INKOMATI-USUTHU

CATCHMENT MANAGEMENT AGENCY

ANNUAL WATER QUALITY STATUS REPORT

FOR THE INKOMATI-USUTHU WMA

2020/21 FINANCIAL YEAR

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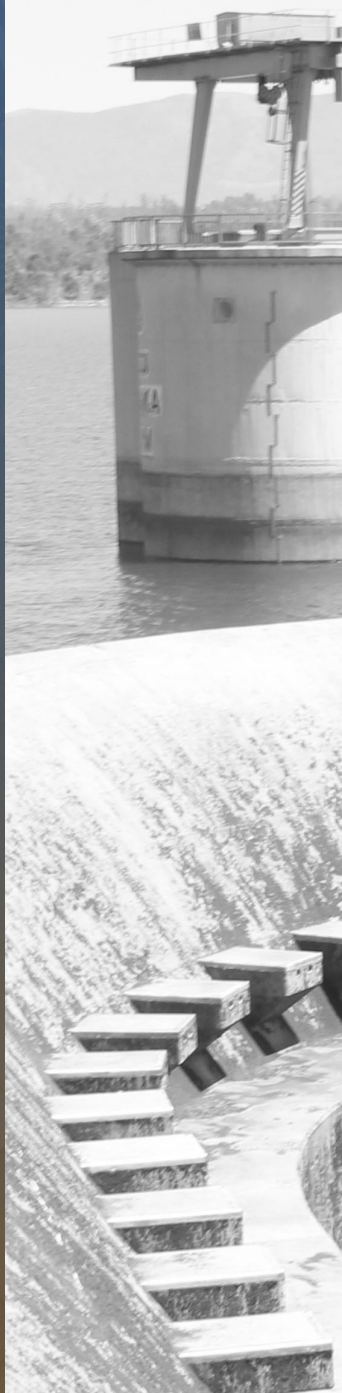

VISION

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 the environment.

VALUES

Integrity
Batho Pele (Stakeholders Orientation)
Accountability
Diversity
Transparency

SLOGAN

“Inkomati-Usuthu CMA, your partner in water management”

ANNUAL WATER QUALITY STATUS REPORT WITHIN INKOMATI-USUTHU WMA

Editors: Mr. Marcus Selepe and Dr Jennifer Balatedi Molwantwa

Acknowledgements for Technical contributions:

Caroline Tlowana	(Senior Scientist)
Jonathan Maenetja	(Scientific Technician)
Sakhile Nkosi	(Scientific Technician)
Bongekile Mahlatsi	(Scientific Technician)
Tebatso Chiloane	(Scientific Technician)
Moses Mojabake	(Scientific Technician)
Mbalenhle Dhlamini	(Scientific Technician)

EXECUTIVE SUMMARY

Chapter 3 of the NWA prescribes the protection of water resources through resource-directed measures including the determination of the management class, 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.

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.

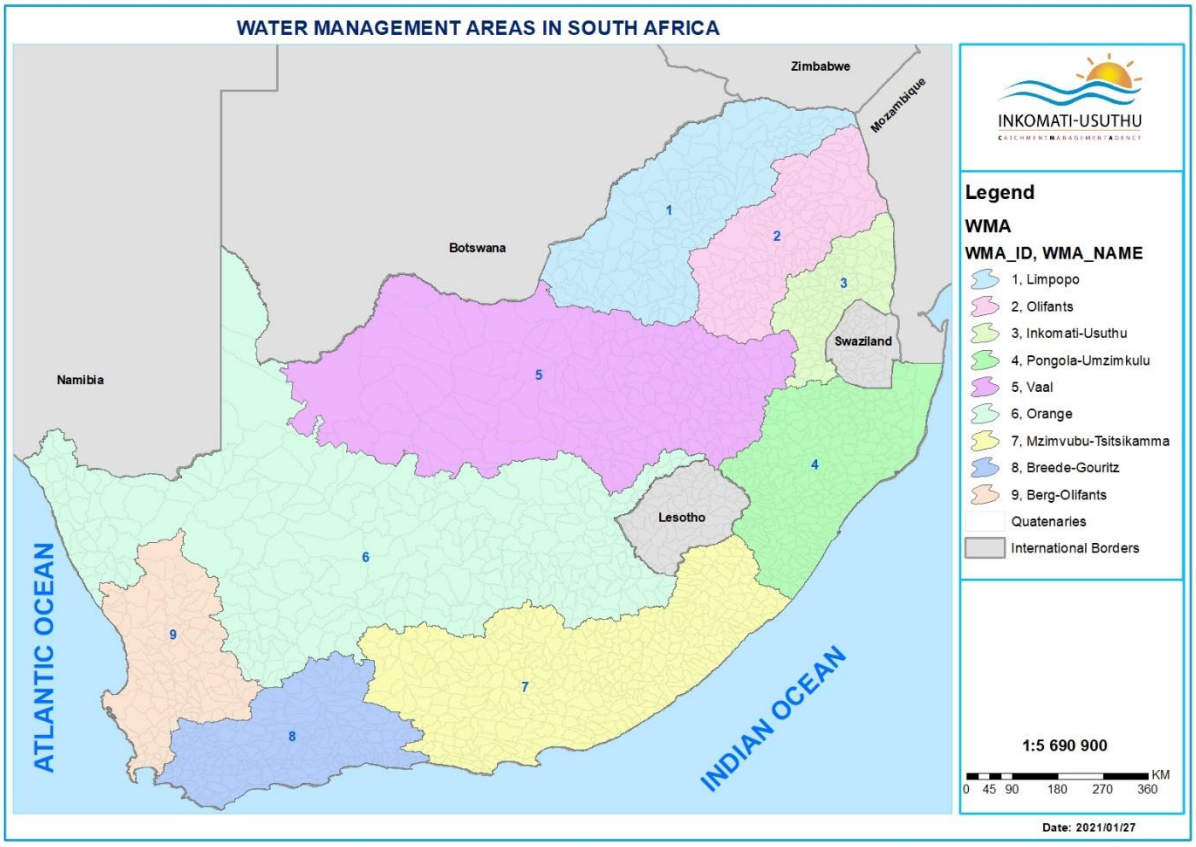


Figure 1: Map of South Africa indicating the nine WMA.

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 2020- December 2020) 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 as illustrated in *Figure 2* below. 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.

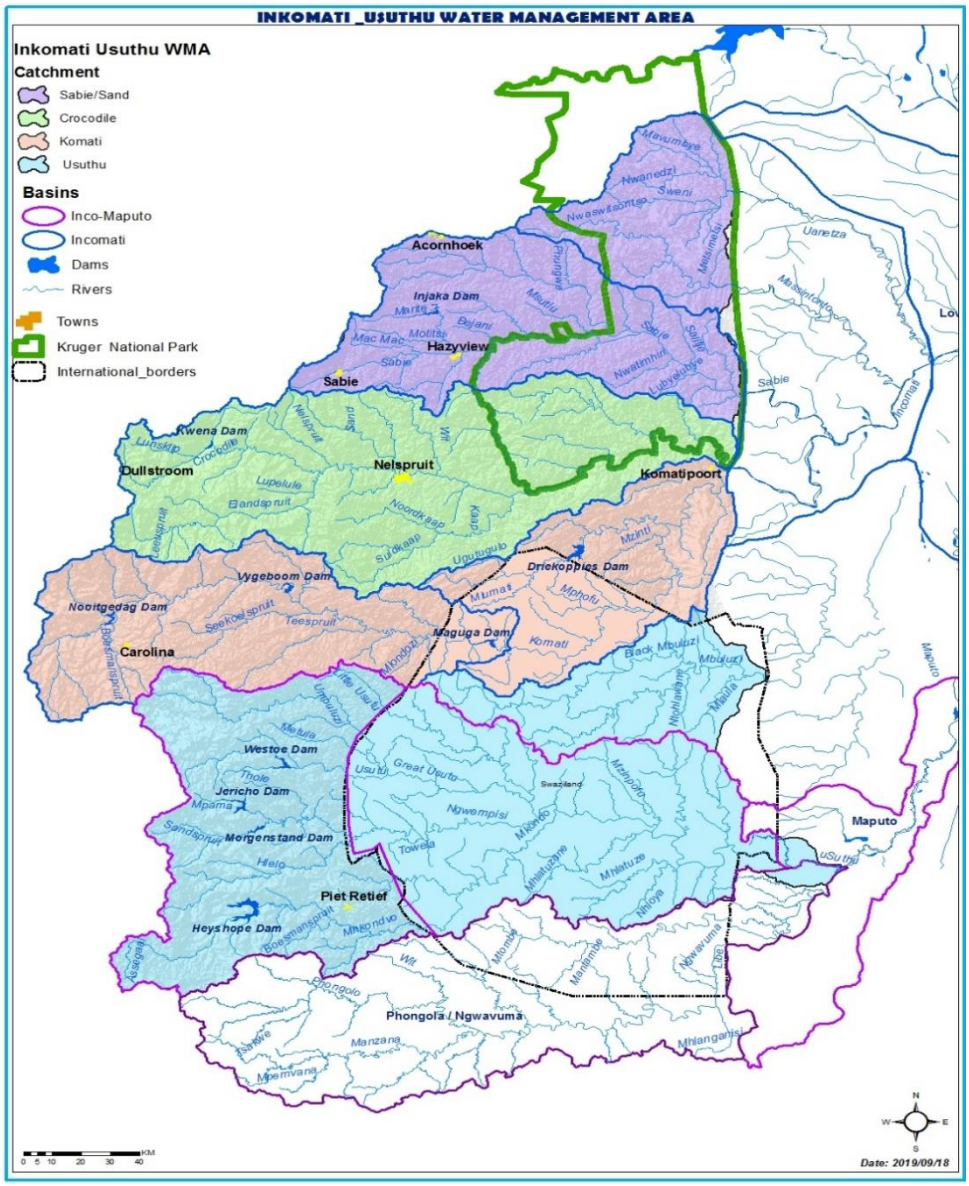


Figure 2: Inkomati-Usuthu Water Management Area

3.2 Materials and Methods

The water quality sample bottles were marked with the site code, date and time of sample collection using a permanent marker. There were no additives 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 system was used to display and interpret water quality data collected over a period of 12 months 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 Marite River. The Sand River confluences with the Sabie River inside the Kruger National Park. There are four main dams in the Sabie Sand Catchment, namely: Inyaka Dam, Da-Gama Dam, Eidenburg Dam and Mahleve 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 are several 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

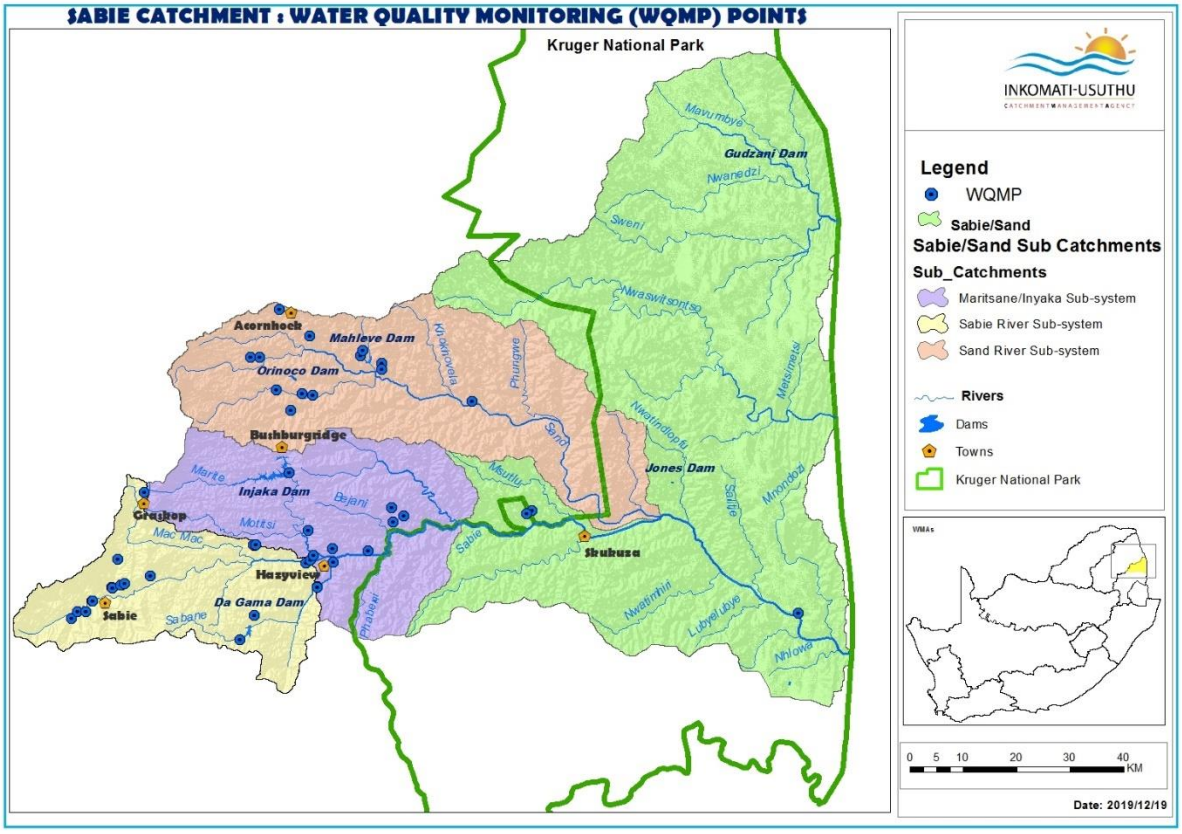


Figure 5: Water quality monitoring points in the Sabie Catchment

1.3 Resource Quality Objectives (RQOs)

The compliance of the indicator parameters is compared with the Resource Quality Objectives (RQOs) 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.

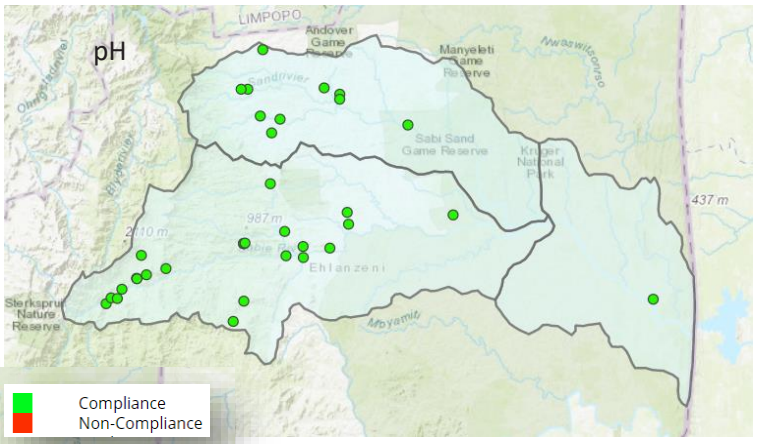
***Table 1**: TWQG and RQOs within Sabie/Sand Catchment*

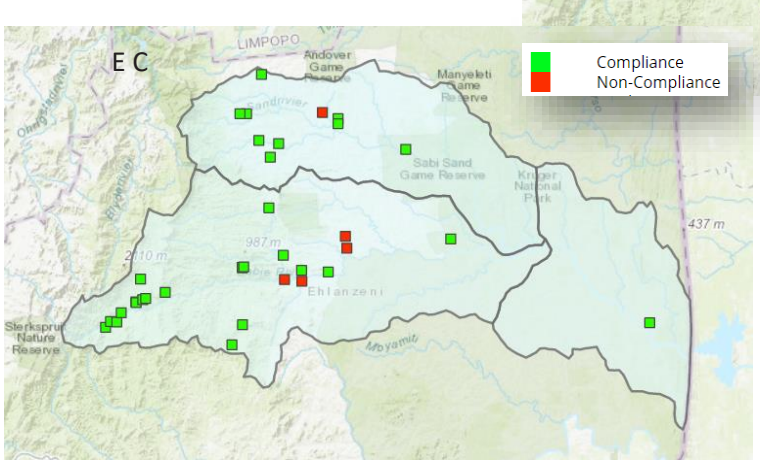
Variables/Parameters	Resource Quality Objectives		TWQG
	Sabie System	Sand System	
pH	6.5 - 8.0	6.5 – 8.8	6.5-8.5 (Recreation)
EC (mS/m)	30	55	40
Phosphate (mg/l)	0.015	0.125	N/A
Nitrates/Nitrites (NO_3 + NO_2) in mg/l)	N/A	N/A	6 (Domestic)
E. coli (cfu/100ml)	130	130	0

N/A=Not available

1.4 Water Quality Status Map(s) and Discussion of Results

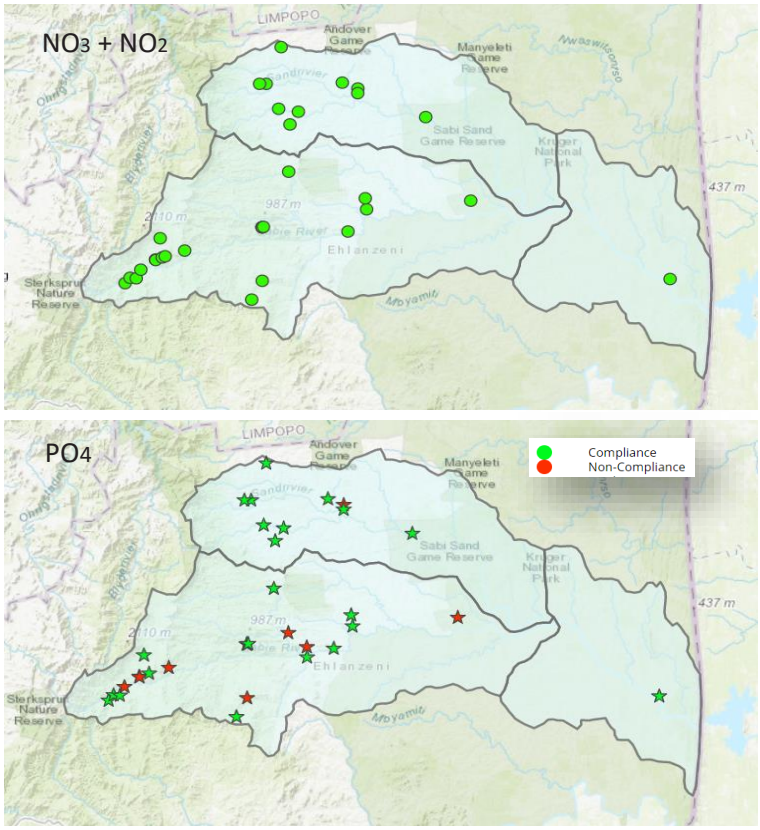
pH is a vital indicator of water that is changing chemically and measures how acidic/or basic the water is, ranging from 0 to 14. **pH** levels complied with the RQOs throughout the Sabie/Sand catchment.





Electrical Conductivity (EC) complied with RQOs except in the tributary of Sabie River downstream of Hazyview WWTW, the Bega River downstream of Mkhuhlu settlement, Upstream of Thulamahashe WWTWs on Sand River and Noordsand River before confluence with Sabie River.

Figure 6: Water quality status within Sabie/Sand Catchment showing acidity & alkalinity (pH) and Salts (EC) concentrations.

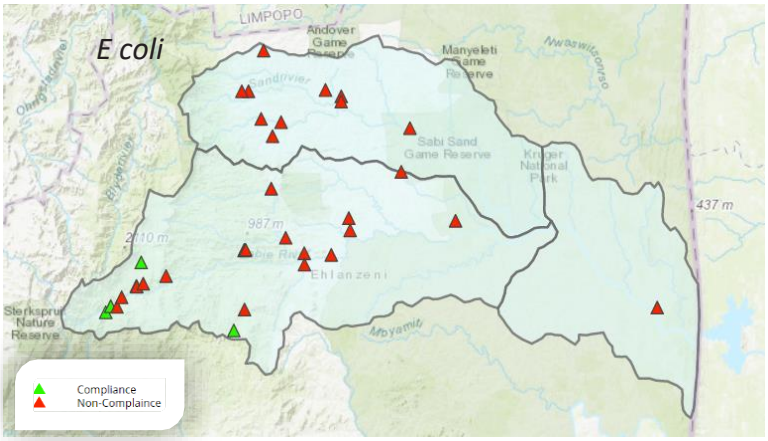


Nitrates/Nitrites concentrations complied with the TWQG throughout the sites monitored in the catchment.

Phosphate indicated compliance with the RQOs for most sites within Sabie/Sand sub-catchment except for few sites which indicated non-compliance.

Nutrients are required in water resource; however excessive amount can lead to eutrophication process which is harmful to fish and other aquatic life.

Figure 7: Water quality status within Sabie/Sand Catchment Nutrients (NO_3+NO_2 and PO_4) concentrations.



E. coli counts in the Sabie/Sand Catchment indicated compliance with the set RQOs of 130 (cfu/100ml) in headwater of Sabie River and Klein Sabie River, Lone Greek River 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.

Figure 8: Water quality status within Sabie/Sand Catchment showing Microbial (E coli) counts.

E. coli in water is a strong indicator of sewage or animal waste contamination in water bodies. 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.

1.6 Ecological Water Requirements (EWR) Sites Compliance Status

The data reported was collected over a period of a year from January 2020- December 2020 and was statistically analysed using percentiles and average as tabulated below in *Table 3*. The Sabie/Sand catchment comprises of eight (8) Ecological Water Requirements (EWR) sites across the catchment as presented in *Figure 9*.

***Table 2**: 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

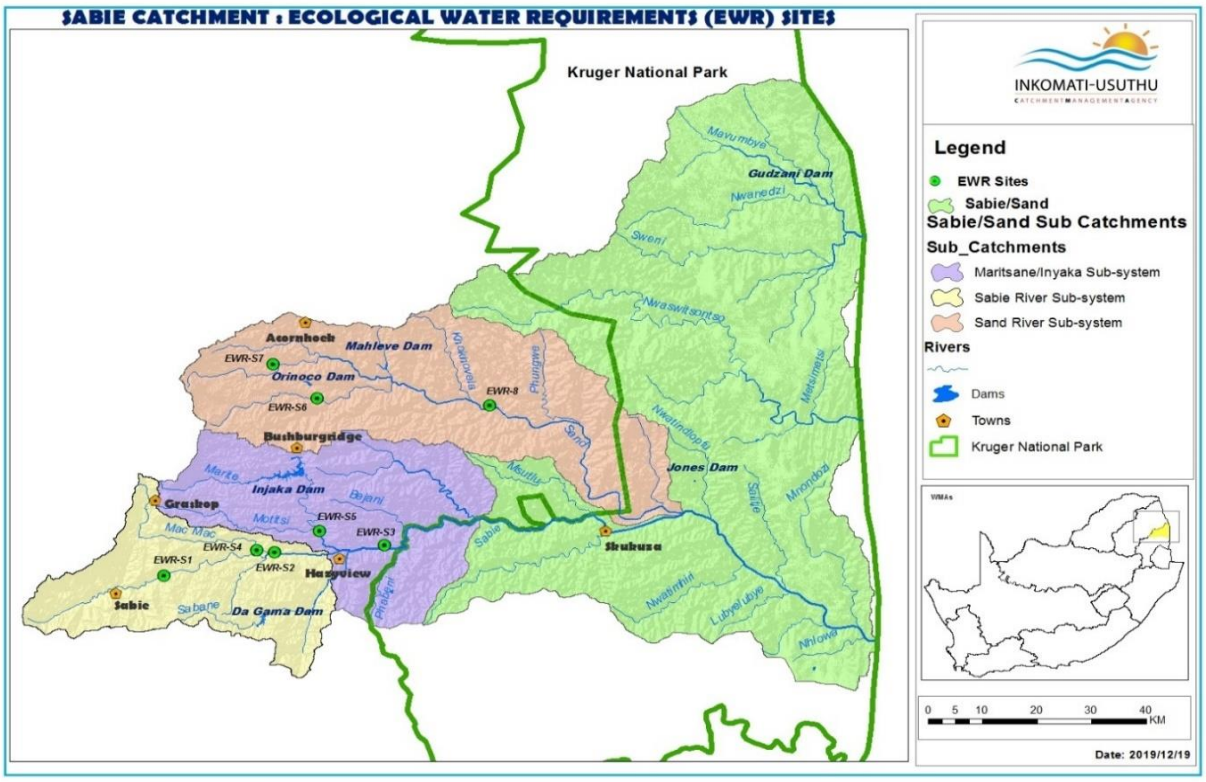


Figure 9: Map showing Ecological Water Requirement sites within Sabie/Sand Catchment

The compliance status of each EWR site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in **Table 3** below.

Table 3: *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	7.1-8.1	30	12	0.015	0.016	130	886
EWR S-2	6.5 - 8.0	7.1-8.0	30	11.4	0.015	0	130	246
EWR S-3	6.5 - 8.0	7.5-7.9	30	24.6	0.015	0	130	443
EWR S-4	6.5 - 8.0	7.1-8.3	30	35.7	0.015	0	130	72
EWR S-5	6.5 - 8.0	7.5-8.7	30	18.1	0.015	0	130	866
EWR S-6	6.5 – 8.8	7.4-8.0	55	11.2	0.125	0	130	206
EWR S-7	6.5 – 8.8	7.3-8.4	42	38.3	0.125	0	130	643
EWR S-8	6.5 – 8.8	7.5-8.1	42	27.4	0.125	0.011	130	1396

Discussion of results: Ecological Water Requirements Sites

Year 2020 compliance percentage of EWR sites within the Sabie/Sand catchments with the water quality numerical RQOs are as follows: pH (75%), Electrical Conductivity (87.5%), phosphate (87.5%) and *E coli* (12.5%). Compliance percentage showed improvement in terms of pH and remained constant for EC, PO_4 and *E coli* compared to 2019 as illustrated in *Figure 10*.

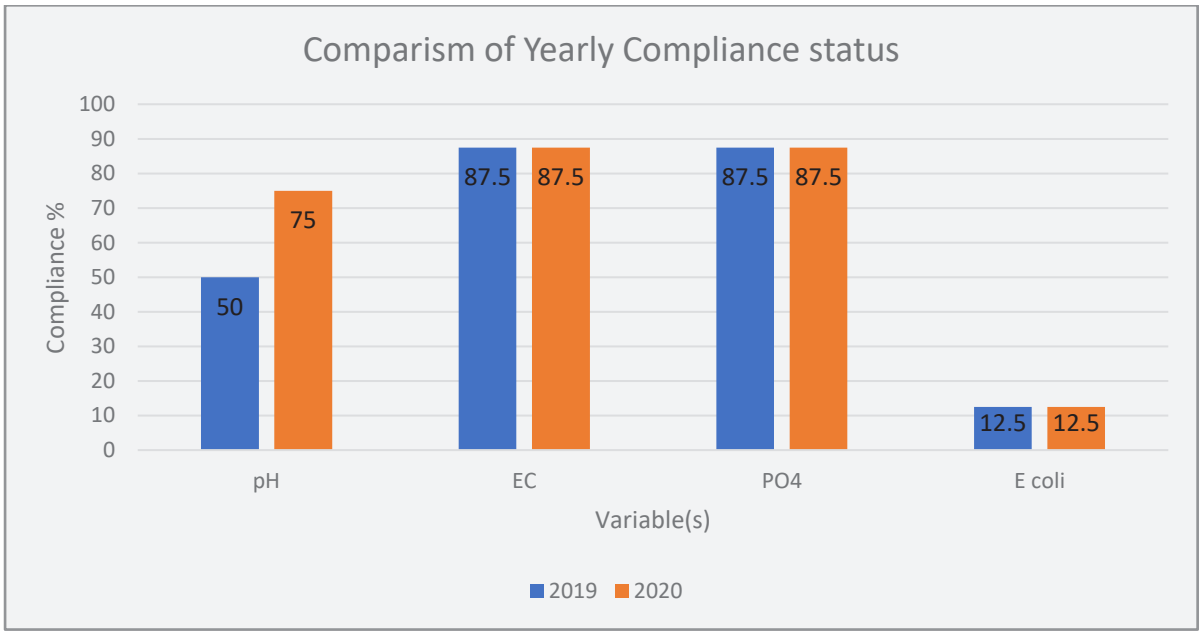


Figure 10: Compliance percentage of EWR Sites within Sabie Sand Catchment

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 reaches of the Crocodile River catchment area around Ka-Nyamazane area.

2.2 Water Quality Monitoring Points

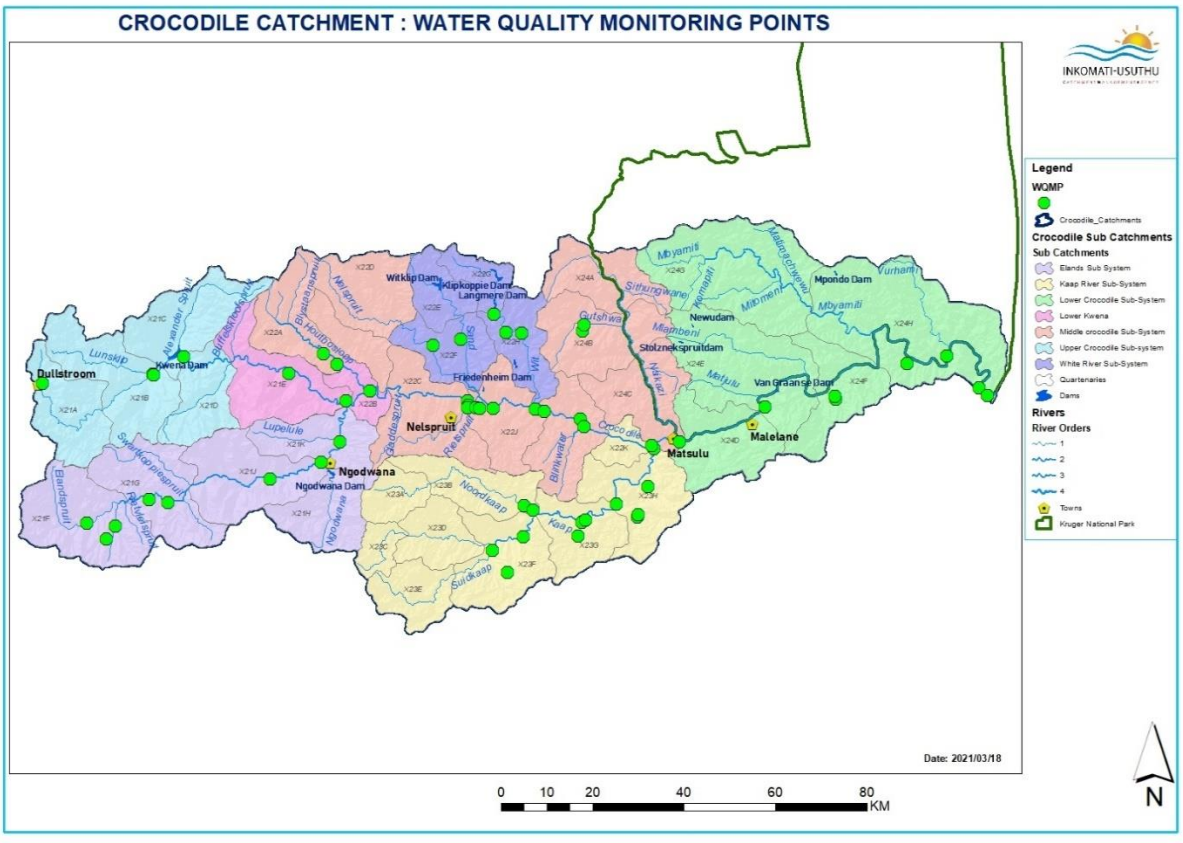


Figure 11: Water quality monitoring points in the Crocodile Catchment.

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 4**: TWQG and RQOs within Crocodile Catchment*

Variables/Parameters	RQOS	TWQG
pH	6.5 – 8.0	6.5 - 8.5
Electrical Conductivity (mS/m)	30 and 55	40
Phosphate (mg/l)	0.015, 0.025, 0.075 & 0.125	0.025
E coli (cfu/100ml)	120 and 130	130
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	-

N/A=Not available

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 as indicated below *Figure 12*.

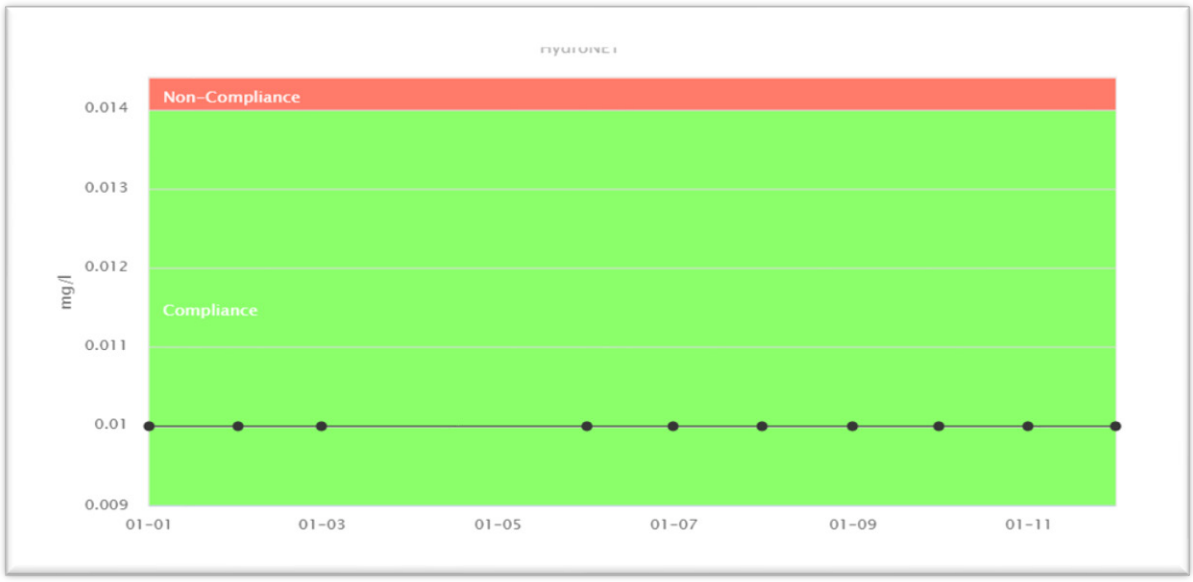


Figure 12: Chromium (VI) trend chart at Leeuspruit

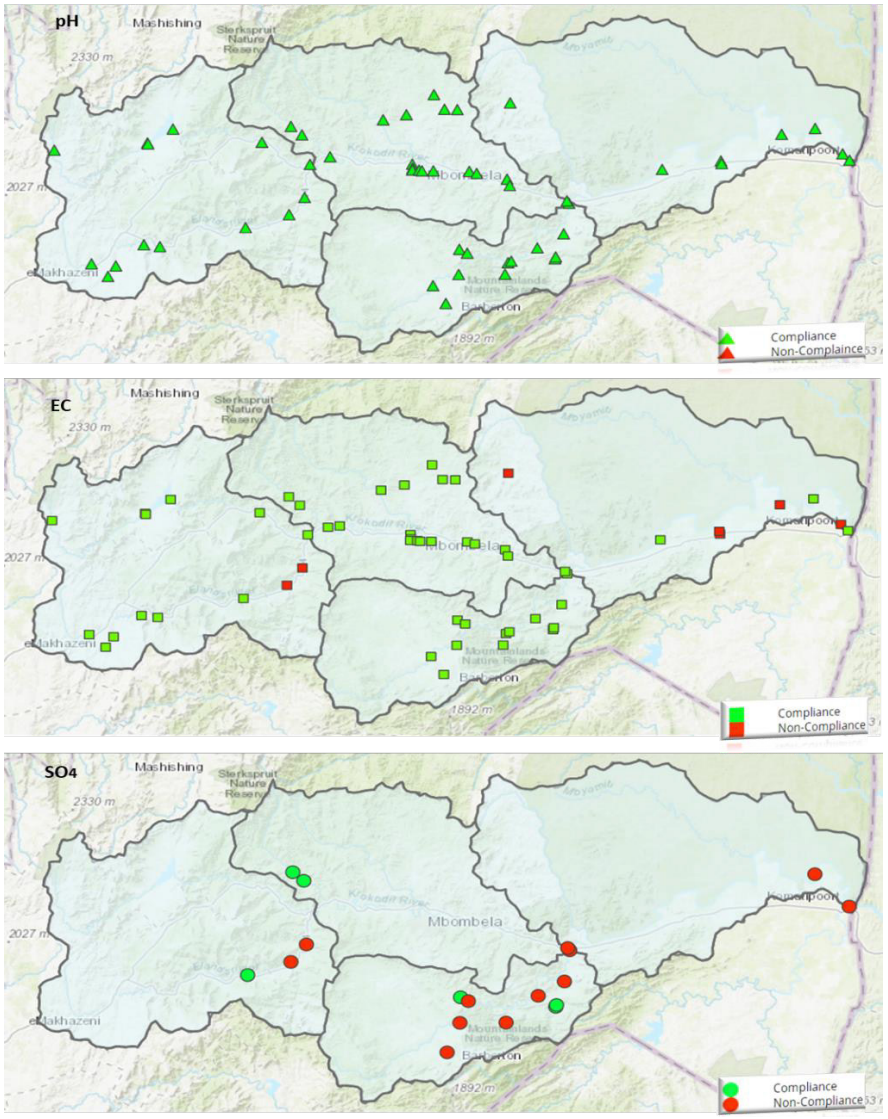


Figure 13: Water quality status within Crocodile Catchment showing acidity or basicity (pH) and salts (EC and SO_4) concentrations.

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 Elands River downstream of Ngodwana Mill, 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 industrial effluent, WWTWs, stormwater runoff from formal /informal settlements and agricultural runoff.

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, Noorkkapp upstream of Consort Mine and the tributary of Kimberley Creek in the Kaap River System.

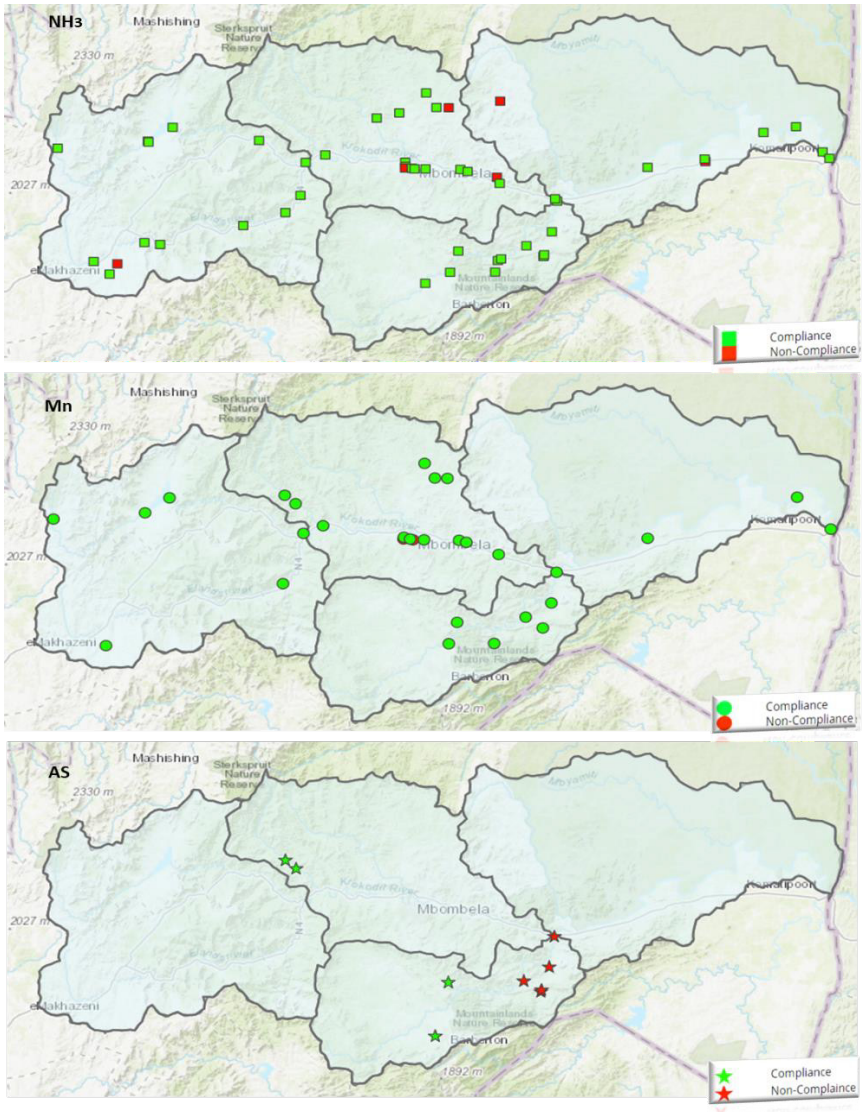


Figure 14: Water quality status within Crocodile Catchment showing toxic substances (NH_3, Mn and As) concentrations.

Ammonia (NH_3)

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 Leeuspruit downstream WWTW and 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 and Besterspruit which indicated noncompliance. The mineral manganese can be found naturally in the environment (surface water) or as a result of land use activities such as 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.

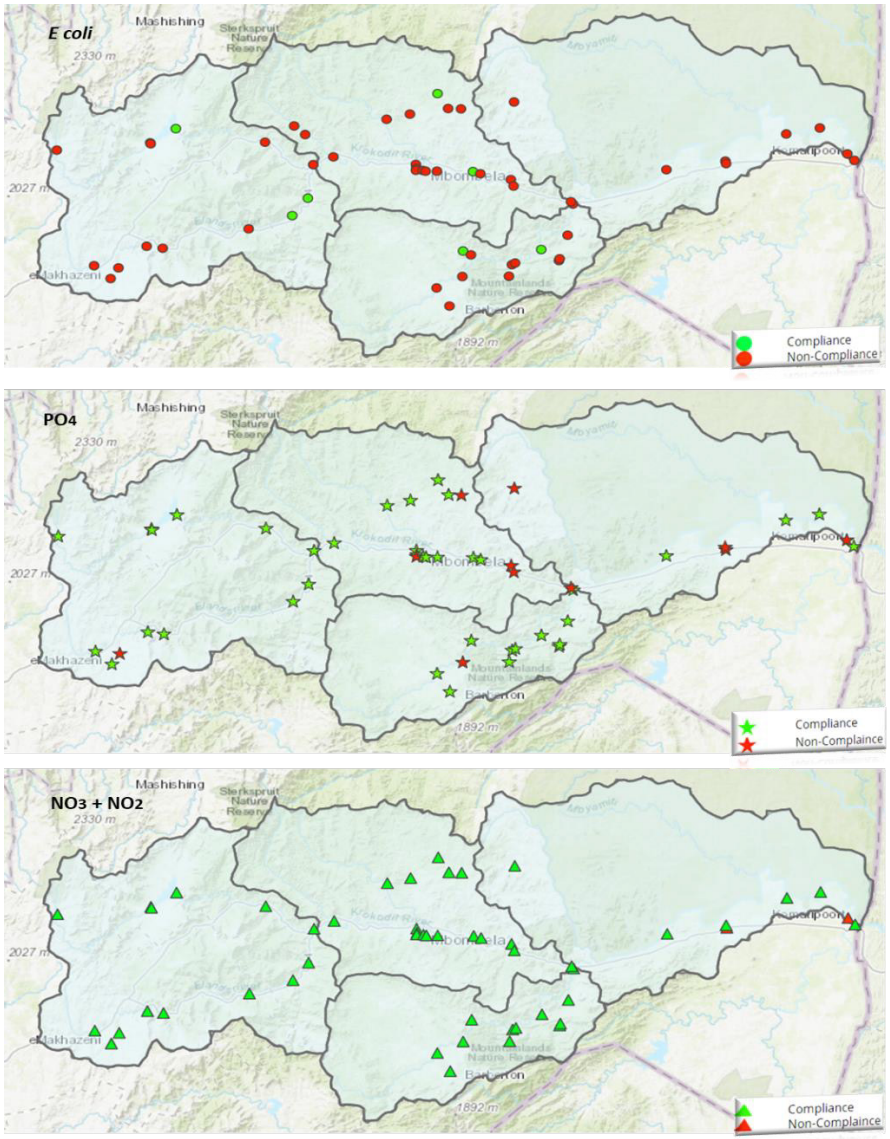


Figure 15: Water quality status within Crocodile Catchment showing microbiological (E coli) and nutrients (PO_4 and NO_3+NO_2).

Escherichia coli (E. coli)

E. coli counts in the Crocodile Catchment show elevated counts which 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 Seven (07) 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, White River, Matsulu, Komatipoort, Berbaton and Kabokweni WWTWs, upstream & downstream of Hectorspruit WWTWs as well as the Kanyamazane stream. The impacts are attributed to effluent discharges from WWTWs and illegal dumping of solid waste.

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 and Hectorspruit upstrem of the WWTWs. 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 2020- December 2020 and was statistically analysed using percentiles and average as tabulated below in **Table 5**. The Crocodile catchment comprises of nine (9) Ecological Water Requirements (EWR) sites across the catchment as presented in *Figure 16*.

***Table 5**: 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

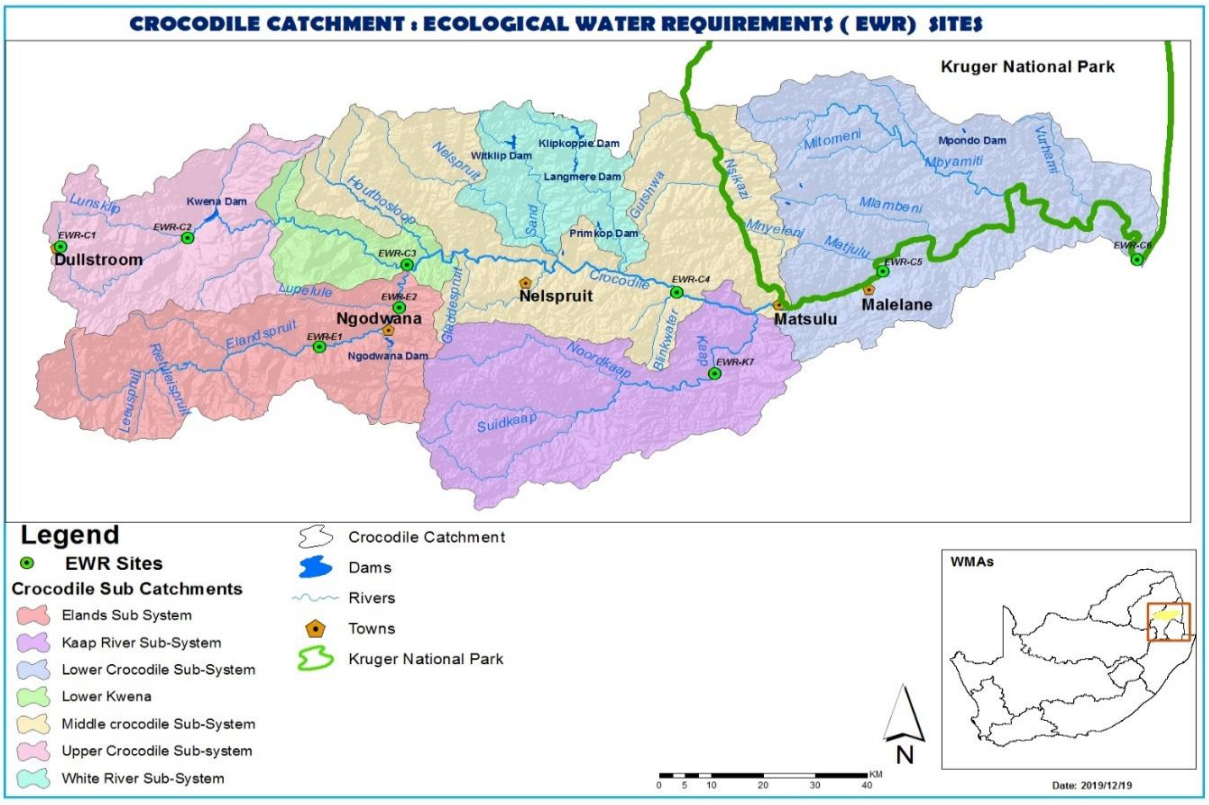


Figure 16: Map showing Ecological Water Requirement sites within Crocodile Catchment.

The compliance status of each EWR site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in **Table 6** below.

Table 6: *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	**6.9-8.0**	30	**13.4**	0.015	**0**	120	**140**
EWR C-2	6.5 - 8.0	**6.6-7.9**	30	**13.6**	0.025	**0**	130	**541**
EWR C-3	6.5 - 8.0	**7.1-8.1**	30	**13.7**	0.015	**0**	130	**324**
EWR E-1	6.5 - 8.0	**6.9-8.0**	30	**21.2**	0.025	**0.013**	130	**847**
EWR E-2	6.5 - 8.0	**7.0-8.1**	55	**81.7**	0.015	**0**	130	**116**
EWR C-4	6.5 - 8.8	**7.2-8.1**	70	**33.5**	0.125	**0.11**	130	**1365**
EWR C-5	6.5 - 8.8	**7.4-8.0**	70	**57.2**	0.075	**0.072**	130	**1058**
EWR C-6	6.5 - 8.8	**7.2-8.7**	70	**81.0**	0.125	**0.03**	130	**274**
EWR C-7	6.5 - 8.8	**7.4-8.1**	200	**74.7**	0.125	**0.018**	130	**56**

Discussion of results: Ecological Water Requirements Sites

Year 2020 compliance percentage of EWR sites within the Crocodile catchments with the water quality numerical RQOs are as follows: pH (77.7%), Electrical Conductivity (77.7%), phosphate (100%) and *E coli* (22.2%). Compliance percentage showed improvement in terms of pH and PO_4 and indicated deterioration for *E coli* while it remained constant for EC as illustrated in *Figure 17*.

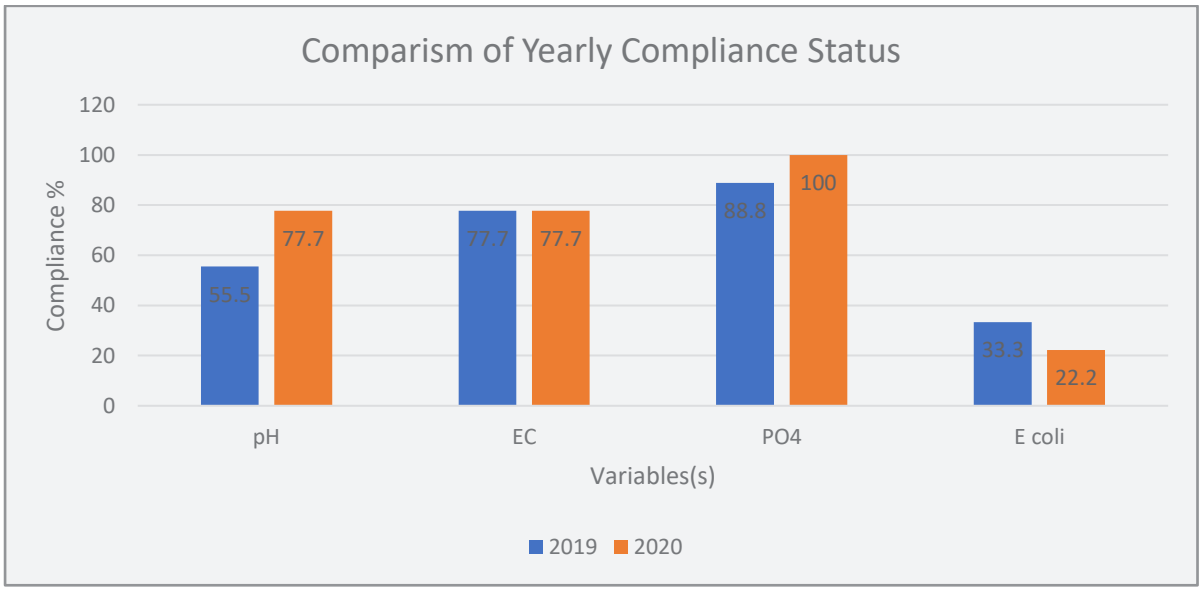


Figure 17: Compliance percentage of EWR Sites within Crocodile Catchment

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, Vaalwaterspruit and the Witkloofspruit 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

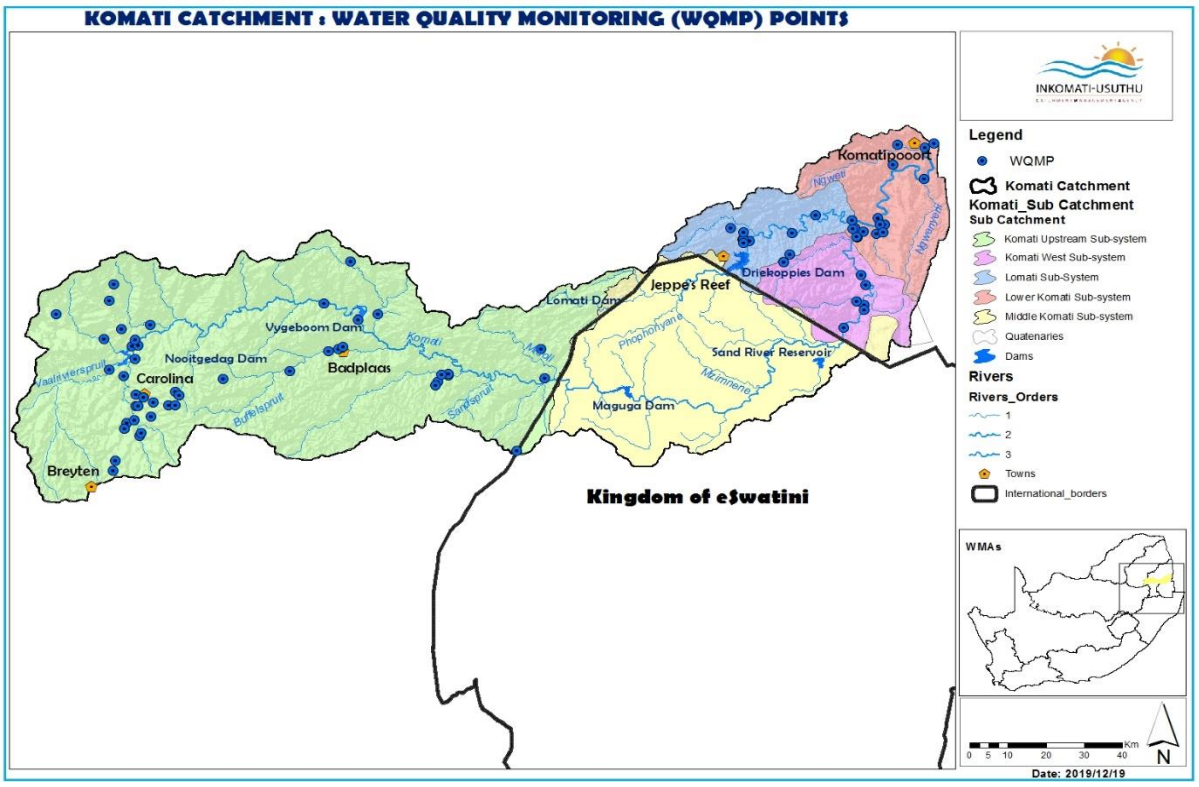


Figure 18: Water quality Monitoring points in the Komati Catchment.

3.3 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 as tabulated below.

***Table 7**: TWQG and RQOs within Komati Catchment*

Variables/Parameters	RQOs	TWQG
pH	6.5 - 8.0	6.5 - 8.5
Electrical Conductivity (mS/m)	30, 40, 50, 55 & 85	40
Phosphate (mg/l)	0.02	0.025
E coli (cfu/100ml)	130	130
Nitrates/Nitrites (mg/l)	-	6 (Domestic)
Ammonia (NH_3) in mg/l	-	1 (Domestic)
Sulphate	30 and 80	30 (Industry category 1)
Nickel	-	0.2 (Agriculture: Irrigation)

N/A=Not available

3.4 Water quality status and Discussion of Results

Nickel

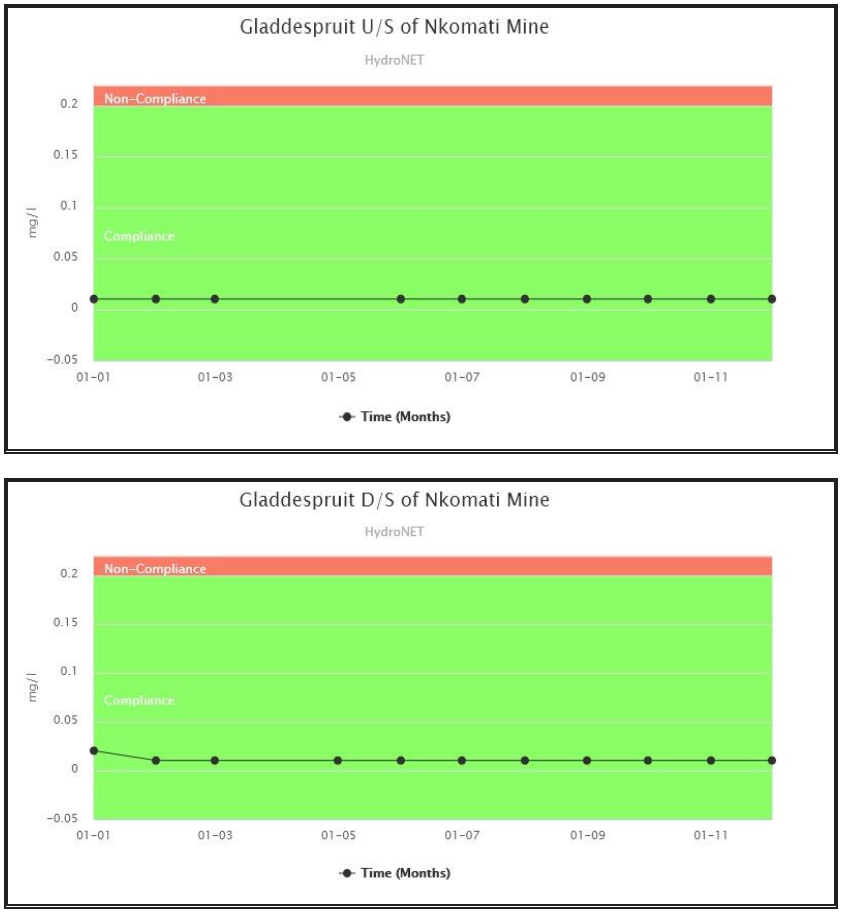


Figure 19: Nikel trend chard at Gladdespruit (US and DS of Nkomati Mine).

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 shown in

***Figure** 19*

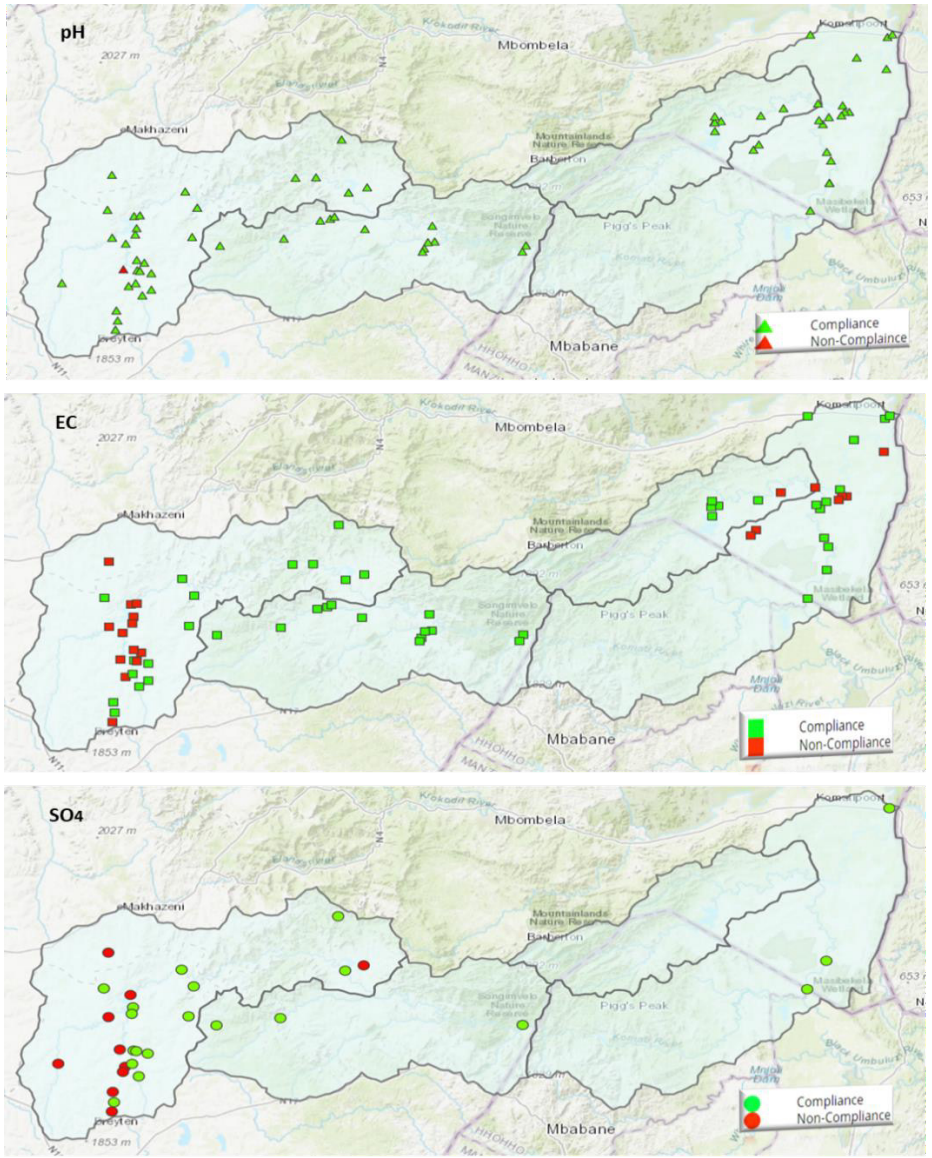


Figure 20: Water quality status within Komati Catchment showing pH, EC and SO_4 concentrations.

pH

pH complied with the RQO, except for Vaalwaterspruit at R38 within Upper Komati sub catchment, which is acidic, this may be due to the decanting mine water from active 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 within the Catchment.

Sulphate (SO_4)

Sulphate concentration showed non-compliance with the RQOs limit within priority resource units or the TWQG limits in the Boesmanspriut, Witkloofspruit 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.

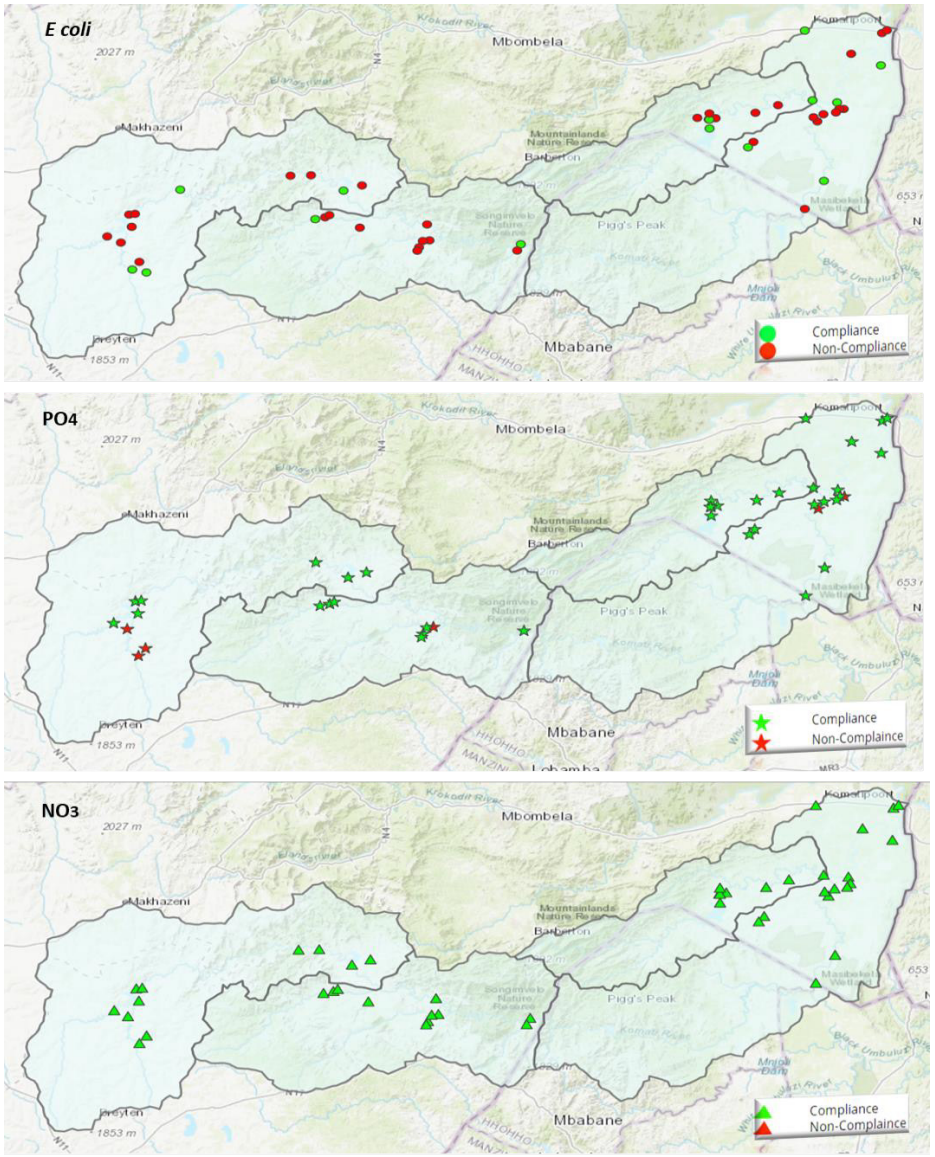


Figure 21: Water quality status within Komati Catchment showing microbiological (E.coli) and nutrients (PO_4 and NO_3) concentrations.

Escherichia coli (E. coli)

E. coli counts in the Komati Catchment complied with the RQO of 130 (cfu/100ml) for only fourteen (14) points and the other sites in Carolina, Badplaas and Elukwatini areas within the upper Komati sub catchment and KaMatsamo, 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 compliance with the RQOs for most of the points within upper Komati sub catchment, except for three points. However, in the Lower Komati only two (2) 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

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 2020- December 2020 and was statistically analysed using percentiles and average as tabulated below in **Table 8**. The Komati catchment comprises of six (6) Ecological Water Requirements (EWR) sites across the catchment as presented in *Figure 16*.

Table 8: 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

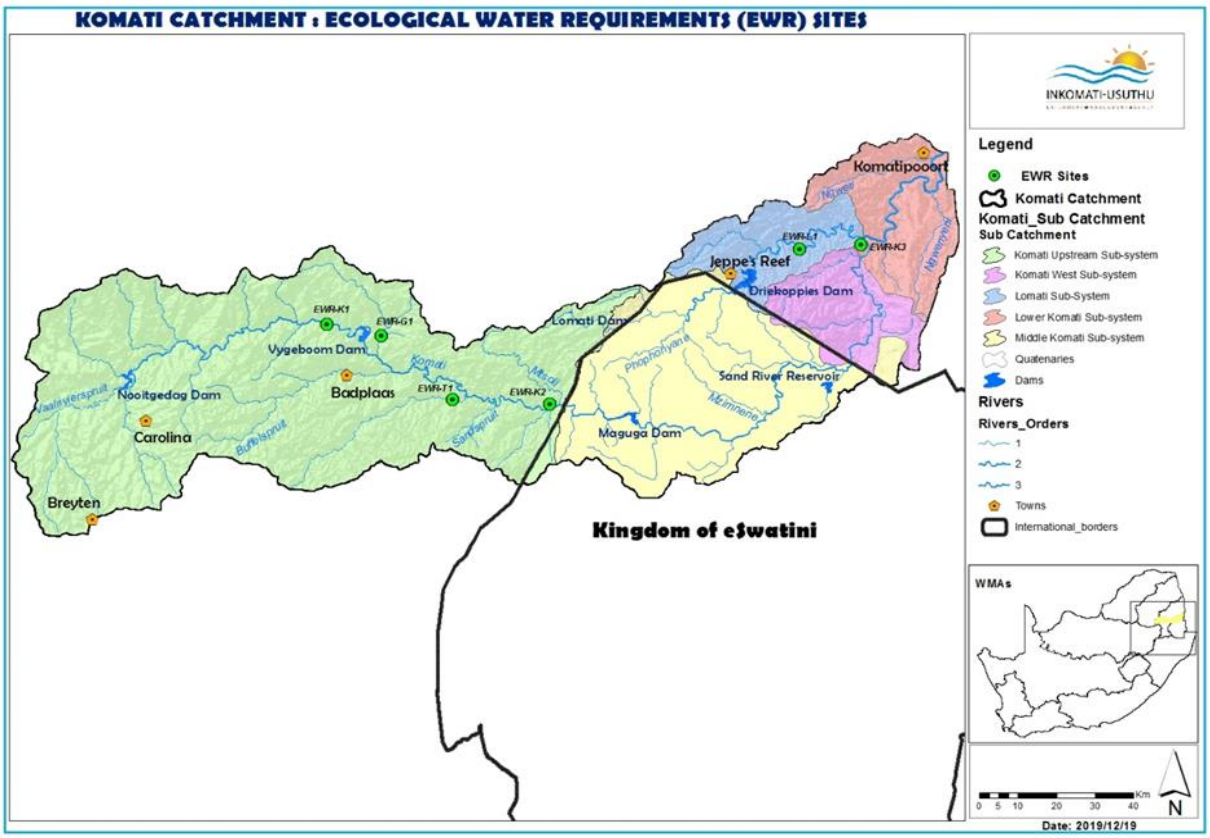


Figure 22: Map showing Ecological Water Requirement sites within Crocodile Catchment.

The compliance status of each EWR site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in **Table 9** below.

Table 9: *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	**6.9-8.3**	50	**24.3**	0.02	**0**	130	**293**
EWR G-1	6.5 - 8.0	**7.3-8.2**	N/A	**53.7**	0.02	**0**	N/A	**541**
EWR T-1	6.5 - 8.0	**7.5-8.0**	N/A	**23**	0.125	**0.21**	130	**1376**
EWR K-2	6.5 - 8.0	**7.3-8.2**	55	**27.7**	0.02	**0**	130	**109**
EWR K-3	6.5 - 8.0	**7.6-8.4**	85	**53.4**	0.125	**0**	130	**535**
EWR L-1	6.5 - 8.0	**7.2-8.4**	40	**38.8**	0.075	**0**	130	**184**

N/A=Not available

Discussion of results: Ecological Water Requirements Sites

Year 2020 compliance percentage of EWR sites within the Komati catchments with the water quality numerical RQOs are as follows: pH (16.6%), Electrical Conductivity (100), phosphate (83.3%) and *E coli* (20%). Compliance percentage showed improvement in terms of *E coli* and indicated deterioration for pH and PO_4 while remained constant at 100% compliance for EC as illustrated in *Figure 23*.

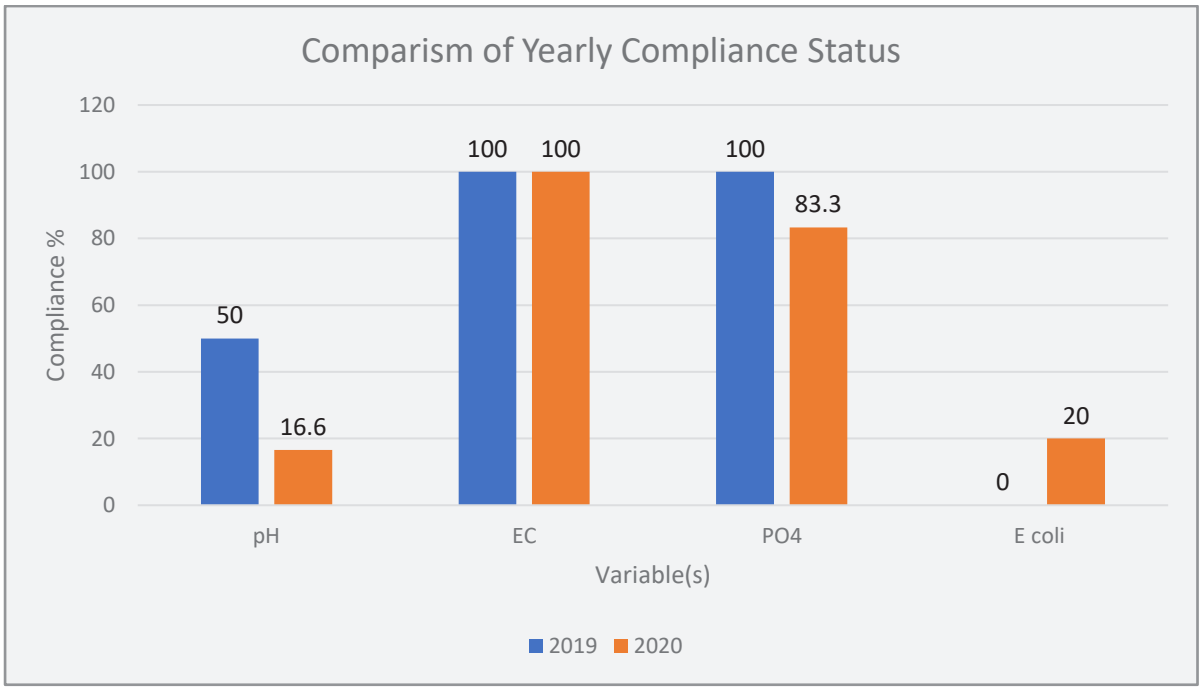


Figure 23: Compliance percentage of EWR Sites within Komati Catchment

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 then 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

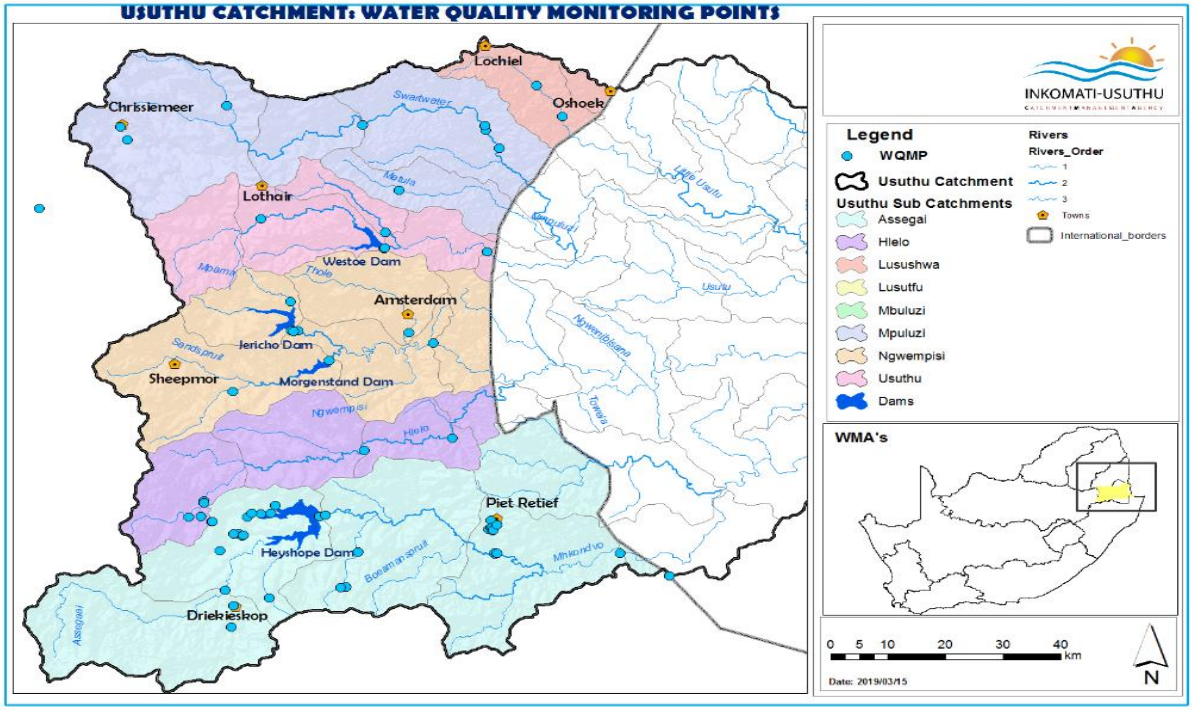


Figure 24: Water quality monitoring points in the Usuthu Catchment

4.3 Target Water Quality Guideline

The RQO are currently not determined 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) as indicated in **Table 10**.

***Table 10**: 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

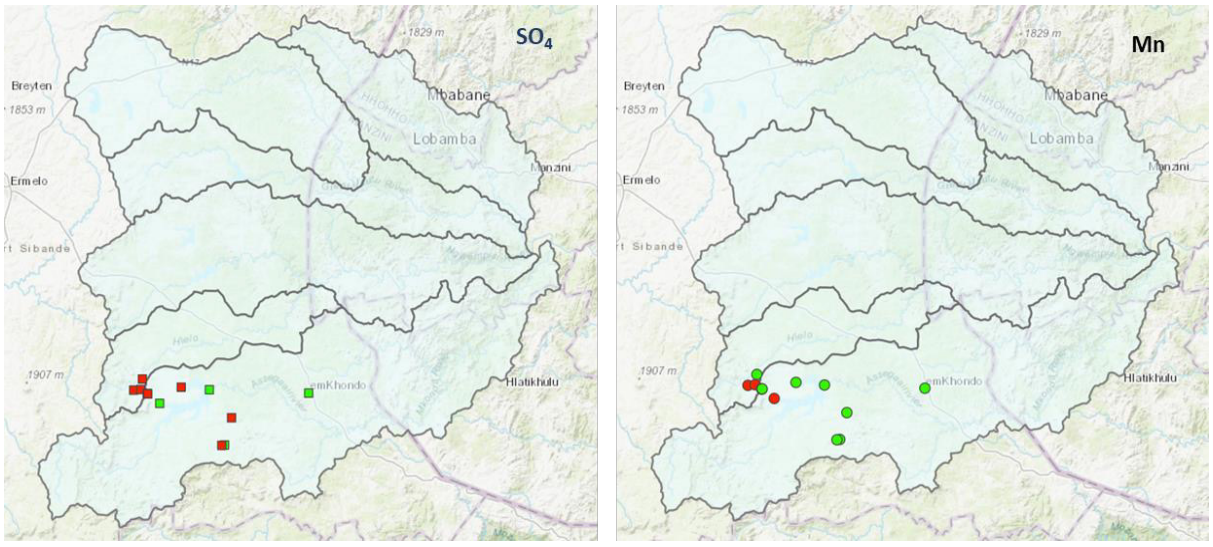


Figure 25 : Water quality status within Usuthu Catchment showing SO_4 and Mn concentrations

Sulphate and manganese are monitored to assess the impact of coal mining activities in the upper Assegaai River and Hlelo River sub-systems in the Usuthu Catchment. SO_4 indicated noncompliance with the TWQG for Industry of 30 (mg/l) except for 4 sites which indicated compliance as shown in *Figure 25* and Mn indicated compliance with aquatic ecosystem of 0.18 (mg/l) throughout the reporting period except for 3 sites which exceeded the set TWQG.

The compliance status is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in the maps below.

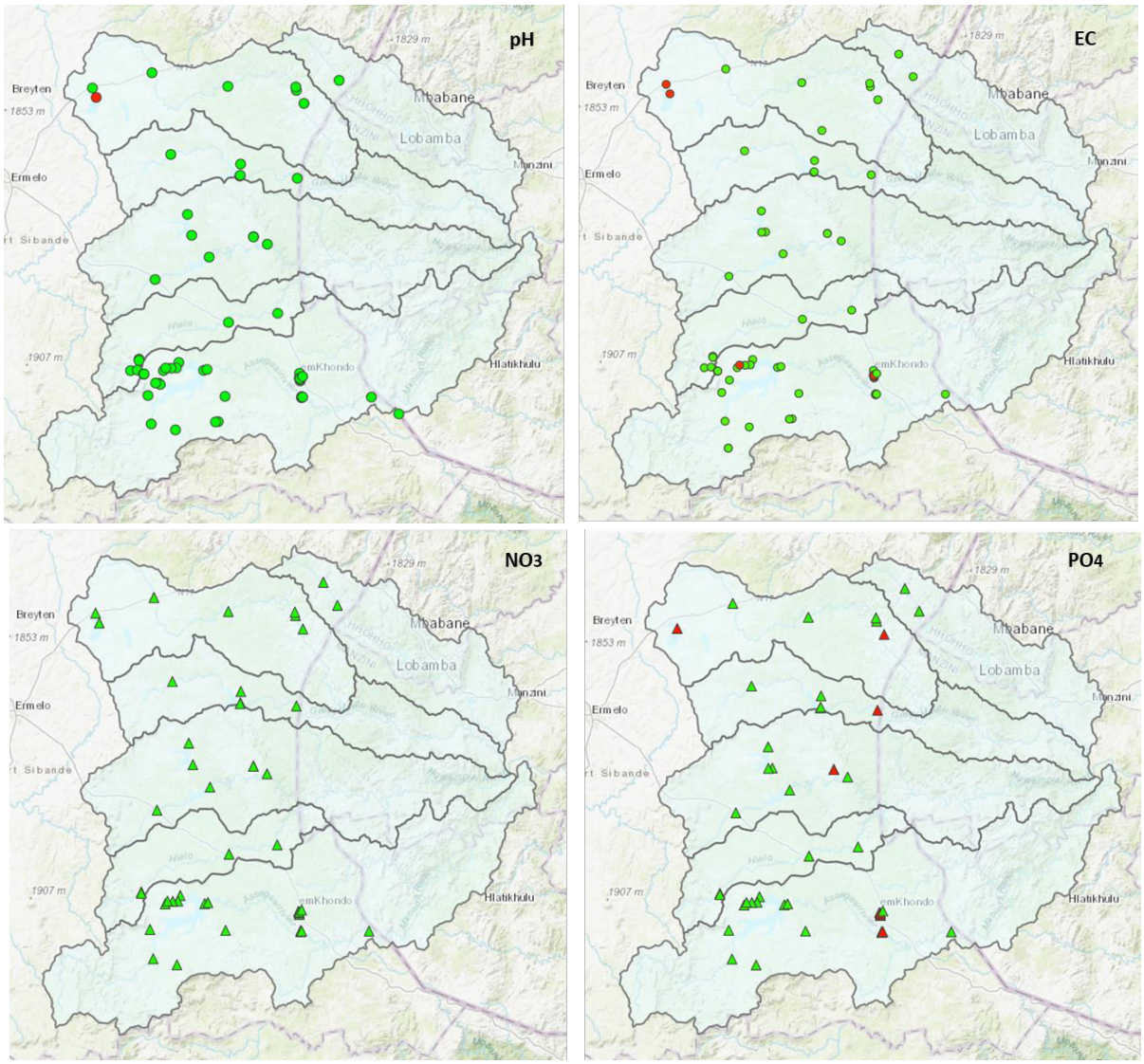


Figure 26 : Water quality status in Usuthu Catchment showing pH, EC, PO_4 and NO_3 concentrations

As shown in *Figure 26* **pH** complied with the TWQG limit, except for the points downstream of Chrissiessmeer WWTWs which is alkaline and **EC** complied with the TWQG limits within the Usuthu Catchment except for downstream of Chrissiessmeer WWTWs, Hlelo River, Egude River as well as five points at Klipmisselspruit and its tributaries.

As shown in *Figure 26* **Nitrates and Phosphate** concentrations complied with the TWQG throughout the reporting period in the catchment, except for ten (10) points that indicated noncompliance for phosphate which are downstream of the WWTW as well as Klipmisselspruit and its tributaries.

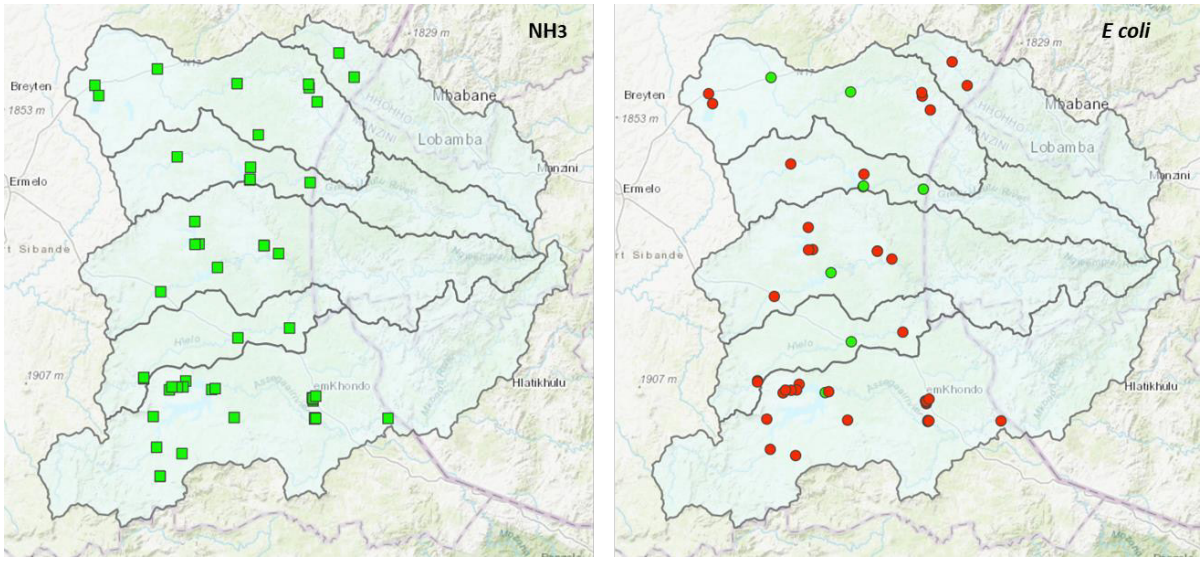


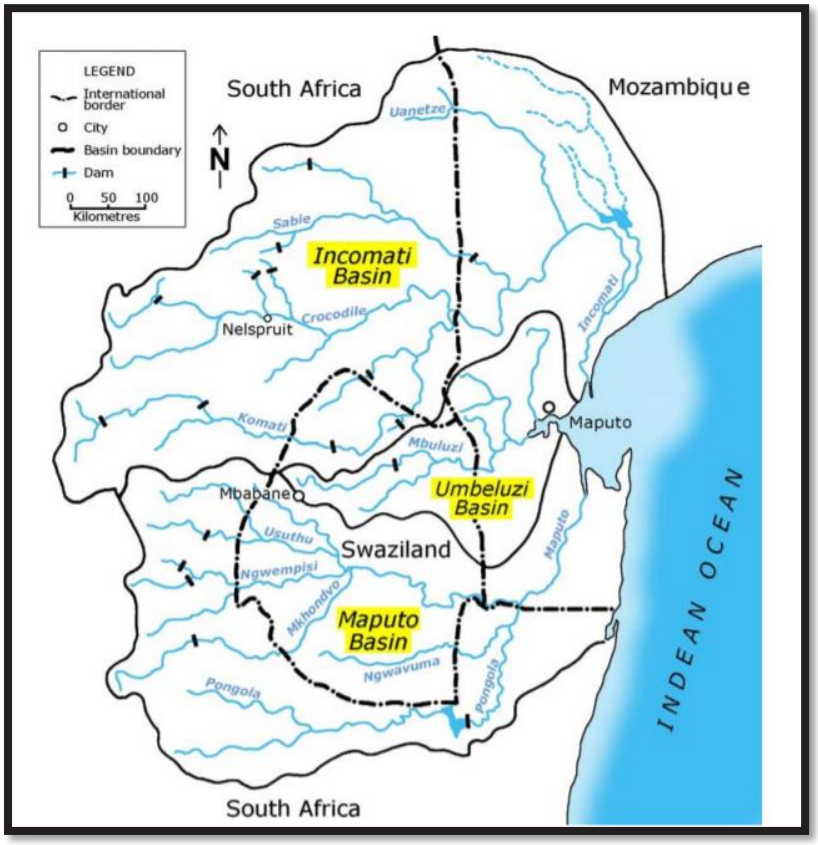
Figure 27 : Water quality status within Usuthu Catchment showing toxicity (NH_3) and microbial (*E coli*) concentrations.

Ammonia concentrations complied with the TWQG throughout the catchment and ***Escherichia coli*** counts 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.

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 (RSA) 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

The catchment comprises of ten (6) international obligation (IO) sites across the WMA as presented in Figure 28.

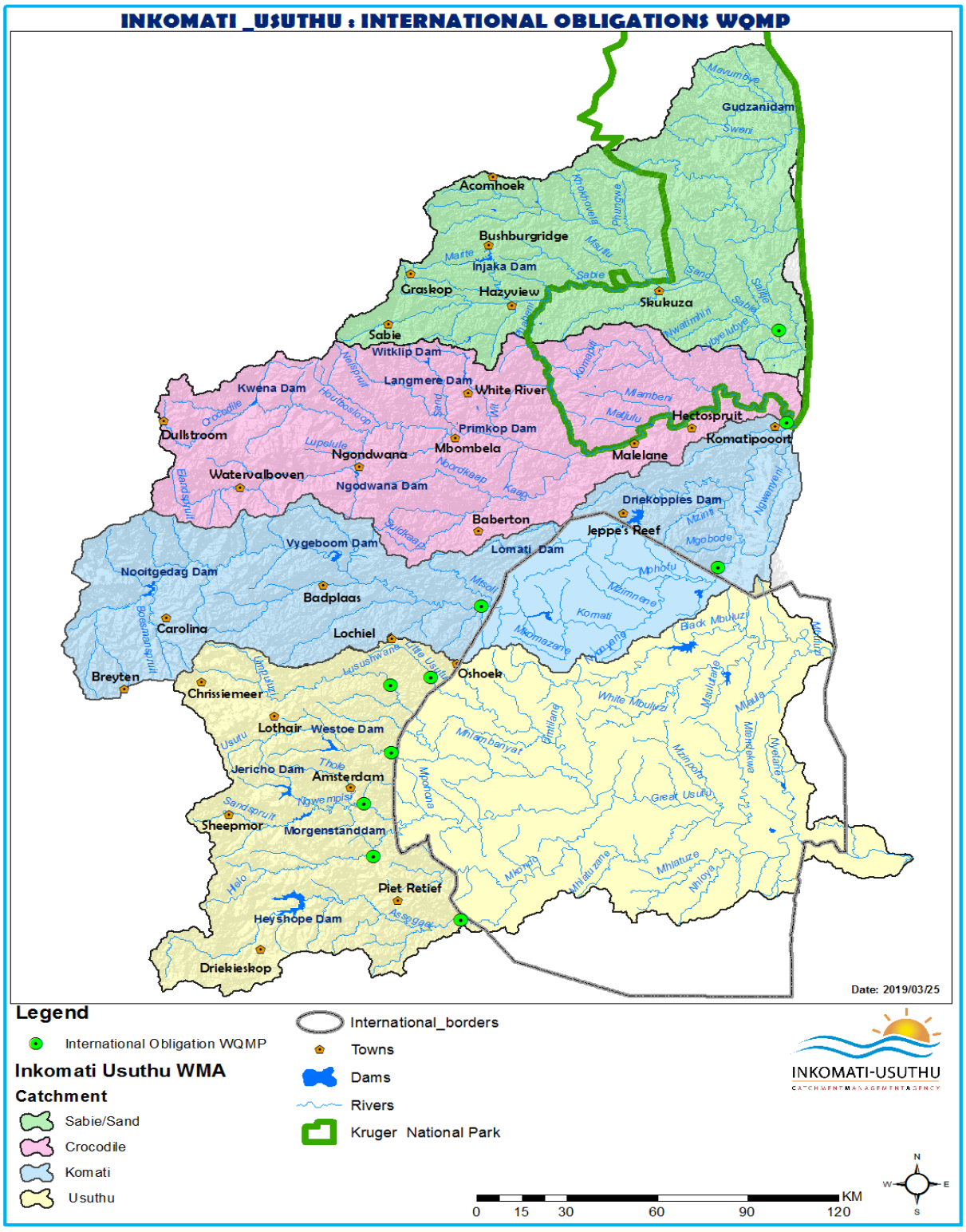


Figure 28: International Obligation water quality monitoring points in the Inkomati-Usuthu WMA

5.3 International Water Quality Guideline limits

The average data reported was collected over a period of a year from January 2020- December 2020. The compliance of the indicator parameters is compared with the water quality guidelines as per the Interim IncoMaputo Agreement (IIMA), tabulated below.

***Table 11**: International Water Quality Guideline limits*

Variables/Parameters	International Water Quality Guidelines Limits
Total Coliforms (TC) in cfu/100ml	10 000
Faecal coliforms (FC) 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
Dissolved Oxygen (DO) in %	>75

5.4 Water Quality Status

The compliance status of each IO site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in the maps below.

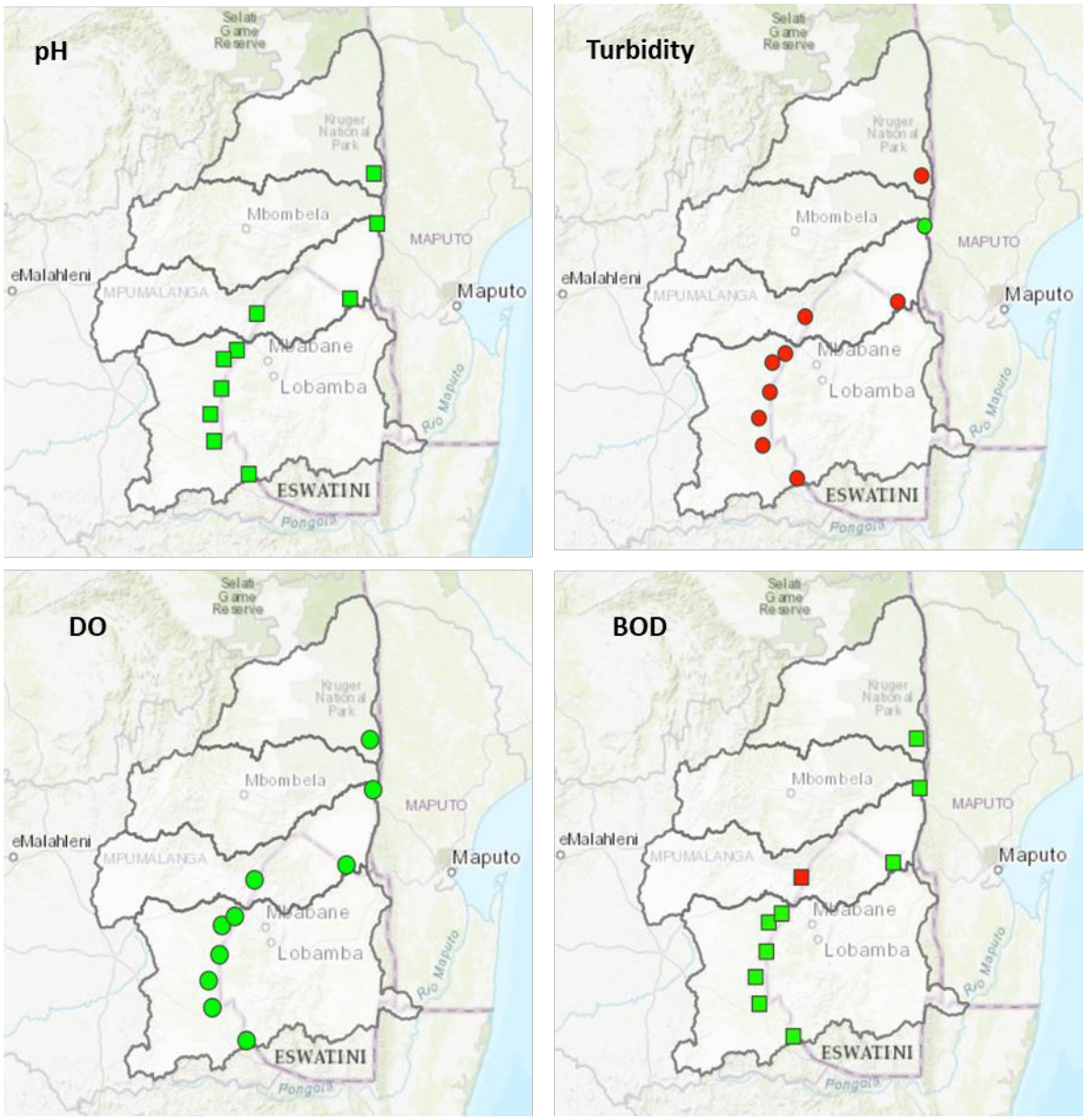


Figure 29: Maps showing water quality status for international obligation site (*s*)

Discussion of Results

All variables as shown in *Figure 29* complied with the international water quality guidelines limit as per the IIMA. The RSA 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 and BOD at Komati River (Ekulindeni).

The compliance status of each IO site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in the maps below.

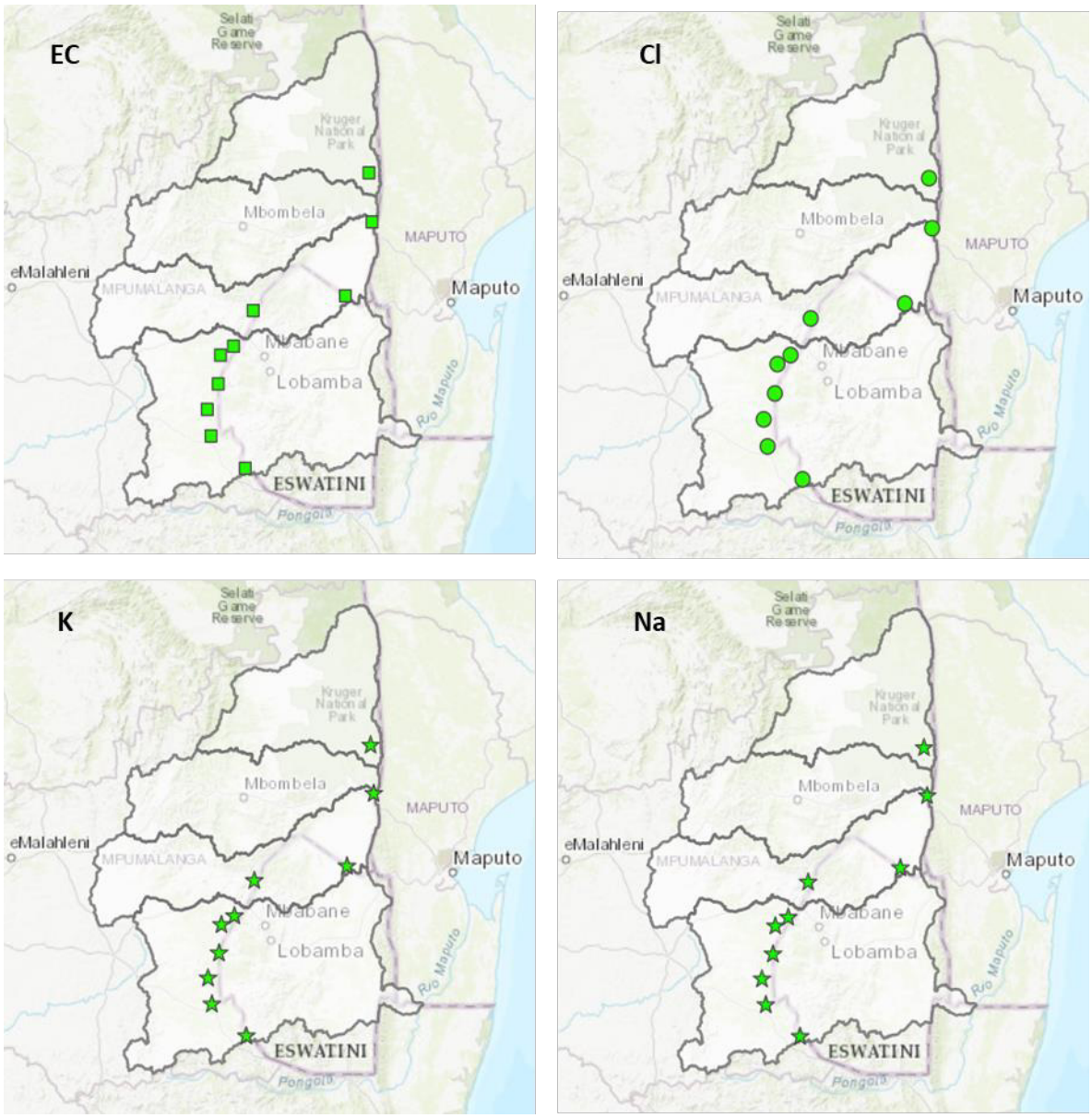


Figure 30: Maps showing water quality status for international obligation site(s)

Discussion of Results

All variables as shown in *Figure 30* complied with the international water quality guidelines limit as per the IIMA. The RSA 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.

The compliance status of each IO site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in the maps below.

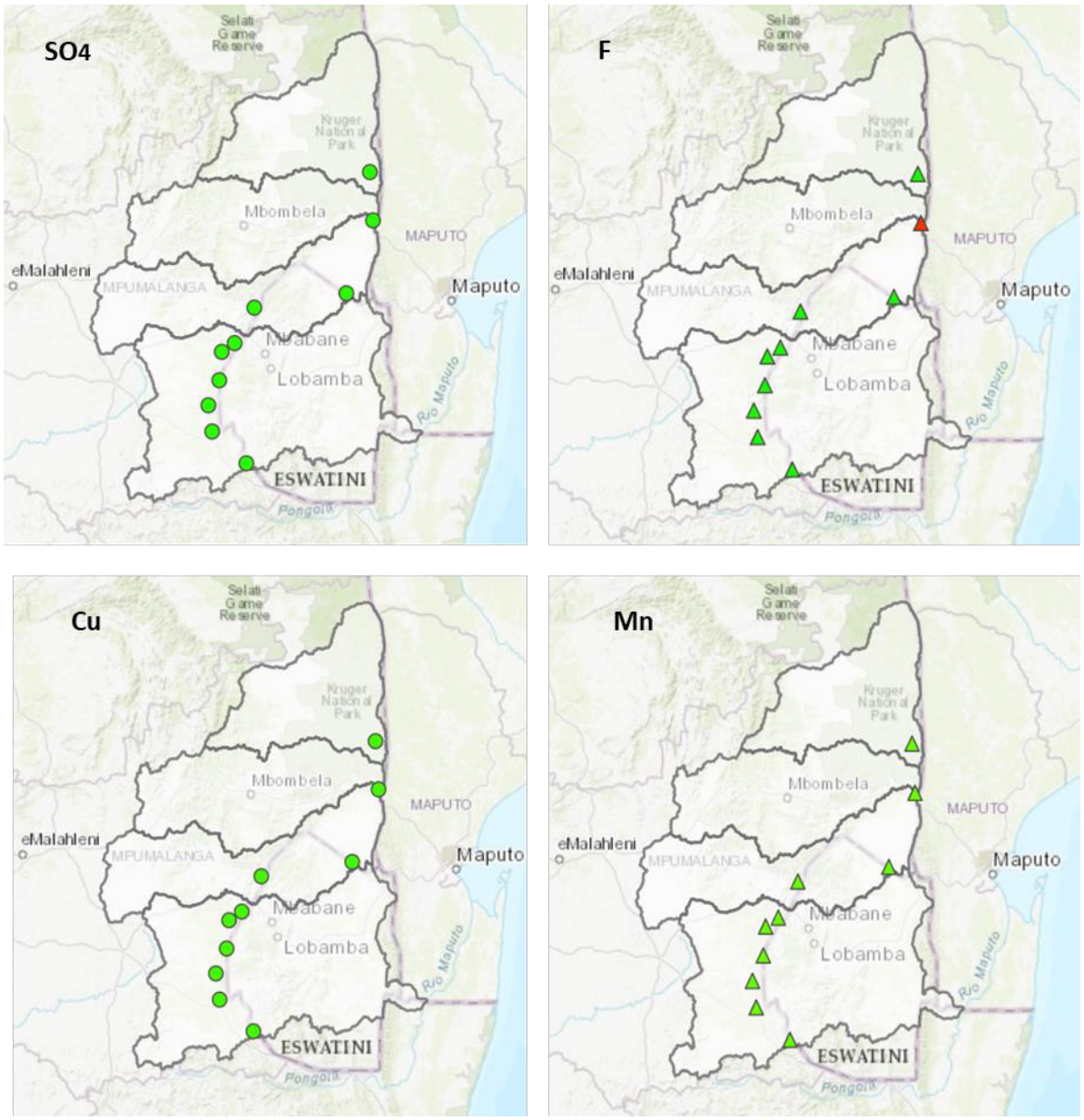


Figure 31: Maps showing water quality status for international obligation site(s)

Discussion of Results

All variables as shown in *Figure 31* complied with the international water quality guidelines limit as per the IIMA. The RSA 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 fluoride which indicated non-compliance at Komati River (Komatipoort).

The compliance status of each IO site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in the maps below.

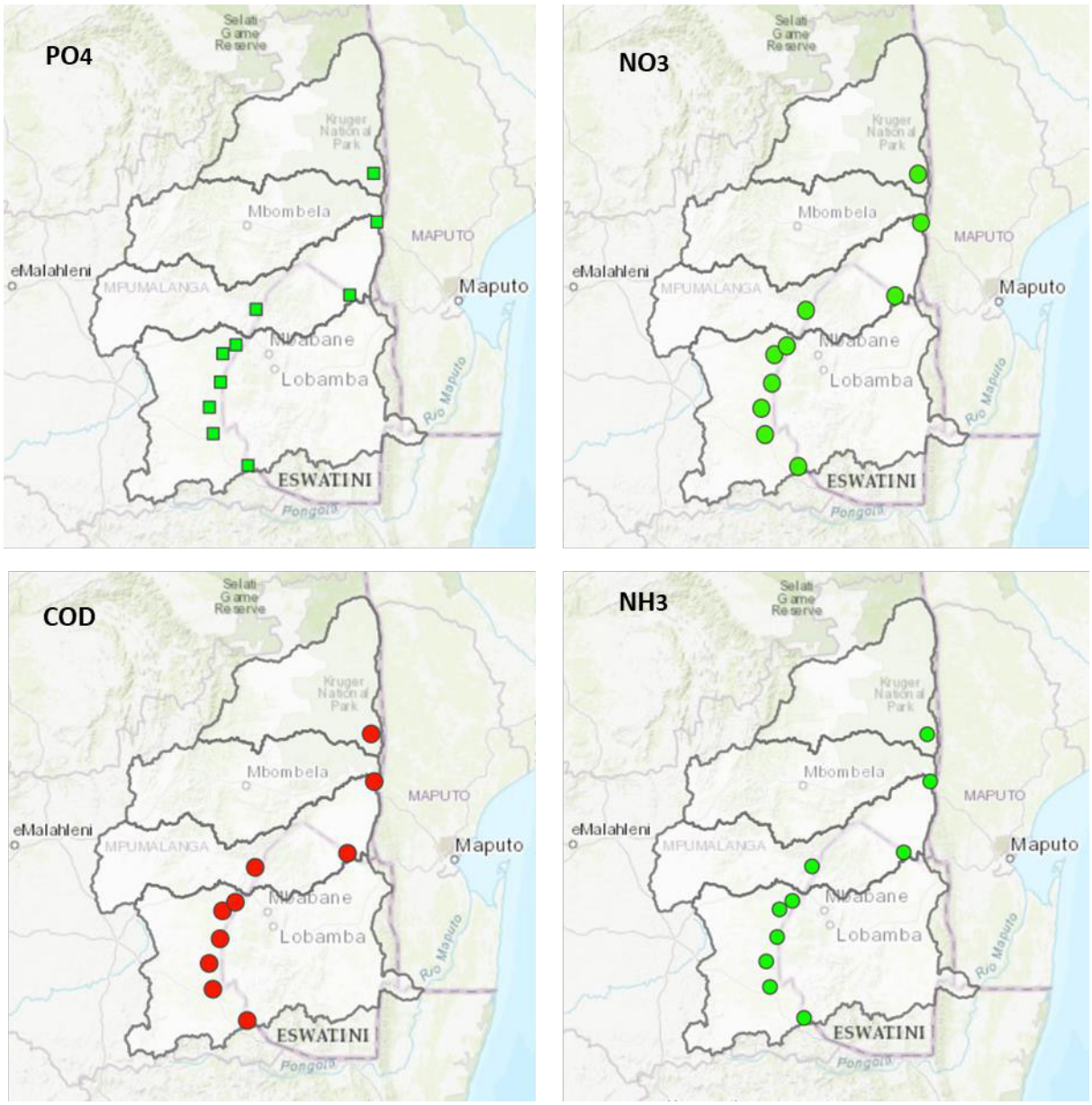


Figure 32: Maps showing water quality status for international obligation site(s)

Discussion of Results

All variables as shown in *Figure 32* complied with the international water quality guidelines limit as per the IIMA. The RSA 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 chemical oxygen demand which indicated non-compliance for at all international Obligation sites within the basin.

The compliance status of each IO site is indicated by colours: Compliance (Green) or non-compliance (Red) as indicated in the maps below.

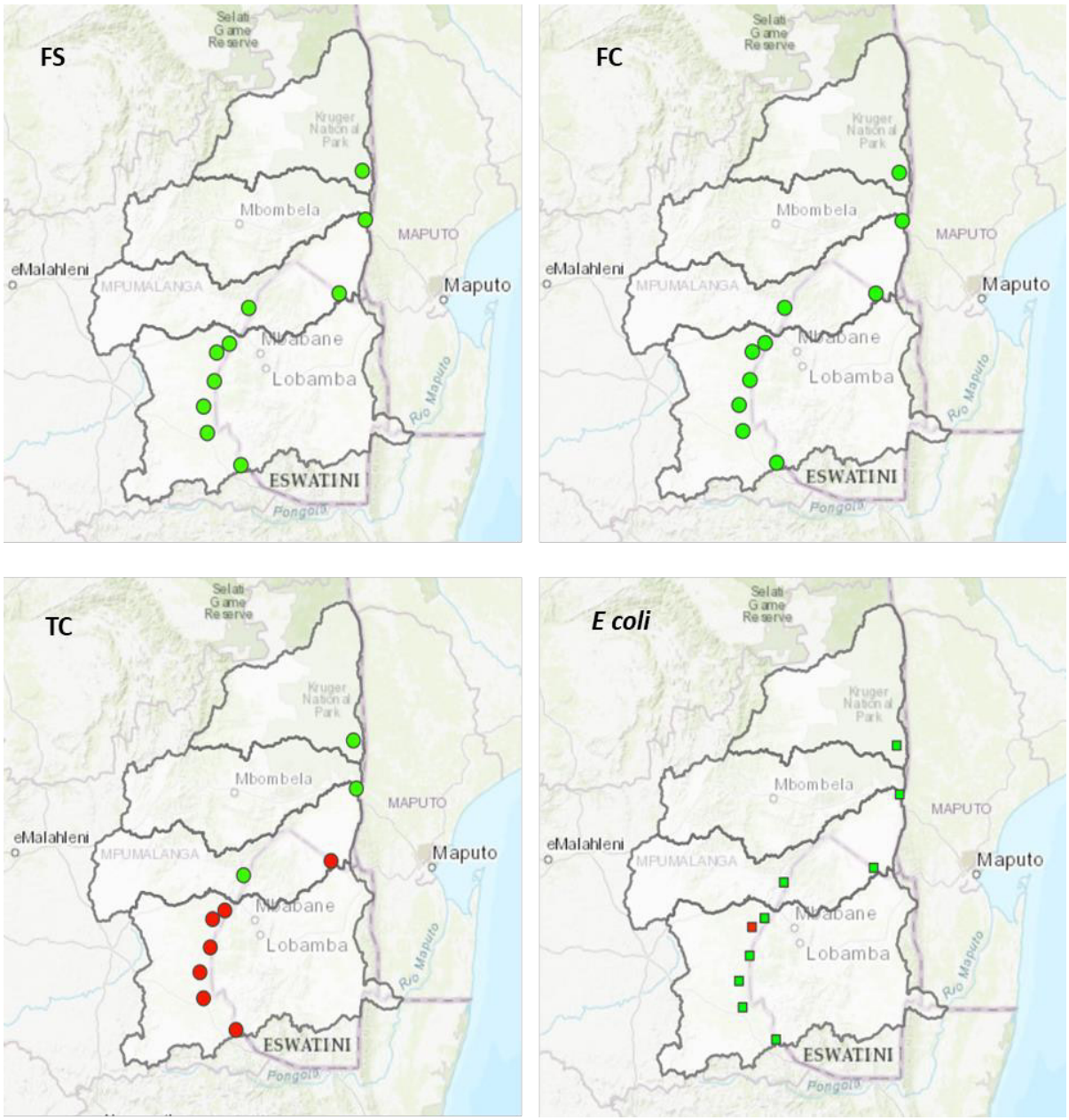


Figure 33: Maps showing water quality status for international obligation site(s)

Discussion of Results

All variables as shown in *Figure 33* complied with the international water quality guidelines limit as per the IIMA. The RSA 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 within Maputo basin which indicated non-compliance. Note that *E coli* does not form part of the IIMA however reported for information purposes using 2 000 (cfu/100ml) as a limit and Mpuluzi River exceeded the limit.

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, Gladdespruit, and Kaap River systems are being threatened by metal contamination especially manganese and arsenic as well as high concentrations of sulphate 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 variables and sites that 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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INKOMATI-USUTHU
CATCHMENT MANAGEMENT AGENCY

Private bag X11214,
Mbombela, 1200

Suite 801, The MAXSA Building,
13 Streak Street, Mbombela, 1200

Tel: 013 753 9000

information@iucma.co.za