses at the mercy of expanding, largely unserviced urban informal settlements beyond the mandate or resources of CSRM to manage.
- Crime, vandalism, extortion and highly polluted unsafe watercourses hinder sewage overflow responses and pollution mitigation efforts.
- The City's attention in recent years has been on areas for which it has received directives or pre-directives from DEA&DP 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 are unmanaged (e.g. Bloekombos, Wallacedene areas of the Mosselbank and Kuils River subcatchments respectively).

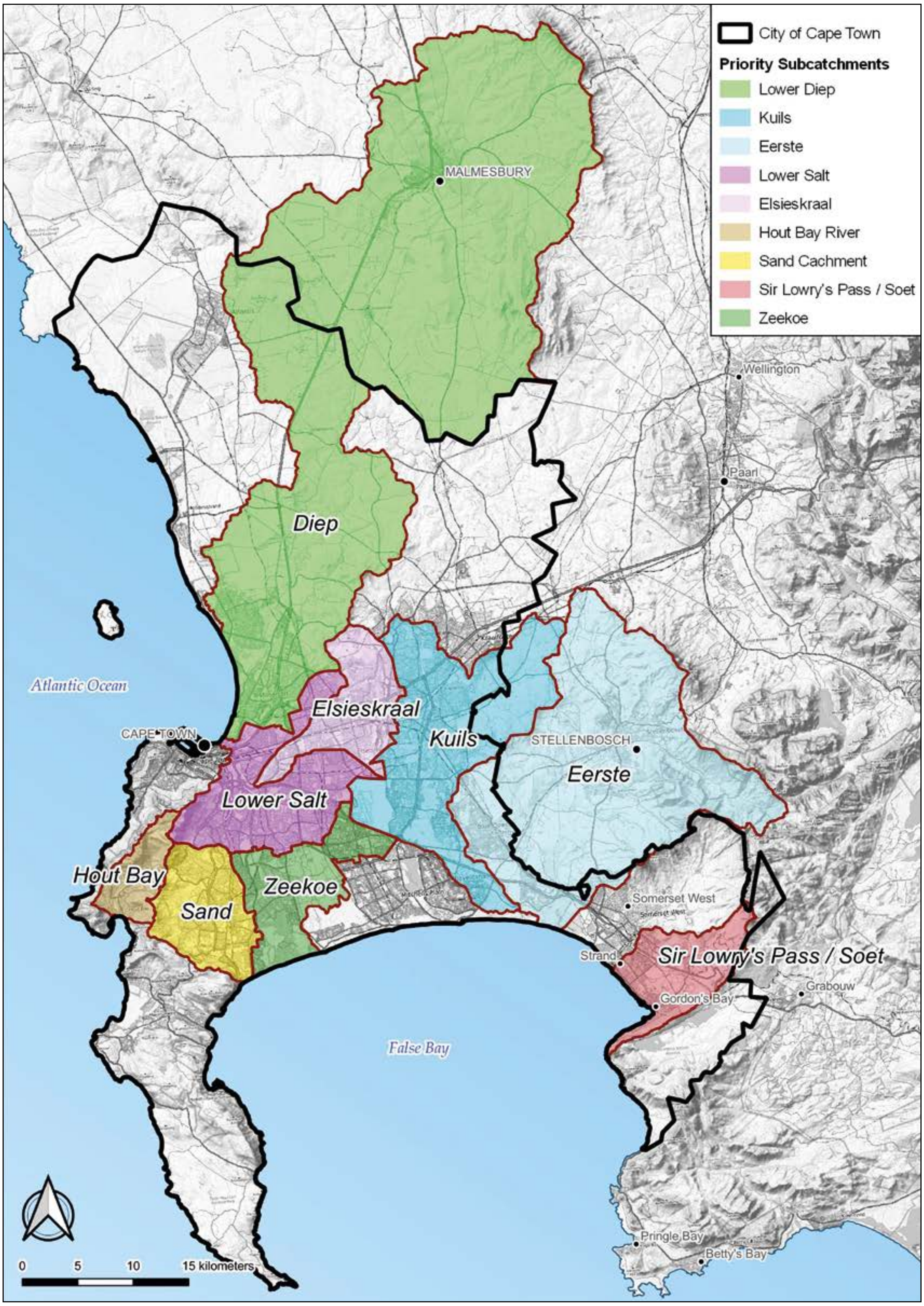
Informal settlement in Dunoon on the Diep River floodplain – following June 2023 floods. (Photo: Ms C Marx: "Rethink the Stink")

Informal housing built right over the edge of the Jakkalsvlei canal, along the N2 past Langa.

Accumulation of solid waste in the Bokmakierie canal just upstream of the Black River confluence, despite the City's attempts to reduce access for dumping with fences.

Polluted water in the Soet River canal.

Figure 7.1: The City's priority subcatchments



7.3. Mapped *Escherichia coli* data results and key recommendations for each priority catchment

The technical report provides detailed descriptions of each priority catchment; their key water quality issues and challenges; measures implemented or planned by the City to address these; the main challenges faced in implementing such interventions; and recommendations to consider going forward to improve intervention outcomes.

Readers with an interest in any of the priority catchments should consult section 8 of the technical report for these details.

This section of the summary report focuses on *E. coli* data as one of the key indicators of sewage pollution in waterbodies. It also presents the main recommendations made in the technical report for each priority area.

7.3.1. Diep River subcatchment

Figure 7.2 maps *E. coli* data for samples collected within this priority subcatchment during the 2023 reporting period, as an indicator of health risks to people engaged in intermediate-contact recreational activities only. Colour coding of (geometric) mean annual data for each sample point within the subcatchment allows interpretation of the level of risk that would have been associated with the use of different sections of the subcatchment for intermediate-contact recreational purposes.

To address water quality issues in this priority subcatchment, the technical report recommended prioritisation of:

- Upgrades to Potsdam WWTW (and fast-tracking where possible);
- Interventions to reduce delays in repairs of sewerage infrastructure;
- Diversion of the Kleine Stink River from the Dunoon and Doornbach informal settlements on the Diep River floodplain;
- Defence of remaining areas of the Diep River floodplain that have not been settled on; and
- Innovative measures to address crime and security that impact on service delivery and water quality.

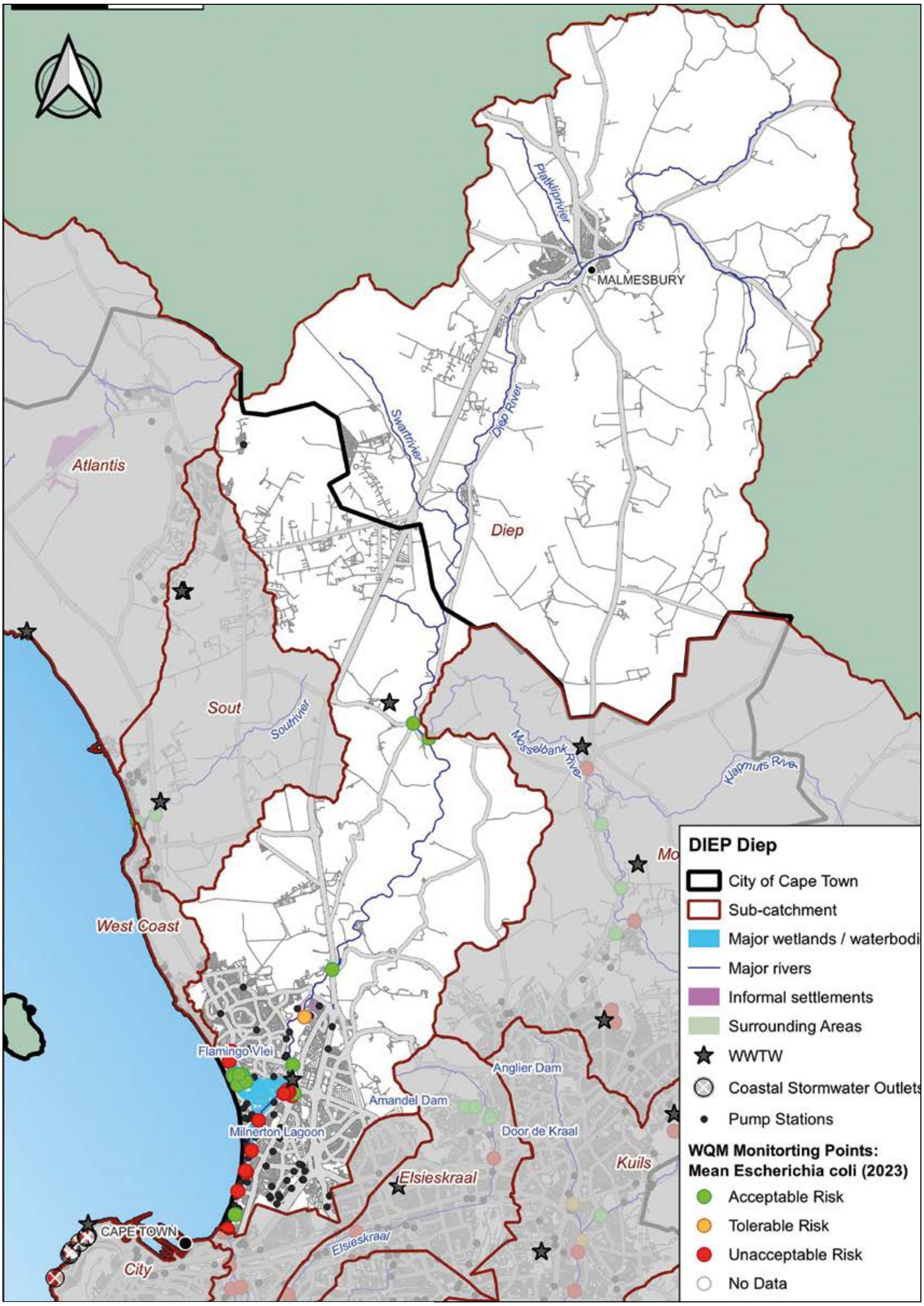
7.3.2. Soet River subcatchment

This priority area is impacted by extensive informal settlements with high levels of solid waste and highly polluted runoff. Figure 7.3 maps *E. coli* data for samples collected within this priority subcatchment during the 2023 reporting period, as an indicator of health risks to people engaged in intermediate-contact recreational activities. Again, colour coding of (geometric) mean annual data for each sample point within the subcatchment allows interpretation of the level of risk that would have been associated with the use of different sections of the subcatchment for intermediate-contact recreational purposes.

The technical report noted that most of the interventions proposed in the Pollution Abatement Strategy and Action Plan (PASAP) for the subcatchment are long term and vague, and are unlikely to achieve actual pollution abatement in the near future. The main recommendations put forward in the technical report were:

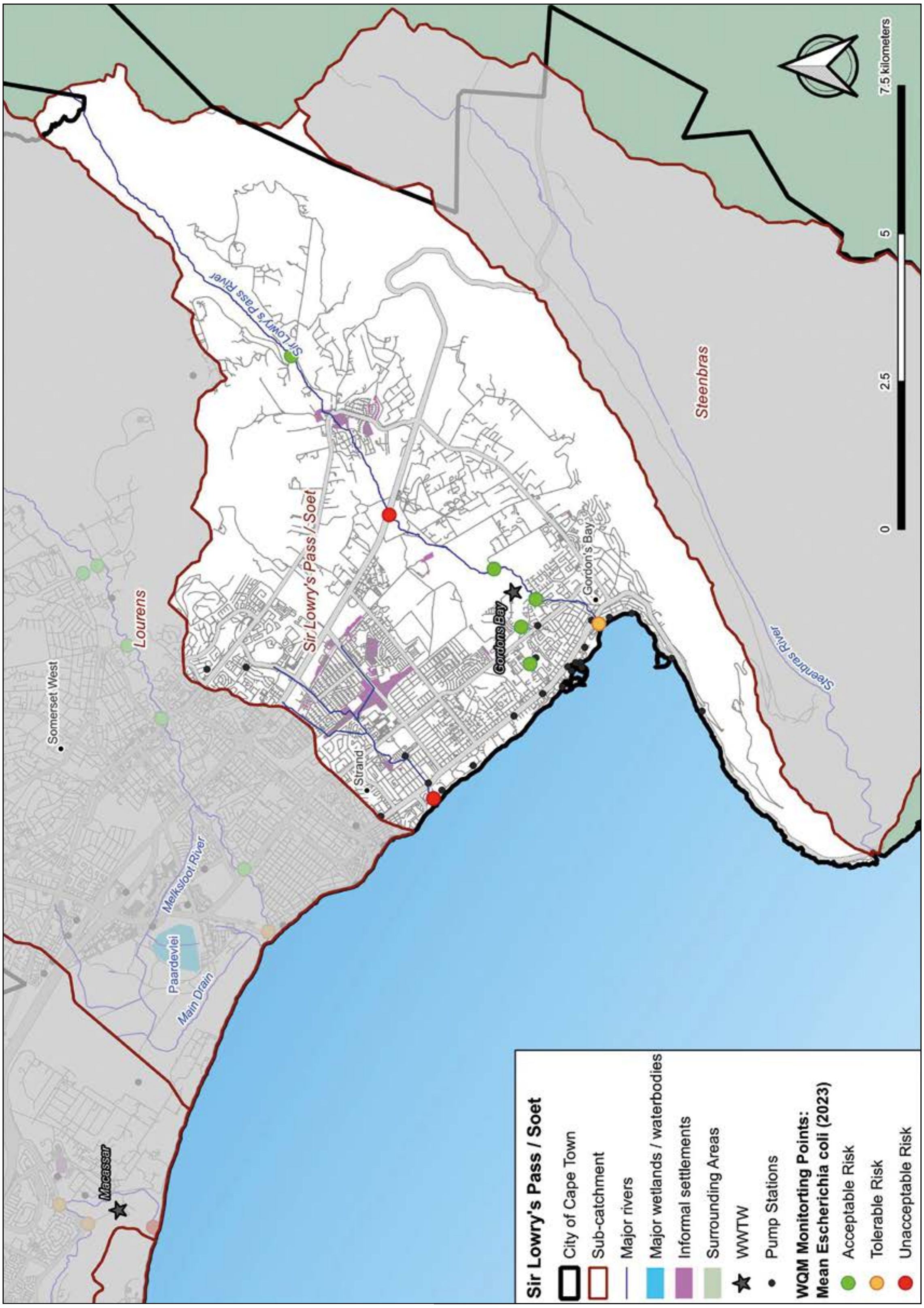
- Fast-tracking of measures such as diversions of polluted low flows to sewers and trailing of water quality remediation devices such as nano-bubblers and other specific measures; and
- Paying specific attention to the maintenance of the Asanda Wetland Park to ensure that this project remains a City and community asset.

Figure 7.2: Mean *E. coli* data (geometric means), focusing on the Diep subcatchment



Data coded as to human health risk (see table 5.3).

Figure 7.3: Mean *E. coli* data (geometric means), focusing on the Soet subcatchment



Data coded as to human health risk (see table 5.3).

7.3.3. Lower Salt River subcatchment

Summary *E. coli* data for samples collected within this priority subcatchment during the 2023 reporting period are mapped in figure 7.4 as an indicator of health risks to people engaged in intermediate-contact recreational activities only. Colour coding of (geometric) mean annual data for each sample point within the subcatchment allows interpretation of the level of risk that would have been associated with the use of different sections of the subcatchment for intermediate-contact recreational purposes.

The technical report noted that Citywide budget cuts were a major impediment to implementing measures in this subcatchment that would have measurable impacts on water quality. The following recommendations were made:

- A practical strategy and associated plan must be formulated, which specifically allows for the different stormwater regional managers for this subcatchment to work together meaningfully; and
- The Liesbeek River system was highlighted as a river system in better condition than many other in the city, and which could benefit from implementing sustainable urban drainage (SUD) treatment interventions in developing and developed parts of its catchment. Such interventions would at least maintain relatively good water quality in this portion of the subcatchment.

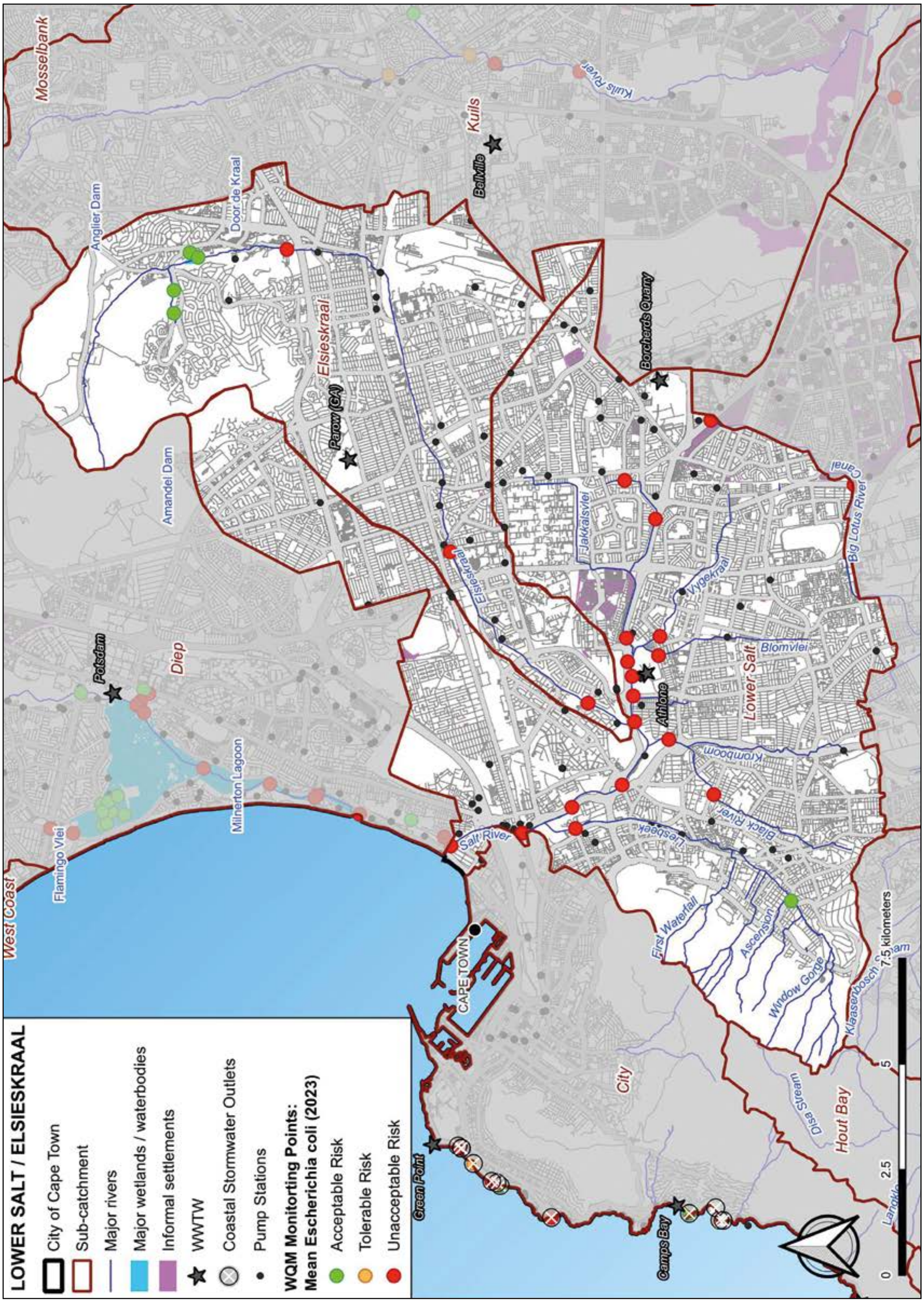
7.3.4. Kuils/Eerste River subcatchment

This large priority catchment includes the Kuils River subcatchment and the downstream portion of the Eerste River subcatchment. Figure 7.5 maps *E. coli* data for samples collected within this priority subcatchment during the 2023 reporting period as an indicator of health risks to people engaged in intermediate-contact recreational activities only. Again, colour coding of (geometric) mean annual data for each sample point within the subcatchment allows interpretation of the level of risk that would have been associated with the use of different sections of the subcatchment for intermediate-contact recreational purposes.

The main recommendations of the technical report were for the urgent compilation of a strategy for pollution abatement, accompanied by a practical action plan, which should allow for:

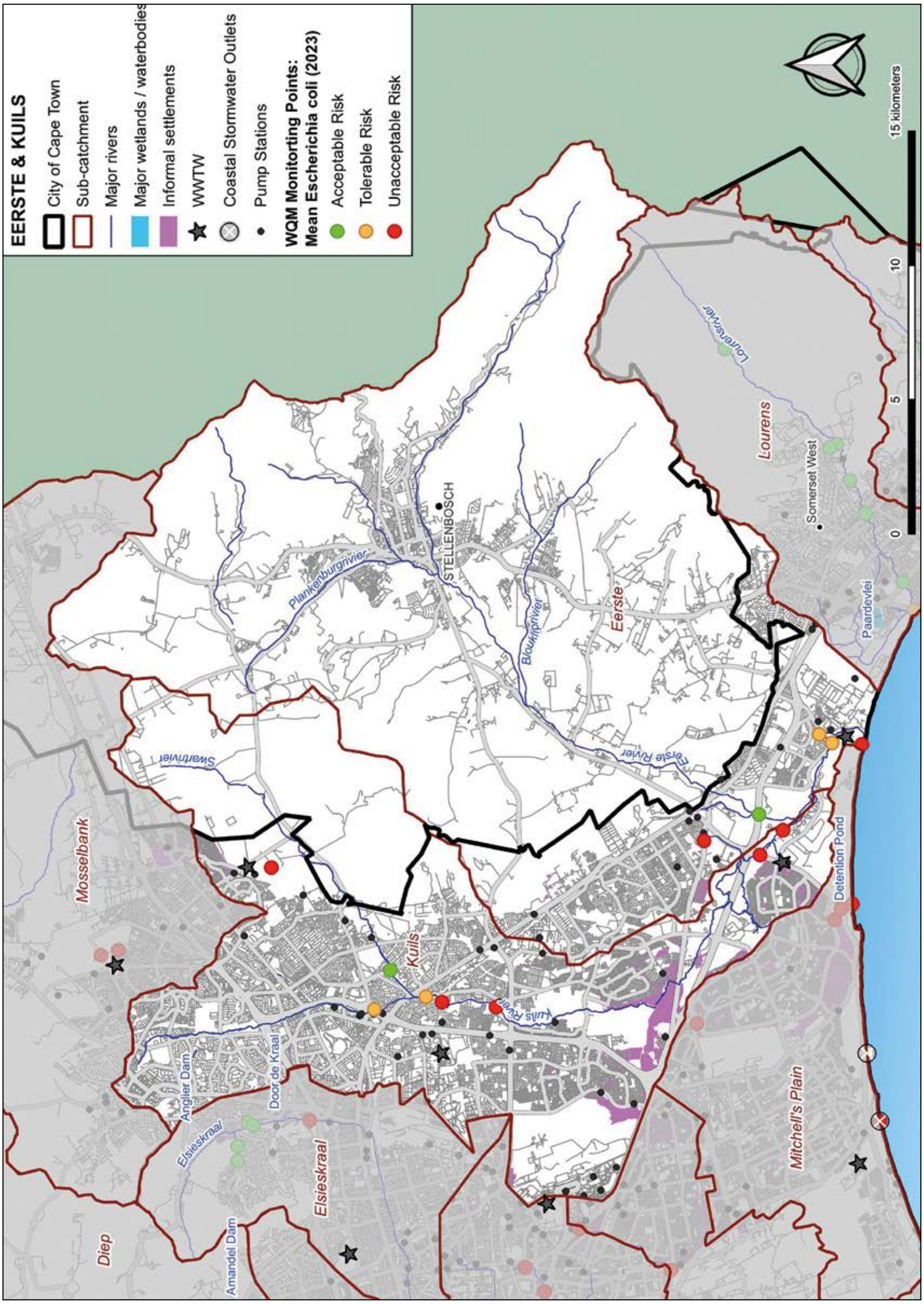
- A sustained and measurable increase in solid waste collection;
- Pollution tracking within new and existing high-density housing areas to identify pollution streams and sources and guide repairs, maintenance and other interventions (e.g. diversions of polluted stormwater to sewers);
- Urgent implementation of interventions to provide sewage and stormwater servicing to rapidly expanding informal and backyard settlements in the area;
- Measures to minimise sewage pump station failures related to load-shedding and electrical faults; and
- Prioritisation of upgrades of the Scottsdene, Bellville and Macassar WWTW to improve final effluent quality.

Figure 7.4: Mean *E. coli* data (geometric means), focusing on the Lower Salt subcatchment



Data coded as to human health risk (see table 5.3).

Figure 7.5: Mean *E. coli* data (geometric means), focusing on the Kuils and Eerste subcatchments



Data coded as to human health risk (see table 5.3).

7.3.5. Hout Bay River subcatchment

Summary *E. coli* data for samples collected within this priority subcatchment during the 2023 reporting period are mapped in figure 7.6 as an indicator of health risks to people engaged in intermediate-contact recreational activities only. Colour coding of (geometric) mean annual data for each sample point within the subcatchment allows interpretation of the level of risk that would have been associated with the use of different sections of the subcatchment for intermediate-contact recreational purposes.

It was noted in the technical report that 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 were 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;
- 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 implementation of measures to address the current issues hampering the more frequent collection of solid waste from Imizamo Yethu; and
- Increased attention on 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.

7.3.6. Sand River subcatchment

The Sand subcatchment was added to the priority catchment areas during compilation of the 2023 Water Quality Inland Report at the recommendation of CSRM, supported by the consultant team, mainly because it is the focal catchment for the pilot phase of the LUW Programme. Figure 7.7 maps *E. coli* data for samples collected within this priority subcatchment during the 2023 reporting period, as an indicator of health risks to people engaged in intermediate-contact recreational activities only. Again, colour coding of (geometric) mean annual data for each sample point within the subcatchment allows interpretation of the level of risk that would have been associated with the use of different sections of the subcatchment for intermediate-contact recreational purposes.

The following recommendations were made in the technical report 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 prototype, and thus facilitating the ongoing attention to the repairs to and upgrades of sewer infrastructure in this catchment;
- Proactive lining and clearing of sewer pipes in the catchment are supported and should continue as required;
- The Sand catchment should be formally listed among the MMP's priority subcatchments so that it can benefit from assignment of budget to ongoing sewer upgrades and repairs even during the current City budget cuts. This is important, as Zandvlei is the only one of the city's recreational waterbodies that has seen some improvement in ecological condition over the past five years, but is vulnerable to rapid deterioration if pollution is not addressed on an ongoing and accelerating basis;
- 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 Langevlei 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 planned, should be implemented as a priority action in this catchment as this should help to lower nutrient levels (especially phosphate 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 forward. This means that the City should engage with landowners, particularly in agriculture and with 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 Keysers River systems and their upstream reaches in particular;
- The City should continue to actively engage with the recently re-established Sand River Subcatchment Forum, to understand where the most urgent problem areas are and to formulate solutions together; and
- Finally, it is strongly recommended that the City should re-evaluate the cut in LUW budget to allow implementation of the five pilot projects planned in the Sand subcatchment, if this programme is to gain the traction that it requires by acting at scale, at a catchment level.

7.3.7. Big and Little Lotus River subcatchments

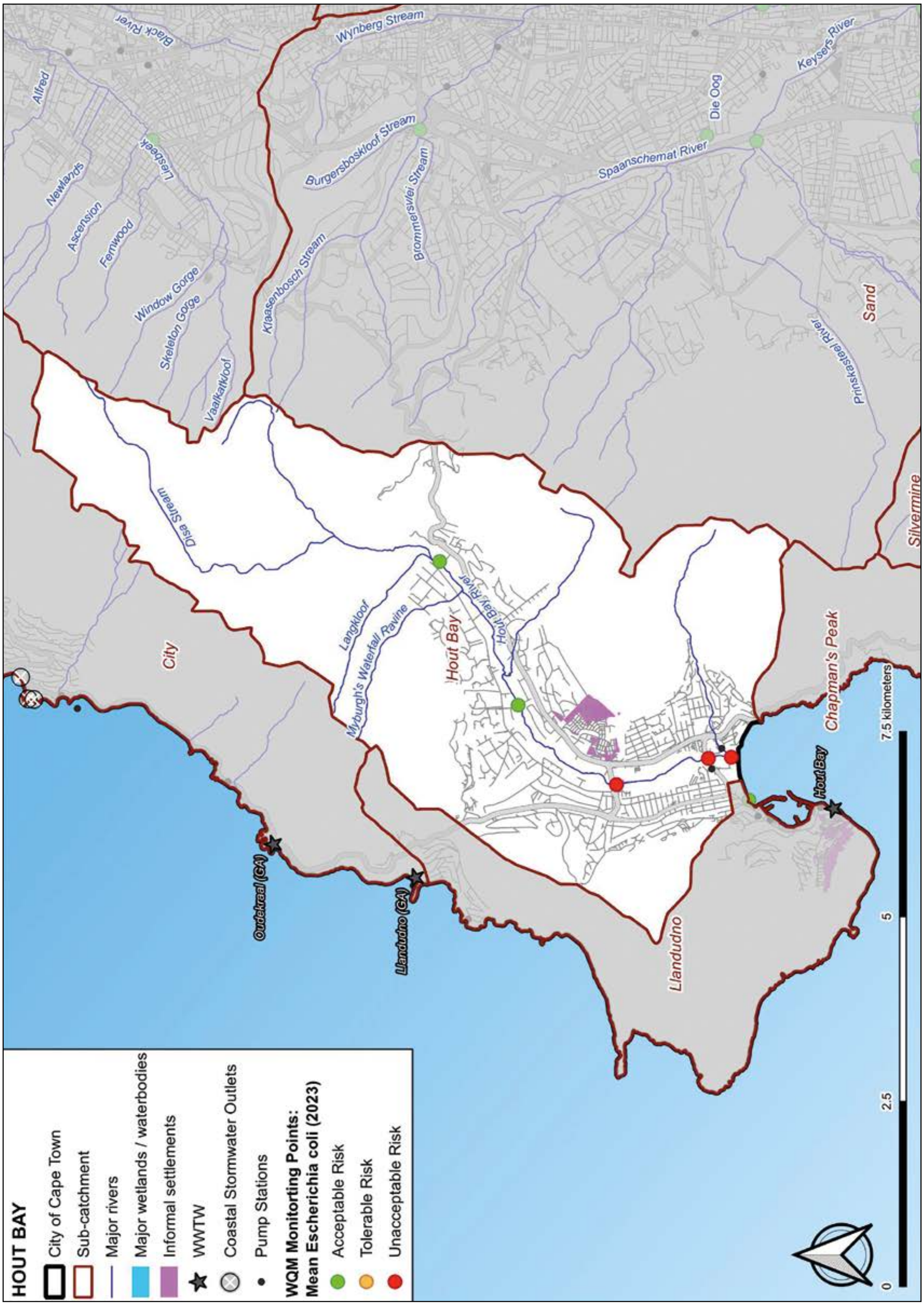
The Big and Little Lotus rivers are the main sources of surface flow into Zeekoevlei and the False Bay Nature Reserve (FBNR). Figure 7.8 maps *E. coli* data for samples collected within this priority subcatchment during the 2023 reporting period, as an indicator of health risks to people engaged in intermediate-contact recreational activities only. Colour coding of (geometric) mean annual data for each sample point within the subcatchment again allows interpretation of the level of risk that would have been associated with the use of different sections of the subcatchment for intermediate-contact recreational purposes.

The technical report notes that faecal 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 on important downstream inland aquatic ecosystems (Zeekoevlei). In this context, the following measures, which require cooperative buy-in across multiple City departments and branches, should be focused on by the City 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:

- Significantly increased focus on the frequency and volume of removal of solid waste at source – this requires innovative thinking around how to address the broader issues of safety and security of City workers, within a context of gangsterism and general criminality in many areas;
- Attention to addressing existing known effluent discharges into the Big Lotus canal, by diversion into sewers, or alternative re-routing of currently piped sections of the river away from significant sewage inflow areas, to allow for diversion of concentrated black- and greywater flows into sewers without dilution from river flows;
- A focus on interventions to provide 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 – progress in this regard should be reported on to the FBNR PAAC on an ongoing basis, against the total number of pump stations to be addressed in the subcatchment;
- Since mechanical and electrical failure appear to be the main reasons for pump station failure/ sewage overflows in the Zeekoe subcatchment, it seems reasonable that proactive maintenance attention should be paid to addressing the most persistently poorly performing pump stations;
- Implementation of the City's existing plans for upgrading of the Cape Flats WWTW and ongoing rehabilitation and upgrading of the sewers in the catchment;

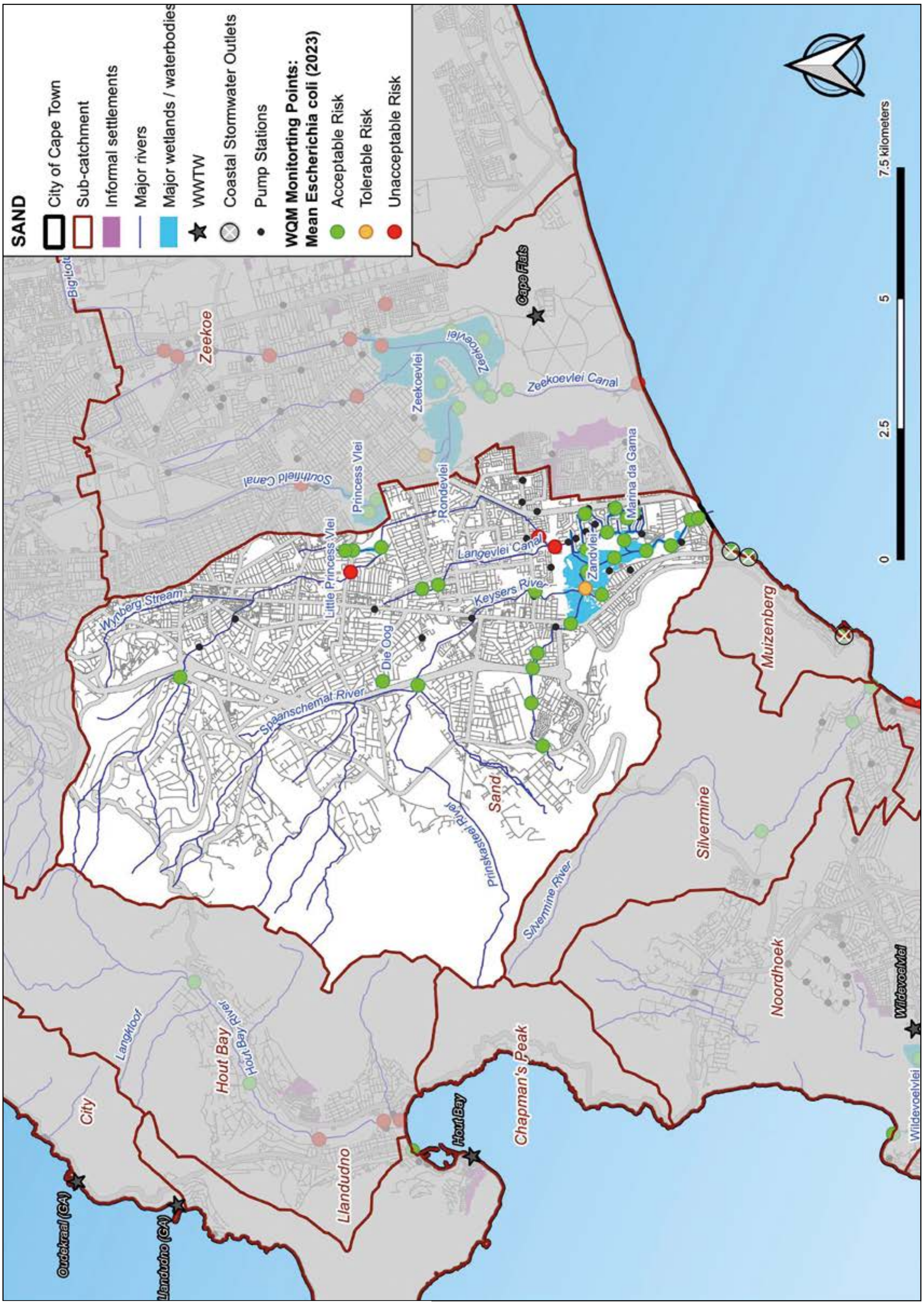
- A change in the City's regional structure, so as to align with hydrological (major river) catchments, rather than with the current stormwater management regions and sewage reticulation management regions, which do not relate to surface runoff and do not facilitate strategic pollution abatement at a catchment level, since different managers have responsibility for different parts of the catchment;
- As recommended in the previous Inland Water Quality Report, it is also noted that there are no routine monitoring points between the N2 and Govan Mbeki Road downstream of Jakes Gerwel Drive. This means that point-source pollutants between these points cannot be identified without focused pollution tracking. Additional routine monitoring sites within this pollution hotspot should be included to assist in pollution tracking, and pollution tracking itself should be followed up by active interventions to address identified pollution sources.

Figure 7.6: Mean *E. coli* data (geometric means), focusing on the Hout Bay subcatchment



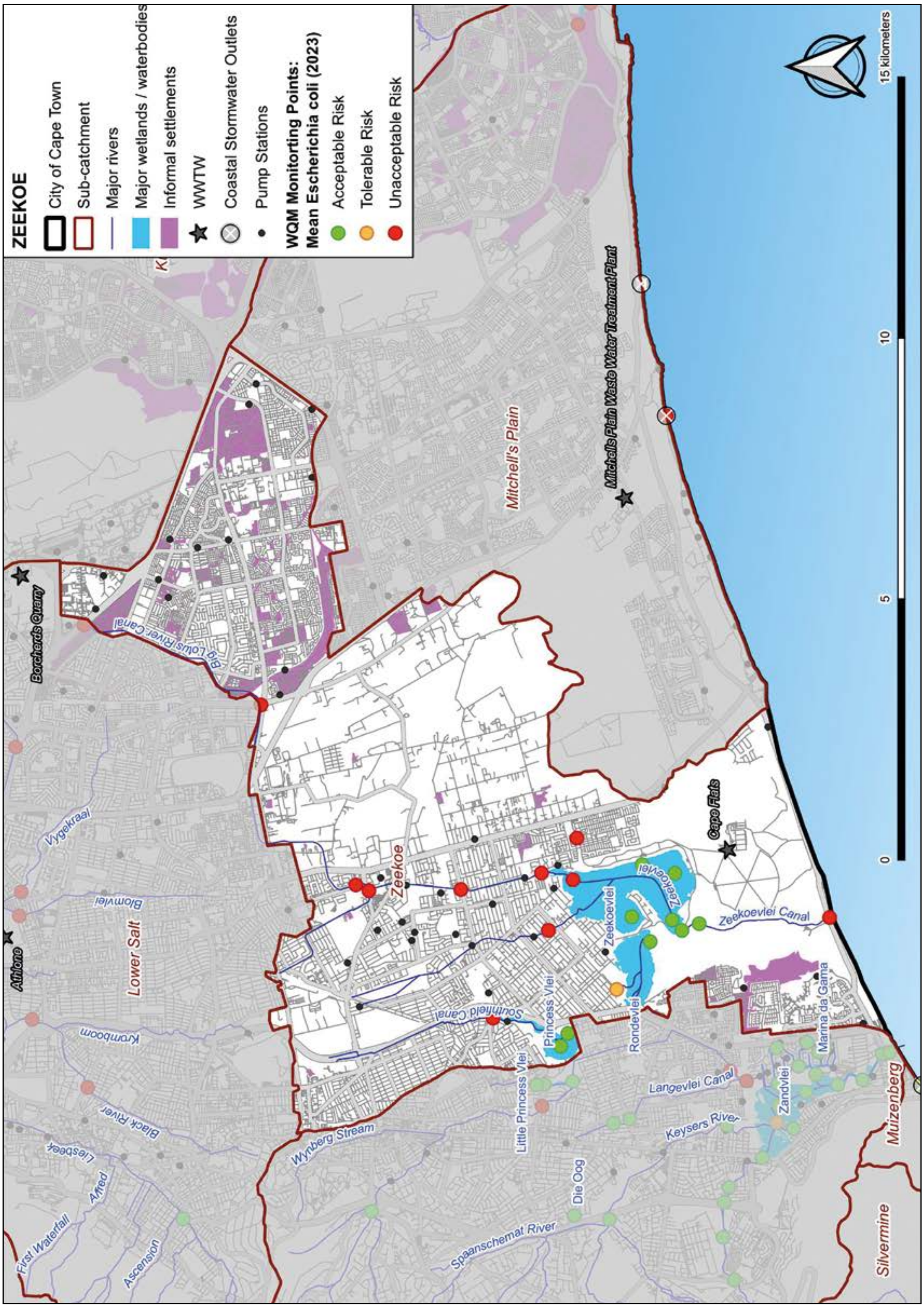
Data coded as to human health risk (see table 5.3).

Figure 7.7: Mean *E. coli* data (geometric means), focusing on the Sand subcatchment



Data coded as to human health risk (see table 5.3).

Figure 7.8: Mean *E. coli data* (geometric means), focusing on the Big and Little Lotus rivers in the Zeekoe subcatchment



Data coded as to human health risk (see table 5.3).

7.4. Key take-away points

The following key points emerged from the above discussions:

- 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 sustainable drainage system (SUD) principles and other stormwater quality polishing/improvement approaches are unlikely to be effective. Of the seven priority catchments, the Sand is the least impacted by informal and backyard settlement.
- 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 subcatchments, which are the Silvermine River, Lourens River and South Peninsula subcatchments and the Liesbeek River and its tributaries within the Lower Salt subcatchment.
- The accumulation of solid waste is also rife in many areas of the city, particularly in low-income areas. This waste passes readily into stormwater systems, from where it is costly to remove. It also blocks or is used to block sewers and pump stations, resulting in added watercourse pollution. Addressing this issue through significantly ramped-up solid waste collection and devising innovative ways to address dumping of solid waste and criminality in areas that impact on service delivery are all essential.
- Halting of the planned implementation of four of six of Liveable Urban Water Projects, all within the Sand catchment (see section 9) is a highly problematic decision by the City. In this less-polluted catchment in particular, implementation of the projects might well have given rise to measurable water quality (and other) improvements, as a result of catchment-scale interventions, carried out in combination with pollution abatement strategies such as sewer and pump station upgrades and repairs.
- The City's current 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 difficult, and accountability for catchment condition unwieldly.
- Similarly, sewage 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 coordination with upstream managers, or different strategies and level of effort in different areas.

7.5. What of non-priority catchment areas?

The technical report stressed that implementing effective catchment management measures that prevent pollution of the city's waterways and downstream receiving environments is as important in non-priority catchments as it is in priority catchments.

The priority catchments addressed in this report include, with the exception of the Sand subcatchment, most of the worst-performing, most problematic catchments in the city of Cape Town. Inclusion of the Sir Lowry's Pass River catchment as an additional priority catchment is, however, strongly recommended. 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 N2, the City has commenced with a major river works project (the Sir Lowry's Pass River realignment). This will result in channelisation of the river to provide space for floodplain development. If water quality problems from upstream persist, the required ecological mitigation measures that made this project ecologically acceptable will not be realised.

The remaining non-priority subcatchments 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. Attention should be paid to any noted deterioration in water quality in these subcatchments. This should allow timeous interventions to small-scale problems before they become unmanageable. Such approaches would benefit from close cooperation between the City and local residents, Friends groups, and other organisations.

The relatively unpolluted Else River at Glencairn in the South Peninsula subcatchment. Photo: City of Cape Town

8. THE CITY'S APPROACH TO ADDRESSING WATER QUALITY ISSUES

8.1. The City's Water Strategy

The City's 2020 Water Strategy commits the City to transition 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 its diverse water resources to improve resilience, competitiveness, and liveability for the prosperity of its people. The strategy recognised that achieving the 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.

Achieving and maintaining water quality that is fit for use is a critical part of achieving the City's vision, where 'users' include domestic, industrial, agricultural and ecological uses, managed in a sustainable manner.

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 all measures that are recognised by the City as critical early milestones on its path to a water-sensitive city.

8.2. Programmes to improve water quality in Cape Town's watercourses

A number of programmes have been developed and prioritised within the City in order to try to address the pervasive issues of poor and deteriorating water quality in the city. These programmes are explored in more detail in the technical report (section 7) but comprise:

- The Water Quality Improvement Programme (WQIP), developed by CSRM as a strategic intervention to integrate short-term priority responses to water quality problems, with more strategic medium- and long-term interventions. The overall objective of the programme is to bring about a progressive improvement in water quality in the city's rivers and waterbodies. The programme is based on the compilation of:

  Pollution Abatement Strategies and Action Plans (PASAPs) that set out strategies to address pollution and poor water quality on a river catchment or subcatchment basis; and

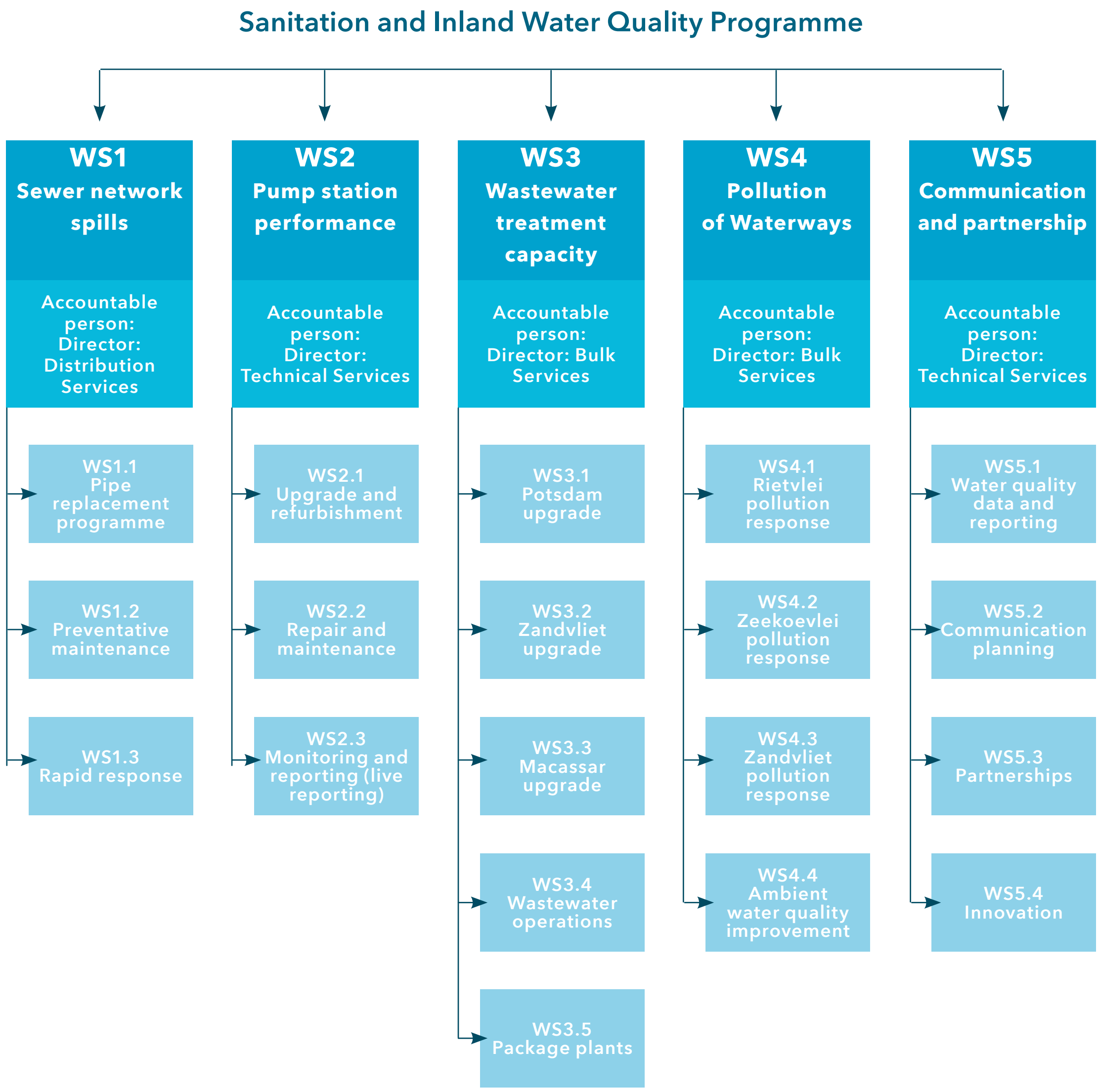
  Transversal Action Plans (TAPs), which are supposed to outline the actual short- to long-term interventions and projects needed across various City directorates and work streams in order to achieve the PASAP objectives.

- The Mayor's Priority Programme on Sanitation and Inland Water Quality (MPP) – This 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 WQIP and its associated PASAPs were integrated into the MPP as one of its five work streams (WS4 – Pollution of waterways) (see figure 7.1).

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 in 2021 and 2022 as a result of extended suspected and/or actual pollution with raw sewage; poor public access to, and trust in, the City's water quality data from the City's Scientific Services Branch; 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 five work streams making up the MPP are shown in figure 7.1, which lists subprogrammes under each work stream. Their effective and timeous implementation should 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.

Figure 8.1: The Mayor's Priority Programme (MPP) on Sanitation and Inland Water Quality is structured around five work streams, each comprised of a number of subprogrammes



Budgetary constraints are clearly a major consideration in achieving the combined goals of the above MPP, with competing funding demands from the following programmes, at a time when the City is experiencing significant financial stress as a result of National Treasury budget cuts:

The City's New Water Programme

- Refurbishment of existing water treatment plants
- Sewage pump station upgrades
- Sewer network replacements
- Wastewater treatment works upgrades and capacity increases

Subsequent Citywide budget cuts in early 2024 will exacerbate budget issues and are likely to impact on the delivery of many aspects of this MPP.

8.3. The Liveable Urban Waterways Programme

8.3.1. Background

The Liveable Urban Waterways (LUW) Programme is a programme developed by the City with the aim of demonstrating how water-sensitive design, waterway rehabilitation and a new approach to waterway management can achieve multiple benefits for society, the environment, and the economy.

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.

8.3.2. Completed LUW projects

- Asanda Village Wetland Park project: This project commenced before the start of the LUW Programme but has since been incorporated into the programme. It comprises the rehabilitation of the Asanda wetland and development of the Asanda Village Wetland Park. Construction was completed in June 2023 and included a rehabilitated and ecologically functioning wetland area, a stormwater system that can handle the upstream catchment flows, a formal pedestrian route through the public open space, hard and soft landscaping upgrades and a multi-use recreational and play area.

Further establishment of wetland vegetation in disturbed areas and solid waste removal are, however, challenges affecting the success of this LUW project going forward.

8.3.3. Implementable LUW projects

Six LUW projects have been taken through to a stage where they are ready for implementation.

- Sand River catchment: This was the pilot phase of the LUW Programme. Working closely with local stakeholders, five project sites were identified for interventions. Detailed designs have been prepared, involving different degrees 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.

- Lower Salt River subcatchment: The Nantes Park upgrade project is planned for the Vygekraal River, where it flows through Nantes Park in the Lower Salt River subcatchment. The project includes rehabilitation of parts of the river corridor, creation of new wetland areas, installing new footpaths, seating, and lighting, and replacing footbridges.

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 is used and enjoyed by communities; and
6. provides a range of ecosystem services, economic and social benefits.

Construction of a gabion weir across the Asanda wetland to spread flows.

Pedestrian walkway over wetland at Asanda Wetland Park.

8.3.4. Planning for future LUW projects

Nantes Park – site for planned LUW project on the Vygekraal River. Photo: McDonald (2024)

- Zeekoe subcatchment and Diep (Sand) subcatchment projects: These projects focus on the identification of opportunities for future LUW projects. They were carried out with funding by the C40 Cities Finance Facility (CFF) for the City's 'Green Infrastructure Options for Improved Waterway and Catchment Management Project'. The projects will develop masterplans for implementing waterway rehabilitation, green infrastructure (GI) and nature-based solutions (NbS) through the LUW Programme and the City's Green Infrastructure Programme. They include a number of technical studies, which were conducted to inform a climate change vulnerability and ecosystem goods and services assessment.
- Elsieskraal River: Conceptual planning and design for this project commenced in early 2024.

8.3.5. Current status of LUW project implementation

Implementation of the Sand and Lower Salt subcatchment projects was expected to start in 2024, once internal approval processes and detailed design had been finalised and the required Water Use, Environmental and Heritage Authorisations from various national and provincial government departments had been obtained. This implementation phase lies outside of the current water quality reporting period. However, it is material to this report to note that, in early 2024, budget cuts effected through National Treasury resulted in the implementation of four of the six planned LUW projects being pushed out to the City's 2033/34 financial cycle. Only the Sand/Langvlei canal and Vygekraal River projects have been allocated funding for implementation.

The technical report elaborates on the serious implications of these cutbacks.

The report strongly recommended that the LUW Programme budget should be re-evaluated by the City and funds to recommence with the four halted projects at least should be prioritised, if this programme is to gain the traction that it requires to bring about the change in Cape Town's waterways that is a prerequisite for the City to meet its commitment to becoming a water-sensitive city by 2040.

9. CONCLUSIONS

9.1. Overview of water quality in rivers and other monitored waterbodies

This summary report has been compiled to pull out the main findings of the City's Inland Water Quality Report, presented in the 2024 technical report. Water quality data for the 2022 and 2023 reporting periods were focused on against a baseline of data from the previous three years (2019 to 2021 reporting periods). Other data such as rainfall data, sewage pump station overflow data and WWTW effluent quality data were also considered where useful.

Overall, the analyses highlighted the fact that, from an ecological perspective, the most problematic and pervasive water quality issue throughout the city's monitored rivers and other watercourses was (and remains) phosphate enrichment. Since many of these nutrient enriched rivers feed into the city's vleis and dams, the impacts of river phosphorus enrichment is passed on to, and magnified within these standing waterbodies.

The Silvermine, Lourens and Hout Bay subcatchments continued to be the best-performing catchments among monitored riverine systems in the city, but nevertheless all showed a decrease in the proportion of samples in an acceptable condition over the 2023 reporting period. In the Silvermine subcatchment, this was attributed at least in part to the impacts of periodic pump station failure, the effects of which are exacerbated by upstream abstraction.

The worst-performing subcatchments, characterised by permanent non-compliance in analysed samples, comprised the Mosselbank, Sout and Soet systems.

The City's monitored standing water systems (vleis and dams) were also all highly nutrient-enriched, with water quality lying within either the range for poor (eutrophic) or for unacceptable (hypertrophic) conditions throughout the three reporting periods considered. These data reflect inflows from significantly more polluted rivers and stormwater systems, which load standing waterbodies with nutrients that accumulate over time in the waterbodies themselves, as well as in bottom sediments and living plant material. In inland aquatic ecosystems, high phosphate availability results in excessive plant growth, promoting the growth of reeds, aquatic weeds (many of them invasive alien species) and algae (particularly blue-green algae). These come at high management costs, requiring ongoing removal or other management interventions, and affecting the fitness for use of at least some recreational waterbodies.

These findings highlight how 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 characterised by impacted river waters.

In the city's recreational waterbodies, microcystin toxin data showed that, although blue-green algal blooms were clearly present on numerous occasions over the 2022 and 2023 reporting periods covered in this report, the only vlei in which microcystin toxins from these algae were recorded at concentrations of concern was Zeekoevlei.

This means that, excluding Zeekoevlei's waters on an occasional basis, and despite periodic blue-green algal blooms, Cape Town's recreational watercourses were assumed to be relatively safe for human use over the 2022 and 2023 reporting periods, from the perspective of exposure to microcystin toxins during intermediate contact of these systems.

A major contributor to the degradation of many of the city's watercourses is contamination with raw sewage. This study assessed *Escherichia coli* data for the 2023 reporting period, and compared these with data from the 2019 and 2020 reporting periods, due to issues over data reliability in the intervening periods. It found that the proportion of river samples rated as unacceptable from a human risk perspective increased over the assessed reporting periods (2019, 2020 and 2023), with data showing increases from 49% unacceptable (2019 dataset) to 59% in the 2023 dataset. These increases were attributed to an increased frequency of load-shedding, with its effects on sewage pump stations and WWTW, as well as burgeoning poorly serviced informal settlements in many subcatchments and poorly maintained and/or vandalised infrastructure.

The data showed that the worst-performing subcatchment was the Soet (90–100% unacceptable samples) reflecting a stormwater system fed almost entirely by grey- and blackwater inflows from informal settlements. By contrast, the Silvermine and the Lourens River subcatchments were least impacted by *E. coli* (and by assumption, raw sewage) with > 80% of samples lying within the acceptable range, and explaining in part their generally low levels of nutrient enrichment and generally better ecosystem condition.

Standing water systems (vleis, dams, detention ponds) typically showed lower *E. coli* concentrations and performed better in terms of compliance data than the rivers feeding into them. This is attributed mainly to extended retention time within standing waterbodies (especially the large vleis), allowing exposure of *E. coli* to ultraviolet (UV) light in sunlight (which kills these bacteria) and dilution of point-source inflows in large waterbodies.

Summary *E. coli* data for standing water systems suggest that although all the city's recreational waterbodies periodically posed risks to human health during the 2023 reporting period, they were largely in an acceptable condition, conducive to their safe recreational use. The exception to this was Milnerton Lagoon, which was mostly in an unacceptable condition, and its use for recreation would probably have posed risks to human health most of the time. The main sources of raw sewage are assumed to stem from the catchment between Blaauwberg Bridge and Otto du Plessis Drive, including overflows from the Koeberg and other sewage pump stations, overflows from the Potsdam WWTW, inflows of polluted stormwater from poorly serviced informal settlements, unmanaged urban areas (e.g. Phoenix and Jo Slovo Park) and backyard dwellings.

9.2. Key pollution sources

The main drivers of aquatic ecosystem degradation and phosphate enrichment, in particular over the current reporting periods, revolved around a number of issues, most of which are related to inflows of sewage and solid waste from various sources. These issues comprise the following:

1. **Inflows** of treated effluent from WWTW;
2. **Episodic overflows from sewage pump stations and surcharging manholes** that result in overflows that pass either directly into watercourses or enter them via the stormwater system;
3. **Runoff from informal settlements** and housing areas with high levels of backyard dwellings and/or where existing infrastructure is poorly maintained result in permanent, generally low-level but highly contaminated waste streams passing; and
4. **Accumulations of large volumes of solid waste and illegal dumping of waste** that characterise many areas of the city's open spaces, roadways and pavements and which enter the stormwater system. This waste may contribute harmful pollutants to aquatic ecosystems or block stormwater drains and channels.

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 subcatchments.

9.3. The City's response to water quality issues

The above findings are not new – similar findings were presented in both the 2020 and 2023 Inland Water Quality Reports, and the MPP for Sanitation and Inland Water Quality all recognise the urgent need to address the above complex issues.

However, budget cuts (from early 2024) will clearly constrain the ability of the City to increase sewer servicing to expanding informal communities; increase solid waste collection frequency and efficiency; enforce existing by-laws around dumping and pollution; and ensure within-City compliance with meeting the water quality licensing requirements of its WWTW and preventing pollution of watercourses through sewage pump station failure and sewer overflows.

The colour of the Silvermine River is due to tannins that leach from fynbos vegetation and stain the water brown/black.

10. KEY RECOMMENDATIONS FROM THIS REPORT

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. These have been summarised in this report – interested readers should consult section 9.4 for a more thorough discussion and access to more detailed recommendations.

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 turnaround in water quality in many areas.

Drawing on analysed water quality data, as well as on comments and suggestions from City regional stormwater management teams, the technical report provides discussion of and recommendations to:

- Reduce the impacts of point-source pollution on aquatic ecosystems, with different measures suggested to reduce pollution from:
  - major WWTW;
  - informal settlements and suburbs with high levels of backyard settlement; and
  - overflows from pump station failure
- Reduce the passage of solid waste into stormwater systems and watercourses
- Amend stormwater and sewerage reticulation management structures to align management boundaries with city catchments
- Fast-track implementation of PASAPs and TAP
- Actively conserve existing subcatchments or parts of subcatchments in relatively good condition
- Conserve remnant floodplains and their wetlands
- 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
- Improve water quality data reporting
- 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.

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.

11. WHAT CAN YOU DO?

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.

The following are the City's top ten changes that could lead to a measurable improvement in water quality in many systems, if they are consistently applied by enough residents:

1. Household waste should be binned, recycled or composted, depending on the type. Do not throw it down the stormwater drain or into the sewer network, as it either blocks the system and causes localised flooding or sewer overflows, or ends up in and pollutes our waterways.

   If household waste is not collected often enough, then contact your ward councillor, or the City via the 'Report a fault' (C3 notification) system, by phoning 0860 103 089 or going online to: www.capetown.gov.za/servicerequests.

   If waste is accumulating in streets and open spaces, ask the City to trial a dedicated fenced space for legal disposal of waste that can be cleared by the City.

2 Do not flush nappies, sanitary products, wipes, earbuds, condoms, hair, rags or newspapers into toilets or sewers. These can block the sewer network, which result in overflows of raw sewage into the environment.

3. 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 WWTW for treatment, rather than the stormwater system. If such wastewater reaches the stormwater system instead, it is destined for our waterways and, ultimately, the ocean, where it will pollute and harm these ecosystems.

4. Report 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.
5. Get involved – join local river clean-up groups and help prevent waste from getting into waterways in the first place.
6. Restaurants should clean out grease traps regularly, as a build-up of fats in the sewer system is a major cause of blockages and sewer overflows.
7. Do not wash vehicles on hard surfaces near a drain, as the chemicals in the greywater will run directly into the stormwater system. Rather wash your vehicle on a soft surface, where the greywater gets absorbed into the soil. Also make sure that your local car wash facility takes steps to prevent runoff of dirty detergent-laden wastewater.
8. Dispose of used oil, paint and other products that contain harmful chemicals at a City-approved drop-off facility, and not into the stormwater system or sewer network.
9. Use 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.
10. Make a concerted effort to use low-phosphate detergents and other products, wherever possible, to help reduce the phosphate load on rivers, vleis and wetlands, and to help transition Cape Town towards a phosphorus-free city.

This report can be found online by visiting **www.capetown.gov.za** and searching for *'Inland water quality'*.

Information on Cape Town's coastline, beaches and coastal amenities can also be found online by visiting **www.capetown.gov.za** and searching for *'Our unique coastline' and 'Coastal water quality'*.

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

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