INKOMATI-USUTHU
CATCHMENT MANAGEMENT AGENCY

# ANNUAL WATER QUALITY STATUS REPORT

**FOR THE INKOMATI-USUTHU WMA**

2019/20 FINANCIAL YEAR

www.iucma.co.za

## VISION

***Sufficient, equitable and quality water resources for all in the Inkomati-Usuthu Water Management Area***

## MISSION

To efficiently manage water resources by empowering our stakeholders in our quest to contribute towards transformation by promoting equal access to water and protecting our environment

## VALUES

Integrity
Customer Orientation (Batho pele)
Efficiency
Accountability
Diversity
Transparency

# ANNUAL WATER QUALITY STATUS REPORT FOR THE INKOMATI-USUTHU WATER MANAGEMENT AREA


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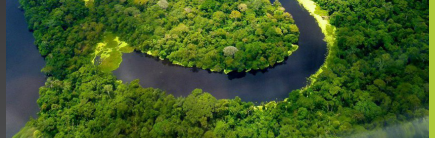


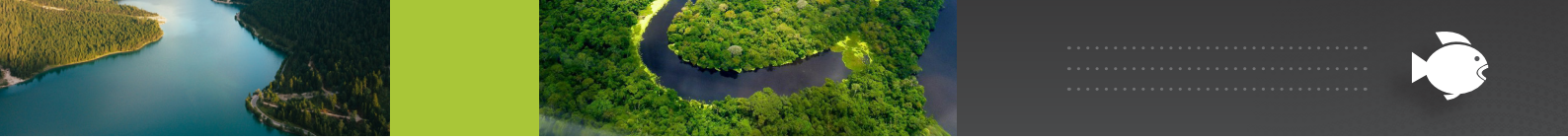

# EXECUTIVE SUMMARY

Chapter 3 of the NWA prescribes the protection of water resources through resource-directed measures including the determination of the management classification, Resource Quality Objectives and the Reserve of significant water resources. These are measures which together are intended to ensure the protection of the water resource as well as measures to regulate and control the impacts of land-based activities by ensuring pollution prevention and remedying the effects of pollution. It is further required that the protection of water resources is balanced with the need to use water as a factor of production to enable socio-economic growth and development.

The challenges affecting water quality in the Inkomati-Usuthu WMA have always been mainly due to industrial and mining activities and the poor state of water services authorities' sewage infrastructure. Pollution of the resource is caused due to contamination of sewage (e.g. from overflows, spills and leakages or by discharge of untreated/partially treated sewage into the resource); and decanting of mining effluents or leachate into the water resources as well as solid waste especially nappies.

The microbial pollution remains a human health risk, especially to the vulnerable rural communities that at times must use the river water for domestic, religious, cultural and recreational purposes. Deteriorating water quality on certain Ecological Water Requirements sites especially microbiological quality has largely been attributed to inadequate compliance, monitoring and enforcement, weak co-operative governance, absence of regulation and delays in the implementation of the Waste Discharge Charge System.

The surface water quality in the Inkomati-Usuthu WMA complied with the Resource Quality Objectives (RQOs), South African Target Water Quality Guideline limits (SATWQG) and International Water Quality Guideline limits (IWQG) for most of the monitored points and this showed that the water quality within the WMA is in a relatively good state.



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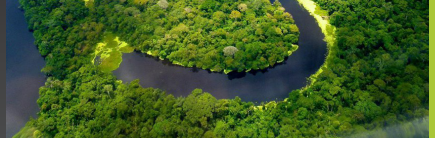
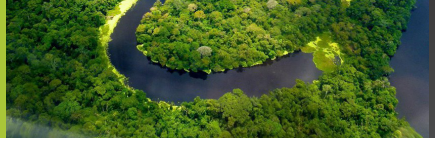






# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| NWA | National Water Act, Act 36 of 1998 |
| IUCMA | Inkomati-Usuthu Catchment Management Agency. |
| IUWMA | Inkomati-Usuthu Water Management Area |
| RQOs | Resource Quality Objectives |
| RSA | Republic of South Africa |
| DWS | Department of Water and Sanitation. |
| WWTWs | Wastewater Treatment Works. |
| CFU | Colony-forming unit. |
| *E. coli* | *Escherichia coli*. |
| KNP | Kruger National Park. |
| EWR | Ecological Water Requirements |
| CME | Compliance Monitoring and Enforcement |
| SANAS | South African National Accreditation System |
| U/S | Up Stream |
| D/S | Down Stream |
| EC | Electrical Conductivity |
| mS/m | milli siemens per meter |
| mg/l | milli-grams per liter |
| TWQG | Target Water Quality Guide |
| WMA | Water Management Area |
| SATWQG | South African Target Water Quality Guidelines |
| IWQG | International Water Quality Guidelines |
| $PO_4$ | Phosphate |
| $NO_3$+$NO_2$ | Nitrates and nitrites |
| pH | Acid base relation |
| $SO_4$ | Sulphate |
| $NH_3$ | Ammonia |

# 1. INTRODUCTION AND BACKGROUND

## 1.1 Introduction

The Inkomati-Usuthu Catchment Management Agency (IUCMA) is the responsible authority within the jurisdiction of the Inkomati-Usuthu Water Management Area (WMA). The WMA is located in the eastern part of the country and falls wholly within the Mpumalanga Provincial boundary as depicted in Figure 1 below as WMA three (3) of the nine (9) demarcated WMAs. The WMA is part of international basins called the Incomati River Basin and Maputo River Basin. The water resources in the area are strategically important for international obligations as well as inter-basin transfers for power generation. As an authority, the IUCMA is responsible for managing, controlling, protecting and monitoring water resources in its area of responsibility.

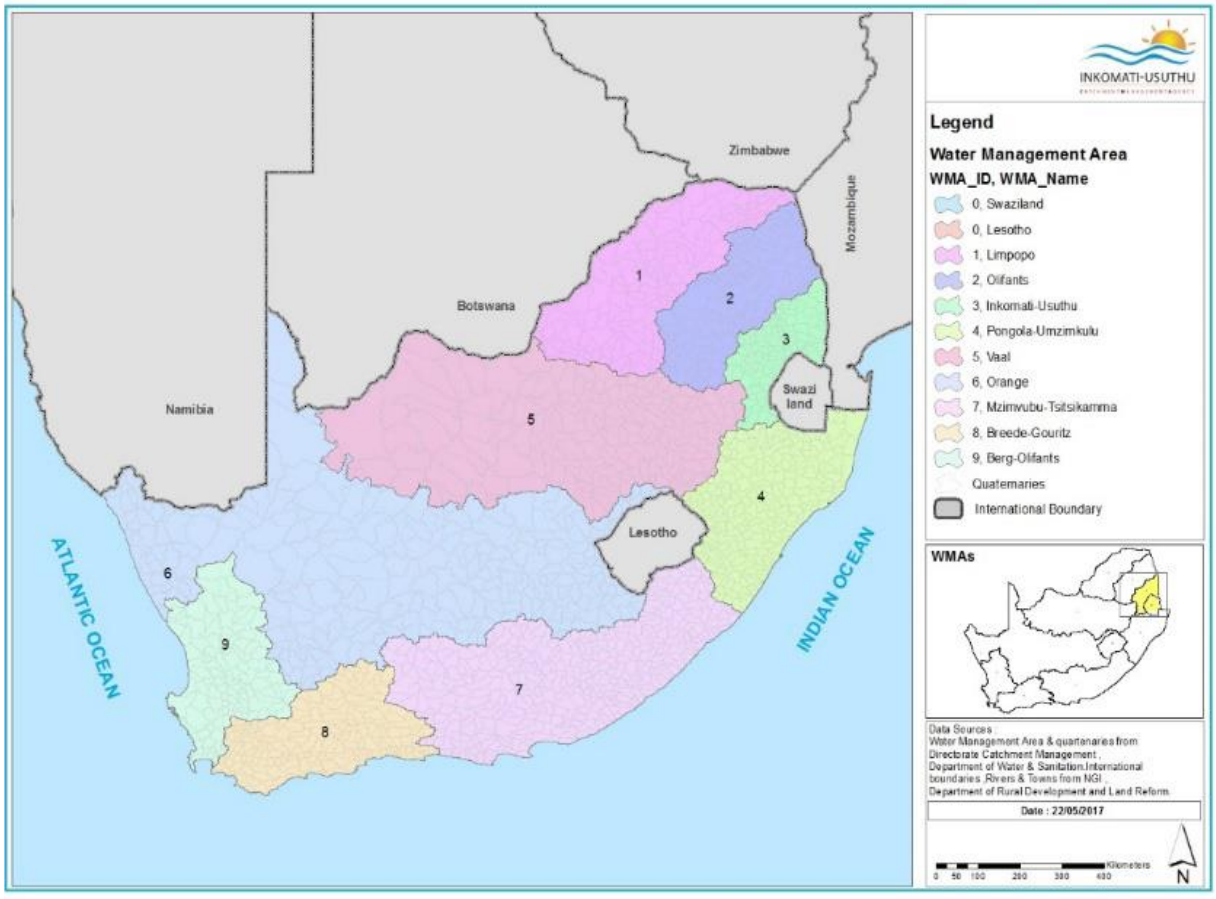
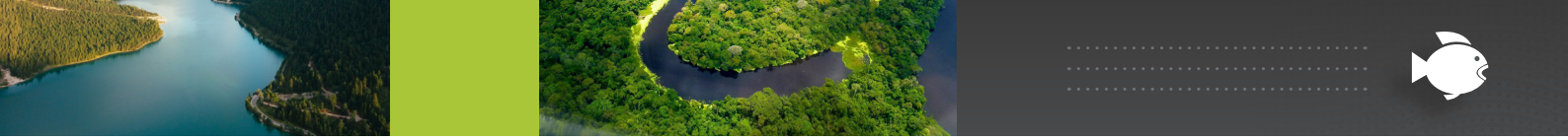



*Figure 1: Map of South Africa indicating the nine WMA.*



## 1.2 Background

National Water Act, Act 36 of 1998 (NWA) of South Africa Chapter 14: Requires the Minister to establish national monitoring systems for the collection of appropriate data and information that is adequate and responsive to the present and future challenges of efficient management of the country's water resources. The Inkomati-Usuthu Catchment Management Agency (IUMCA) conducts regional water quality monitoring in the Inkomati-Usuthu WMA which feeds into the national monitoring system. Water quality is vital as it determines fitness for uses and the protection of the health and integrity of aquatic ecosystems and is described as chemical, physical, and biological characteristics of water (DWS, 1996).

Surface water quality within Inkomati-Usuthu WMA is measured by means of physical, chemical and microbiological monitoring programme conducted monthly through grab sampling. The samples are then submitted to a South African National Accreditation System (SANAS) accredited laboratory for analysis. The variables of concern differ from catchment to catchment and are based on the types of activities occurring within a specific catchment. Monitoring is conducted for both surface water to determine the water resource quality as well as at the discharge points for Compliance Monitoring and Enforcement (CME) purposes to establish the water users' compliance to the conditions of their respective authorisations or set standards.

For this report, the surface water quality monitoring points for Ecological Water Requirement (EWR) Sites and International Obligation have been selected for reporting purposes, since it would not be practical to report on all 264 monitoring sites. The data reported was collected over a period of 12 Months (January 2019- December 2019) within the WMA.

The water quality status of parameters is compared with the Resource Quality Objectives published in a Government Gazette dated 30 December 2016, the Target Water Quality Guideline limits (TWQG) and International Water Quality Guideline limits as per the Tripartite Interim Agreement between Republic of Mozambique, Republic of South Africa (RSA) and the Kingdom of eSwatini. The water quality status for compliance is represented by colour Green and for non-compliance is represented by colour Red throughout the report unless indicated otherwise.

# 2. Objectives

- To determine the water quality trends within the Inkomati Usuthu Water Management Area.

- To determine compliance at Ecological Water Requirements (EWR) Sites with Resource Quality Objectives (RQOs) and International Obligation sites with set international water quality guidelines.

# 3. Methodology

## 3.1 Study Area

The physical, chemical and microbiological programme of water resources takes place within the jurisdiction of the Inkomati-Usuthu WMA and comprises of Sabie/Sand Catchment, Crocodile Catchment, Komati Catchment and Usuthu Catchment. The IUWMA is situated in the north-eastern part of South Africa in the Mpumalanga Province. It borders on Mozambique in the east and on eSwatini in the south-east. The water management area extends over several parallel river catchments which all drain in a general easterly direction, and flow together at the border with Mozambique or within Mozambique, to form the Incomati River which discharges into the Indian Ocean immediately North of Maputo at Villa Laisa, while the Usuthu River confluences with Pongola River to form the Maputo River which discharges into the Indian Ocean South of Maputo and is called Maputo basin.

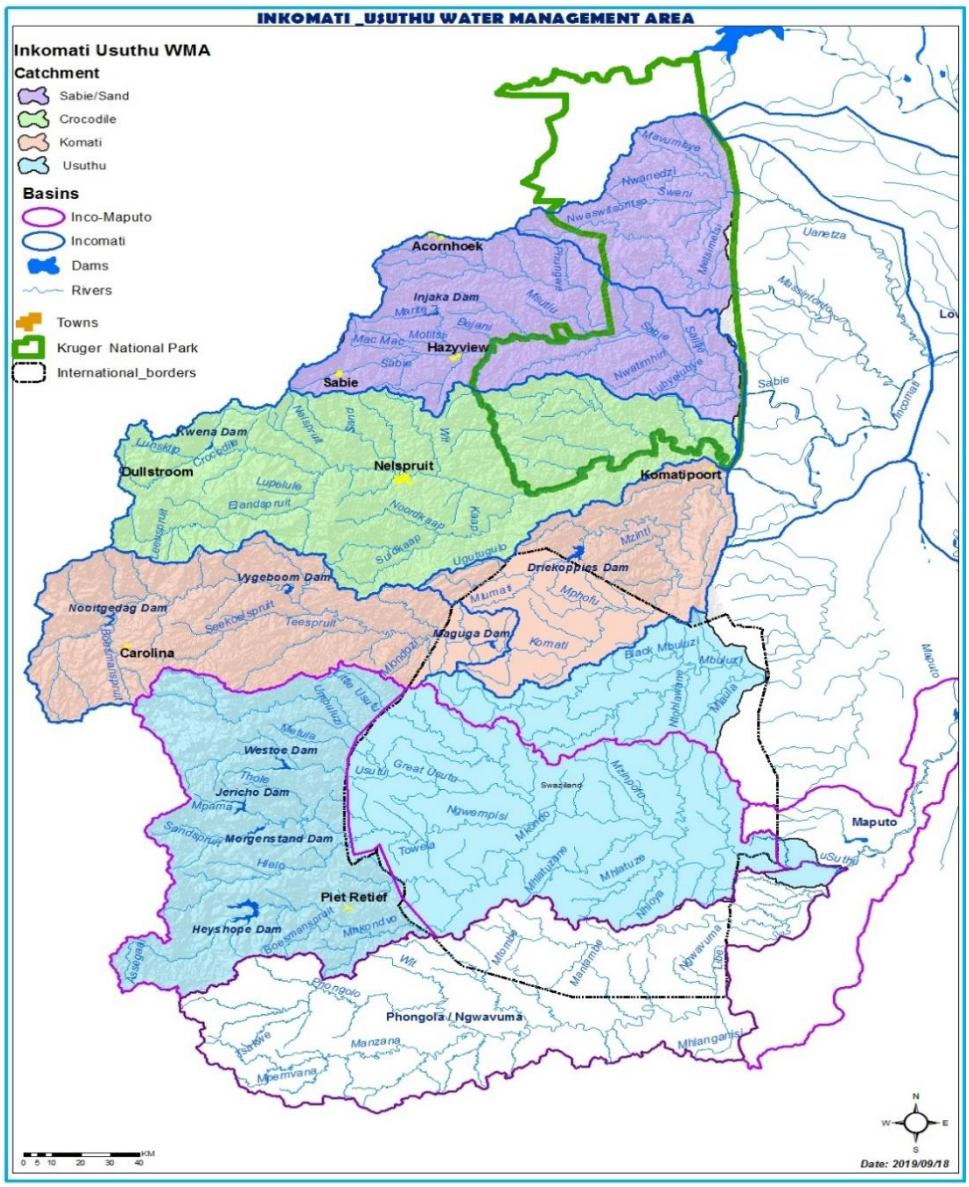



*Figure 2: Inkomati-Usuthu Water Management Area*

## 3.2 Materials and Methods

The water quality sample bottles were marked with the site code, date and time of collection using a permenant marker. Additives were only introduced in the microbial sample collecting bottles as they were pre-sterilized. The grab sample method was used for chemical and microbiological sampling. The caps of the bottles were not removed until the sample was ready to be taken. Some of the samples were taken on bridges using a bucket and bailer. The bucket was rinsed three times before collecting the sample and filling the sampling bottles.

One (1) litre chemical sample collecting bottles were rinsed three times before they were filled. The 300ml microbial sample collecting bottles were not rinsed since they were sterilized, ample air space was left in the sample bottle to facilitate mixing by shaking.

Both chemical and microbial water quality samples were stored in two separate cooler boxes and preserved with ice packs or cubes. The samples were then submitted to a SANAS accredited laboratory for analysis and microbiological samples were delivered within 12 hours to the Laboratory. The HydroNet systems was used to display and interpret the average of 12 months water quality data for the sites monitored.

*Figure 3: Chemical and Microbiological samples taken at Komati River downstream of Vygeboom Dam at R38 bridge using the bailer and the bucket*

*Figure 4: IUCMA official taking water quality chemical sample at tributary of Seekoeispruit in the Komati Catchment*

# Chapter 1: Sabie/ Sand Catchment

## 1.1 Introduction

The Sabie River originates in the upper reaches of the Sabie Town and passes through Sabie where industries such as York Timber Sawmill and the defunct underground gold mines of the Transvaal Gold Mine Estate (TGME) are situated. The Sabie River further flows through Hazyview and Mkhuhlu and other residential areas before it enters the Kruger National Park, Mozambique and the Indian Ocean respectively. The main tributaries of the Sabie River are Mac-Mac River, Klein Sabie River, Noord-Sand River, Bega River, Sand River and Mutlumuvi River. The Sand River confluences with the Sabie River inside the Kruger National Park. There are five main dams in the Sabie Sand Catchment, namely: Inyaka Dam, Da-Gama Dam, Eidenburg Dam, Mahleve Dam and the Swartfontein Dam. The catchment is dominated by trout farming, forestry at the upper reaches of the catchment and housing development such as guest houses, lodges and hotels. There is a number of wastewater treatment works, the majority of which are operated by municipalities. The middle reaches from Hazyview to the Kruger National Park are affected mostly by agriculture, eco-adventure tourism, irrigation, water abstraction and urban development while the lower reaches of the catchment are inside the Kruger National Park which is a protected area.

## 1.2 Water Quality Monitoring Points

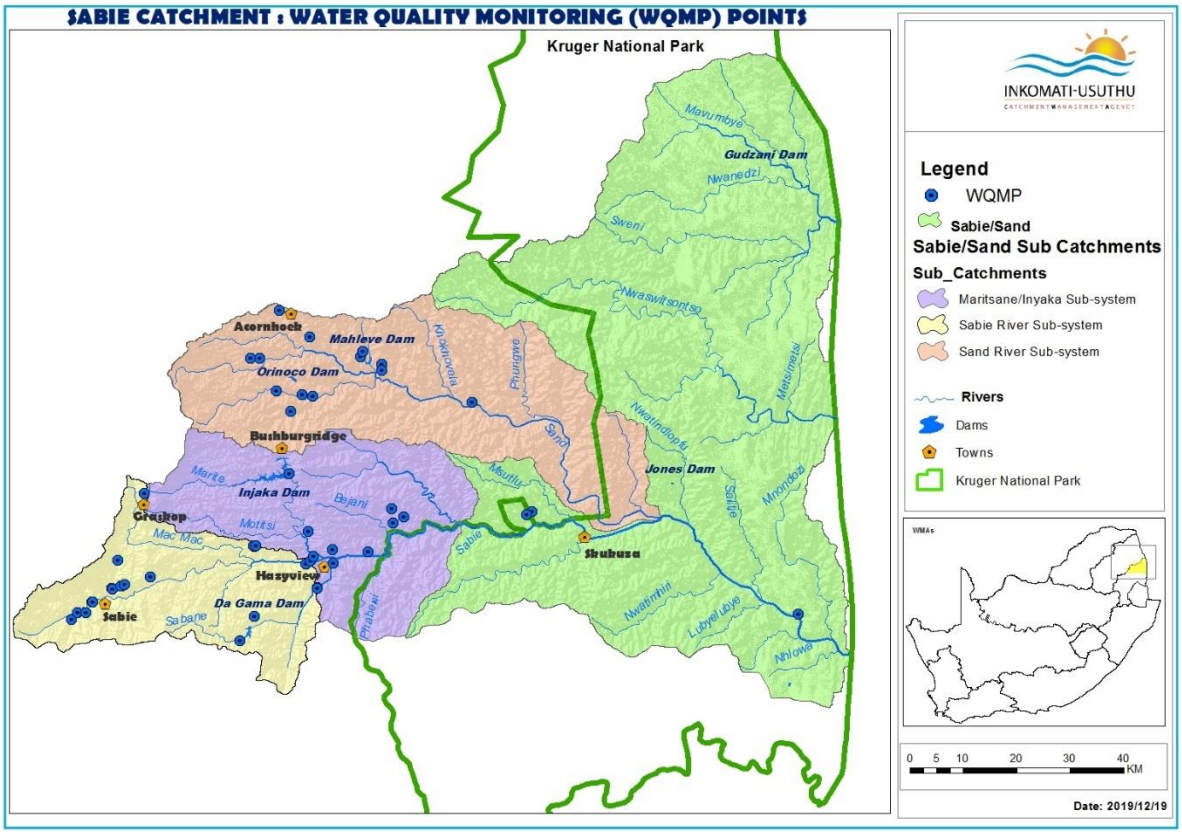


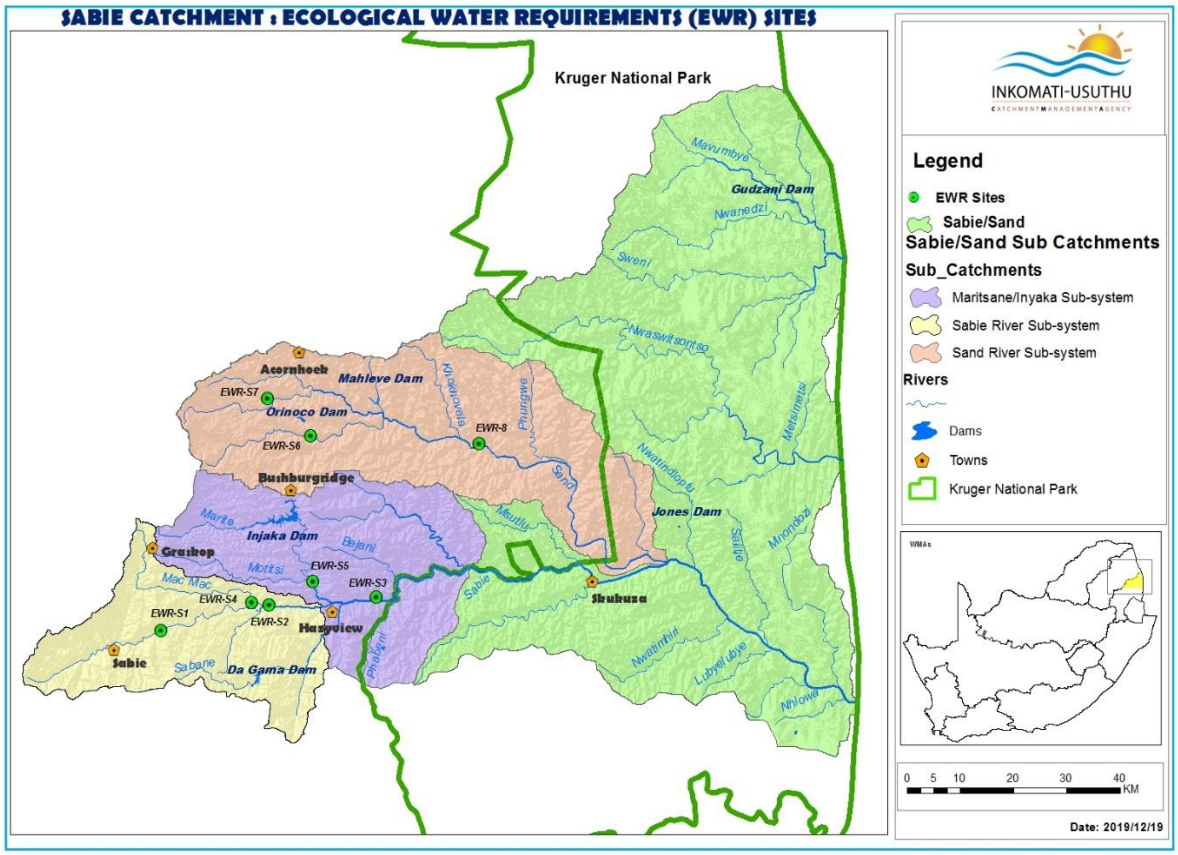

*Figure 5: Water quality monitoring points in the Sabie Catchment*

## 1.3 Resource Quality Objectives (RQOs)

The compliance of the indicator parameters is compared with the Resource Quality Objectives published in a Government Gazette dated 30 December 2016 or the Target Water Quality Guideline limits (TWQG) where the RQOs were not available or set.

*Table 1: Resource Quality Objectives within Sabie/Sand Catchment*

| Parameters | RQOs | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Ecological Water Requirement (EWR) Sites | | | | | | | |
| | EWR-S1 | EWR-S2 | EWR-S3 | EWR-S4 | EWR-S5 | EWR-S6 | EWR-S7 | EWR-S8 |
| ***E. coli* (cfu/100ml)** | 130 | 130 | 130 | N/A | 130 | 130 | 130 | 130 |
| **EC (mS/m)** | 30 | 30 | 30 | N/A | 30 | 55 | 42 | N/A |
| **Phosphate (mg/l)** | 0.015 | 0.015 | 0.015 | N/A | 0.015 | 0.125 | 0.125 | 0.125 |
| **pH** | 6.5 – 8.0 | | | | | 6.5 – 8.8 | | |




N/A=Not available

*Table 2: Target Water Quality Guideline limits (TWQG)*

| Variables/Parameters | Target Water Quality Guideline limits (TWQG) |
|---|---|
| pH | 6.5-8.5 (Recreation) |
| Nitrates/Nitrites ($NO_3$ + $NO_2$) in mg/l) | 6 (Domestic) |
| Ammonia ($NH_3$) in mg/l | 1 (Domestic) |

## 1.4 Water Quality Status and Discussion of Results

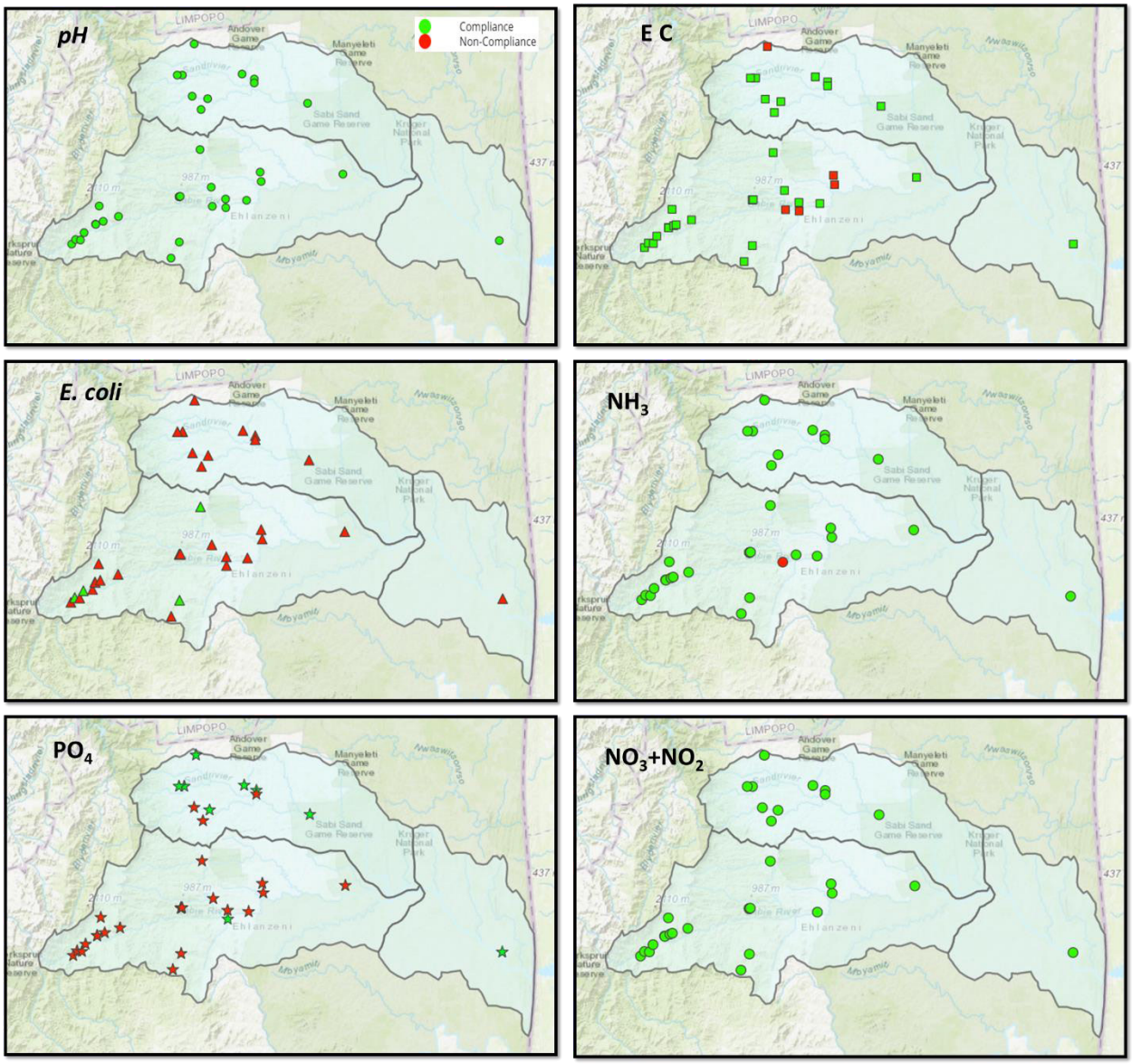



*Figure 6: Water quality status within Sabie/Sand Catchment showing physical (pH), Salts (EC) Microbial (E coli),Toxics ($NH_3$) and Nutrients ($PO_4$, $NO_3$+$NO_2$) concentrations.*

## 1.5 Discussion of Results

**pH** concentrations complied with the RQOs throughout the Sabie Sand catchment.

**Electrical Conductivity** complied with RQOs except in the Sabie River downstream of Hazyview WWTW, the Bega River downstream of Mkhuhlu settlement and piggery Project, Mahleve Dam and Noordsand River.

***E. coli*** counts in the Sabie Catchment indicated compliance with the set RQOs of 130 (cfu/100ml) in Sabie River at Sabie Saw Mill, Lone Greek River, Mac-Mac River, Inyaka Dam and Da-Gama Dam , however the areas downstream of Sabie and Sand River showed elevated *E. coli* counts which did not comply with the set RQOs.

**Ammonia** concentrations complied with the TWQG throughout the Sabie Sand catchment except downstream of Hazyview WWTW.

**Phosphate** indicated non-compliance with the RQOs for all points within Sabie sub-catchment except for Noordsand River which indicated compliance. The Sand sub-catchment indicated compliance for all points except for three (3) points which indicated non-compliance.

**Nitrates/Nitrites** concentrations complied with the TWQG (Domestic -Human consumption) throughout the catchment.

## 1.6 Ecological Water Requirements (EWR) Sites Compliance Status

The data reported was collected over a period of a year from January 2019- December 2019 and was statistically analysed using percentiles and average as tabulated below in Table 3. The compliance status of Ecological Water Requirements is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in Table 4 below.

**Table 3**: Water Quality Variables

| Classified Water quality variables | Indicator Variables | Statistical analysis of data |
|---|---|---|
| System | pH | 5 and 95 percentiles |
| Salts | Electrical Conductivity | 95 percentiles |
| Nutrients | Phosphate | 50 percentiles |
| Microbial | *E coli* | Average |

**Table 4:** EWR Sites water quality status: Compliance (Green) or non-compliance (Red)

| EWR Site | pH | | EC (mS/m) | | $PO_4$ (mg/l) | | *E coli* (cfu/100ml) | |
|---|---|---|---|---|---|---|---|---|
| | RQOs | Results | RQOs | Results | RQOs | Results | RQOs | Results |
| EWR S-1 | 6.5 - 8.0 | 7.4 - 8.3 | 30 | 15.0 | 0.015 | 0.023 | 130 | 601 |
| EWR S-2 | 6.5 - 8.0 | 7.0 – 8.1 | 30 | 56.7 | 0.015 | 0 | 130 | 358 |
| EWR S-3 | 6.5 - 8.0 | 7.2 – 8.0 | 30 | 12.1 | 0.015 | 0.010 | 130 | 611 |
| EWR S-4 | 6.5 - 8.0 | 6.8 – 8.2 | 30 | 12.1 | 0.015 | 0 | 130 | 89 |
| EWR S-5 | 6.5 - 8.0 | 7.3 – 8.7 | 30 | 9.4 | 0.015 | 0 | 130 | 337 |
| EWR S-6 | 6.5 – 8.8 | 7.0 - 8.6 | 55 | 13.9 | 0.125 | 0 | 130 | 934 |
| EWR S-7 | 6.5 – 8.8 | 7.0 – 8.1 | 42 | 10.4 | 0.125 | 0.014 | 130 | 773 |
| EWR S-8 | 6.5 – 8.8 | 7.1 – 7.9 | 42 | 33.4 | 0.125 | 0.023 | 130 | 2608 |

## 1.7 EWR Sites Trends Analysis

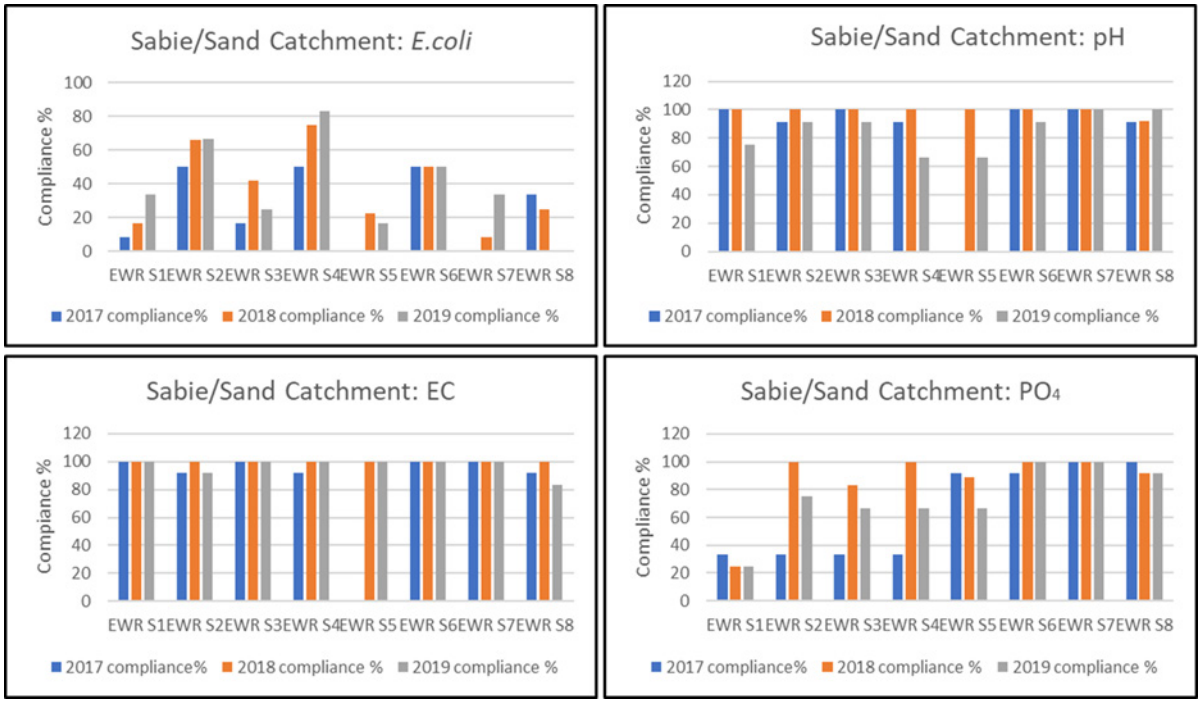



*Figure 7: The compliance % of E coli, pH, EC and $PO_4$ concentrations on EWR sites in the Sabie/Sand Catchment for calendar years 2017, 2018 and 2019.*

# Chapter 2: Crocodile Catchment

## 2.1 Introduction

The Crocodile River catchment originates near Dullstroom, where it flows into the Kwena Dam and eastwards through Nelspruit and confluences with the Komati River before entering Mozambique at the Lebombo Border Gate. The Elands River and Kaap River are two large tributaries of the Crocodile River system. The other smaller tributaries of the Crocodile River include the Lunsklip River, Nels River, Houtbosloop, Gladdespruit, White River and Besterspruit. The Significant Dams include the Kwena Dam, Ngodwana Dam, Witklip Dam, Klipkoppie Dam, Longmere Dam & Primkop Dam. The Crocodile River Catchment is dominated by agricultural activities (dry land, and irrigated cultivation), forestry, rural and urban settlements. The middle region of the Crocodile River is characterized by increased urbanization. The river flows through the major towns of Nelspruit, Kaapmuiden and Malelane as well as commercial farming activities (sugar cane, fruit orchards, and vegetables) which are important characteristics of this catchment. There are also mining activities in the Kaap River and the Sappi Mill in the Elands River sub-catchment. Other activities that existed in the catchment but have since closed are, Manganese Metal Corporation, Papas Quarry and Assmang Chrome. Illegal sand mining is posing a severe water quality problem in the middle regions of the Crocodile River catchment area around Kanyamazane area.

## 2.2 Water Quality Monitoring Points

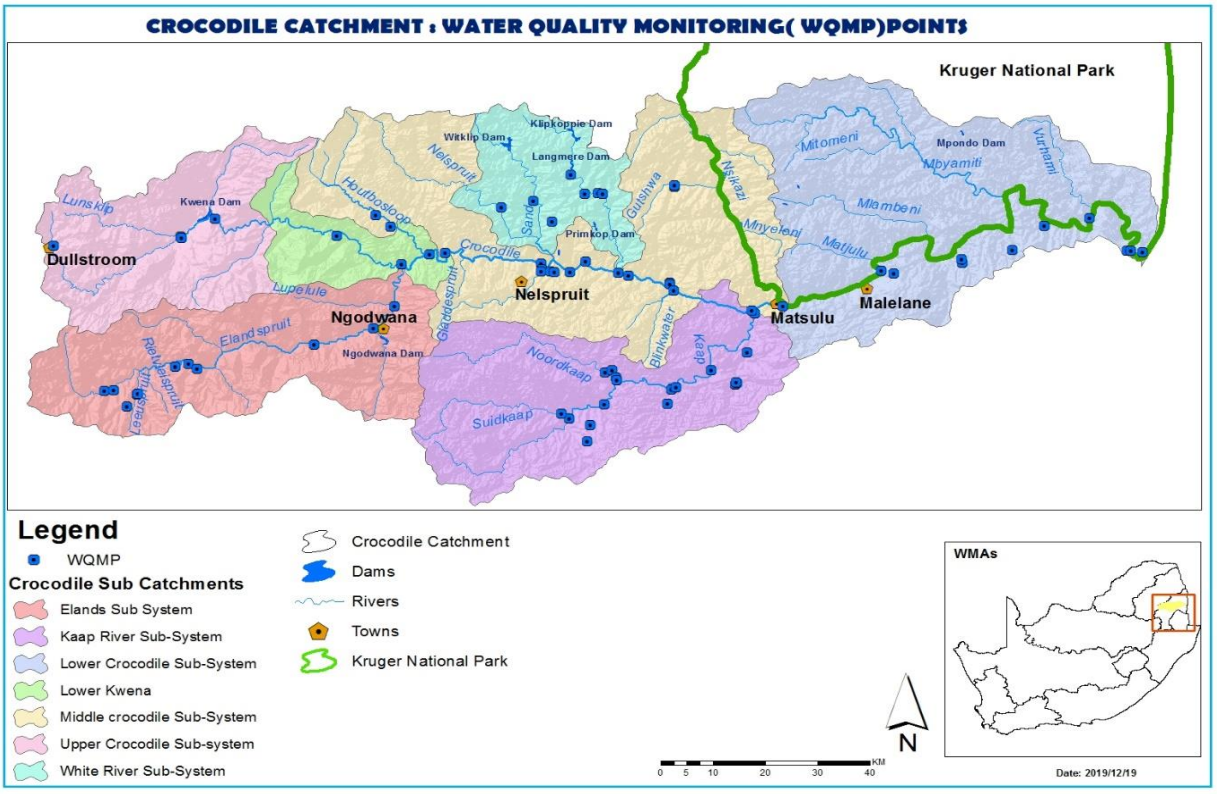


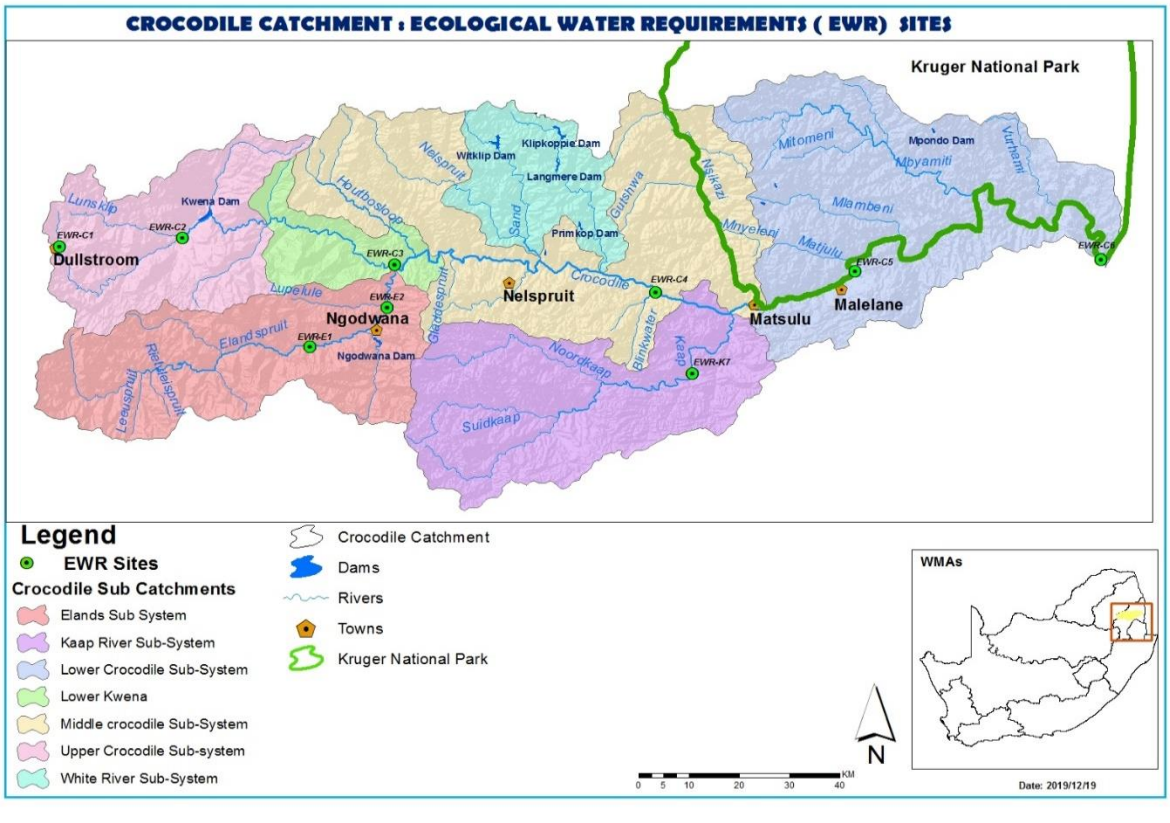
*Figure 8: Water quality monitoring points in the Crocodile Catchment.*

## 2.3 Resource Quality Objectives and Target Water Quality Guideline limits

The compliance of the indicator parameters is compared with the Resource Quality Objectives published in a Government Gazette dated 30 December 2016 or the Target Water Quality Guideline limits (TWQG) where the RQOs were not available or set as tabulated below.

*Table 5: Resource Quality Objectives within Crocodile Catchment*

| Parameters | RQOs | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ecological Water Requirement (EWR) Sites | | | | | | | | |
| | EWR-C1 | EWR-C2 | EWR-C3 | EWR-E1 | EWR-E2 | EWR-C4 | EWR-C5 | EWR-C6 | EWR-C7 |
| *E. coli* (cfu/100ml) | 120 | 130 | N/A | 130 | 130 | 130 | 130 | 130 | 130 |
| EC (mS/m) | 30 | 30 | 30 | 30 | 55 | 70 | 70 | 70 | 200 |
| Phosphate (mg/l) | 0.015 | 0.025 | 0.015 | 0.025 | 0.025 | 0.125 | 0.075 | 0.125 | 0.125 |
| pH | 6.5 – 8.0 | | | | | 6.5 – 8.8 | | | |




N/A=Not available

*Table 6: Target Water Quality Guideline limits (TWQG) or RQOs*

| Variables/Parameters | RQOS | TWQG |
|---|---|---|
| pH | - | 6.5 - 8.5 |
| Nitrates/Nitrites (mg/l) | - | 6 (Domestic) |
| Ammonia ($NH_3$) in mg/l | - | 1 (Domestic) |
| Sulphate | - | 30 (Industry) |
| Arsenic (As) in mg/l | 0.02 | - |
| Manganese (Mn) in mg/l | 0.18 | - |
| Chromium (Cr) VI in mg/l | 0.014 | - |

## 2.4 Water Quality Status and Discussion of Results

**Chromium (Cr) VI**

Cr (VI) is monitored at Leeuspruit to assess the impact from Assmang Chrome on the water resource, Cr (VI) complied with the RQOs of 0.014 (mg/l) throughout the reporting period except in April and May 2019 which exceeded the set RQO as indicated below.

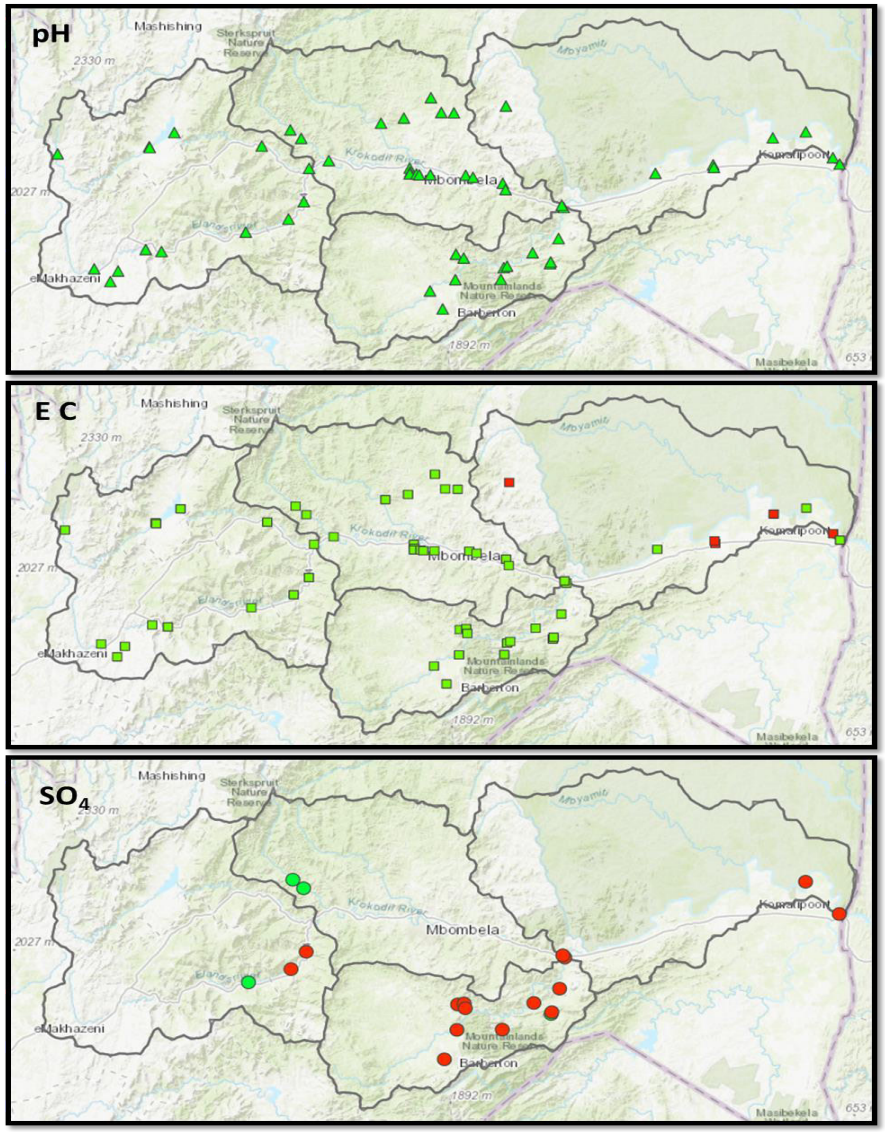




*Figure 9: Water quality status within Crocodile Catchment showing acidity or basicity (pH) and salts (EC and $SO_4$) concentrations.*

**pH**

pH is a vital indicator of water that is changing chemically and measures how acidic/or basic the water is, ranging from 0 to 14. The pH levels complied with the TWQG throughout the Crocodile Catchment.

**Electrical Conductivity (EC)**

The electrical conductivity is an indicator of the estimated levels of dissolved salts in water. Electrical Conductivity within Crocodile Catchment complied with the RQOs (Aquatic Ecosystem drivers), except in the tributary of Gutshwa River downstream of Kabokweni WWTW, Crocodile River at Tenbosch, and up and down stream of Hectorspruit WWTWs as well as in the tributary of Crocodile River downstream of Komati WWTW. The high level of EC may be due to presence of inorganic dissolved solids such as chloride, phosphate, and nitrate arising from WWTWs, stormwater runoff from formal /informal settlements (Hectorspruit areas) and agricultural runoff around Tenbosch.

**Sulphate ($SO_4$)**

The average sulphate concentration within the Crocodile Catchment indicated non-compliance with TWQG (Industry: category one) of 30 (mg/l) except for Elands River at Hemlock upstream of Sappi's Ngodwana Mill, Houtbosloop River and the tributary of Kimberley Creek in the Kaap River System.

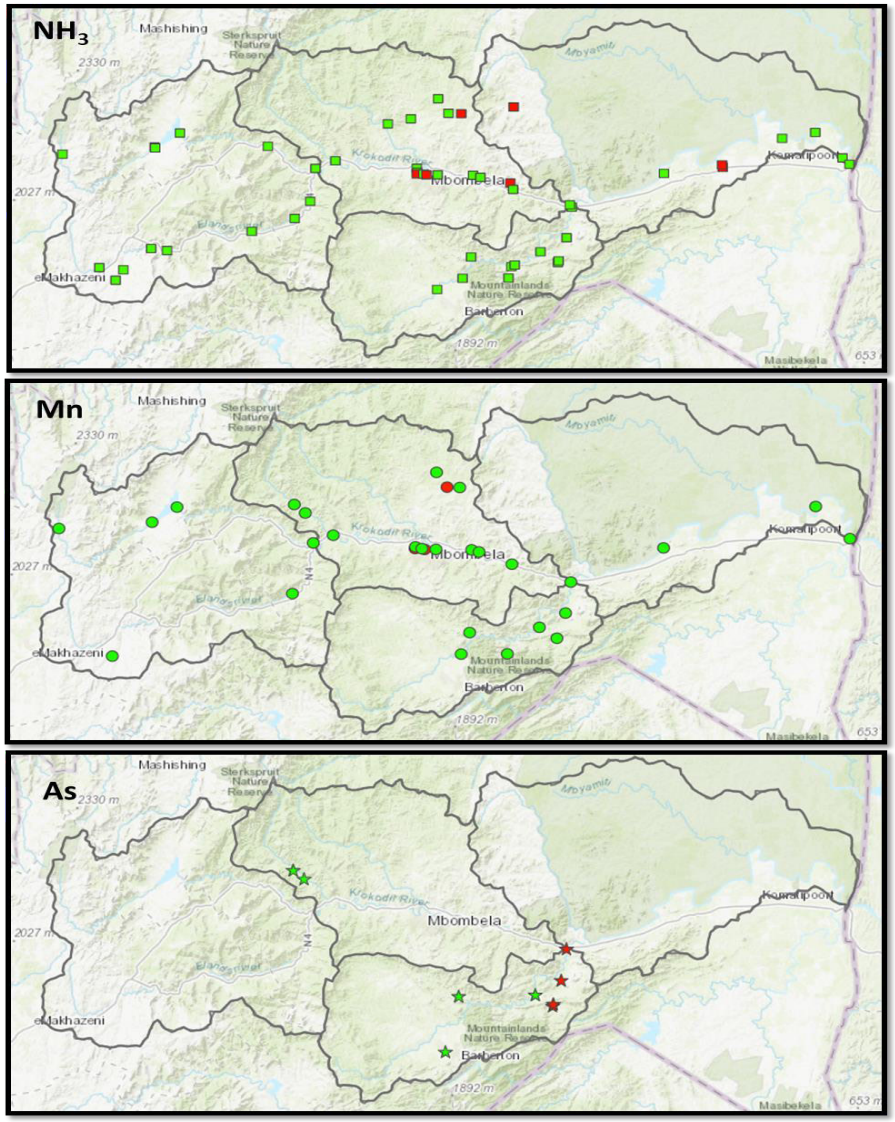



*Figure 10: Water quality status within Crocodile Catchment showing toxic substances ($NH_3$, Mn and As) concentrations.*

**Ammonia (NH3)**

Ammonia is formed from the decomposition of nitrogenous organic material (plants or animals) in surface water and if found in relative abundance, it can be highly toxic to fish and other aquatic life. Ammonia within the Crocodile Catchment indicated compliance with TWQG (Domestic) of 1 (mg/l) except in the tributaries of Crocodile River, namely the Gladdespruit, Besterspruit, KaNyamazane Stream, Hectorspruit as well as White River downstream of WWTWs and the tributary of Gutshwa River downstream of Kabokweni WWTW.

**Manganese (Mn)**

Manganese complied with the RQOs of 0.18 (mg/l) within Crocodile Catchment, except for three points Gladdespruit, Besterspruit and White River upstream of WWTWs which indicated no compliance. The mineral manganese can be found naturally in the environment (surface water) or as a result of land use activities such in mining and industrial discharges.

**Arsenic (As)**

Arsenic is a toxic metalloids mainly found in gold mining areas and also a naturally occurring element. Arsenic complied with the RQOs of 0.02 (mg/l) within the Houtbosloop, Noordkaap, tributary of Queens, however indicated non-compliance within the Louws Creek and its tributaries as well as Kaap River after confluence with Louws Creek. The impact are attributed to gold mine activities in the area as well as illegal gold mining within Louws Creek and its tributaries.

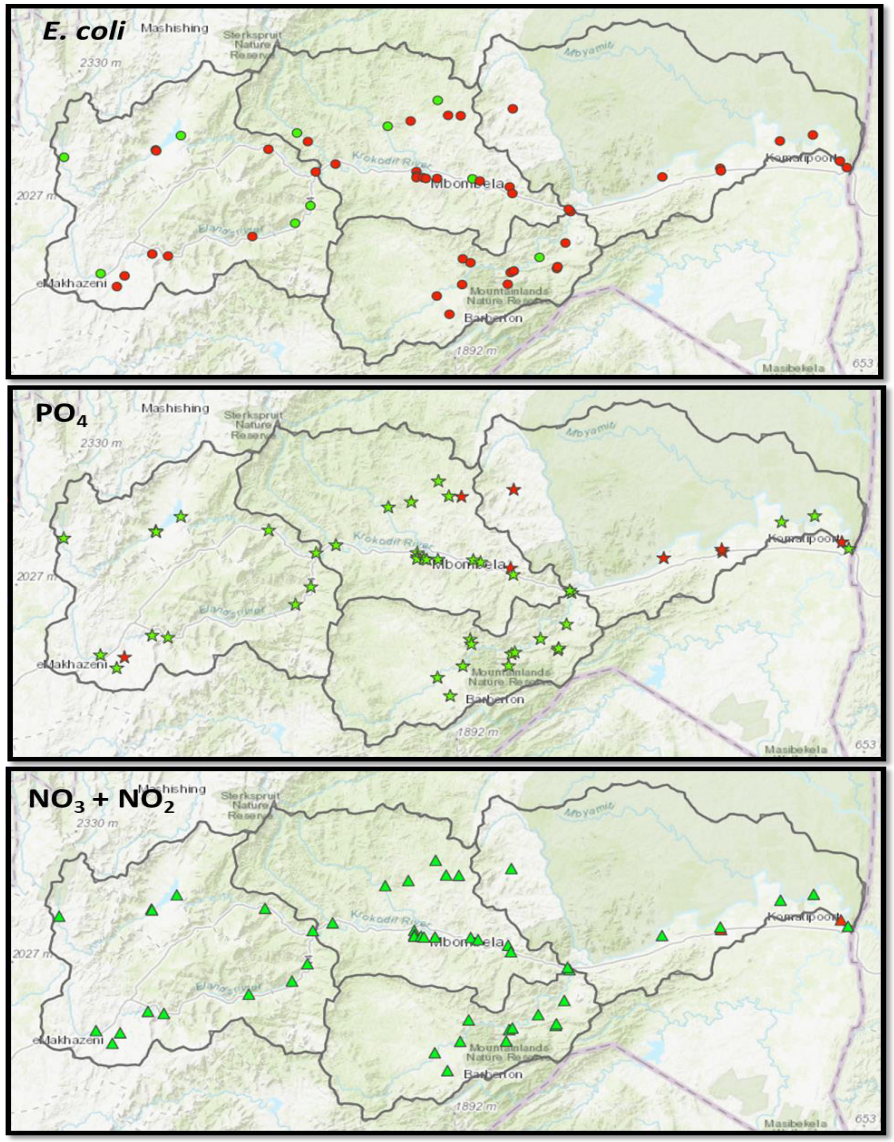



*Figure 11: Water quality status within Crocodile Catchment showing microbiological (E coli) and nutrients ($PO_4$ and $NO_3$+$NO_2$).*

***Escherichia coli (E. coli)***

*E. coli* counts in the Crocodile Catchment show elevated counts which from time to time exceeded the set RQOs of 130 (cfu/100ml). The non-compliance from the upper, middle and lower parts of the Crocodile River and its tributaries are due to contamination of human faecal material or/and other animals. Only ten (10) points in the catchments complied with the RQO of 130 (cfu/100ml).

**Phosphate ($PO_4$)**

Phosphates enter surface water from human and animal feacal waste, effluent discharges and fertilizers runoff. Phosphate concentrations in the Crocodile Catchment complied with the RQOs for most of the time except for points downstream of Emthonjeni, Waterval Boven, White River, Komatipoort, Mahlatikop and Kabokweni WWTWs, downstream & upstream of Hectorspruit WWTWs as well as the Kanyamazane stream. The impacts are attributed by effluent discharges from WWTWs and illegal dumping of solid waste especially disposable nappies.

**Nitrates/Nitrites**

Nitrates/Nitrites concentrations complied with the TWQG (Domestic -Human consumption) throughout the catchment, except a tributary of Crocodile River downstream of Komatipoort WWTW. Nitrate/Nitrites can also reach surface water from runoff from agricultural activities (inorganic nitrogenous fertilizers), partially treated effluent from WWTWs and from oxidation of nitrogenous waste products in human and animal excreta.

## 2.5 Ecological Water Requirements (EWR) Sites

The data reported was collected over a period of a year from January 2019- December 2019 and was statistically analysed using percentiles and average as tabulated below. The compliance status of Ecological Water Requirements is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in Table 8 below.

**Table 7**: Water Quality Variables

| Classified Water quality variables | Indicator Variables | Statistical analysis of data |
|---|---|---|
| System | pH | 5 and 95 percentiles |
| Salts | Electrical Conductivity | 95 percentiles |
| Nutrients | Orthophosphate | 50 percentiles |
| Microbial | *E coli* | Average |
| Toxic | Cyanide | 95 percentiles |

**Table 8:** EWR Sites water quality status: Compliance (Green) or non-compliance (Red)

| EWR Site | pH | | EC (mS/m) | | $PO_4$ (mg/l) | | *E coli* (cfu/100ml) | |
|---|---|---|---|---|---|---|---|---|
| | RQOs | Results | RQOs | Results | RQOs | Results | RQOs | Results |
| EWR C-1 | 6.5 - 8.0 | **7.1 – 8.9** | 30 | **9.1** | 0.015 | **0.005** | 120 | **55** |
| EWR C-2 | 6.5 - 8.0 | **7.2 – 8.4** | 30 | **17.4** | 0.015 | **0.005** | 130 | **287** |
| EWR C-3 | 6.5 - 8.0 | **7.5 – 8.5** | 30 | **15.8** | 0.015 | **0** | 130 | **358** |
| EWR E-1 | 6.5 - 8.0 | **7.6 – 8.1** | 55 | **20.7** | 0.015 | **0.005** | 130 | **171** |
| EWR E-2 | 6.5 - 8.0 | **7.6 – 8.2** | 55 | **94.2** | 0.015 | **0** | 130 | **102** |
| EWR C-4 | 6.5 - 8.8 | **7.5 – 8.3** | 70 | **33.2** | 0.125 | **0.116** | 130 | **1607** |
| EWR C-5 | 6.5 - 8.8 | **7.7 – 8.4** | 70 | **48.7** | 0.075 | **0.079** | 130 | **861** |
| EWR C-6 | 6.5 - 8.8 | **7.3 – 8.3** | 70 | **83.5** | 0.125 | **0.032** | 130 | **505** |
| EWR K-7 | 6.5 - 8.8 | **7.8 – 8.4** | 200 | **69.6** | 0.125 | **0.02** | 130 | **107** |

**N: B- The accuracy of Cn is inconclusive due to the detection limit of the laboratory which recorded <0.07(mg/l) throughout the year which is higher that RQOs of 0.004 (mg/l), at EWR site K7 within Kaap River System.**

## 2.6 EWR Sites Trends Analysis

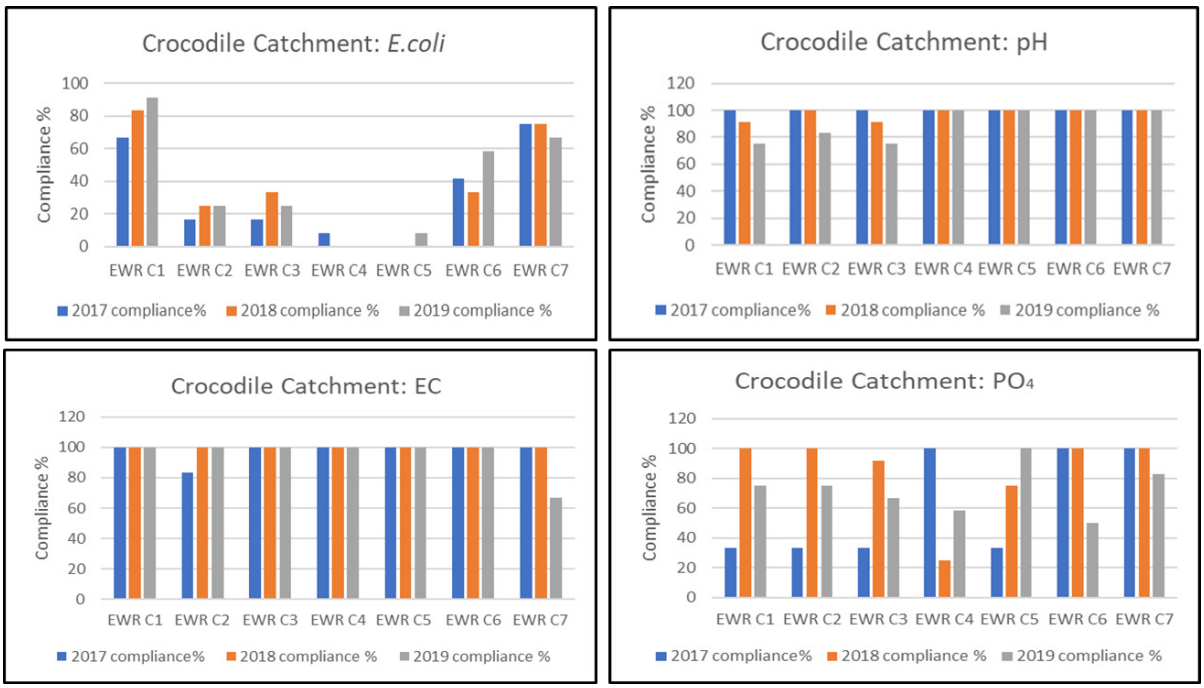



*Figure 12: The % compliance of E coli, pH, EC and $PO_4$ concentrations on EWR sites in the Crocodile Catchment for calendar years 2017, 2018 and 2019.*

# Chapter 3: Komati Catchment

## 3.1 Introduction

The Komati River originates from the outflow of the Nooitgedacht dam next to Carolina, Mpumalanga province. The catchment of the Nooitgedacht dam includes the Boesmanspruit and the Vaalwaterspruit tributaries that feed directly into the dam. The most unique feature of the Komati River is that it starts in South Africa and flows through eSwatini in a North-easterly direction and comes back to South Africa at the Mananga Border Gate. It then confluences with the Crocodile River (one of its main tributaries) at Komatipoort before it enters Mozambique where it confluences with the Sabie River which is another one of its main tributaries. After entering Mozambique, the Komati River is referred to as the Incomati River and flows into the Indian Ocean at Maputo Bay. From source to mouth, the length of the Inkomati River is 480 kilometers. The catchment is dominated by coal mining in the upper reaches of the catchment and irrigation agriculture in the lower reaches of the catchment. There are also WWTWs the majority of which are operated by municipalities. For the purposes of this report the Komati River upstream of eSwatini will be referred to as the Upper Komati and downstream of eSwatini, it will be referred to as the Lower Komati.

## 3.2 Water Quality Monitoring Points

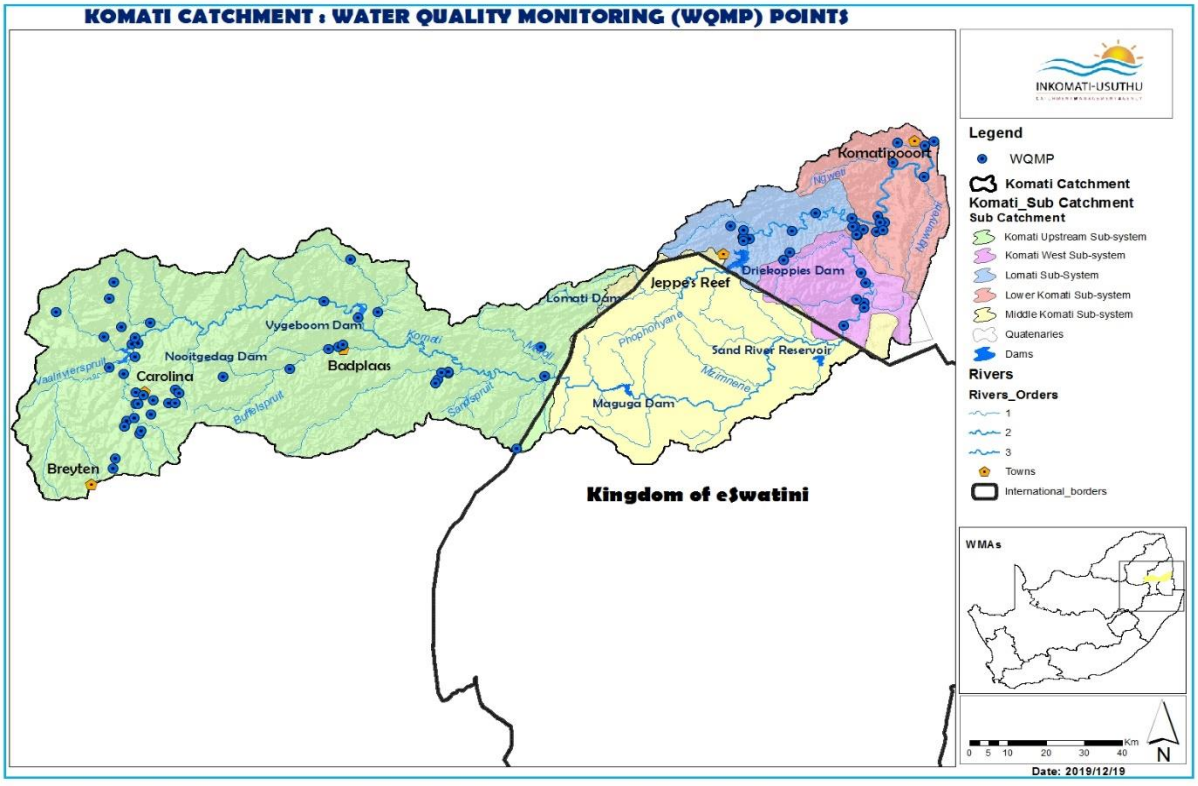


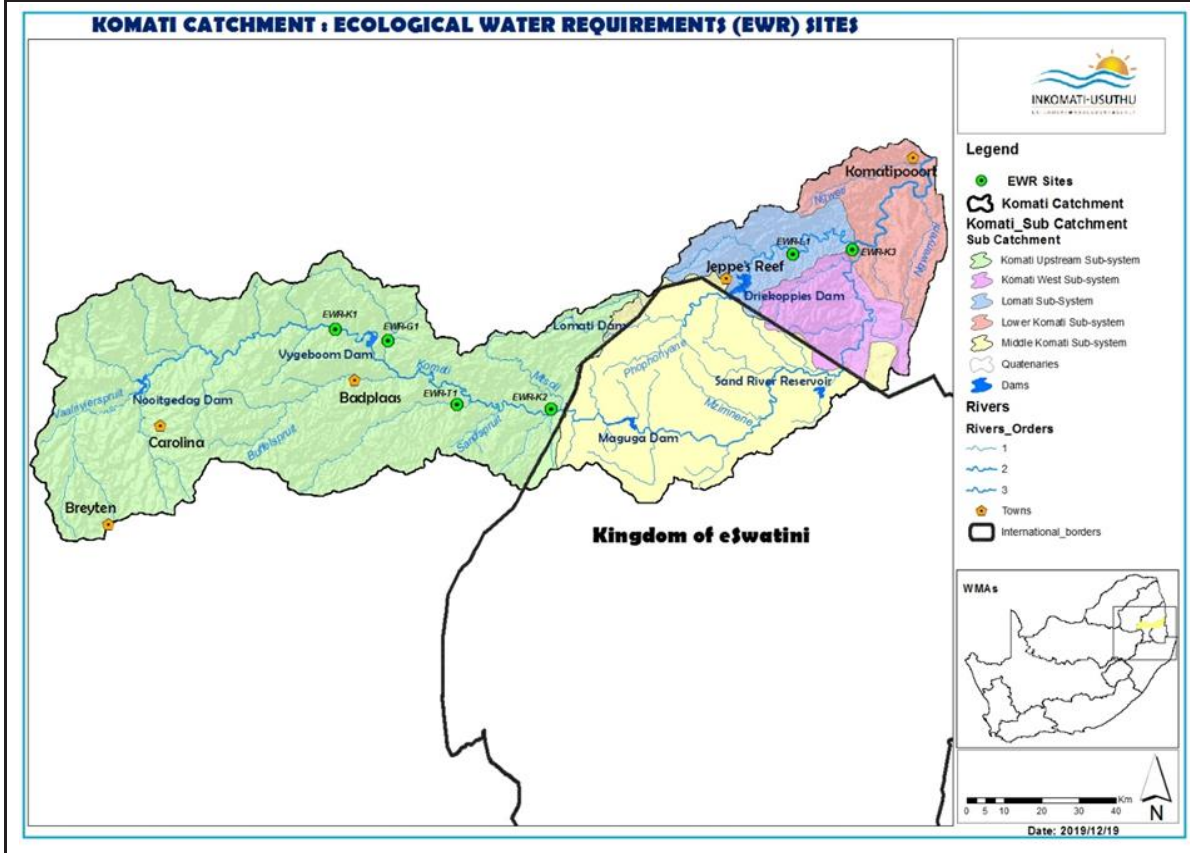

*Figure 13: Water quality Monitoring points in the Komati Catchment.*

## 3.3 Resource Quality Objectives (RQOs)

The compliance of the indicator parameters was compared with the Resource Quality Objectives published in a Government Gazette dated 30 December 2016 or the Target Water Quality Guideline limits (TWQG) where the RQOs were not available or set.

*Table 9: Resource Quality Objectives within Komati Catchment*

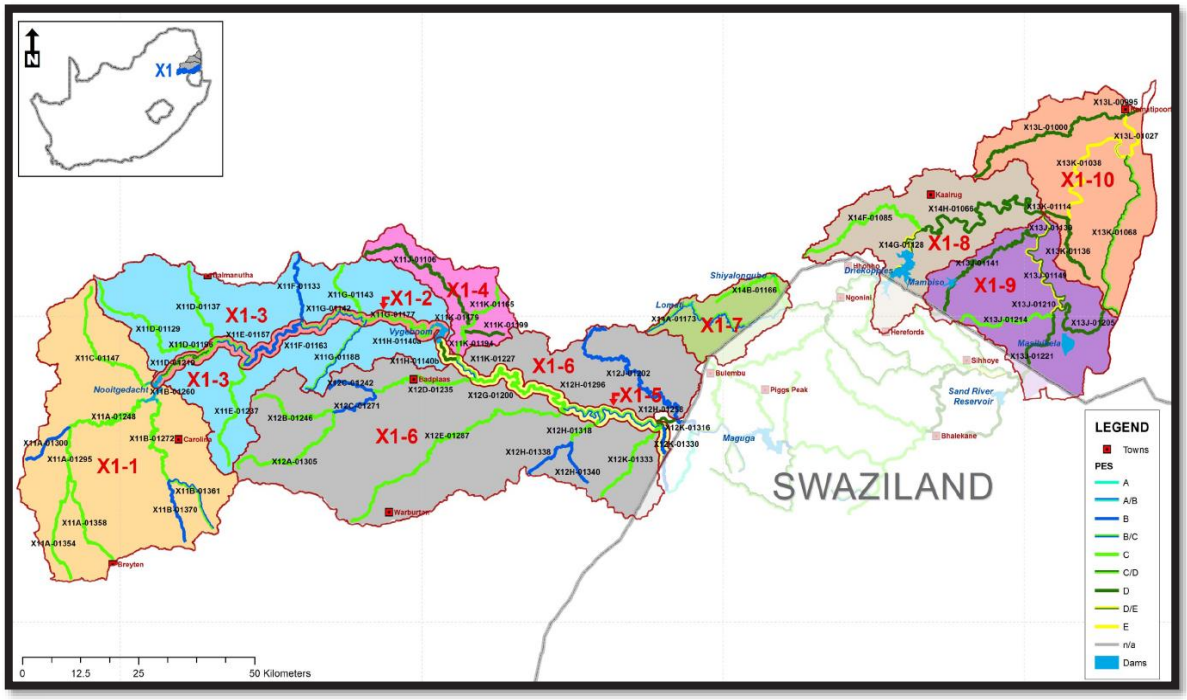
| Variables/Parameters | RQOs | | | | | |
|---|---|---|---|---|---|---|
| | Ecological Water Requirement (EWR) Sites | | | | | |
| | EWR-K1 | EWR-K2 | EWR-G1 | EWR-T1 | EWR-K3 | EWR-L1 |
| *E. coli* (cfu/100ml) | N/A | 130 | N/A | 130 | 130 | 130 |
| Electrical Conductivity (mS/m) | 50 | 55 | N/A | N/A | 85 | 40 |
| Phosphate (mg/l) | 0.02 | 0.02 | 0.02 | 0.125 | 0.125 | 0.075 |
| pH | 6.5 – 8.0 | | | | | |




N/A=Not available

*Table 10: Water Quality Priority RUs within Komati Catchment*

| Variables/Parameters | RQOs | | | |
|---|---|---|---|---|
| | Water Quality Priority RUs X1-1 | | | |
| | RUK1-X11A | RUK2-X11B | RUK3-X11C-D | RUK2-X11E |
| Sulphate (mg/l) | 30 | 80 | 30 | N/A |
| Electrical Conductivity (mS/m) | 30 | 30 | 30 | 30 |




N/A=Not available

*Table 11: Target Water Quality Guideline limits (TWQG)*

| **Variables/Parameters** | **TWQG** |
|---|---|
| pH | 6.5 - 8.5 |
| Nitrates/Nitrites (mg/l) | 6 (Domestic) |
| Ammonia ($NH_3$) in mg/l | 1 (Domestic) |
| Sulphate | 30 (Industry category 1) |
| Magnesium | 30 (Domestic) |
| Nickel | 0.2 (Agriculture: Irrigation) |

## 3.4 Water quality status and Discussion of Results

**Magnesium**

Environmental problems indirectly caused by magnesium in surface water may be due to chemical industries, and fertilizers that contain magnesium which can diffuse into surface waters.

Magnesium complied with TWQG in all points monitored in the reporting period of 2019, except for one tributary of Nooitgedag Dam and two points in the tributary of Boesmanspruit at Tselentis Colliery.

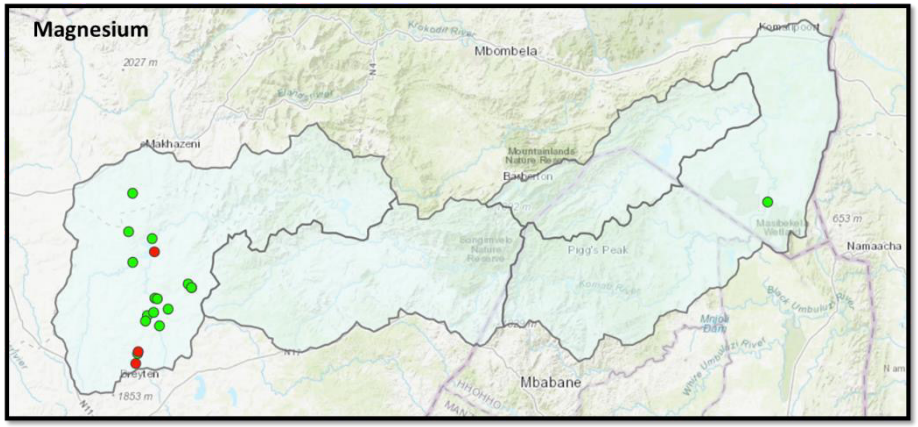



*Figure 14: Water quality status within Komati Catchment showing magnesium concentrations.*

**Nickel**

Nickel is found naturally in surface water and can also directly be emitted from various industries through discharge in surface waters. Nickel complied with TWQG in the Gladdespruit throughout the reporting period as indicated below.

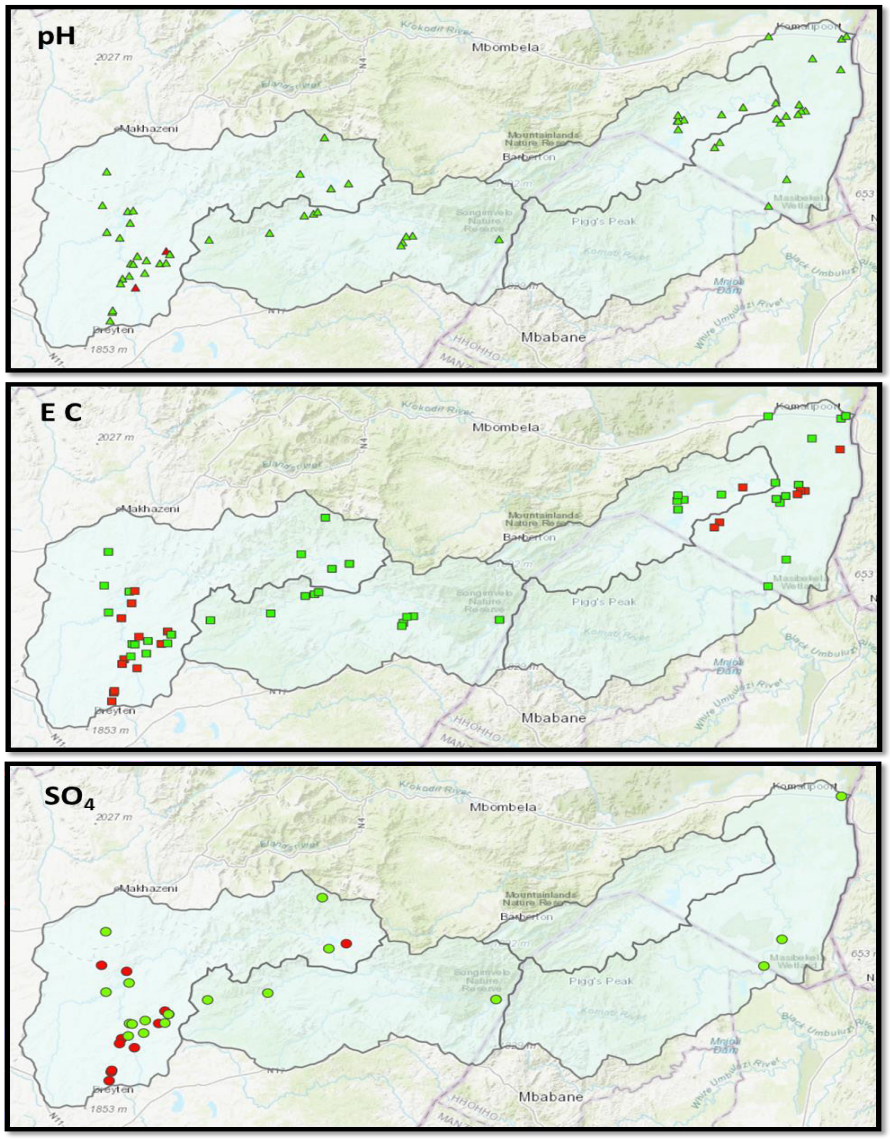



*Figure 15: Water quality status within Komati Catchment showing system (pH) and salts (EC and $SO_4$) concentrations.*

**pH**

pH complied with the RQO, except for two points the tributary of Boesmaspruit and Swartspruit within Upper Komati sub catchment, which is acidic, this may be due to the decanting mine water from active mines and defunct mines within the area.

**Electrical Conductivity (EC)**

Electrical Conductivity was compliant at most monitoring points with the RQOs (Aquatic Ecosystem drivers) set within the Komati Catchment. There were a few points where the EC did not comply with the set RQOs in the Upper Komati sub-catchment especially on the Boesmaspruit which is dominated by coal mines. In the Lower Komati sub catchment mainly dominated by agricultural activities, there were also a few monitoring points where EC did not comply with the set RQOs. The high level of EC is due to presence of dissolved solids arising from mining activities, effluent from WWTWs, stormwater runoff from formal /informal settlements areas and agricultural runoff.

**Sulphate ($SO_4$)**

Sulphate concentration showed non-compliance with the RQOs limit within priority resource units or the TWQG limits in the Boesmanspriut, Klien Komati, Swartspruit, and Gladdespruit. These priority resource unit is dominated by coal mines and the high levels of sulphates are mostly attributed to active mines and defunct mines some of which are decanting.

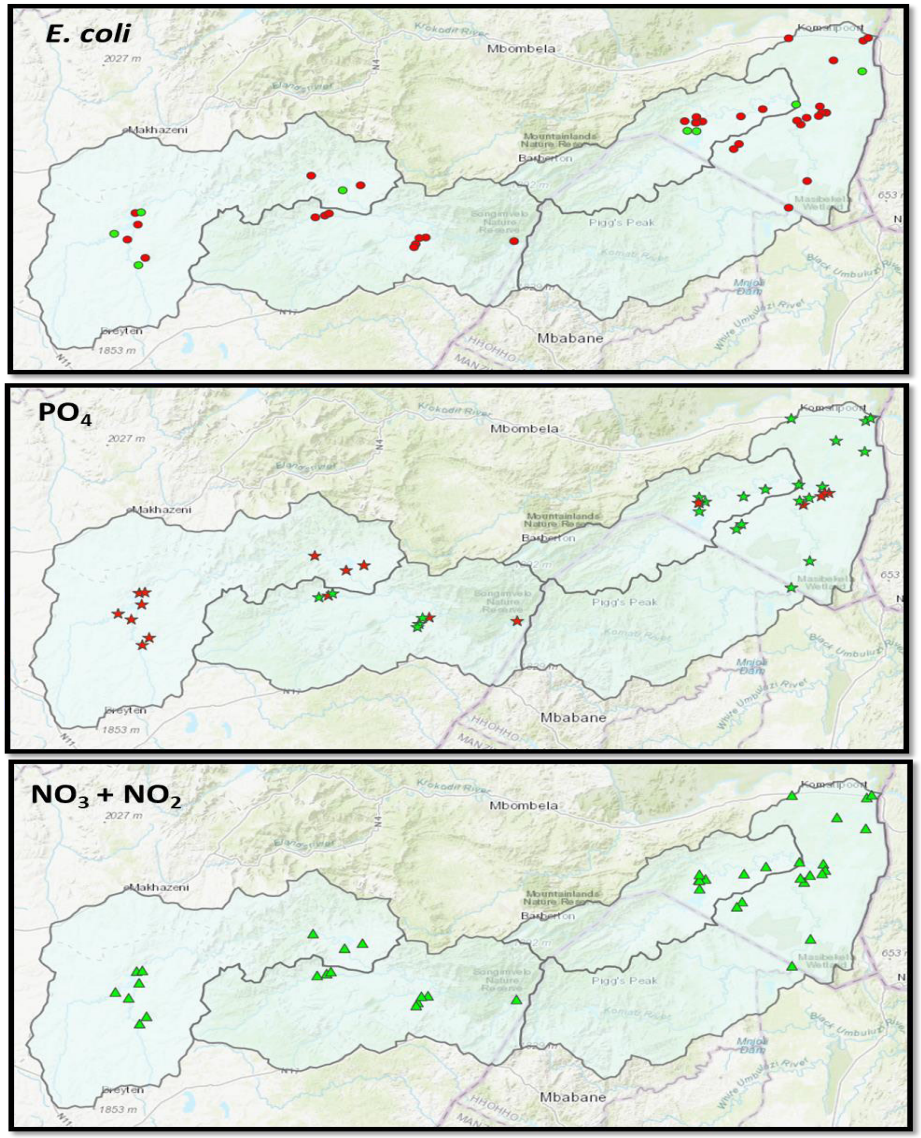



*Figure 16: Water quality status within Komati Catchment showing microbiological (E.coli) and nutrients ($PO_4$ and $NO_3$+$NO_2$) concentrations.*

***Escherichia coli (E. coli)***

***E. coli*** counts in the Komati Catchment complied with the RQO of 130 (cfu/100ml) for only eight (8) points and the others sites in Carolina, Badplaas and Elukwatini areas within the upper Komati sub catchment and Tonga, Skoonplaas, KaMaqhekeza and Buffelspuit settlement within lower Komati sub catchment showed elevated *E. coli* counts which did not comply with the set RQOs due to contamination of human faecal material or/and other animals.

**Phosphate ($PO_4$)**

Phosphate showed noncompliance with the RQOs for most of the points within upper Komati sub catchment, except for two points. However, in the Lower Komati only four (4) monitoring points did not comply and the rest were compliant with the set RQOs. The impacts are attributed by effluent discharges from WWTWs and illegal dumping of solid waste especially disposable nappies.

**Nitrates/Nitrites**

Nitrates/Nitrites concentrations complied with the TWQG (Domestic - Human consumption) throughout the Komati catchment.

## 3.5 Ecological Water Requirements (EWR) Sites

The data reported was collected over a period of a year from January 2019 - December 2019 and was statistically analysed using percentiles and average as tabulated below. The compliance status of Ecological Water Requirements is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in Table 8 below.

**Table 12**: Water Quality Variables

| Classified Water quality variables | Indicator Variables | Statistical analysis of data |
|---|---|---|
| System | pH | 5 and 95 percentiles |
| Salts | Electrical Conductivity | 95 percentiles |
| Nutrients | Orthophosphate | 50 percentiles |
| Microbial | *E coli* | Average |

**Table 13:** EWR Sites water quality status: Compliance (Green) or non-compliance (Red)

| EWR Site | pH | | EC (mS/m) | | $PO_4$ (mg/l) | | *E coli* (cfu/100ml) | |
|---|---|---|---|---|---|---|---|---|
| | RQOs | Results | RQOs | Results | RQOs | Results | RQOs | Results |
| EWR K-1 | 6.5 - 8.0 | **7.1 – 7.9** | 30 | **17.05** | 0.02 | **0** | 130 | **203** |
| EWR G-1 | 6.5 - 8.0 | **7.2 – 8.0** | N/A | **33.6** | 0.02 | **0.** | N/A | **504** |
| EWR T-1 | 6.5 - 8.0 | **7.1 – 8.0** | N/A | **44.0** | 0.125 | **0.021** | 130 | **31686** |
| EWR K-2 | 6.5 - 8.0 | **7.5 – 8.1** | 55 | **19.3** | 0.02 | **0** | 130 | **277** |
| EWR K-3 | 6.5 - 8.0 | **7.3 – 8.2** | 85 | **51.1** | 0.125 | **0.005** | 130 | **386** |
| EWR L-1 | 6.5 - 8.0 | **7.3 – 8.5** | 40 | **26.1** | 0. 075 | **0.018** | 130 | **293** |
| N/A=Not available | | | | | | | | |

## 3.6 EWR Sites Trends Analysis

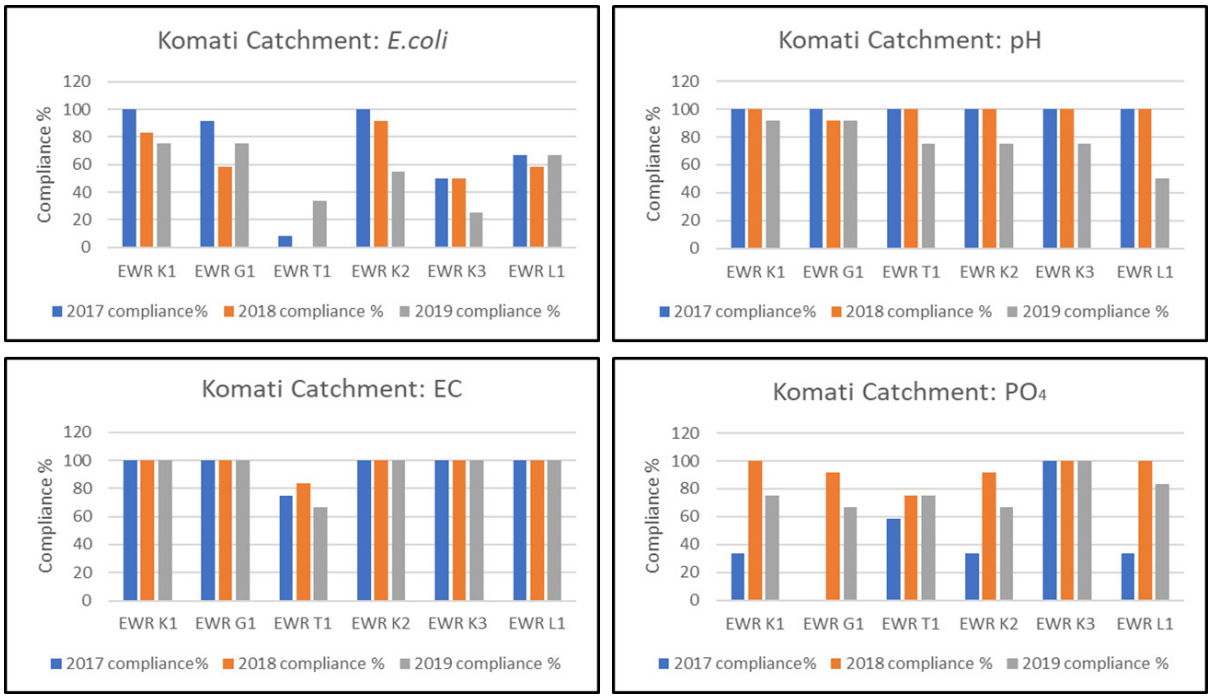



*Figure 17: The compliance % of E coli, pH, EC and $PO_4$ concentrations on EWR sites in the Komati Catchment for year 2017, 2018 and 2019.*

# Chapter 4: Usuthu Catchment

## 4.1 Introduction

The headwaters of the Usutu River emerge from the highlands of Amsterdam, Mpumalanga province, flow through the Kingdom of eSwatini and the Republic of Mozambique before entering the Indian Ocean. The Usuthu Catchment is unique from the other three catchments due to the short distance from the headwaters to the border with eSwatini. Consequently, it has independent rivers that start at the source and flow directly into a neighbouring country before confluence with the main stem. While the main stem is the Usuthu River, the other tributaries confluence with the Usuthu River in eSwatini. These tributaries are the Lusushwana, Mpuluzi, bordering the Usuthu River to the North, and Sandspruit immediately south of the Usuthu River, followed by the Ngwempisi, Hlelo and Assegai consecutively to the south.

The major activities in the catchment include forestry, mining, agricultural activities and municipal wastewater treatment works. The Usuthu catchment is characterised by large transfers out of the catchment (and out of the WMA) to the Vaal and Olifants Water Management Areas mainly for cooling purposes at ESKOM power stations but also for other economically important activities. Four large dams in the Usuthu support these transfers, namely, Heyshope, Morgenstond, Westoe and Jericho dams. Pollution of these strategic water resources will significantly impact on power generation and the economy of the country at large.

## 4.2 Water Quality Monitoring Points

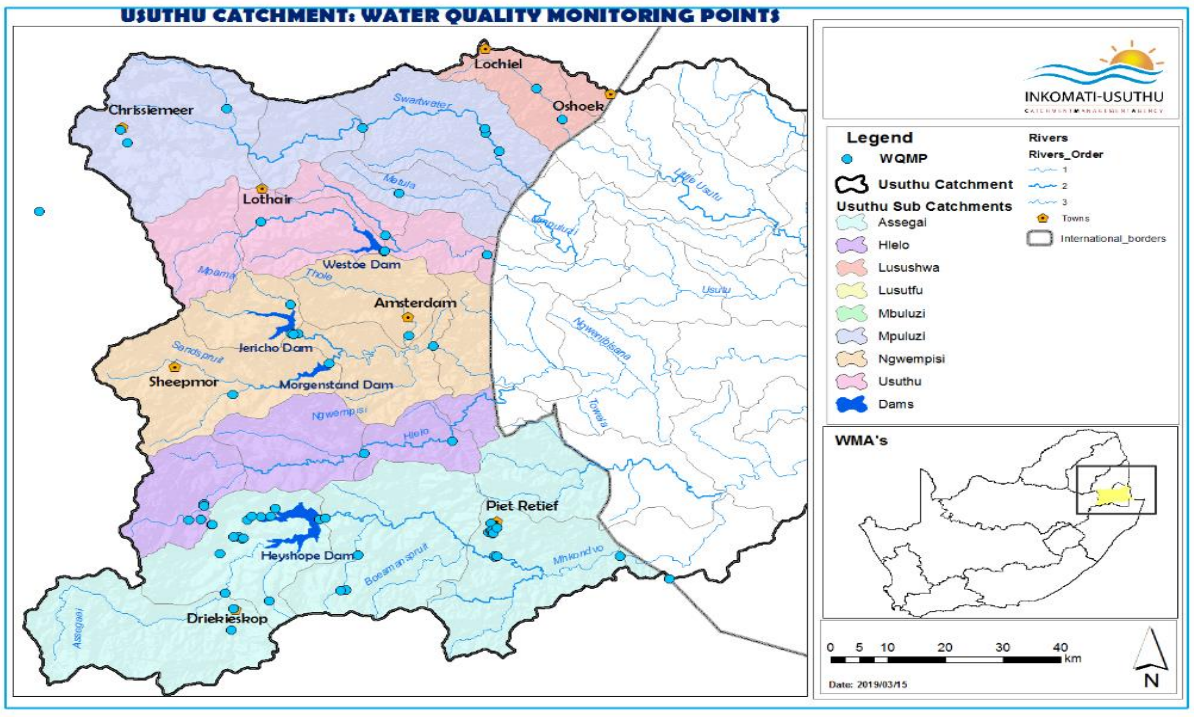



*Figure 18: Water quality monitoring points in the Usuthu Catchment*

## 4.3 Target Water Quality Guideline

There are currently no RQOs for the Usuthu Catchment. Thus, the South African Target Water Quality Guidelines (SATWQG) were used to benchmark the water quality data for all variables. The compliance of the indicator parameters was compared with the Target Water Quality Guideline Limits (TWQG).

*Table 14: Target Water Quality Guideline*

| Variables/Parameters | TWQG |
|---|---|
| *E. coli* (cfu/100ml) | 130 (Recreation: full contact) |
| Electrical Conductivity (mS/m) | 40 |
| Phosphate (mg/l) | 0.025 |
| pH | 6.5-8.5 |
| Nitrates/Nitrites (mg/l) | 6 (Domestic) |
| Manganese (mg/l) | 0.18 (Aquatic ecosystem) |
| Ammonia (mg/l) | 1 (Domestic) |
| Sulphate (mg/l) | 30 (Industry Category 1) |

## 4.4 Water Quality Status and Discussion of Results

Sulphate and manganese are monitored to assess the impact of coal mining activities in the catchment and complied with the TWQG for Industry of 30 (mg/l) and aquatic ecosystem of 0.18 (mg/l) respectively throughout the reporting period except for 4 sites for sulphate and 3 sites for manganese within the Assegaai catchment which exceeded the set TWQG.

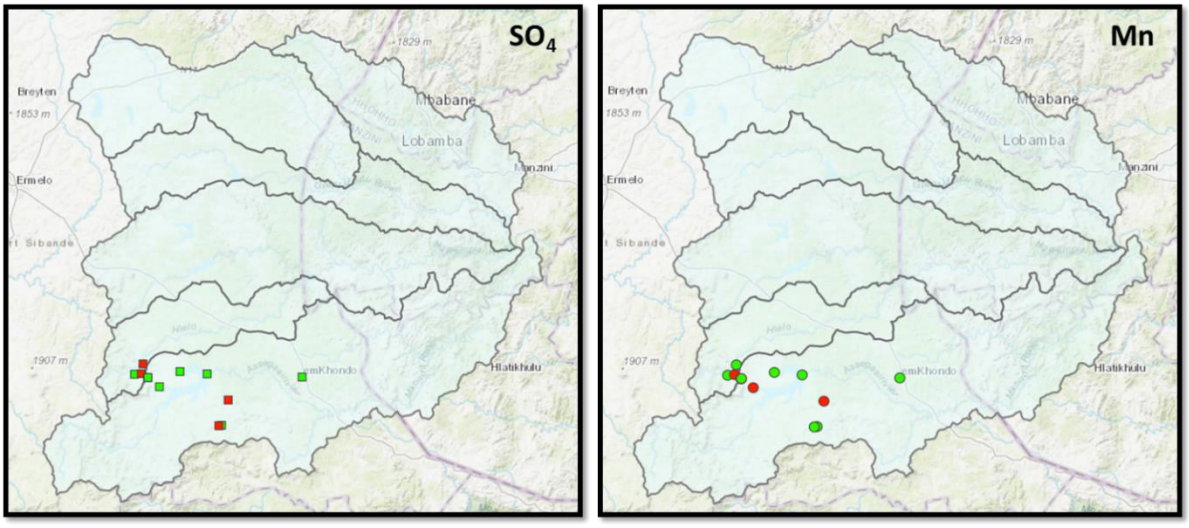



*Figure 19 : Water quality status within Usuthu Catchment showing salts (SO4) and toxic (Mn) concentrations.*

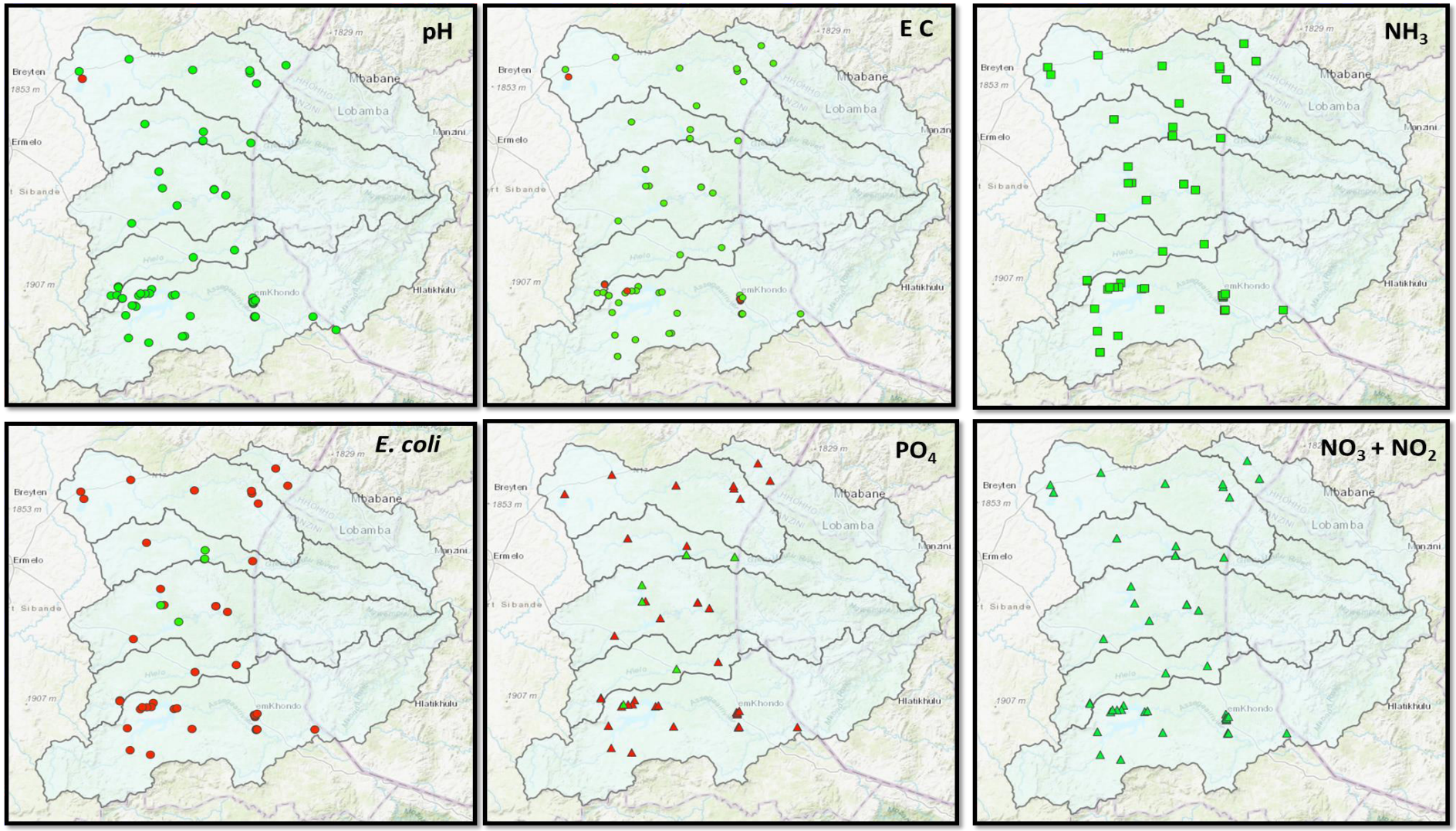



*Figure 20* : *Water quality status within Usuthu Catchment showing system (pH), salt (EC), toxic ($NH_3$), microbiological (E coli) and nutrients ($PO_4$, $NO_3$+$NO_2$) concentrations.*

**pH** complied with the TWQG limit, except for the point downstream of Chrissiessmeer WWTWs which is alkaline as shown in figure 22 below.

As shown in figure 22 below the **Electrical Conductivity** complied with the TWQG limits within the Usuthu Catchment except for downstream of Chrissiessmeer Oxidation Ponds, Hlelo River, Egude Rive as well as five points at Klipmisselspruit and its tributaries.

**Ammonia** concentrations complied with the TWQG throughout the catchment except one-point Klipmisselspruit before confluence with Assegai River.

***Escherichia coli*** counts in the Usuthu Catchment did not comply with the TWQG limits of 130 (cfu/100ml). The non-compliance can mostly be attributed to the WWTW which discharge untreated or partially treated wastewater into the streams, overflowing sewer pump stations, non-point sources such as illegal waste dumping.

**Nitrates/Nitrites** concentrations complied with the TWQG (Domestic -Human consumption) throughout the catchment.

**Phosphate** concentrations did not comply with the TWQG for points within Usuthu Catchment, except six (6) points that indicated compliance.

## 4.5 Usuthu Catchment Rivers Trends Analysis

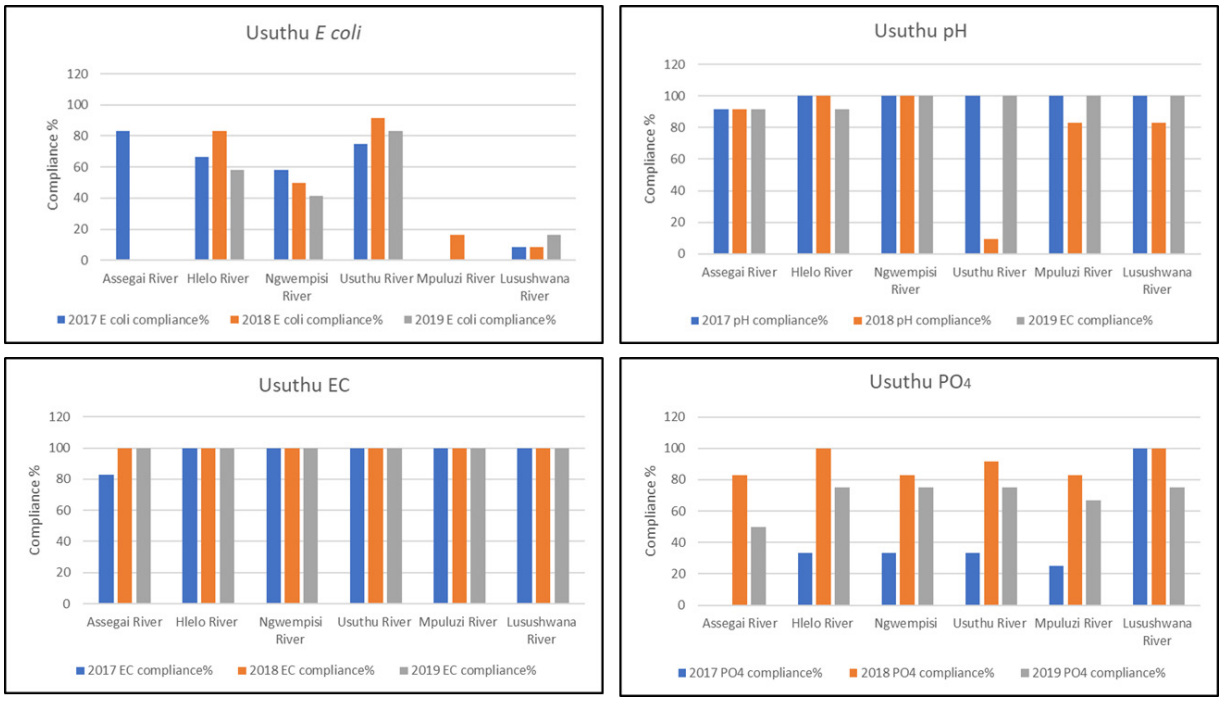
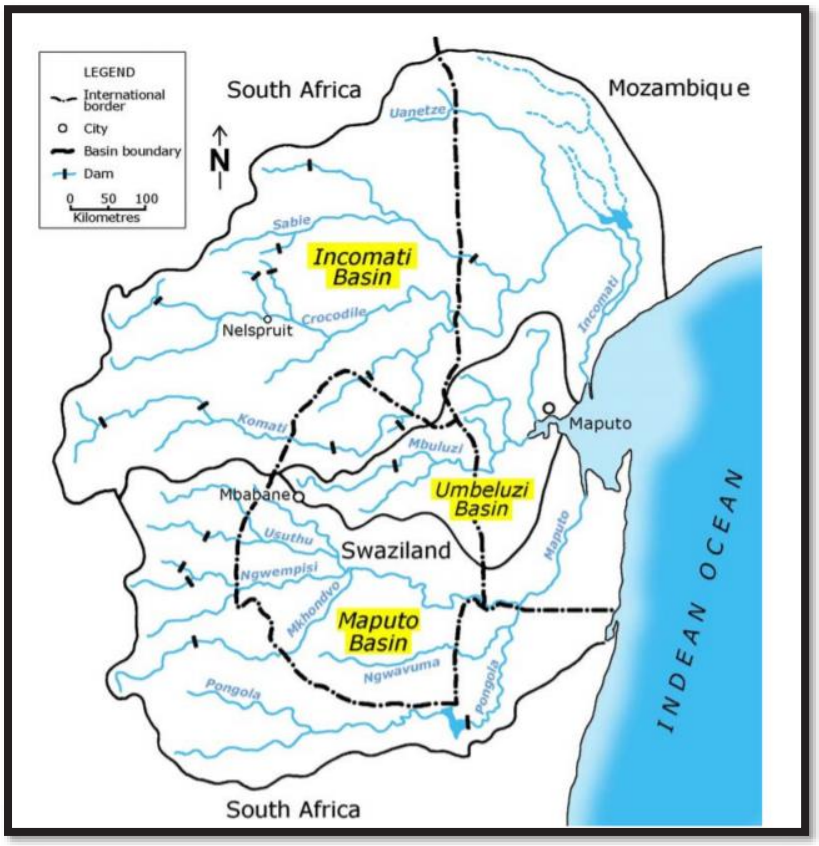



*Figure 21: The compliance % of E coli, pH, EC and $PO_4$ concentrations on Usuthu Catchment Rivers for year 2017, 2018 and 2019.*

# Chapter 5: International Obligations

## 5.1 Introduction

The Inkomati-Usuthu water management area falls within two river basins namely Incomati River Basin and Maputo River Basin (insert). The Incomati River Basin is located in the eastern region of southern Africa and is shared by South Africa, eSwatini and Mozambique. The basin is 480 kilometres long, with drainage basin 50,000 square kilometres in size. The headwater of Maputo River Basin originates in South Africa, Usuthu River in Mpumalanga province, and flows easterly through eSwatini and the River is called Great Usuthu or Lusutfu, where it enters the Republic of Mozambique after confluence with Pongola River and it's called Maputo River flowing into the estuary in Maputo Bay. The 13 km gorge (Valley) forms the boundary between Kingdom of eSwatini and Republic of South Africa and approximately twenty kilometres forms the border between South Africa (province of KwaZulu-Natal) and the Republic of Mozambique. The land area of the Maputo River basin is about 30 000 km$^2$.




Water is used by forest plantations and for domestic and industrial use, while irrigation is the major water user in both basins. The governments of the Republic of Moçambique, the Republic of South Africa and the Kingdom of eSwatini have been collaborating in the exchange of information, agreements on sharing of water, and in joint studies that are of mutual interest and benefit. These initiatives have been done through the Tripartite Permanent Technical Committee (TPTC), which was formally established on 17 February 1983. The TPTC is responsible for providing advice to the shared watercourse States on equitable utilisation and management of the shared waters. It was identified in the Interim IncoMaputo Agreement (IIMA), (August 2002) that a "Comprehensive Agreement" is required for the watercourse states to participate more effectively in the utilisation, development and protection of the shared waters.

## 5.2 International Water Quality Monitoring Points

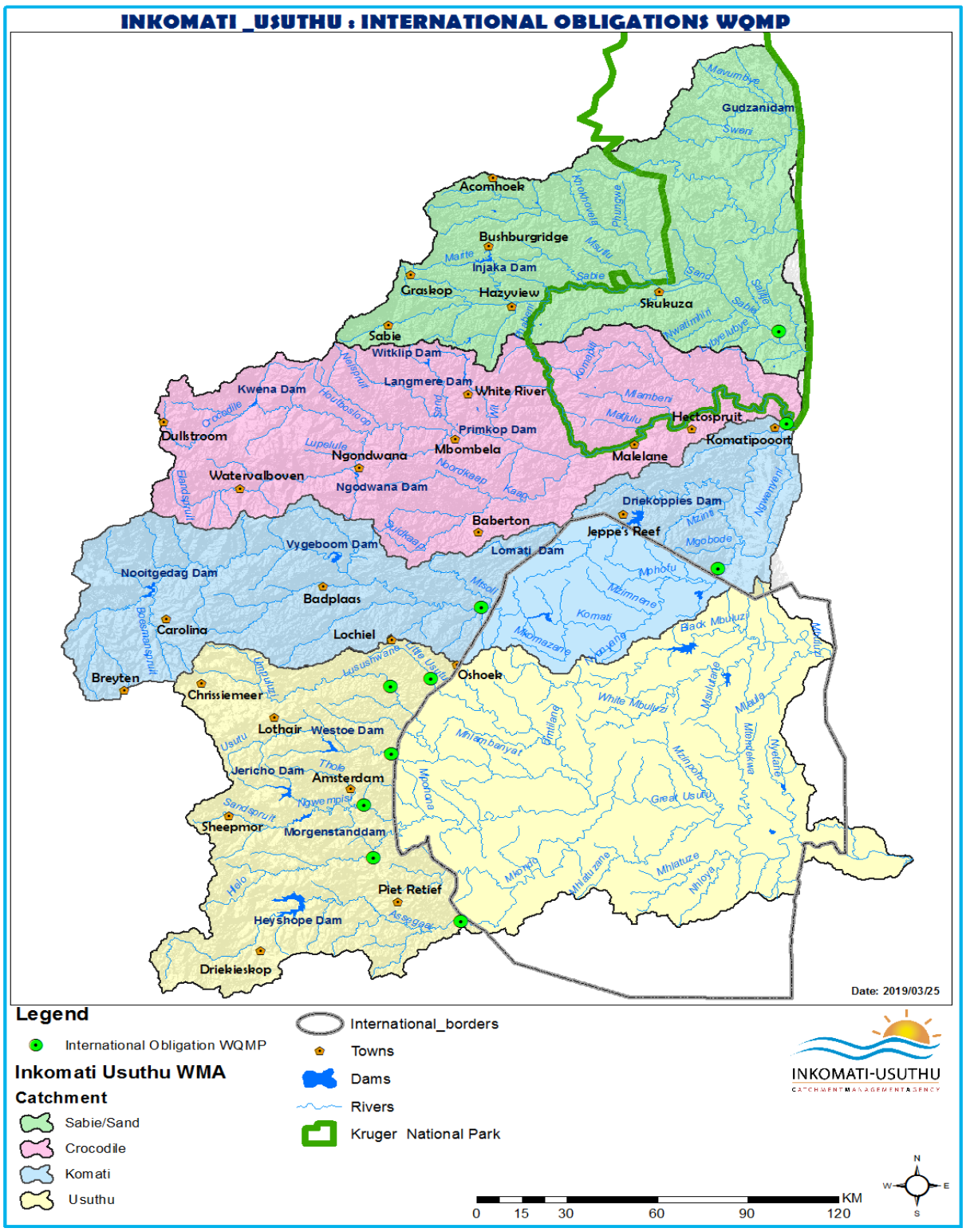
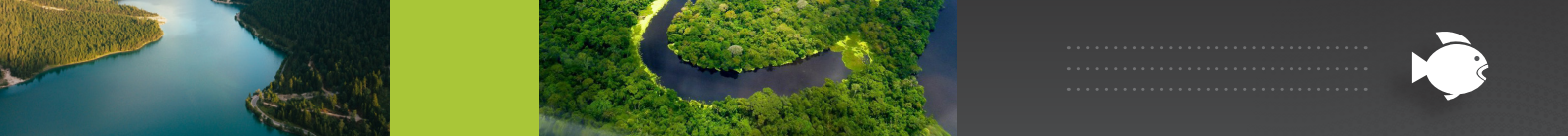



*Figure 22: International Obligation water quality monitoring points in the Inkomati-Usuthu WMA*

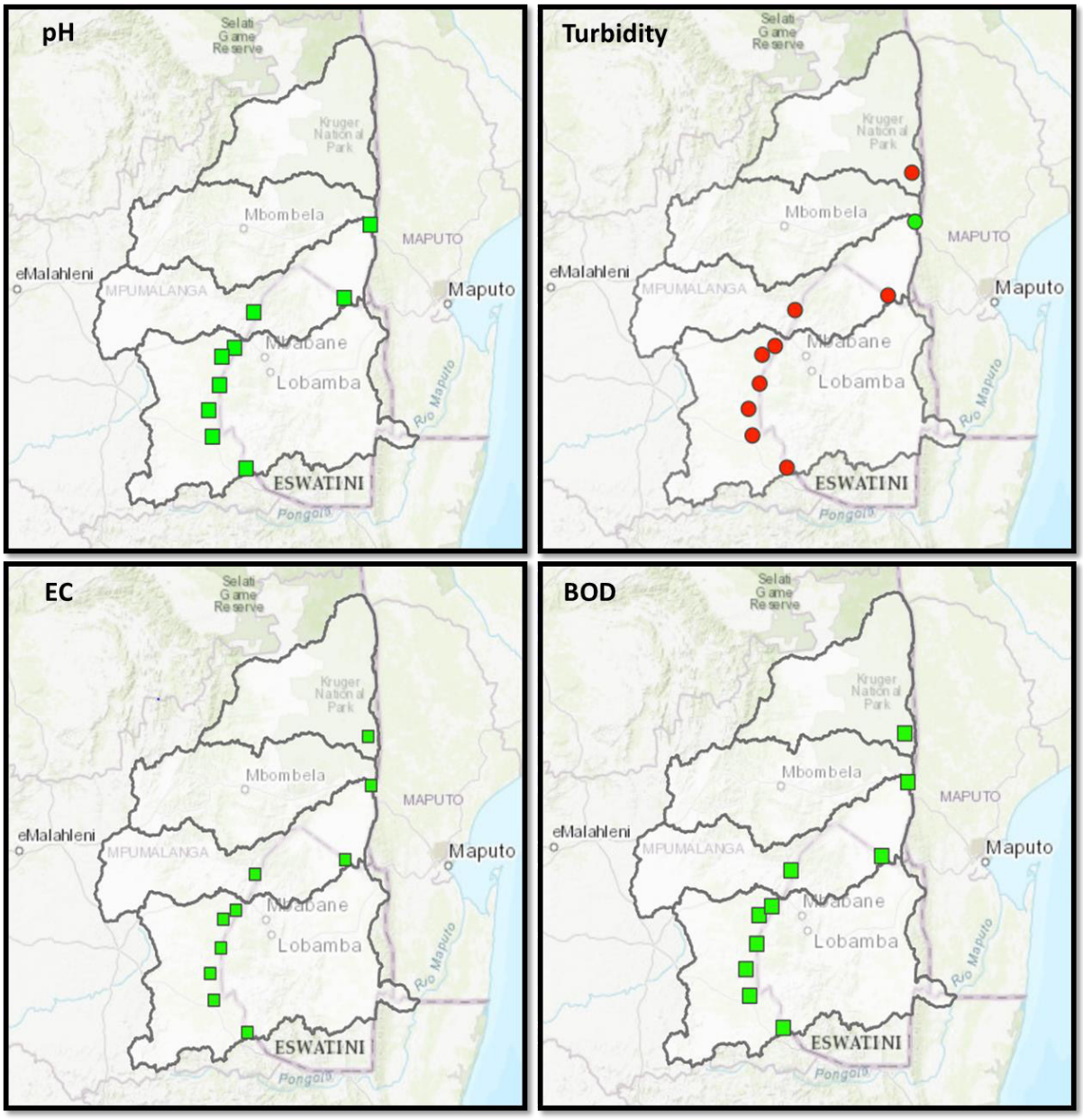


## 5.3 International Water Quality Guideline limits

*Table 15: International Water Quality Guideline limits*

| Variables/Parameters | International Water Quality Guidelines Limits |
|---|---|
| *Escherichia coli (E. coli)* in cfu/100ml | N/A |
| *Total Coliforms (TC) in cfu/100ml* | 10 000 |
| Faecal coliforms (FFC) in cfu/100ml) | 2 000 |
| Faecal Streptococci (FS) in cfu/100ml) | 1 000 |
| Electrical Conductivity (EC) in mS/m) | 150 |
| Sulphate ($SO_4$) in mg/l) | 250 |
| Phosphate ($PO_4$) in (mg/l) | 2 |
| pH | 6.5-8.5 |
| Nitrates ($NO_3$) in mg/l | 50 |
| Ammonia ($NH_3$) in mg/l | 1 |
| Copper (Cu) in mg/l | 0.02 |
| Iron (Fe) in mg/l | N/A |
| Manganese (Mn) in mg/l | 0.3 |
| Biological Oxygen Demand (BOD) in mg/l | <5 |
| Chemical Oxygen Demand (COD) in mg/l | 10 |
| Chloride (Cl) in mg/l | 250 |
| Fluoride (F) in mg/l | 0.75 |
| Potassium (K) mg/l | 50 |
| Sodium (Na) in mg/l | 200 |
| Turbidity (TUR) in NTU | 5 |

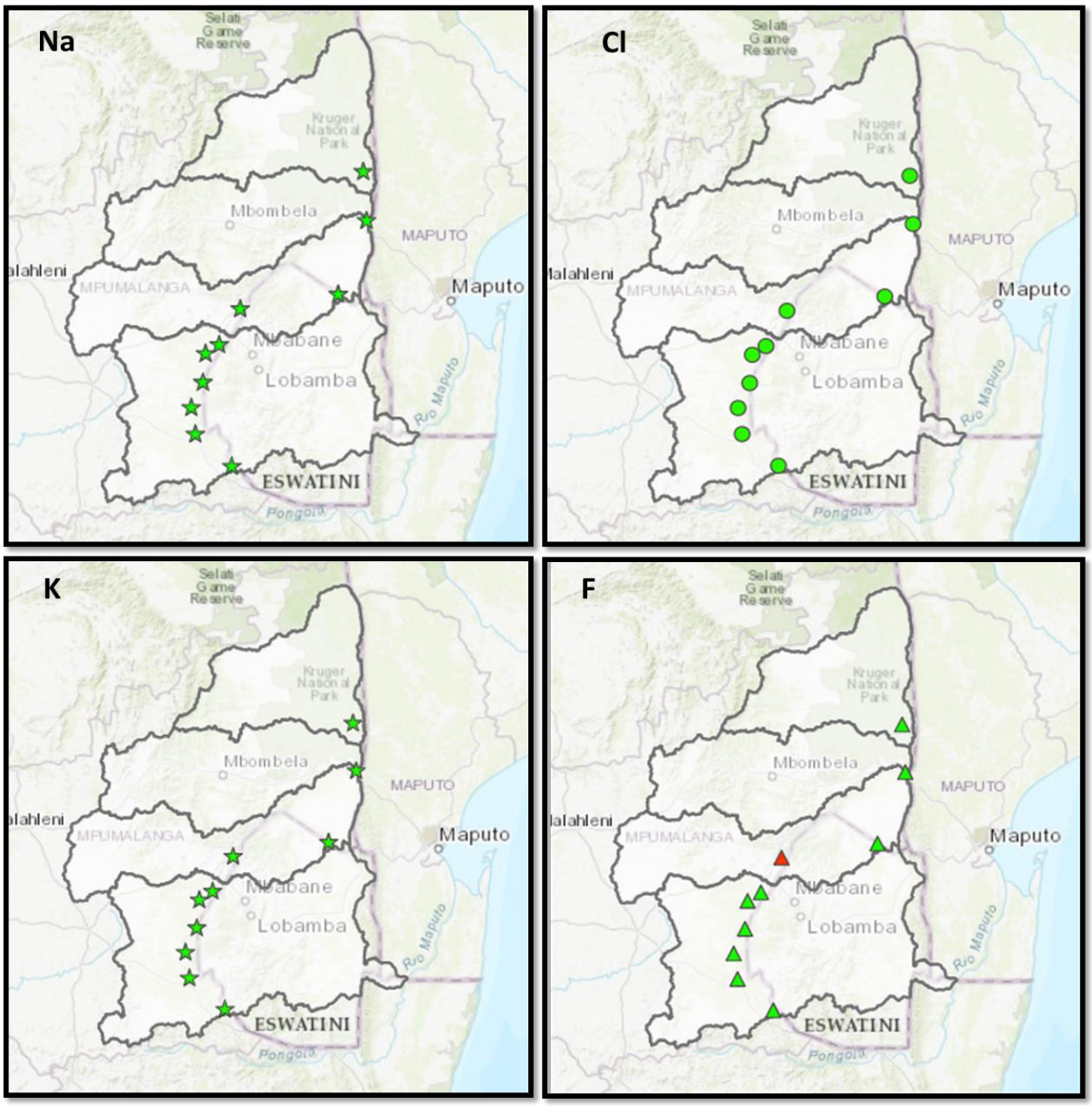
## 5.4 Water Quality Status




*Maps showing water quality status for international obligation sites*

**Discussion of Results**

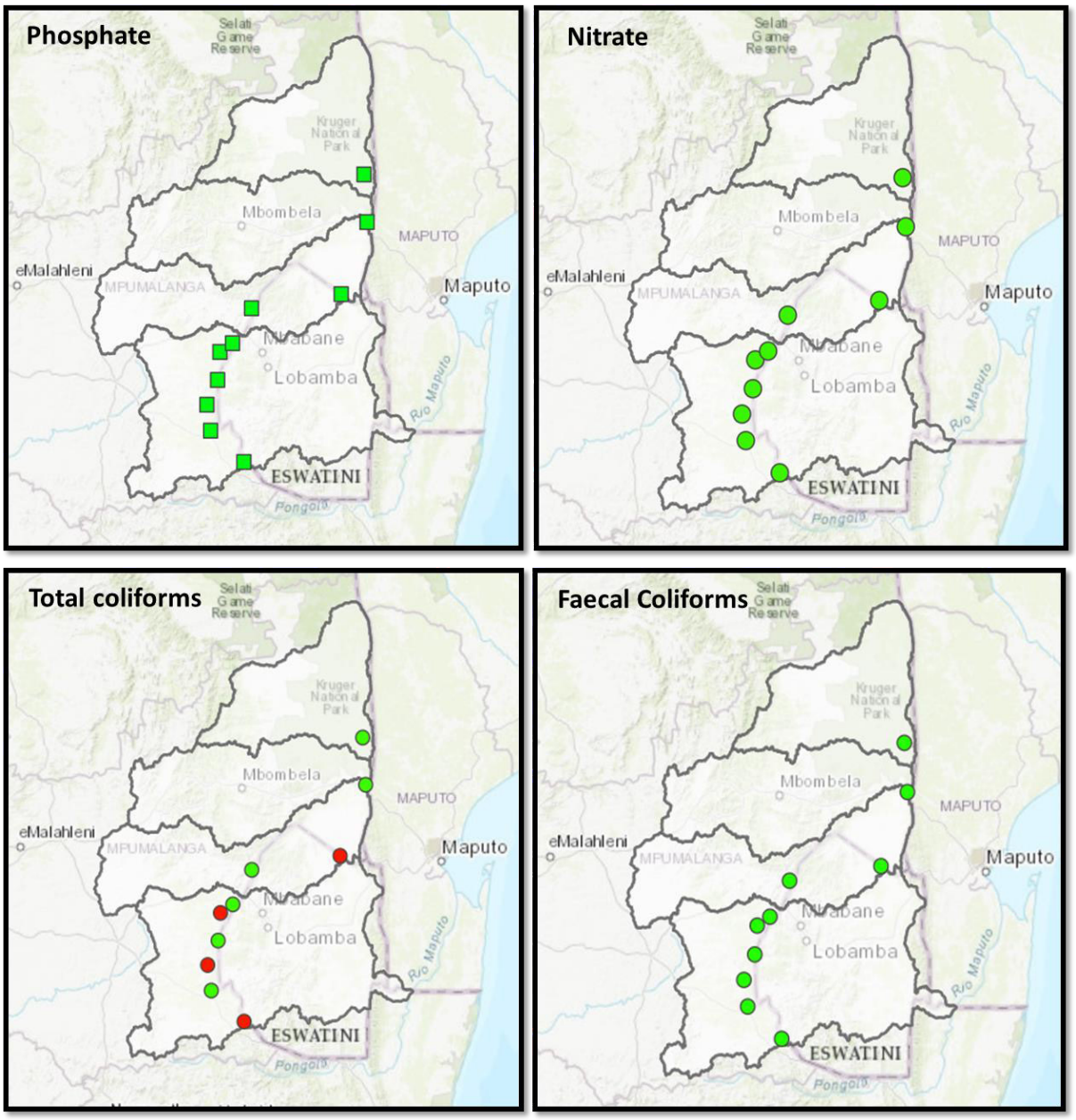
All variables reported complied with the international water quality guidelines limit as per the Tripartite Interim Agreement between Republic of Mozambique, Republic of South Africa (RSA) and the Kingdom of eSwatini. The Republic of South Africa therefore complied with the water quality limits discharged (allowed to flow) into the Republic of Mozambique and Kingdom of eSwatini as per the international obligation agreement throughout the reporting period, except for turbidity which indicated non-compliance however Komati River at Komatipoort.




*Maps showing water quality status for international obligation sites*

**Discussion of Results**

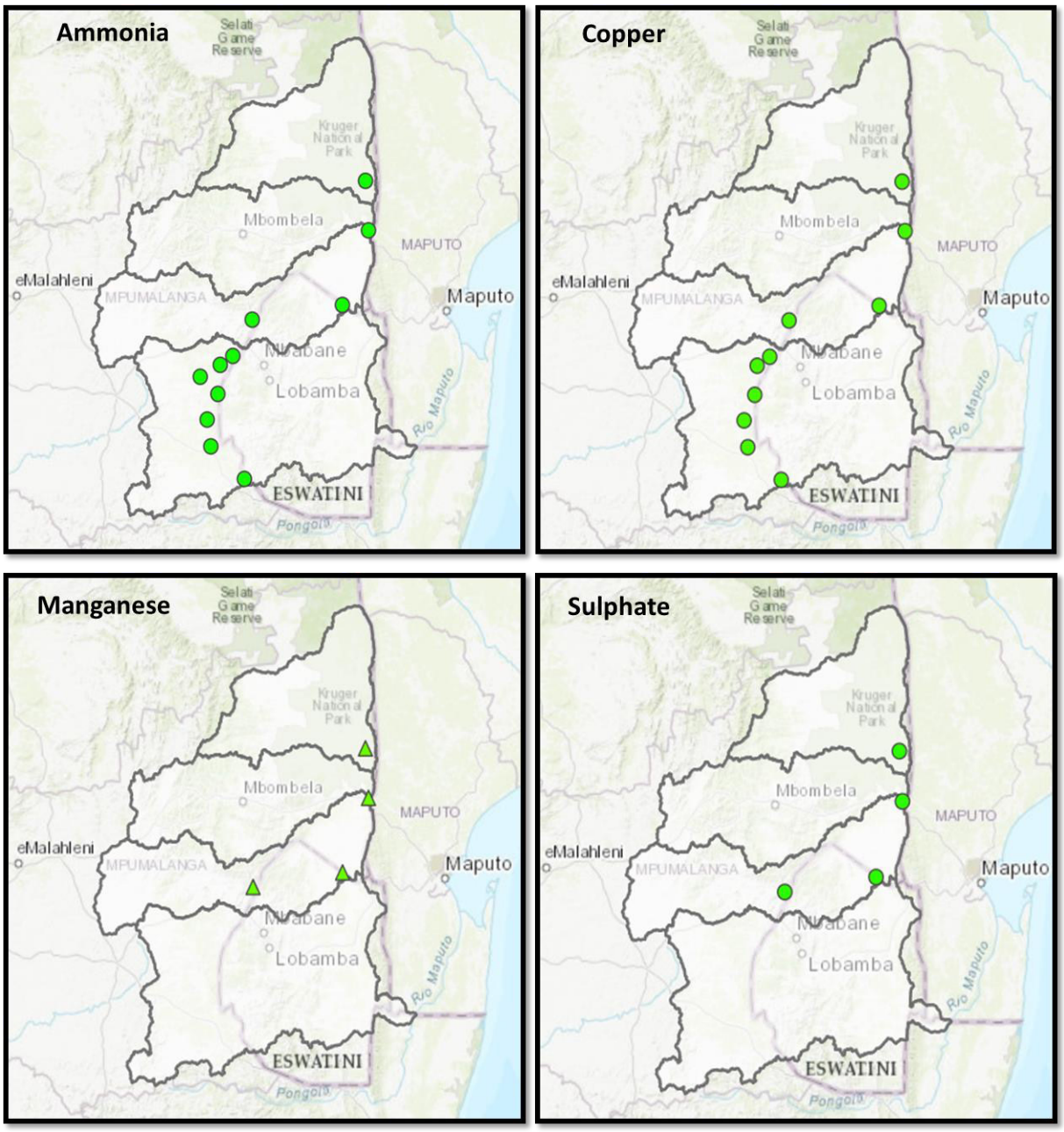
All variables reported complied with the international water quality guidelines limit as per the Tripartite Interim Agreement between Republic of Mozambique, Republic of South Africa (RSA) and the Kingdom of eSwatini. The Republic of South Africa therefore complied with the water quality limits discharged (allowed to flow) into the Republic of Mozambique and Kingdom of eSwatini as per the international obligation agreement throughout the reporting period, except for Komati River at Ekulindeni for Fluoride which indicated non-compliance.




*Maps showing water quality status for international obligation sites*

**Discussion of Results**

All variables reported complied with the international water quality guidelines limit as per the Tripartite Interim Agreement between Republic of Mozambique, Republic of South Africa (RSA) and the Kingdom of eSwatini. The Republic of South Africa therefore complied with the water quality limits discharged (allowed to flow) into the Republic of Mozambique and Kingdom of eSwatini as per the international obligation agreement throughout the reporting period, except for *total coliforms* at Assegaai River, Mpuluzi River and Ngwempisi River which indicated non-compliance. Eswatini's total coliform counts did not comply with the international obligations at Mananga Border discharging into South Africa.




*Maps showing water quality status for international obligation sites*

**Discussion of Results**

All variables reported complied with the international water quality guidelines limit as per the Tripartite Interim Agreement between Republic of Mozambique, Republic of South Africa (RSA) and the Kingdom of eSwatini. The Republic of South Africa therefore complied with the water quality limits discharged (allowed to flow) into the Republic of Mozambique and Kingdom of eSwatini as per the international obligation agreement throughout the reporting period. Note that the Manganese and Sulphate variable within Usuthu catchment will be analysed in year 2020.

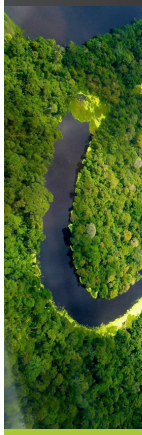
*Table 16: Water Quality Status: Compliance (Green) or non-compliance (Red)*

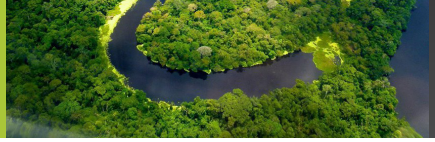
| Name of Resource | *Faecal Streptococci (Cfu/100ml)* | | | | | Chemical Oxygen Demand (mg/l) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sep | Oct | Nov | Dec | Limit | Oct | Nov | Dec | Limits |
| Sabie River @KNP | NA | >1000 | 920 | 760 | **1 000** | <12 | 21 | <12 | **10** |
| Komati River @Ekulindeni | 550 | 260 | 400 | 130 | **1 000** | NA | <12 | <12 | **10** |
| Komati River @ Mananga | 750 | >1000 | >1000 | 290 | **1 000** | NA | <12 | <12 | **10** |
| Komati River @Komatipoort | 300 | >1000 | 860 | 470 | **1 000** | NA | <12 | <12 | **10** |
| Lusushwana River | 800 | 120 | >1000 | >1000 | **1 000** | NA | 51 | 16 | **10** |
| Mpuluzi River | >1000 | 900 | >1000 | >1000 | **1 000** | NA | 16 | 21 | **10** |
| Usuthu River | 150 | >1000 | 190 | 70 | **1 000** | NA | 71 | <12 | **10** |
| Ngwempisi River | 350 | 850 | 180 | >1000 | **1 000** | NA | <12 | 13 | **10** |
| Hlelo River | 260 | >1000 | 920 | 320 | **1 000** | NA | 14 | 16 | **10** |
| Assegaai River | >1000 | 350 | >1000 | 510 | **1 000** | NA | <12 | 18 | **10** |

**NA= Not Analysed**

**Kindly note** that the accuracy of Chemical Oxygen Demand levels are inconclusive due to the laboratory detection limit of 12 (mg/l). The international obligation limit of 10mg/l could not be detected since the results showed < 12 mg/l.





## CONCLUSION

Surface Water Quality in the Inkomati-Usuthu WMA complied with the RQOs, TWQG and IWQG limits for most of the monitored points and this showed that the water quality within the WMA is relatively good. However, there are challenges with other variables in the water resources.

The presence of *E coli* in water resource indicates that the water has been contaminated with human faecal material or other animals and this is a challenge in the entire water management area. *Escherichia coli* contamination has a potential health risk for individuals who use water directly from the resource which may also lead to waterborne diseases for those people and is a threat for crop production, especially those crops eaten raw. It is also reported that the presence of *E coli* tends to affect humans more than it does aquatic organisms, though not exclusively.

Electrical Conductivity and phosphate are not major causes for concern in the catchment. It is only in selected areas where the water quality status related to these parameters are punctuated by non-compliance. The Boesmanspruit, Swartspruit, Gladdespruit, and Kaap River systems are being threatened by metal contamination especially manganese and arsenic as well high sulphates and low pH arising from mining activities (active mines, defunct mines and decanting mines).

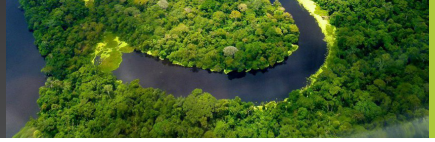
The Republic of South Africa complied with the international water quality limits discharged (allowed to flow) into Kingdom of eSwatini as well as Republic of Mozambique per the international agreement throughout the reporting period, except few monitoring sites which indicated non-compliance.

## RECOMMENDATIONS

The following recommendations are made in dealing with the resource quality as indicated:

- **Implementation of Waste Discharge Charge System.**
- **Continuous stakeholder awareness workshops.**
- **Compliance Monitoring and Enforcement:**

  It is recommended that the CME division investigate the critical areas and ensure that the necessary corrective actions are taken to achieve resource protection.

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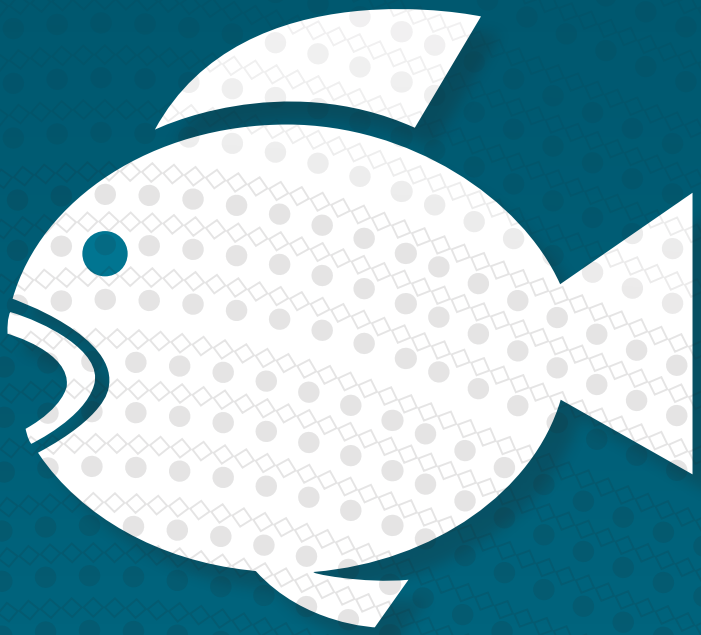

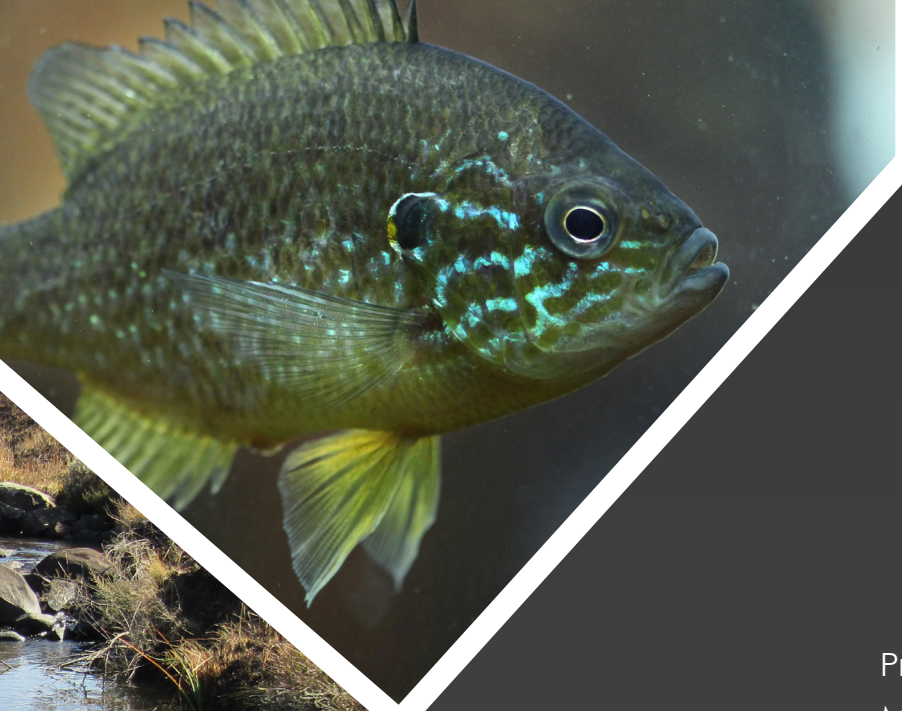

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