## DEPARTMENT OF WATER AND SANITATION

**NO. 1248** **10 NOVEMBER 2017**

**NATIONAL WATER ACT, 1998**
**(ACT NO 36 OF 1998)**

**PROPOSED RESERVE DETERMINATION OF WATER RESOURCES FOR THE INKOMATI CATCHMENT**

I, Nomvula Paula Mokonyane, in my capacity as Minister of Water and Sanitation, having complied with section 13 of the National Water Act, 1998 (Act No. 36 of 1998) ("the Act") and Regulation 3 of the Regulations for the Establishment of Water Resource Classification System (No. R. 810 Government Gazette No. 33541, 17 September 2010), and duly authorised in terms of section 16(1) of the Act, hereby publish, for public comment in accordance with section 16(3) of the Act, the proposed Reserve determination for the water resources in the Inkomati catchment, as set out in the Schedule to this Notice.

Any person who wishes to submit written comments with regard to the proposed Reserve determination should submit the comments within 60 days from the date of publication of this Notice to:

Director: Reserve Determination
Attention: Mr Yakeen Atwaru
Department of Water and Sanitation
Ndinaye Building 185 Francis Baard Street
Private Bag X313
Pretoria
0001

Email: Atwaruy@dws.gov.za **or** MazibukoM@dws.gov.za

**MRS NR MOKONYANE**
**MINISTER OF WATER AND SANITATION**
**DATE:** 14. 09. 15 17.

**RESERVE DETERMINATION OF WATER RESOURCES IN THE INKOMATI CATCHMENT IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)**

**SCHEDULE**

## 1. DESCRIPTION OF WATER RESOURCE

1.1 The Reserve is determined for all or part of every significant water resource within the Inkomati catchment as set out below:

| | |
|---|---|
| Water Management Area: | Inkomati-Usutu |
| Drainage Regions: | X Primary Drainage Region |
| Rivers: | Komati, Crocodile and Sabie-Sand River Systems |

1.2 The Minister has in terms of section 12 of the National Water Act, 1998 (Act No.36 of 1998) ("the Act"), prescribed a system for classifying water resources by issuing Government Notice No. R. 810, published in Government Gazette No. 33541 dated 17 September 2010. In terms of section 16(1) of the Act, the Minister must, as soon as reasonably practicable after the class of all or part of a water resource has been determined, by Notice in the Gazette, determine the Reserve for all or part of that water resource.

1.3 The Minister, in terms of section 16(3) of the Act, proposes, for the purpose of section 16(1) of the Act, the following Reserves for the Inkomati catchment.

## 2. PROPOSED RESERVE DERMINATION AS REQUIRED IN TERMS OF SECTION 16(1) AND (2) OF THE NATIONAL WATER ACT, 1998

A summary of the quantity component for the Rivers which include the EWR (**Figure 1 & 2**) and the BHN in terms of section 16(1) of the Act for the Inkomati catchment is set out in Section 4. **Table 4.1** includes the results of the EWR Sites and the biophysical nodes.

A summary of the quality component for the Rivers at the EWR sites in terms of section 16(1) of the Act for the Inkomati catchment is set out in **Tables 5.1.1 – 5.3.1**.

A summary of the groundwater contribution to the Reserve for Water Quantity in terms of section 16(1) of the Act for the Inkomati catchment is set out in **Table 6.1**.

A summary of the groundwater contribution to the Reserve for Water Quality in terms of section 16(1) of the Act for the Inkomati catchment is set out in **Tables 7.1**, **7.2** and **7.3**.

A summary of the Water Quantity & Quality Reserve for selected Wetlands in terms of section 16(1) of the Act for the Inkomati catchment is set out in **Tables 8.1 and 8.2**.

The Reserve will apply from the date signed off as determined in terms of Section 16(1) of the Act, unless otherwise specified by the Minister.

## 3. ACRONYMS AND DEFINITIONS

### 3.1. Acronyms

| | |
|---|---|
| BHN | Basic Human Needs |
| EcoSpecs | Ecological Specifications |
| EIS | Ecological Importance and Sensitivity |
| EWR | Ecological Water Requirement |
| EWR_MLF | Ecological Water Requirement_Maintenance Low Flows |
| WMA | Water Management Area |
| WARMS | Water Allocation Registration Management System |
| GRAII | Groundwater Resource Assessment Phase II |
| GRDM | Groundwater Resource Directed Measures |
| MAR | Mean Annual Runoff |
| MCM | Million Cubic Metres |
| PES | Present Ecological Status |
| REC | Recommended Ecological Category |
| DWS | Department of Water and Sanitation |
| DWAF | Department of Water Affairs and Forestry |
| EC | Electrical Conductivity |
| TIN | Total Inorganic Nitrogen |
| SRP | Soluble Reactive Phosphorus |
| RC | Reference Condition |
| WQU | Water Quality Unit |

### 3.2. Definitions

**Baseflow** is a sustained low flow in rivers during dry or fair weather conditions, but not necessarily all contributed by groundwater; includes contribution from delayed interflow and groundwater discharge.

**EWR (Ecological Water Requirements)** refers to the flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition.

**Recharge** is the addition of water to the zone of saturation, either by downward percolation of precipitation or surface water and/ or the lateral migration of groundwater from adjacent aquifers.

**Reserve** is the quantity and quality of the water required to satisfy the basic human needs by securing a basic water supply and to protect the aquatic ecosystem in order to secure ecologically sustainable development and use of the relevant water resource.

## 4. SURFACE-WATER - QUANTITY COMPONENT FOR RIVERS

The proposed results for the Reserve determination and ecological categorisation for the Inkomati Catchment, where the Reserve is expressed as a percentage of the NMAR for the respective catchments (cumulative) in terms of section (16) (1) are tabulated below.

**Table 4.1:** Summary of the quantity component for the Rivers which includes the results of the EWR Sites and the biophysical nodes.

| Quaternary catchment | Water Resource | PES | EIS | REC | Ecological Reserve (%NMAR)[4] | BHN Reserve (%NMAR)[3] | Total Reserve (%NMAR)[2] | NMAR (MCM)[1] |
|---|---|---|---|---|---|---|---|---|
| **Komati River Catchment** | | | | | | | | |
| X11A | Vaalwaterspruit | C | Moderate | C | 23.50 | 0.09 | 23.59 | 26.30 |
| X11B | Boesmanspruit | C | High | B/C | 24.20 | 0.16 | 24.36 | 51.20 |
| X11C | Witkloofspruit | C | Very High | B | 22.10 | 0.00 | 22.10 | 11.40 |
| X11D | Komati | C | Moderate | C | 20.10 | 0.00 | 20.10 | 95.40 |
| X11E | Komati | B/C | High | B/C | 25.60 | 0.00 | 25.60 | 118.30 |
| X11F | Bankspruit | B | High | B | 30.80 | 0.00 | 30.80 | 6.50 |
| **X11G** | **Upper Komati (EWR K1: Gevonden)** | **B/C** | **Moderate** | **B/C** | **27.50** | **0.00** | **27.50** | **158.62** |
| **X11J** | **Gladdespruit (EWR G1: Vaalkop)** | **D** | **Moderate** | **D** | **26.90** | **0.00** | **26.90** | **29.52** |
| X11K | Gladdespruit | C | Moderate | C | 19.10 | 0.00 | 19.10 | 71.20 |
| X12A | Buffelspruit | C | Very High | B | 30.30 | 0.00 | 30.30 | 32.00 |
| X12B | Hlatjiwe | C | Moderate | C | 30.50 | 0.00 | 30.50 | 22.10 |
| X12C | Buffelspruit | B | High | B | 40.50 | 0.00 | 40.50 | 71.10 |
| X12D | Seekoeispruit | C | High | B/C | 30.50 | 0.03 | 30.53 | 97.00 |
| **X12E** | **Teespruit (EWR T1: Teespruit)** | **C** | **Moderate** | **C** | **35.30** | **0.00** | **35.30** | **56.36** |
| **X12H** | **Upper Komati (EWR K2: Kromdraai)** | **C** | **High** | **B** | **18.30** | **0.01** | **18.31** | **545.56** |
| X12J | Mtsoli | B | Very High | B | 33.50 | 0.01 | 33.51 | 66.50 |
| X12K | Komati | D | Moderate | D | 21.20 | 0.02 | 21.22 | 577.00 |
| **X13J** | **Lower Komati (EWR K3: Tonga)** | **D** | **Moderate** | **D** | **17.20** | **0.14** | **17.34** | **1021.67** |
| X13K | Komati | D | Moderate | D | 18.10 | 0.04 | 18.14 | 1341.40 |
| X13L | Komati | D | Moderate | D | 11.10 | 0.01 | 11.11 | 1356.60 |
| X14A | Lomati | C | High | C | 36.30 | 0.00 | 36.30 | 84.40 |
| X14B | Ugutugulo | C | High | B/C | 31.70 | 0.02 | 31.72 | 20.90 |
| **X14H** | **Lomati (EWR L1: Kleindoringkop)** | **C** | **Moderate** | **C** | **17.30** | **0.12** | **17.42** | **294.31** |
| **Crocodile River Catchment** | | | | | | | | |
| **X21A** | **Crocodile River (EWR 1: Valyspruit)** | **A/B** | **Moderate** | **A/B** | **30.90** | **0.02** | **30.92** | **15.19** |
| X21B | Lunsklip | C | High | C | 31.30 | 0.12 | 31.42 | 25.80 |
| **X21B** | **Crocodile (EWR 2: Goedenhoop)** | **B** | **High** | **B** | **57.00** | **0.01** | **50.01** | **47.11** |
| X21C | Alexanderspruit | C | High | C | 31.50 | 0.11 | 31.61 | 28.80 |
| X21D | Crocodile | C | High | C | 24.00 | 0.02 | 24.02 | 124.80 |
| **X21E** | **Crocodile (EWR 3: Poplar Creek)** | **B/C** | **High** | **B** | **55.20** | **0.09** | **55.29** | **169.90** |
| X21F | Elands | C | High | C | 35.50 | 0.17 | 35.67 | 50.80 |
| **X21G** | **Elands River (EWR ER 1)** | **B** | **Moderate** | **B** | **48.82** | **0.26** | **49.08** | **50.10** |
| X21H | Ngodwana | C | Very High | B | 22.10 | 0.01 | 22.11 | 59.60 |
| X21J | Elands | C | High | B/C | 30.50 | 0.01 | 30.51 | 151.50 |
| **X21K** | **Elands River (EWR ER 2)** | **B** | **High** | **B** | **45.02** | **0.01** | **45.03** | **50.10** |
| X22A | Houtbosloop | C | Very High | B | 41.30 | 0.01 | 41.31 | 75.30 |
| X22C | Gladdespruit | C | High | B/C | 20.90 | 0.07 | 20.97 | 16.30 |
| X22D | Nels | C | Moderate | C | 29.60 | 0.02 | 29.62 | 20.60 |
| X22E | Kruisfonteinspruit | C | Moderate | C | 26.60 | 0.00 | 26.60 | 11.10 |
| X22F | Nels | C/D | High | C/D | 24.10 | 0.01 | 24.11 | 125.40 |
| X22H | Wit | D/E | High | D | 14.90 | 0.00 | 14.90 | 43.00 |
| **X22K** | **Crocodile (EWR 4: KaNyamazane)** | **C** | **High** | **B** | **34.50** | **0.01** | **34.51** | **754.10** |
| X23B | Noordkaap | D | Very High | C | 23.50 | 0.01 | 23.51 | 50.90 |
| X23C | Suidkaap | C | High | B/C | 39.50 | 0.01 | 39.51 | 61.80 |
| X23E | Queens | C | High | B/C | 27.10 | 0.01 | 27.11 | 39.50 |
| X23F | Suidkaap | C | Moderate | C | 31.00 | 0.45 | 31.45 | 109.80 |
| **X23G** | **Kaap River (EWR 7: Honeybird)** | **C** | **High** | **B** | **36.80** | **0.02** | **36.82** | **169.00** |

| Quaternary catchment | Water Resource | PES | EIS | REC | Ecological Reserve (%NMAR)[4] | BHN Reserve (%NMAR)[3] | Total Reserve (%NMAR)[2] | NMAR (MCM)[1] |
|---|---|---|---|---|---|---|---|---|
| X24A | Nsikazi | B | High | B | 40.60 | 4.25 | 44.85 | 11.70 |
| X24B | Nsikazi | A/B | High | A/B | 44.00 | 3.70 | 47.70 | 42.40 |
| X24C | Nsikazi | B | High | B | 40.50 | 3.21 | 43.71 | 52.30 |
| **X24D** | **Crocodile (EWR 5: Malelane)** | **C** | **Very High** | **B** | **40.20** | **0.01** | **40.21** | **1006.20** |
| **X24H** | **Crocodile (EWR 6: Nkongoma)** | **C** | **Very High** | **B** | **43.90** | **0.01** | **43.91** | **1063.10** |
| **Sabie River Catchment** | | | | | | | | |
| X31A | Klein Sabie | C | High | B/C | 23.00 | 0.73 | 23.73 | 14.60 |
| **X31B** | **Sabie River (EWR 1: Upper Sabie)** | **B/C** | **High** | **B** | **46.30** | **0.00** | **46.30** | **140.18** |
| **X31C** | **Mac Mac River (EWR 4: Mac Mac)** | **B** | **High** | **A/B** | **37.00** | **0.03** | **37.03** | **65.78** |
| X31E | Marite | B/C | High | B | 34.70 | 0.36 | 35.06 | 79.90 |
| X31F | Motitsi | C | High | B | 26.50 | 0.05 | 26.55 | 43.90 |
| **X31D** | **Sabie River (EWR 2: Aan de Vliet)** | **C** | **High** | **B** | **35.70** | **0.08** | **35.78** | **262.10** |
| **X31G** | **Marite River (EWR 5: Marite)** | **B/C** | **High** | **B** | **36.30** | **0.07** | **36.37** | **157.09** |
| X31H | White Waters | C | High | B/C | 31.40 | 0.00 | 31.40 | 28.90 |
| X31J | Noord-Sand | D | Moderate | D | 16.00 | 0.63 | 16.63 | 45.10 |
| **X31K** | **Sabie River (EWR 3: Kidney)** | **A/B** | **Very High** | **A/B** | **37.00** | **0.07** | **37.07** | **495.86** |
| X31L | Saringwa | C | Moderate | C | 24.50 | 3.45 | 27.95 | 10.90 |
| X31M | Musutlu | B/C | Moderate | B/C | 19.00 | 10.94 | 29.94 | 1.80 |
| X32B | Motlamogatsana | C | High | C | 25.70 | 0.69 | 26.39 | 15.40 |
| **X32C** | **Tlulandziteka (Sand) River (EWR 7: Upper Sand)** | **C** | **Moderate** | **C** | **31.70** | **0.57** | **32.27** | **28.88** |
| X32E | Nwarhele | C/D | High | C | 26.10 | 2.87 | 28.97 | 10.60 |
| **X32F** | **Mutlumuvi River (EWR 6: Mutlumuvi)** | **C** | **High** | **B** | **32.20** | **0.42** | **32.62** | **44.99** |
| X32G | Khokhovela | C | Moderate | C | 17.00 | 8.57 | 25.58 | 3.90 |
| X32H | Phungwe | A | High | A | 26.10 | 2.33 | 28.43 | 7.60 |
| **X32J** | **Sand River (EWR 8: Lower Sand)** | **B** | **High** | **B** | **25.30** | **0.30** | **25.60** | **133.61** |

**The bolded quaternary catchments are the EWR Sites**

1) NMAR is the Natural Mean Annual Runoff.

2) The total Reserve amount accounts for both the Ecological Reserve and the Basic Human Needs Reserve (BHN).

3) Represents the percentage of BHN.

4) This amount represents the long term mean based on the NMAR. If the NMAR changes, this volume will also change.

## 5. SURFACE-WATER - QUALITY COMPONENT FOR RIVERS

### 5.1 Croc-East Catchment

**Table 5.1.1:** EWR 1– Crocodile River: EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Crocodile** | | **EWR 1** | **Monitoring site: X2H074Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES and REC** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 30 mS/m. | |
| | pH | The 5th and 95th percentiles of the data must range from 6.5 to 8.0. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.5 mg/L. | |
| | Turbidity | Vary (small amount) from natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.25 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.015 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be <10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | The 95th percentile of the data must be within the TWQR as stated in DWAF (1996). | |

**Table 5.1.2:** EWR 2 –Crocodile River: EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Crocodile** | | **EWR Site 2** | **Monitoring site: X2H074Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES and REC** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 27 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 22 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 39 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 118 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 43 mS/m. | |
| | pH | The 5th and 95th percentiles of the data must range from 6.5 to 8.0. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.5 mg/L. | |
| | Turbidity | Vary (small amount) from natural turbidity range; minor silting of habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.25 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.015 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be <10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | The 95th percentile of the data must be within the TWQR as stated in DWAF (1996). | |

**Table 5.1.3:** EWR 3– Crocodile River: EcoSpecs relating to physico-chemical data (PES)

| **River: Crocodile** | | **EWR 3** | **Monitoring site: X2H013Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 30 mS/m. | |
| | pH | The 5th and 95th percentiles of the data must range from 6.5 to 8.0. | |
| | Temperature | Small to moderate deviation from the natural temperature range. Some highly temperature sensitive species in lower abundances and frequency of occurrence than expected for reference. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 6 mg/L. | |
| | Turbidity | Moderate changes to the catchment land-use resulting in temporary unnaturally high sediment loads and high turbidity. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.25 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.025 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 52.5 mg/m$^2$. | |
| | Toxics | The 95th percentile of the data must be within the TWQR as stated in DWAF (1996). | |

**Table 5.1.4:** EWR 4 Crocodile River - EcoSpecs relating to physico-chemical data (PES)

| **River: Crocodile** | | **EWR 4** | **Monitoring site: X2H032Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 38 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 191 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 55 mS/m | |
| | pH | The 5th percentile of the data must be 5.9 – 6.5, and the 95th percentile 8.0 – 8.8. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.5 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 1.0 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.125 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | The 95th percentile of the data must be within the CEV as stated in DWAF (1996). | |

**Table 5.1.5**: EWR 5 Crocodile River: EcoSpecs relating to physico-chemical data (PES)

| **River: Crocodile** | | **EWR 5** | **Monitoring site: X2H017Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 45 mg/L.** | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 70 mS/m.*** | |
| | pH | The 5th percentile of the data must be 5.9 – 6.5, and the 95th percentile 8.0 – 8.8. | |
| | Temperature | Moderate deviation from the natural temperature range. Most highly temperature sensitive species in lower abundances and frequency of occurrence than expected for reference. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.125 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | The 95th percentile of the data must be within the TWQR as stated in DWAF (1996). | |

**Table 5.1.6:** EWR 6 Crocodile River: EcoSpecs relating to physico-chemical data (PES)

| **River: Crocodile** | | **EWR 6** | **Monitoring site: X2H016Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 45 mg/L | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 30 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 57 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 85 mS/m. | |
| | pH | The 5th percentile of the data must be 5.9 – 6.5, and the 95th percentile 8.0 – 8.8. | |
| | Temperature | Small to moderate deviation from the natural temperature range. Some highly temperature sensitive species in lower abundances and frequency of occurrence than expected for reference. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.125 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | The 95th percentile of the data must be within the CEV as stated in DWAF (1996) | |

**Table 5.1.7:** EWR 7 Crocodile River: EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Kaap** | | **EWR 7** | **Monitoring site: X2H022Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES and REC** | |
| **Inorganic salts** | ALL | - | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 100 mS/m. | |
| | pH | The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 8.0 to 8.8. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 8 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 1.0 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.125 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 52.5 mg/m$^2$. | |
| | Toxics | The 95th percentile of the data must be within the TWQR as stated in DWAF (1996). | |

### 5.2 Sabie-Sand Catchment

**Table 5.2.1:** EWR 1 (Upper Sabie): EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Sabie** | | **EWR 1** | **Monitoring site: X3H001Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES and REC** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 30 mS/m. | |
| | pH | The 5th and 95th percentiles of the data must range from 6.5 to 8.0. | |
| | Temperature | No deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 8.0 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.025 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be <10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

**Table 5.2.2:** EWR 2 (Aan de Vliet): EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Sabie** | | **EWR Site: 2** | **Monitoring site: X3H006Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 118 mg/L (A/B category). | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 30 mS/m. | |
| | pH | The 5th and 95th percentiles of the data must range from 6.5 to 8.0. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.5 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.25 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.025 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 84 mg/m$^2$. | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

**Table 5.2.3:** EWR 3 (Kidney): EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Sabie** | | **EWR 3** | **Monitoring site: X3H013Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES and REC** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 30 mS/m. | |
| | pH | The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.5 mg/L. | |
| | Turbidity | Small to moderate changes to the catchment land-use resulting in minor effects of silting of habitats, largely of a temporary nature, with very intermittent temporary unnaturally high sediment loads and high turbidity. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.25 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.015 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be <10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

**Table 5.2.4:** EWR 4 (Mac Mac) - EcoSpecs relating to physico-chemical data (PES)

| **River: Mac Mac** | | **EWR 4** | **Monitoring site: X3H003Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 30 mS/m. | |
| | pH | The 5th and 95th percentiles of the data must range from 6.5 to 8.0. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 8.0 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.015 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 84 mg/m$^2$. | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

**Table 5.2.5:** EWR 5 (Marite): EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Marite** | | **EWR 5** | **Monitoring site: X3H011Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES and REC** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 30 mS/m. | |
| | pH | The 5th and 95th percentiles of the data must range from 6.5 to 8.0. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.0 mg/L. | |
| | Turbidity | Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.015 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be <10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 84 mg/m$^2$. | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

**Table 5.2.6:** EWR 6 (Mutlumuvi): EcoSpecs relating to physico-chemical data (PES)

| **River: Mutlumuvi** | | **EWR 6** | **Monitoring site: X3H008Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 42 mS/m (A/B category). | |
| | pH | The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.0 mg/L. | |
| | Turbidity | Small to moderate changes to the catchment land-use resulting in minor effects of silting of habitats, largely of a temporary nature, with very intermittent temporary unnaturally high sediment loads and high turbidity. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.125 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 84 mg/m$^2$ | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

**Table 5.2.7:** EWR 7 (Tlulandziteka): EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Tlulandziteka** | | **EWR 7** | **Monitoring site: X3H008Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 42 mS/m (A/B category). | |
| | pH | The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.0 mg/L. | |
| | Turbidity | Moderate changes to the catchment land-use resulting in temporary unnaturally high sediment loads and high turbidity. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.125 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be < 10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 84 mg/m$^2$. | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

**Table 5.2.8:** EWR 8 (Lower Sand): EcoSpecs relating to physico-chemical data (PES and REC)

| **River: Sand** | | **EWR 8** | **Monitoring site: X3H008Q01** |
|---|---|---|---|
| **Water quality metrics** | | **ECOSPEC: PES and REC** | |
| **Inorganic salts** | $MgSO_4$ | The 95th percentile of the data must be ≤ 16 mg/L. | |
| | $Na_2SO_4$ | The 95th percentile of the data must be ≤ 20 mg/L. | |
| | $MgCl_2$ | The 95th percentile of the data must be ≤ 15 mg/L. | |
| | $CaCl_2$ | The 95th percentile of the data must be ≤ 21 mg/L. | |
| | NaCl | The 95th percentile of the data must be ≤ 45 mg/L. | |
| | $CaSO_4$ | The 95th percentile of the data must be ≤ 351 mg/L. | |
| **Physical variables** | EC | The 95th percentile of the data must be ≤ 42 mS/m (A/B category). | |
| | pH | The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8. | |
| | Temperature | Small deviation from the natural temperature range. | |
| | Dissolved Oxygen | The 5th percentile of the data must be ≥ 7.5 mg/L. | |
| | Turbidity | Small to moderate changes to the catchment land-use resulting in minor effects of silting of habitats, largely of a temporary nature, with very intermittent temporary unnaturally high sediment loads and high turbidity. | |
| **Nutrients** | TIN | The 50th percentile of the data must be ≤ 0.7 mg/L. | |
| | $PO_4$-P | The 50th percentile of the data must be ≤ 0.125 mg/L. | |
| **Response variables** | Chl-a phytoplankton | The 50th percentile of the data must be <10 µg/L. | |
| | Chl-a periphyton | The 50th percentile of the data must be ≤ 21 mg/m$^2$. | |
| | Toxics | An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996). | |

### 5.3 Komati Catchment

**Table 5.3.1**: EWR K1 – Upper Komati

| **River** | **Upper Komati** | **DWS Water Quality Monitoring Points** | | |
|---|---|---|---|---|
| **WQU** | **2** | **RC** | | **X1H033Q01** |
| **EWR Site** | **K1** | **PES** | | **X1H033Q01** |
| **Water Quality Constituents** | | **Present State** | | **Quality EcoSpecs (Benchmark Classification)** |
| Inorganic Salts | $MgSO_4$ | B | | 16 mg/L. |
| | $Na_2SO_4$ | A | | 20 mg/L. |
| | $MgCl_2$ | A | | 15 mg/L. |
| | $CaCl_2$ | A | | 21 mg/L. |
| | NaCl | A | | 45 mg/L. |
| | $CaSO_4$ | A | | 351 mg/L. |
| Nutrients | SRP | B/C (0.025) | | 0.017 mg/L. |
| | TIN | A (0.09) | | 0.129 mg/L. |
| Physical Variable | pH | B (6.3 – 8.58) | | 5th Percentile: 6.00-6.25<br>95th Percentile: 8.37-8.69 |
| | Temperature | Expected to increase due to dams and surface runoff | Potential impacts associated with the operational procedure and releases from the Nooitgedacht Dam as there are only surface warm water spills. | Vary not more than 2°C when compared to natural mean monthly |
| | Dissolved Oxygen | No data | | 7-8 mg/L. |
| | Turbidity (NTU) | No data- The river banks are eroded due to steep slopes as well as animal trampling. The Dam will reduce turbidity. | | Small change allowed – largely natural and related to natural catchment processes such as rainfall runoff. |
| Response variables | Chl-a periphyton | Chlorophyll-a values low (2.9 µg/L) and phaeton phyte (2.5 µg/L) in Nooitgedacht Dam. Diatoms on rocks in river. | | < 1.7 mg/m$^2$ |
| | Chl-a phytoplankton | | | 5 µg/L |
| | Biotic community composition - macroinvertebrate | Fish: B/C<br>ASPT: 5.4 – 5.8<br>SASS5: 134-163 | | ASPT 6 |
| | Instream toxicity | Not sampled | | |
| Toxics | Fluoride | 200 (A) | | 1500 µg/L (A category) |
| | Al | | | 20 µg/L (A category) |
| | Ammonia | | | 15 µg/L (A category) |
| | As | | | 20 µg/L (A category) |
| | Atrazine | | | 19 µg/L (A category) |
| | Cd soft | | | 0.2 µg/L (A category) |
| | Cd mod | | | 0.2 µg/L (A category) |
| | Cd hard | | | 0.3 µg/L (A category) |
| | Chlorine | | | 0.4 µg/L (A category) |
| | Cr(III) | | | 24 µg/L (A category) |
| | Cr(VI) | | | 14 µg/L (A category) |
| | Cu soft | | | 0.5 µg/L (A category) |
| | Cu mod | | | 1.5 µg/L (A category) |
| | Cu hard | | | 2.4 µg/L (A category) |
| | Cyanide | | | 4 µg/L (A category) |

**Table 5.3.2**: EWR K2 – Upper Komati

| **River** | **Upper Komati** | **DWS Water Quality Monitoring Points** | | |
|---|---|---|---|---|
| **WQU** | **3** | **RC** | | **X1H001Q01** |
| **EWR Site** | **K2** | **PES** | | **X1H001Q01** |
| **Water Quality Constituents** | | **Resent State** | | **Quality EcoSpecs (Benchmark Classification)** |
| Inorganic Salts | $MgSO_4$ | B | | 16 mg/L. |
| | $Na_2SO_4$ | A | | 20 mg/L. |
| | $MgCl_2$ | B | | 15 mg/L. |
| | $CaCl_2$ | A | | 21 mg/L. |
| | NaCl | A | | 45 mg/L. |
| | $CaSO_4$ | A | | 351 mg/L. |
| Nutrients | SRP | B (0.018) | | 0.017 mg/L. |
| | TIN | B (0.146) | | 0.129 mg/L. |
| Physical Variable | pH | B/C (6.2 – 9.19) | | 5th Percentile: 6.24-6.46<br>95th Percentile: 8.69-9.00 |
| | Temperature | No data | Impacts expected as a result of warming in the Vygeboom and operational procedures. | Vary not more than 2°C when compared to natural mean monthly. |
| | Dissolved Oxygen | No data | | 7-8 mg/L. |
| | Turbidity (NTU) | High sediment inputs especially from Seeikoespruit. | | Small change allowed – largely natural and related to natural catchment processes such as rainfall runoff. |
| Response variables | Chl-a periphyton | Chlorophyll-a values in Vygeboom Dam low (1.0-1.25 µg/L). | | 21 mg/m$^2$ |
| | Chl-a phytoplankton | | | < 5 µg/L |
| | Biotic community composition - macroinvertebrate | ASPT: 6-8<br>SASS5 ca.200 | | ASPT 6 |
| | Instream toxicity | Not sampled | | |
| Toxics | Fluoride | A (252) | | 1500 µg/L (A category) |
| | Al | | | 20 µg/L (A category) |
| | Ammonia | | | 15 µg/L (A category) |
| | As | | | 20 µg/L (A category) |
| | Atrazine | | | 19 µg/L (A category) |
| | Cd soft | | | 0.2 µg/L (A category) |
| | Cd mod | | | 0.2 µg/L (A category) |
| | Cd hard | | | 0.3 µg/L (A category) |
| | Chlorine | | | 0.4 µg/L (A category) |
| | Cr(III) | | | 24 µg/L (A category) |
| | Cr(VI) | | | 14 µg/L (A category) |
| | Cu soft | | | 0.5 µg/L (A category) |
| | Cu mod | | | 1.5 µg/L (A category) |
| | Cu hard | | | 2.4 µg/L (A category) |
| | Cyanide | | | 4 µg/L (A category) |

**Table 5.3.3:** EWR K3 – Lower Komati

| **River** | **Upper Komati** | **DWS Water Quality Monitoring Points** | |
|---|---|---|---|
| **WQU** | **7** | **RC** | **X1H003Q01** |
| **EWR Site** | **K3** | **PES** | **X1H003Q01** |
| **Water Quality Constituents** | | **Resent State** | **Quality EcoSpecs (Benchmark Classification)** |
| Inorganic Salts | $MgSO_4$ | B | 16 mg/L. |
| | $Na_2SO_4$ | B | 20 mg/L. |
| | $MgCl_2$ | B | 15 mg/L. |
| | $CaCl_2$ | A | 21 mg/L. |
| | NaCl | B | 45 mg/L. |
| | $CaSO_4$ | A | 351 mg/L. |
| Nutrients | SRP | C (0.025) | 0.017 mg/L. |
| | TIN | C (0.32) | 0.129 mg/L. |
| Physical Variable | pH | B (6.01-8.77) | 5th Percentile: 6.5-6.8<br>95th Percentile: 8.0-8.5 |
| | Temperature | No data | Vary not more than 2°C when compared to natural mean monthly. |
| | Dissolved Oxygen | No data | 7-8 mg/L. |
| | Turbidity (NTU) | Expected high turbidity after rains due to removal of riparian vegetation and the natural steep topography. | |
| Response variables | Chl-a periphyton | Not sampled/ rocks clogged with filamentous algae. | |
| | Chl-a phytoplankton | | < 5 µg/L |
| | Biotic community composition - macroinvertebrate | ASPT: 5<br>SASS5: < 50 | ASPT 6 |
| | Instream toxicity | Not sampled | |
| Toxics | Fluoride | 225 (A) | 1500 µg/L (A category) |
| | Al | | 20 µg/L (A category) |
| | Ammonia | | 15 µg/L (A category) |
| | As | | 20 µg/L (A category) |
| | Atrazine | | 19 µg/L (A category) |
| | Cd soft | | 0.2 µg/L (A category) |
| | Cd mod | | 0.2 µg/L (A category) |
| | Cd hard | | 0.3 µg/L (A category) |
| | Chlorine | | 0.4 µg/L (A category) |
| | Cr(III) | | 24 µg/L (A category) |
| | Cr(VI) | | 14 µg/L (A category) |
| | Cu soft | | 0.5 µg/L (A category) |
| | Cu mod | | 1.5 µg/L (A category) |
| | Cu hard | | 2.4 µg/L (A category) |
| | Cyanide | | 4 µg/L (A category) |

**Table 5.3.4:** EWR G1 – Upper Komati

| **River** | **Upper Komati** | **DWS Water Quality Monitoring Points** | |
|---|---|---|---|
| **WQU** | **4** | **RC** | **X1H019Q01** |
| **EWR Site** | **G1** | **PES** | **X1H019Q01** |
| **Water Quality Constituents** | | **Resent State** | **Quality EcoSpecs (Benchmark Classification)** |
| Inorganic Salts | $MgSO_4$ | B | 16 mg/L. |
| | $Na_2SO_4$ | A | 20 mg/L. |
| | $MgCl_2$ | A | 15 mg/L. |
| | $CaCl_2$ | A | 21 mg/L. |
| | NaCl | A | 45 mg/L. |
| | $CaSO_4$ | A | 351 mg/L. |
| Nutrients | SRP | B/C (0.014) | > 0.125 mg/L. |
| | TIN | B/C (0.235) | 0.75 mg/L. |
| Physical Variable | pH | B/C (7.25-8.44) | 5th Percentile: 6.00-6.25<br>95th Percentile: 8.37-8.69 |
| | Temperature | No data | |
| | Dissolved Oxygen | No data | |
| | Turbidity (NTU) | High TDS values recorded (range 7 to 155). | |
| Response variables | Chl-a periphyton | None recorded | |
| | Chl-a phytoplankton | None recorded | |
| | Biotic community composition - macroinvertebrate | ASPT: 4.21-6.3<br>SASS5:30-160 | ASPT 5 |
| | Instream toxicity | Not sampled | |
| Toxics | Fluoride | 167 (A) | 1500 µg/L (A category) |
| | Al | | 20 µg/L (A category) |
| | Ammonia | | 15 µg/L (A category) |
| | As | | 20 µg/L (A category) |
| | Atrazine | | 19 µg/L (A category) |
| | Cd soft | | 0.2 µg/L (A category) |
| | Cd mod | | 0.2 µg/L (A category) |
| | Cd hard | | 0.3 µg/L (A category) |
| | Chlorine | | 0.4 µg/L (A category) |
| | Cr(III) | | 24 µg/L (A category) |
| | Cr(VI) | | 14 µg/L (A category) |
| | Cu soft | | 0.5 µg/L (A category) |
| | Cu mod | | 1.5 µg/L (A category) |
| | Cu hard | | 2.4 µg/L (A category) |
| | Cyanide | | 4 µg/L (A category) |

**Table 5.3.5:** EWR T1 – Upper Komati

| **River** | **Upper Komati** | **DWS Water Quality Monitoring Points** | | |
|---|---|---|---|---|
| **WQU** | **6** | **RC** | | |
| **EWR Site** | **T1** | **PES** | | |
| **Water Quality Constituents** | | **Resent State** | | **Quality EcoSpecs (Benchmark Classification)** |
| Inorganic Salts | $MgSO_4$ | B | | 16 mg/L. |
| | $Na_2SO_4$ | A | | 20 mg/L. |
| | $MgCl_2$ | A | | 15 mg/L. |
| | $CaCl_2$ | A | | 21 mg/L. |
| | NaCl | B | | 45 mg/L. |
| | $CaSO_4$ | B | | 351 mg/L. |
| Nutrients | SRP | C/D (0.04) | | > 0.125 mg/L. |
| | TIN | A (0.186) | | 0.75 mg/L. |
| Physical Variable | pH | A (7.78-7.74) | | 5th Percentile: 6.00-6.25<br>95th Percentile: 8.37-8.69 |
| | Temperature | No data | No impacts expected | |
| | Dissolved Oxygen | No data | | |
| | Turbidity (NTU) | Expected high turbidity after rains due to removal of riparian vegetation and the natural steep topography. | | |
| Response variables | Chl-a periphyton | Not sampled | | |
| | Chl-a phytoplankton | | | |
| | Biotic community composition - macroinvertebrate | ASPT:5.7 7.2<br>SASS: 163-239 | | ASPT > 6 |
| | Instream toxicity | Not sampled | | |
| Toxics | Fluoride | 363 (A) | | 1500 µg/L (A category) |
| | Al | | | 20 µg/L (A category) |
| | Ammonia | | | 15 µg/L (A category) |
| | As | | | 20 µg/L (A category) |
| | Atrazine | | | 19 µg/L (A category) |
| | Cd soft | | | 0.2 µg/L (A category) |
| | Cd mod | | | 0.2 µg/L (A category) |
| | Cd hard | | | 0.3 µg/L (A category) |
| | Chlorine | | | 0.4 µg/L (A category) |
| | Cr(III) | | | 24 µg/L (A category) |
| | Cr(VI) | | | 14 µg/L (A category) |
| | Cu soft | | | 0.5 µg/L (A category) |
| | Cu mod | | | 1.5 µg/L (A category) |
| | Cu hard | | | 2.4 µg/L (A category) |
| | Cyanide | | | 4 µg/L (A category) |

**Table 5.3.6:** EWR L1 – Lomati

| **River** | **Upper Komati** | **DWS Water Quality Monitoring Points** | | |
|---|---|---|---|---|
| **WQU** | **10** | **RC** | | **X1HO49Q1** |
| **EWR Site** | **L1** | **PES** | | **X1HO49Q1** |
| **Water Quality Constituents** | | **Resent State** | | **Quality EcoSpecs (Benchmark Classification)** |
| Inorganic Salts | $MgSO_4$ | B | | 16 mg/L. |
| | $Na_2SO_4$ | A | | 20 mg/L. |
| | $MgCl_2$ | A | | 15 mg/L. |
| | $CaCl_2$ | A | | 21 mg/L. |
| | NaCl | B | | 45 mg/L. |
| | $CaSO_4$ | A | | 351 mg/L. |
| Nutrients | SRP | C (0.022) | | 0.058 mg/L. |
| | TIN | B/C (0.277) | | <0.25 mg/L. |
| Physical Variable | pH | B (6.9-8.6) | | 5th Percentile: 5.75-6.00<br>95th Percentile: 8.05-8.37 |
| | Temperature | No data | Driekoppies Dam operational procedures will impact on temperatures due to releases from deeper colder water. | |
| | Dissolved Oxygen | No data | | |
| | Turbidity (NTU) | Sediments settled out in dams. | | |
| Response variables | Chl-a periphyton | Not sampled | | 21 mg/m$^2$ |
| | Chl-a phytoplankton | | | 5 µg/L in Driekoppies Dam |
| | Biotic community composition - macroinvertebrate | ASPT: 5.5-7.0<br>SASS5:60-250 | | ASPT > 6 |
| | Instream toxicity | Not sampled | | |
| Toxics | Fluoride | 154 (A) | | 1500 µg/L (A category) |
| | Al | | | 20 µg/L (A category) |
| | Ammonia | | | 15 µg/L (A category) |
| | As | | | 20 µg/L (A category) |
| | Atrazine | | | 19 µg/L (A category) |
| | Cd soft | | | 0.2 µg/L (A category) |
| | Cd mod | | | 0.2 µg/L (A category) |
| | Cd hard | | | 0.3 µg/L (A category) |
| | Chlorine | | | 0.4 µg/L (A category) |
| | Cr(III) | | | 24 µg/L (A category) |
| | Cr(VI) | | | 14 µg/L (A category) |
| | Cu soft | | | 0.5 µg/L (A category) |
| | Cu mod | | | 1.5 µg/L (A category) |
| | Cu hard | | | 2.4 µg/L (A category) |
| | Cyanide | | | 4 µg/L (A category) |

**Table 5.3.7:** EWR M1 – Maguga

| **River** | **Upper Komati** | **DWS Water Quality Monitoring Points** | |
|---|---|---|---|
| **WQU** | **11** | **RC** | **X1H021Q01** |
| **EWR Site** | **M1** | **PES** | **X1H021Q01** |
| **Water Quality Constituents** | | **Resent State** | **Quality EcoSpecs (Benchmark Classification)** |
| Inorganic Salts | $MgSO_4$ | A | 16 mg/L. |
| | $Na_2SO_4$ | A | 20 mg/L. |
| | $MgCl_2$ | A | 15 mg/L. |
| | $CaCl_2$ | A | 21 mg/L. |
| | NaCl | A | 45 mg/L. |
| | $CaSO_4$ | A | 351 mg/L. |
| Nutrients | SRP | B (0.012) | 0.125 mg/L. |
| | TIN | A (0.06) | <0.75 mg/L. |
| Physical Variable | pH | C (6.12-8.61) | 5th Percentile: 6.00-6.25<br>95th Percentile: 8.37-8.69 |
| | Temperature | No data | |
| | Dissolved Oxygen | No data | |
| | Turbidity (NTU) | | |
| Response variables | Chl-a periphyton | Not sampled | |
| | Chl-a phytoplankton | | |
| | Biotic community composition - macroinvertebrate | ASPT: 6-7.6<br>SASS5: 96-234 | ASPT > 6 |
| | Instream toxicity | Not sampled | |
| Toxics | Fluoride | 50 (A) | 1500 µg/L (A category) |
| | Al | | 20 µg/L (A category) |
| | Ammonia | | 15 µg/L (A category) |
| | As | | 20 µg/L (A category) |
| | Atrazine | | 19 µg/L (A category) |
| | Cd soft | | 0.2 µg/L (A category) |
| | Cd mod | | 0.2 µg/L (A category) |
| | Cd hard | | 0.3 µg/L (A category) |
| | Chlorine | | 0.4 µg/L (A category) |
| | Cr(III) | | 24 µg/L (A category) |
| | Cr(VI) | | 14 µg/L (A category) |
| | Cu soft | | 0.5 µg/L (A category) |
| | Cu mod | | 1.5 µg/L (A category) |
| | Cu hard | | 2.4 µg/L (A category) |
| | Cyanide | | 4 µg/L (A category) |

## 6. GROUNDWATER - QUANTITY COMPONENT

The groundwater quantity component was determined using values (recharge, baseflow, groundwater use and stress index) obtained during the determination of water resource classes and associated resource quality objectives in the Inkomati Water Management Area, (DWS 2015), shown in Table 6.1. The average annual groundwater recharge for the entire WMA based on the Groundwater Resource Assessment project Phase II (GRA II) dataset is estimated to be more than 1 500 $Mm^3/a$. The Ecological Water Requirements_Maintenance Low Flow (EWR_MLF) values were obtained from the Rapid groundwater Reserve determination study for the Inkomati WMA (AGES, 2010).

Population values were obtained from the Water Services dataset of 2011. The Basic Human Needs Reserve provides for the essential needs of individuals served by the water resource in question and includes water for drinking, food preparation and for personal hygiene. A life-line amount of 25 litres per person per day was used. The current study approach took also cognisance of the GRA II and WARMS 2013 datasets to achieve a more balanced estimate of groundwater use. The total groundwater use for the Inkomati WMA was subsequently estimated at 52.3 $Mm^3/a$. The groundwater stress index reflects groundwater used versus recharge.

**Table 6.1 Summary of the Reserve**

| Quaternary | Area($km^2$) | Recharge ($Mm^3/a$) | Population | Baseflow ($Mm^3/a$) (DWS, 2015) | EWR_MLF ($Mm^3/a$) | BHN Reserve ($Mm^3/a$) | Reserve ($Mm^3/a$) | Groundwater Use ($Mm^3/a$) | Stress Index |
|---|---|---|---|---|---|---|---|---|---|
| X11A | 672 | 24.36 | 2561 | 7.21 | 11.47 | 0.023 | 11.49 | 0.33 | 1% |
| X11B | 597 | 22.93 | 8946 | 6.96 | 10.72 | 0.082 | 10.80 | 0.83 | 4% |
| X11C | 319 | 13.12 | 0 | 3.68 | 5.99 | 0 | 5.99 | 1.56 | 12% |
| X11D | 590 | 25.97 | 0 | 23.59 | 12.24 | 0 | 12.24 | 0.51 | 2% |
| X11E | 242 | 11.38 | 0 | 9.97 | 4.77 | 0 | 4.77 | 0.02 | 0% |
| X11F | 183 | 9.49 | 0 | 7.54 | 4.24 | 0 | 4.24 | 0.15 | 2% |
| X11G | 264 | 20.58 | 0 | 17.25 | 9.65 | 0 | 9.65 | 0.2 | 1% |
| X11H | 265 | 21.55 | 0 | 17.17 | 10.09 | 0 | 10.09 | 0.44 | 2% |
| X11J | 186 | 15.75 | 0 | 11.98 | 7.24 | 0 | 7.24 | 0.26 | 2% |
| X11K | 211 | 16.73 | 0 | 10 | 7.38 | 0 | 7.38 | 0.82 | 5% |
| X12A | 244 | 15.45 | 0 | 13.94 | 7.27 | 0 | 7.27 | 0.08 | 0% |
| X12B | 155 | 10.3 | 0 | 12.05 | 4.84 | 0 | 4.84 | 0.04 | 0% |
| X12C | 186 | 13.28 | 0 | 8.03 | 6.52 | 0 | 6.52 | 0.08 | 1% |
| X12D | 223 | 14.19 | 2735 | 7.54 | 6.23 | 0.025 | 6.25 | 0.29 | 2% |
| X12E | 333 | 20.72 | 1020 | 11.5 | 9.63 | 0.009 | 9.64 | 0.09 | 0% |
| X12F | 313 | 21.69 | 59707 | 10.85 | 10.63 | 0.545 | 11.17 | 0.13 | 1% |
| X12G | 239 | 16.9 | 13058 | 3.42 | 8.11 | 0.119 | 8.23 | 0.05 | 0% |
| X12H | 286 | 26.31 | 6177 | 9.41 | 12.6 | 0.056 | 12.66 | 0.05 | 0% |
| X12J | 296 | 29.62 | 246 | 5.77 | 14.3 | 0.002 | 14.30 | 0.16 | 1% |
| X12K | 286 | 27.93 | 10338 | 9.37 | 13.57 | 0.094 | 13.66 | 0.08 | 0% |
| X13J | 828 | 20.68 | 157637 | 0 | 8.63 | 1.438 | 10.07 | 0.7 | 3% |
| X13K | 621 | 10.25 | 56636 | 6.86 | 0.13 | 0.517 | 0.65 | 2.56 | 25% |
| X13L | 286 | 5.17 | 3387 | 2.83 | 0.36 | 0.031 | 0.39 | 0.98 | 19% |
| X14A | 141 | 8.89 | 0 | 0 | 4.2 | 0 | 4.20 | 0.09 | 1% |
| X14B | 185 | 11.39 | 457 | 0 | 5.41 | 0.004 | 5.41 | 0.09 | 1% |

| Quaternary | Area($km^2$) | Recharge ($Mm^3/a$) | Population | Baseflow ($Mm^3/a$) (DWS, 2015) | EWR_MLF ($Mm^3/a$) | BHN Reserve ($Mm^3/a$) | Reserve ($Mm^3/a$) | Groundwater Use ($Mm^3/a$) | Stress Index |
|---|---|---|---|---|---|---|---|---|---|
| X14F | 117 | 6.89 | 0 | 4.62 | 3.36 | 0 | 3.36 | 0.07 | 1% |
| X14G | 204 | 6 | 89074 | 6.15 | 2.29 | 0.813 | 3.10 | 0.62 | 10% |
| X14H | 360 | 8.67 | 38790 | 3.19 | 3.62 | 0.354 | 3.97 | 6.68 | 77% |
| X21A | 265 | 13.85 | 446 | 2.69 | 0.93 | 0.004 | 0.93 | 0.67 | 5% |
| X21B | 378 | 18.81 | 0 | 4.01 | 3.27 | 0 | 3.27 | 0.45 | 2% |
| X21C | 311 | 16.25 | 869 | 3.21 | 7.67 | 0.008 | 7.68 | 0.75 | 5% |
| X21D | 219 | 10.95 | 0 | 2.04 | 4.84 | 0 | 4.84 | 0.14 | 1% |
| X21E | 345 | 29.69 | 0 | 3.59 | 16.58 | 0 | 16.58 | 0.2 | 1% |
| X21F | 397 | 18.3 | 9513 | 3.17 | 8.83 | 0.087 | 8.92 | 0.83 | 5% |
| X21G | 347 | 17.51 | 14487 | 4.24 | 8 | 0.132 | 8.13 | 0.16 | 1% |
| X21H | 229 | 21.19 | 0 | 5.7 | 10.23 | 0 | 10.23 | 0.08 | 0% |
| X21J | 355 | 29.26 | 120 | 6.45 | 14.08 | 0.001 | 14.08 | 0.15 | 1% |
| X21K | 245 | 22.78 | 625 | 4.16 | 11.13 | 0.006 | 11.14 | 0.11 | 0% |
| X22A | 252 | 23.67 | 0 | 4.28 | 11.3 | 0 | 11.30 | 0.07 | 0% |
| X22B | 227 | 21.24 | 0 | 4.36 | 9.75 | 0 | 9.75 | 0.46 | 2% |
| X22C | 366 | 20.69 | 0 | 7.51 | 8.43 | 0 | 8.43 | 1.03 | 5% |
| X22D | 274 | 25.58 | 12182 | 3.84 | 12.02 | 0.111 | 12.13 | 0.15 | 1% |
| X22E | 153 | 13.92 | 0 | 3.9 | 6.75 | 0 | 6.75 | 0.04 | 0% |
| X22F | 212 | 11.41 | 947 | 2.05 | 3.02 | 0.009 | 3.03 | 1.19 | 10% |
| X22G | 107 | 9.39 | 0 | 3.02 | 4.72 | 0 | 4.72 | 0.11 | 1% |
| X22H | 200 | 10.22 | 5440 | 2.09 | 2.95 | 0.050 | 3.00 | 0.92 | 9% |
| X22J | 240 | 12.75 | 23373 | 2.56 | 5.48 | 0.213 | 5.69 | 0.81 | 6% |
| X22K | 335 | 14.57 | 33140 | 3.55 | 42.45 | 0.302 | 42.75 | 2.89 | 20% |
| X23A | 127 | 10.69 | 0 | 1.71 | 4.79 | 0 | 4.79 | 0.07 | 1% |
| X23B | 229 | 12.38 | 0 | 3.18 | 5.13 | 0 | 5.13 | 0.65 | 5% |
| X23C | 81 | 6.98 | 0 | 3.34 | 2.93 | 0 | 2.93 | 0.12 | 2% |
| X23D | 182 | 12.89 | 0 | 2.43 | 6.11 | 0 | 6.11 | 0.17 | 1% |

| Quaternary | Area($km^2$) | Recharge ($Mm^3/a$) | Population | Baseflow ($Mm^3/a$) (DWS, 2015) | EWR_MLF ($Mm^3/a$) | BHN Reserve ($Mm^3/a$) | Reserve ($Mm^3/a$) | Groundwater Use ($Mm^3/a$) | Stress Index |
|---|---|---|---|---|---|---|---|---|---|
| X23E | 180 | 12.02 | 0 | 3.18 | 5.32 | 0 | 5.32 | 0.16 | 1% |
| X23F | 310 | 20.29 | 53913 | 1.63 | 8.5 | 0.492 | 8.99 | 2.41 | 12% |
| X23G | 225 | 11.2 | 596 | 2.24 | 4.97 | 0.005 | 4.98 | 0.26 | 2% |
| X23H | 306 | 14.59 | 3837 | 1.92 | 10.78 | 0.035 | 10.82 | 0.66 | 4% |
| X24A | 249 | 7.57 | 54450 | 2.52 | 3.42 | 0.497 | 3.92 | 0.4 | 5% |
| X24B | 335 | 11.06 | 171771 | 2.46 | 5.13 | 1.567 | 6.70 | 0.82 | 7% |
| X24C | 286 | 10.49 | 184218 | 1.35 | 4.87 | 1.681 | 6.55 | 0.09 | 1% |
| X24D | 302 | 10.58 | 340 | 2.08 | 52.22 | 0.003 | 52.22 | 0.38 | 4% |
| X24E | 526 | 12.28 | 5073 | 0 | 5.56 | 0.046 | 5.61 | 0.22 | 2% |
| X24F | 262 | 5.76 | 323 | 0 | 1.89 | 0.003 | 1.89 | 0.72 | 12% |
| X24G | 620 | 11.69 | 0 | 0 | 4.84 | 0 | 4.84 | 0.12 | 1% |
| X24H | 769 | 12.78 | 0 | 0 | 90 | 0 | 90.00 | 0.98 | 8% |
| X31A | 230 | 39.15 | 11707 | 2.14 | 19.1 | 0.107 | 19.21 | 2.33 | 6% |
| X31B | 195 | 32.54 | 1722 | 1.81 | 7.43 | 0.016 | 7.45 | 0.11 | 0% |
| X31C | 154 | 25.8 | 355 | 1.44 | 5.21 | 0.003 | 5.21 | 0.11 | 0% |
| X31D | 192 | 17.49 | 2099 | 0.77 | 11.35 | 0.019 | 11.37 | 1.16 | 7% |
| X31E | 214 | 26.11 | 31805 | 1.92 | 12.42 | 0.290 | 12.71 | 0.37 | 1% |
| X31F | 94 | 11.66 | 2255 | 1.88 | 5.41 | 0.021 | 5.43 | 0.08 | 1% |
| X31G | 169 | 12.43 | 22348 | 1.65 | 10.04 | 0.204 | 10.24 | 1.4 | 11% |
| X31H | 60 | 6.69 | 0 | 0.6 | 2.98 | 0 | 2.98 | 0.12 | 2% |
| X31J | 154 | 13.54 | 30984 | 1.57 | 5.55 | 0.283 | 5.83 | 0.53 | 4% |
| X31K | 488 | 12.58 | 97372 | 0 | 29.39 | 0.889 | 30.28 | 0.58 | 5% |
| X31L | 304 | 13.71 | 41155 | 0 | 6.09 | 0.376 | 6.47 | 0.51 | 4% |
| X31M | 709 | 12.79 | 21584 | 0 | 4.44 | 0.197 | 4.64 | 0.95 | 7% |
| X32A | 112 | 7.4 | 18850 | 0 | 3.24 | 0.172 | 3.41 | 0.5 | 7% |
| X32B | 55 | 3.38 | 11671 | 1.07 | 1.28 | 0.106 | 1.39 | 0.32 | 9% |
| X32C | 233 | 6.52 | 57961 | 0.52 | 3.32 | 0.529 | 3.85 | 0.91 | 14% |

| Quaternary | Area($km^2$) | Recharge ($Mm^3/a$) | Population | Baseflow ($Mm^3/a$) (DWS, 2015) | EWR_MLF ($Mm^3/a$) | BHN Reserve ($Mm^3/a$) | Reserve ($Mm^3/a$) | Groundwater Use ($Mm^3/a$) | Stress Index |
|---|---|---|---|---|---|---|---|---|---|
| X32D | 100 | 6.75 | 30860 | 1.47 | 2.93 | 0.282 | 3.21 | 0.32 | 5% |
| X32E | 78 | 4.68 | 33350 | 0.95 | 1.74 | 0.304 | 2.04 | 2.36 | 50% |
| X32F | 157 | 4.71 | 32638 | 0.76 | 2.73 | 0.298 | 3.03 | 0.4 | 8% |
| X32G | 336 | 5.48 | 36640 | 0.99 | 1.7 | 0.334 | 2.03 | 1.02 | 19% |
| X32H | 488 | 7.21 | 19418 | 0 | 2.84 | 0.177 | 3.02 | 0.28 | 4% |
| X32J | 355 | 4.96 | 0 | 0 | 9.32 | 0 | 9.32 | 0.09 | 2% |
| X33A | 600 | 7.85 | 0 | 0 | 3.16 | 0 | 3.16 | 0.05 | 1% |
| X33B | 311 | 3.24 | 0 | 0 | 0.9 | 0 | 0.90 | 0.02 | 1% |
| X33C | 183 | 1.27 | 0 | 0 | 0.24 | 0 | 0.24 | 0.03 | 2% |
| X33D | 350 | 3.92 | 0 | 0 | 1.93 | 0 | 1.93 | 0 | 0% |
| X40A | 924 | 9.59 | 0 | 0 | 2.77 | 0 | 2.77 | 0.1 | 1% |
| X40B | 743 | 7.71 | 0 | 0 | 2.4 | 0 | 2.40 | 0.07 | 1% |
| X40C | 941 | 10.89 | 7552 | 0 | 3.87 | 0.069 | 3.94 | 0.15 | 1% |
| X40D | 589 | 4.89 | 0 | 0 | 1.59 | 0 | 1.59 | 0.06 | 1% |

## 7. GROUNDWATER - QUALITY COMPONENT

The groundwater quality should comply with the water quality guidelines as shown in Table 7.1. The groundwater quality for the Inkomati WMA was assessed per quaternary catchment (Table 7.2). A summary of the water quality class and parameters of concern per quaternary catchment is shown in Table 7.3. The parameter of concern is the parameter that was used to make a decision about the water quality Class of the quaternary.

**Table 7.1: Assessment guide for the suitability of groundwater for potable use**

| Chemical Parameter | Target Water Quality Ranges [1)] | | | |
|---|---|---|---|---|
| | Class 0 | Class I | Class II | Class III |
| pH (pH units) | 6 – 9 | 5 – 6 & 9 – 9.5 | 4 – 5 & > 9.5 – 10 | <4 & >10 |
| Electrical Conductivity (mS/m) | < 70 | 70 - 150 | 150 – 370 | >370 |
| Calcium as Ca | < 80 | 80 - 150 | 150 – 300 | >300 |
| Magnesium as Mg | < 70 | 70 - 100 | 100 – 200 | >200 |
| Sodium as Na | < 100 | 100 - 200 | 200 – 400 | >400 |
| Chloride as Cl | < 100 | 100 - 200 | 200 – 600 | >600 |
| Sulphate as $SO_4$ | < 200 | 200 - 400 | 400 – 600 | >600 |
| Nitrate as $NO_x$-N | < 6 | 6 - 10 | 10 – 20 | >20 |
| Fluoride as F | <0.7 | 0.7 – 1.0 | 1.0 – 3.5 | >3.5 |

[1)] Ref: *Quality of Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed.*1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa. *Note:* all units of measurement are in *mg/l*, unless otherwise stated.

## Quaternary Catchment

Groundwater quality data was obtained from the WMS and used to determine the quality per quaternary catchment, see Table 7.2 and Table 7.3 for a summary of the water quality class and parameters of concern.

**Table 7.2 Groundwater quality per Quaternary Catchment**

| Chemical Parameter | Unit | Quaternary Catchments X11A, X11B, X11C, X11D | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X11A | X11B | X11C | X11D | X11A | X11B | X11C | X11D | | X11A | X11B | X11C | X11D |
| pH | | 3 | - | - | 1 | 7.07 | - | - | 7.82 | 5.0 – 9.5 | 7.78 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | 3 | - | - | 1 | 42.1 | - | - | 13.3 | <150 | 46.31 | <150 | <150 | <150 |
| Calcium as Ca | mg/l | 3 | - | - | 1 | 41.6 | - | - | 17 | <150 | 45.76 | <150 | <150 | <150 |
| Magnesium as Mg | mg/l | 3 | - | - | 1 | 8.3 | - | - | 4.4 | <100 | 9.13 | <100 | <100 | <100 |
| Sodium as Na | mg/l | 2 | - | - | 1 | 26.2 | - | - | 2.9 | <200 | <200 | <200 | <200 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | 3 | - | - | 1 | 116.1 | - | - | 66.1 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 3 | - | - | 1 | 17 | - | - | 1.5 | <200 | 18.7 | <200 | <200 | <200 |
| Sulphate as $SO_4$ | mg/l | 2 | - | - | 1 | 14 | - | - | 2 | <400 | <400 | <400 | <400 | <400 |
| Nitrate as $NO_x$-N | mg/l | 3 | - | - | 1 | 0.22 | - | - | 0.12 | <10 | 0.24 | <10 | <10 | <10 |
| Fluoride as F | mg/l | 3 | - | - | 1 | 0.12 | - | - | 0.24 | <1.0 | 0.13 | <1.0 | <1.0 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X11E, X11F, X11G, X11H | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X11E | X11F | X11G | X11H | X11E | X11F | X11G | X11H | | X11E | X11F | X11G | X11H |
| pH | | - | - | 2 | 24 | - | - | 8.06 | 7.54 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 | 8.3 |
| Electrical Conductivity | mS/m | - | - | 2 | 24 | - | - | 27.85 | 17.6 | <150 | <150 | <150 | <150 | 19.36 |
| Calcium as Ca | mg/l | - | - | 2 | 23 | - | - | 21.8 | 12.21 | <150 | <150 | <150 | <150 | 13.43 |
| Magnesium as Mg | mg/l | - | - | 2 | 23 | - | - | 13.05 | 5.7 | <100 | <100 | <100 | <100 | 6.27 |
| Sodium as Na | mg/l | - | - | 2 | 23 | - | - | 15.1 | 10.4 | <200 | <200 | <200 | <200 | 11.44 |
| Total Alkalinity as $CaCO_3$ | mg/l | - | - | 2 | 23 | - | - | 134.6 | 70.8 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | - | - | 2 | 23 | - | - | 4.35 | 5 | <200 | <200 | <200 | <200 | 5.5 |
| Sulphate as $SO_4$ | mg/l | - | - | 2 | 23 | - | - | 3.2 | 4.4 | <400 | <400 | <400 | <400 | 4.84 |
| Nitrate as $NO_x$-N | mg/l | - | - | 2 | 23 | - | - | 0.7 | 0.77 | <10 | <10 | <10 | <10 | 0.85 |
| Fluoride as F | mg/l | - | - | 2 | 23 | - | - | 0.29 | 0.16 | <1.0 | <1.0 | <1.0 | <1.0 | 0.17 |

| Chemical Parameter | Unit | Quaternary Catchments X11J, X11K, X12A, X12B | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X11J | X11K | X12A | X12B | X11J | X11K | X12A | X12B | | X11J | X11K | X12A | X12B |
| pH | | - | 3 | 1 | 2 | - | 6.71 | 7.07 | 7.64 | 5.0 – 9.5 | 5.0 – 9.5 | 7.38 | 5.0 – 9.5 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | - | 3 | 1 | 2 | - | 16.2 | 14.5 | 15.85 | <150 | <150 | 17.82 | <150 | <150 |
| Calcium as Ca | mg/l | - | 3 | 1 | 2 | - | 10.1 | 5 | 10.65 | <150 | <150 | 11.11 | <150 | <150 |
| Magnesium as Mg | mg/l | - | 3 | 1 | 2 | - | 5.3 | 8 | 11.55 | <100 | <100 | 5.83 | <100 | <100 |
| Sodium as Na | mg/l | - | 3 | 1 | 2 | - | 13.4 | 2.4 | 2.45 | <200 | <200 | 14.74 | <200 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | - | 3 | 1 | 2 | - | 75.3 | 46.5 | 81.65 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | - | 3 | 1 | 2 | - | 5 | 1.5 | 1.5 | <200 | <200 | 5.5 | <200 | <200 |
| Sulphate as $SO_4$ | mg/l | - | 3 | 1 | 2 | - | 4.5 | 2 | 4.05 | <400 | <400 | 4.95 | <400 | <400 |
| Nitrate as $NO_x$-N | mg/l | - | 3 | 1 | 2 | - | 0.29 | 0.77 | 0.07 | <10 | <10 | 0.32 | <10 | <10 |
| Fluoride as F | mg/l | - | 3 | 1 | 2 | - | 0.11 | 0.05 | 0.14 | <1.0 | <1.0 | 0.12 | <1.0 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X12C, X12D, X12E, X12F | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X12C | X12D | X12E | X12F | X12C | X12D | X12E | X12F | | X12C | X12D | X12E | X12F |
| pH | | 1 | 50 | 1 | 11 | 6.44 | 8.55 | 8.39 | 7.99 | 5.0 – 9.5 | 5.0 – 9.5 | 9.40 | 5.0 – 9.5 | 8.79 |
| Electrical Conductivity | mS/m | 1 | 50 | 1 | 11 | 20.50 | 61.10 | 19.40 | 43.80 | <150 | <150 | 67.21 | <150 | 48.18 |
| Calcium as Ca | mg/l | 1 | 46 | 1 | 11 | 8.30 | 6.10 | 14.00 | 22.80 | <150 | <150 | 6.71 | <150 | 25.08 |
| Magnesium as Mg | mg/l | 1 | 45 | 1 | 11 | 2.60 | 0.50 | 15.90 | 17.40 | <100 | <100 | 0.55 | <100 | 19.14 |
| Sodium as Na | mg/l | 1 | 44 | 1 | 11 | 20.00 | 110.66 | 4.00 | 26.80 | <200 | <200 | 121.73 | <200 | 29.48 |
| Total Alkalinity as $CaCO_3$ | mg/l | 1 | 45 | 1 | 11 | 24.40 | 54.60 | 106.00 | 170.00 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 1 | 46 | 1 | 11 | 17.20 | 124.91 | 3.80 | 6.70 | <200 | <200 | 137.40 | <200 | 7.37 |
| Sulphate as $SO_4$ | mg/l | 1 | 46 | 1 | 11 | 2.00 | 17.46 | 7.00 | 9.70 | <400 | <400 | 19.21 | <400 | 10.67 |
| Nitrate as $NO_x$-N | mg/l | 1 | 46 | 1 | 11 | 8.04 | 0.05 | 0.32 | 0.27 | <10 | <10 | 0.06 | <10 | 0.30 |
| Fluoride as F | mg/l | 1 | 44 | 1 | 11 | 0.25 | 9.93 | 0.49 | 0.66 | <1.0 | <1.0 | 10.92 | <1.0 | 0.73 |

| Chemical Parameter | Unit | Quaternary Catchments X12G, X12H, X12J, X12K | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X12G | X12H | X12J | X12K | X12G | X12H | X12J | X12K | | X12G | X12H | X12J | X12K |
| pH | | 3 | 2 | - | 9 | 8.37 | 8.11 | - | 8.10 | 5.0 – 9.5 | 9.21 | 5.0 – 9.5 | 5.0 – 9.5 | 8.91 |
| Electrical Conductivity | mS/m | 3 | 2 | - | 9 | 64.90 | 28.75 | - | 66.70 | <150 | 71.39 | <150 | <150 | 73.37 |
| Calcium as Ca | mg/l | 3 | 2 | - | 9 | 23.90 | 13.80 | - | 31.70 | <150 | 26.29 | <150 | <150 | 34.87 |
| Magnesium as Mg | mg/l | 3 | 2 | - | 9 | 63.60 | 7.05 | - | 30.40 | <100 | 69.96 | <100 | <100 | 33.44 |
| Sodium as Na | mg/l | 3 | 2 | - | 9 | 23.20 | 35.95 | - | 21.70 | <200 | 25.52 | <200 | <200 | 23.87 |
| Total Alkalinity as $CaCO_3$ | mg/l | 3 | 2 | - | 9 | 349.10 | 113.20 | - | 293.70 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 3 | 2 | - | 9 | 6.50 | 14.05 | - | 9.50 | <200 | 7.15 | <200 | <200 | 10.45 |
| Sulphate as $SO_4$ | mg/l | 3 | 2 | - | 9 | 7.60 | 10.60 | - | 14.50 | <400 | 8.36 | <400 | <400 | 15.95 |
| Nitrate as $NO_x$-N | mg/l | 3 | 2 | - | 9 | 0.32 | 1.55 | - | 0.50 | <10 | 0.36 | <10 | <10 | 0.55 |
| Fluoride as F | mg/l | 3 | 2 | - | 9 | 0.35 | 1.02 | - | 0.25 | <1.0 | 0.39 | <1.0 | <1.0 | 0.28 |

| Chemical Parameter | Unit | Quaternary Catchments X13J, X13K, X13L, X14A | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X13J | X13K | X13L | X14A | X13J | X13K | X13L | X14A | | X13J | X13K | X13L | X14A |
| pH | | 60 | 19 | - | 31 | 8.28 | 8.12 | - | 7.21 | 5.0 – 9.5 | 9.11 | 8.93 | 5.0 – 9.5 | 7.93 |
| Electrical Conductivity | mS/m | 60 | 19 | - | 31 | 138.00 | 155.00 | - | 2.80 | <150 | 151.80 | 170.50 | <150 | 3.08 |
| Calcium as Ca | mg/l | 60 | 19 | - | 27 | 52.10 | 58.50 | - | 1.10 | <150 | 57.31 | 64.35 | <150 | 1.21 |
| Magnesium as Mg | mg/l | 60 | 19 | - | 27 | 45.40 | 52.70 | - | 0.50 | <100 | 49.94 | 57.97 | <100 | 0.55 |
| Sodium as Na | mg/l | 60 | 19 | - | 27 | 201.95 | 200.10 | - | 2.54 | <200 | 222.15 | 220.11 | <200 | 2.79 |
| Total Alkalinity as $CaCO_3$ | mg/l | 60 | 19 | - | 27 | 382.85 | 395.00 | - | 6.70 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 60 | 19 | - | 27 | 189.20 | 292.47 | - | 5.00 | <200 | 208.12 | 321.72 | <200 | 5.50 |
| Sulphate as $SO_4$ | mg/l | 60 | 19 | - | 27 | 14.60 | 27.86 | - | 2.00 | <400 | 16.06 | 30.64 | <400 | 2.20 |
| Nitrate as $NO_x$-N | mg/l | 60 | 19 | - | 27 | 0.72 | 0.42 | - | 0.06 | <10 | 0.79 | 0.47 | <10 | 0.07 |
| Fluoride as F | mg/l | 60 | 19 | - | 27 | 0.51 | 0.65 | - | 0.12 | <1.0 | 0.57 | 0.72 | <1.0 | 0.14 |

| Chemical Parameter | Unit | Quaternary Catchments X14B, X14F, X14G, X14H | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X14B | X14F | X14G | X14H | X14B | X14F | X14G | X14H | | X14B | X14F | X14G | X14H |
| pH | | 4 | 4 | 54 | 8 | 7.97 | 7.79 | 8.54 | 8.54 | 5.0 – 9.5 | 8.76 | 8.56 | 9.39 | 9.39 |
| Electrical Conductivity | mS/m | 4 | 4 | 54 | 8 | 303.00 | 37.15 | 71.40 | 76.40 | <150 | 333.30 | 40.87 | 78.54 | 84.04 |
| Calcium as Ca | mg/l | 4 | 4 | 54 | 8 | 130.40 | 38.40 | 33.95 | 22.20 | <150 | 143.44 | 42.24 | 37.35 | 24.42 |
| Magnesium as Mg | mg/l | 4 | 4 | 54 | 8 | 99.20 | 17.60 | 43.60 | 23.05 | <100 | 109.12 | 19.36 | 47.96 | 25.36 |
| Sodium as Na | mg/l | 4 | 4 | 54 | 8 | 495.75 | 25.10 | 84.35 | 112.30 | <200 | 545.33 | 27.61 | 92.79 | 123.53 |
| Total Alkalinity as $CaCO_3$ | mg/l | 4 | 4 | 54 | 8 | 632.95 | 148.55 | 276.25 | 281.95 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 4 | 4 | 54 | 8 | 831.30 | 9.95 | 38.70 | 89.30 | <200 | 914.43 | 10.95 | 42.57 | 98.23 |
| Sulphate as $SO_4$ | mg/l | 4 | 4 | 54 | 8 | 60.45 | 14.15 | 2.00 | 5.35 | <400 | 66.50 | 15.57 | 2.20 | 5.89 |
| Nitrate as $NO_x$-N | mg/l | 4 | 4 | 54 | 8 | 3.01 | 0.33 | 2.19 | 0.86 | <10 | 3.31 | 0.36 | 2.41 | 0.94 |
| Fluoride as F | mg/l | 4 | 4 | 54 | 8 | 0.64 | 0.35 | 0.44 | 0.81 | <1.0 | 0.70 | 0.39 | 0.48 | 0.89 |

| Chemical Parameter | Unit | Quaternary Catchments X21A, X21B, X21C, X21D | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X21A | X21B | X21C | X21D | X21A | X21B | X21C | X21D | | X21A | X21B | X21C | X21D |
| pH | | 1 | 1 | - | 1 | 7.18 | 7.59 | - | 7.97 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | 1 | 1 | - | 1 | 12.80 | 21.10 | - | 34.70 | <150 | <150 | <150 | <150 | <150 |
| Calcium as Ca | mg/l | 1 | 1 | - | 1 | 10.90 | 11.23 | - | 34.80 | <150 | <150 | <150 | <150 | <150 |
| Magnesium as Mg | mg/l | 1 | 1 | - | 1 | 5.10 | 16.54 | - | 18.40 | <100 | <100 | <100 | <100 | <100 |
| Sodium as Na | mg/l | 1 | 1 | - | 1 | 3.80 | 5.08 | - | 8.50 | <200 | <200 | <200 | <200 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | 1 | 1 | - | 1 | 47.10 | 91.80 | - | 182.90 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 1 | 1 | - | 1 | 3.70 | 5.35 | - | 3.30 | <200 | <200 | <200 | <200 | <200 |
| Sulphate as $SO_4$ | mg/l | 1 | 1 | - | 1 | 2.00 | 4.62 | - | 6.00 | <400 | <400 | <400 | <400 | <400 |
| Nitrate as $NO_x$-N | mg/l | 1 | 1 | - | 1 | 2.92 | 0.09 | - | 0.10 | <10 | <10 | <10 | <10 | <10 |
| Fluoride as F | mg/l | 1 | 1 | - | 1 | 0.10 | 0.14 | - | 0.26 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X21E, X21F, X21G, X21H | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X21E | X21F | X21G | X21H | X21E | X21F | X21G | X21H | | X21E | X21F | X21G | X21H |
| pH | | 1 | 55 | - | - | 6.27 | 8.12 | - | - | 5.0 – 9.5 | 5.0 – 9.5 | 8.93 | 5.0 – 9.5 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | 1 | 55 | - | - | 5.90 | 39.20 | - | - | <150 | <150 | 43.12 | <150 | <150 |
| Calcium as Ca | mg/l | 1 | 49 | - | - | 3.30 | 9.86 | - | - | <150 | <150 | 10.85 | <150 | <150 |
| Magnesium as Mg | mg/l | 1 | 47 | - | - | 3.10 | 3.30 | - | - | <100 | <100 | 3.63 | <100 | <100 |
| Sodium as Na | mg/l | 1 | 46 | - | - | 2.90 | 63.85 | - | - | <200 | <200 | 70.24 | <200 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | 1 | 48 | - | - | 27.00 | 103.90 | - | - | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 1 | 47 | - | - | 1.50 | 49.02 | - | - | <200 | <200 | 53.92 | <200 | <200 |
| Sulphate as $SO_4$ | mg/l | 1 | 49 | - | - | 2.00 | 5.15 | - | - | <400 | <400 | 5.66 | <400 | <400 |
| Nitrate as $NO_x$-N | mg/l | 1 | 49 | - | - | 0.12 | 0.05 | - | - | <10 | <10 | 0.06 | <10 | <10 |
| Fluoride as F | mg/l | 1 | 47 | - | - | 0.22 | 3.38 | - | - | <1.0 | <1.0 | 3.72 | <1.0 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X21J, X21K, X22A, X22B | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X21J | X21K | X22A | X22B | X21J | X21K | X22A | X22B | | X21J | X21K | X22A | X22B |
| pH | | 7 | - | 1 | - | 8.03 | - | 8.48 | - | 5.0 – 9.5 | 8.83 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | 7 | - | 1 | - | 95.70 | - | 17.60 | - | <150 | 105.27 | <150 | <150 | <150 |
| Calcium as Ca | mg/l | 7 | - | 1 | - | 43.25 | - | 18.40 | - | <150 | 47.58 | <150 | <150 | <150 |
| Magnesium as Mg | mg/l | 7 | - | 1 | - | 43.04 | - | 11.50 | - | <100 | 47.35 | <100 | <100 | <100 |
| Sodium as Na | mg/l | 7 | - | 1 | - | 56.70 | - | 2.40 | - | <200 | 62.37 | <200 | <200 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | 7 | - | 1 | - | 116.76 | - | 89.50 | - | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 7 | - | 1 | - | 161.82 | - | 3.20 | - | <200 | 178.00 | <200 | <200 | <200 |
| Sulphate as $SO_4$ | mg/l | 7 | - | 1 | - | 69.54 | - | 7.60 | - | <400 | 76.49 | <400 | <400 | <400 |
| Nitrate as $NO_x$-N | mg/l | 7 | - | 1 | - | 0.62 | - | 0.62 | - | <10 | 0.68 | <10 | <10 | <10 |
| Fluoride as F | mg/l | 7 | - | 1 | - | 0.13 | - | 0.20 | - | <1.0 | 0.14 | <1.0 | <1.0 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X22C, X22D, X22E, X22F | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X22C | X22D | X22E | X22F | X22C | X22D | X22E | X22F | | X22C | X22D | X22E | X22F |
| pH | | 2 | 4 | 1 | - | 7.55 | 7.58 | 7.70 | - | 5.0 – 9.5 | 5.0 – 9.5 | 8.34 | 5.0 – 9.5 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | 2 | 4 | 1 | - | 103.75 | 9.00 | 30.30 | - | <150 | <150 | 9.90 | <150 | <150 |
| Calcium as Ca | mg/l | 2 | 4 | 1 | - | 54.25 | 6.30 | 18.10 | - | <150 | <150 | 6.93 | <150 | <150 |
| Magnesium as Mg | mg/l | 2 | 4 | 1 | - | 51.25 | 1.75 | 6.30 | - | <100 | <100 | 1.93 | <100 | <100 |
| Sodium as Na | mg/l | 2 | 3 | 1 | - | 94.85 | 2.10 | 46.10 | - | <200 | <200 | 2.31 | <200 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | 2 | 4 | 1 | - | 366.10 | 26.40 | 146.10 | - | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 2 | 4 | 1 | - | 116.60 | 3.35 | 9.70 | - | <200 | <200 | 3.69 | <200 | <200 |
| Sulphate as $SO_4$ | mg/l | 2 | 3 | 1 | - | 7.70 | 2.00 | 8.70 | - | <400 | <400 | 2.20 | <400 | <400 |
| Nitrate as $NO_x$-N | mg/l | 2 | 4 | 1 | - | 5.76 | 0.23 | 0.02 | - | <10 | <10 | 0.25 | <10 | <10 |
| Fluoride as F | mg/l | 2 | 4 | 1 | - | 1.32 | 0.11 | 1.36 | - | <1.0 | <1.0 | 0.12 | <1.0 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X22G, X22H, X22J, X22K | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X22G | X22H | X22J | X22K | X22G | X22H | X22J | X22K | | X22G | X22H | X22J | X22K |
| pH | | - | 3 | 1 | 6 | - | 7.31 | 7.28 | 7.81 | 5.0 – 9.5 | 5.0 – 9.5 | 8.04 | 5.0 – 9.5 | 8.59 |
| Electrical Conductivity | mS/m | - | 3 | 1 | 6 | - | 45.40 | 27.00 | 43.55 | <150 | <150 | 49.94 | <150 | 47.91 |
| Calcium as Ca | mg/l | - | 3 | 1 | 6 | - | 16.70 | 11.00 | 34.85 | <150 | <150 | 18.37 | <150 | 38.34 |
| Magnesium as Mg | mg/l | - | 3 | 1 | 6 | - | 12.00 | 6.60 | 10.95 | <100 | <100 | 13.20 | <100 | 12.05 |
| Sodium as Na | mg/l | - | 2 | 1 | 6 | - | 49.70 | 40.70 | 53.00 | <200 | <200 | <200 | <200 | 58.30 |
| Total Alkalinity as $CaCO_3$ | mg/l | - | 3 | 1 | 6 | - | 177.80 | 127.80 | 191.65 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | - | 3 | 1 | 6 | - | 16.70 | 5.10 | 14.30 | <200 | <200 | 18.37 | <200 | 15.73 |
| Sulphate as $SO_4$ | mg/l | - | 2 | 1 | 6 | - | 24.60 | 2.00 | 9.60 | <400 | <400 | <400 | <400 | 10.56 |
| Nitrate as $NO_x$-N | mg/l | - | 3 | 1 | 6 | - | 2.48 | 1.39 | 0.92 | <10 | <10 | 2.73 | <10 | 1.02 |
| Fluoride as F | mg/l | - | 3 | 1 | 6 | - | 0.44 | 0.96 | 1.86 | <1.0 | <1.0 | 0.48 | <1.0 | 2.05 |

| Chemical Parameter | Unit | Quaternary Catchments X23A, X23B, X23C, X23D | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X23A | X23B | X23C | X23D | X23A | X23B | X23C | X23D | | X23A | X23B | X23C | X23D |
| pH | | 1 | 4 | - | 6 | 7.97 | 7.45 | - | 7.39 | 5.0 – 9.5 | 5.0 – 9.5 | 8.19 | 5.0 – 9.5 | 8.12 |
| Electrical Conductivity | mS/m | 1 | 4 | - | 6 | 38.50 | 42.80 | - | 22.50 | <150 | <150 | 47.08 | <150 | 24.75 |
| Calcium as Ca | mg/l | 1 | 4 | - | 6 | 21.20 | 29.90 | - | 14.80 | <150 | <150 | 32.89 | <150 | 16.28 |
| Magnesium as Mg | mg/l | 1 | 4 | - | 6 | 3.50 | 10.85 | - | 10.95 | <100 | <100 | 11.94 | <100 | 12.05 |
| Sodium as Na | mg/l | 1 | 4 | - | 6 | 55.50 | 16.50 | - | 15.60 | <200 | <200 | 18.15 | <200 | 17.16 |
| Total Alkalinity as $CaCO_3$ | mg/l | 1 | 4 | - | 6 | 187.20 | 127.85 | - | 73.85 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 1 | 4 | - | 6 | 10.30 | 5.90 | - | 10.60 | <200 | <200 | 6.49 | <200 | 11.66 |
| Sulphate as $SO_4$ | mg/l | 1 | 4 | - | 6 | 5.60 | 9.10 | - | 6.70 | <400 | <400 | 10.01 | <400 | 7.37 |
| Nitrate as $NO_x$-N | mg/l | 1 | 4 | - | 6 | 0.08 | 0.53 | - | 2.02 | <10 | <10 | 0.58 | <10 | 2.22 |
| Fluoride as F | mg/l | 1 | 4 | - | 6 | 0.74 | 0.55 | - | 0.34 | <1.0 | <1.0 | 0.60 | <1.0 | 0.37 |

| Chemical Parameter | Unit | Quaternary Catchments X23E, X23F, X23G, X23H | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X23E | X23F | X23G | X23H | X23E | X23F | X23G | X23H | | X23E | X23F | X23G | X23H |
| pH | | - | 1 | 2 | 13 | - | 7.68 | 7.48 | 8.14 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 | 5.0 – 9.5 | 8.95 |
| Electrical Conductivity | mS/m | - | 1 | 2 | 13 | - | 93.90 | 57.50 | 66.70 | <150 | <150 | <150 | <150 | 73.37 |
| Calcium as Ca | mg/l | - | 1 | 2 | 13 | - | 49.70 | 36.40 | 28.70 | <150 | <150 | <150 | <150 | 31.57 |
| Magnesium as Mg | mg/l | - | 1 | 2 | 13 | - | 80.50 | 36.60 | 29.20 | <100 | <100 | <100 | <100 | 32.12 |
| Sodium as Na | mg/l | - | 1 | 2 | 13 | - | 42.00 | 41.05 | 54.60 | <200 | <200 | <200 | <200 | 60.06 |
| Total Alkalinity as $CaCO_3$ | mg/l | - | 1 | 2 | 13 | - | 367.50 | 278.05 | 291.80 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | - | 1 | 2 | 13 | - | 42.00 | 12.90 | 24.60 | <200 | <200 | <200 | <200 | 27.06 |
| Sulphate as $SO_4$ | mg/l | - | 1 | 2 | 13 | - | 97.60 | 15.80 | 34.70 | <400 | <400 | <400 | <400 | 38.17 |
| Nitrate as $NO_x$-N | mg/l | - | 1 | 2 | 13 | - | 2.44 | 4.65 | 0.21 | <10 | <10 | <10 | <10 | 0.24 |
| Fluoride as F | mg/l | - | 1 | 2 | 13 | - | 0.57 | 0.62 | 0.38 | <1.0 | <1.0 | <1.0 | <1.0 | 0.42 |

| Chemical Parameter | Unit | Quaternary Catchments X24A, X24B, X24C, X24D | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X24A | X24B | X24C | X24D | X24A | X24B | X24C | X24D | | X24A | X24B | X24C | X24D |
| pH | | 5 | 51 | 5 | 13 | 8.48 | 8.18 | 8.14 | 8.45 | 5.0 – 9.5 | 9.33 | 9.00 | 8.95 | 9.30 |
| Electrical Conductivity | mS/m | 5 | 51 | 5 | 13 | 37.10 | 42.80 | 69.50 | 74.30 | <150 | 40.81 | 47.08 | 76.45 | 81.73 |
| Calcium as Ca | mg/l | 5 | 44 | 5 | 13 | 39.60 | 20.88 | 38.00 | 19.60 | <150 | 43.56 | 22.97 | 41.80 | 21.56 |
| Magnesium as Mg | mg/l | 5 | 44 | 5 | 13 | 5.94 | 21.64 | 31.30 | 41.90 | <100 | 6.54 | 23.81 | 34.43 | 46.09 |
| Sodium as Na | mg/l | 5 | 44 | 5 | 13 | 57.17 | 28.99 | 97.77 | 37.10 | <200 | 62.89 | 31.89 | 107.54 | 40.81 |
| Total Alkalinity as $CaCO_3$ | mg/l | 5 | 44 | 5 | 13 | 131.74 | 145.74 | 348.30 | 380.60 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 5 | 45 | 5 | 13 | 23.22 | 20.80 | 61.80 | 28.50 | <200 | 25.54 | 22.88 | 67.98 | 31.35 |
| Sulphate as $SO_4$ | mg/l | 5 | 45 | 5 | 13 | 5.10 | 23.33 | 13.90 | 18.50 | <400 | 5.61 | 25.66 | 15.29 | 20.35 |
| Nitrate as $NO_x$-N | mg/l | 5 | 43 | 5 | 12 | 0.75 | 2.54 | 0.07 | 2.80 | <10 | 0.82 | 2.79 | 0.08 | 3.08 |
| Fluoride as F | mg/l | 4 | 41 | 5 | 11 | 1.09 | 0.21 | 0.91 | 0.23 | <1.0 | 1.20 | 0.23 | 1.00 | 0.25 |

| Chemical Parameter | Unit | Quaternary Catchments X24E, X24F, X24G, X24H | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X24E | X24F | X24G | X24H | X24E | X24F | X24G | X24H | | X24E | X24F | X24G | X24H |
| pH | | 12 | 5 | 23 | 55 | 8.61 | 8.62 | 8.48 | 8.25 | 5.0 – 9.5 | 9.47 | 9.48 | 9.33 | 9.08 |
| Electrical Conductivity | mS/m | 12 | 5 | 23 | 55 | 100.35 | 119.80 | 88.50 | 77.90 | <150 | 110.39 | 131.78 | 97.35 | 85.69 |
| Calcium as Ca | mg/l | 12 | 5 | 21 | 49 | 36.20 | 64.40 | 27.30 | 39.17 | <150 | 39.82 | 70.84 | 30.03 | 43.08 |
| Magnesium as Mg | mg/l | 12 | 5 | 21 | 48 | 29.55 | 46.40 | 26.80 | 29.43 | <100 | 32.51 | 51.04 | 29.48 | 32.37 |
| Sodium as Na | mg/l | 12 | 5 | 21 | 47 | 190.95 | 155.70 | 117.50 | 68.50 | <200 | 210.05 | 171.27 | 129.25 | 75.35 |
| Total Alkalinity as $CaCO_3$ | mg/l | 12 | 5 | 21 | 49 | 411.60 | 420.00 | 369.50 | 208.14 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 12 | 5 | 21 | 49 | 108.10 | 171.70 | 83.70 | 105.35 | <200 | 118.91 | 188.87 | 92.07 | 115.88 |
| Sulphate as $SO_4$ | mg/l | 12 | 5 | 21 | 49 | 8.35 | 9.00 | 8.10 | 22.15 | <400 | 9.19 | 9.90 | 8.91 | 24.37 |
| Nitrate as $NO_x$-N | mg/l | 12 | 5 | 21 | 49 | 0.02 | 0.81 | 0.05 | 0.57 | <10 | 0.02 | 0.89 | 0.06 | 0.63 |
| Fluoride as F | mg/l | 12 | 4 | 21 | 47 | 0.97 | 0.51 | 0.62 | 0.38 | <1.0 | 1.06 | 0.56 | 0.68 | 0.42 |

| Chemical Parameter | Unit | Quaternary Catchments X31A, X31B, X31C, X31D | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X31A | X31B | X31C | X31D | X31A | X31B | X31C | X31D | | X31A | X31B | X31C | X31D |
| pH | | - | 50 | 50 | 2 | - | 8.08 | 7.54 | 6.96 | 5.0 – 9.5 | 5.0 – 9.5 | 8.89 | 8.29 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | - | 48 | 49 | 2 | - | 23.05 | 6.83 | 251.05 | <150 | <150 | 25.36 | 7.51 | <150 |
| Calcium as Ca | mg/l | - | 45 | 45 | 2 | - | 21.45 | 5.50 | 12.15 | <150 | <150 | 23.59 | 6.05 | <150 |
| Magnesium as Mg | mg/l | - | 45 | 44 | 2 | - | 12.79 | 2.99 | 23.65 | <100 | <100 | 14.07 | 3.29 | <100 |
| Sodium as Na | mg/l | - | 44 | 43 | 2 | - | 2.64 | 2.00 | 20.70 | <200 | <200 | 2.90 | 2.20 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | - | 43 | 45 | 2 | - | 97.70 | 28.80 | 126.00 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | - | 46 | 46 | 2 | - | 3.77 | 3.30 | 28.50 | <200 | <200 | 4.14 | 3.63 | <200 |
| Sulphate as $SO_4$ | mg/l | - | 45 | 46 | 2 | - | 11.02 | 2.00 | 3.60 | <400 | <400 | 12.12 | 2.20 | <400 |
| Nitrate as $NO_x$-N | mg/l | - | 45 | 46 | 2 | - | 0.66 | 0.25 | 2.92 | <10 | <10 | 0.72 | 0.28 | <10 |
| Fluoride as F | mg/l | - | 50 | 50 | 2 | - | 8.08 | 7.54 | 6.96 | <1.0 | 5.0 – 9.5 | 8.89 | 8.29 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X31E, X31F, X31G, X31H | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X31E | X31F | X31G | X31H | X31E | X31F | X31G | X31H | | X31E | X31F | X31G | X31H |
| pH | | 20 | - | 46 | - | 7.31 | - | 7.51 | - | 5.0 – 9.5 | 8.04 | 5.0 – 9.5 | 8.26 | 5.0 – 9.5 |
| Electrical Conductivity | mS/m | 20 | - | 46 | - | 8.52 | - | 21.60 | - | <150 | 9.37 | <150 | 23.76 | <150 |
| Calcium as Ca | mg/l | 20 | - | 46 | - | 5.49 | - | 12.10 | - | <150 | 6.04 | <150 | 13.31 | <150 |
| Magnesium as Mg | mg/l | 20 | - | 46 | - | 1.71 | - | 6.02 | - | <100 | 1.88 | <100 | 6.63 | <100 |
| Sodium as Na | mg/l | 20 | - | 46 | - | 7.52 | - | 16.77 | - | <200 | 8.28 | <200 | 18.45 | <200 |
| Total Alkalinity as $CaCO_3$ | mg/l | 20 | - | 46 | - | 33.07 | - | 68.19 | - | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 20 | - | 46 | - | 5.00 | - | 8.85 | - | <200 | 5.50 | <200 | 9.74 | <200 |
| Sulphate as $SO_4$ | mg/l | 20 | - | 46 | - | 7.31 | - | 2.00 | - | <400 | 8.04 | <400 | 2.20 | <400 |
| Nitrate as $NO_x$-N | mg/l | 20 | - | 46 | - | 0.12 | - | 2.19 | - | <10 | 0.13 | <10 | 2.40 | <10 |
| Fluoride as F | mg/l | 20 | - | 46 | - | 0.14 | - | 0.27 | - | <1.0 | 0.16 | <1.0 | 0.30 | <1.0 |

| Chemical Parameter | Unit | Quaternary Catchments X31J, X31K, X31L, X31M | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X31J | X31K | X31L | X31M | X31J | X31K | X31L | X31M | | X31J | X31K | X31L | X31M |
| pH | | 1 | 91 | 68 | 50 | 6.59 | 8.11 | 8.01 | 8.17 | 5.0 – 9.5 | 5.0 – 9.5 | 8.92 | 8.81 | 8.98 |
| Electrical Conductivity | mS/m | 1 | 92 | 68 | 50 | 13.40 | 49.75 | 98.55 | 113.10 | <150 | <150 | 54.73 | 108.41 | 124.41 |
| Calcium as Ca | mg/l | 1 | 87 | 68 | 50 | 8.80 | 23.70 | 44.09 | 50.90 | <150 | <150 | 26.07 | 48.50 | 55.99 |
| Magnesium as Mg | mg/l | 1 | 86 | 68 | 50 | 3.00 | 17.49 | 31.34 | 71.86 | <100 | <100 | 19.24 | 34.47 | 79.05 |
| Sodium as Na | mg/l | 1 | 85 | 68 | 50 | 18.00 | 47.10 | 134.61 | 91.30 | <200 | <200 | 51.81 | 148.07 | 100.43 |
| Total Alkalinity as $CaCO_3$ | mg/l | 1 | 85 | 68 | 50 | 41.50 | 204.70 | 288.47 | 481.35 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 1 | 87 | 68 | 50 | 10.60 | 24.91 | 108.70 | 82.40 | <200 | <200 | 27.40 | 119.57 | 90.64 |
| Sulphate as $SO_4$ | mg/l | 1 | 87 | 68 | 50 | 7.80 | 8.00 | 13.22 | 11.75 | <400 | <400 | 8.80 | 14.54 | 12.93 |
| Nitrate as $NO_x$-N | mg/l | 1 | 85 | 68 | 50 | 0.07 | 1.65 | 8.60 | 4.07 | <10 | <10 | 1.82 | 9.46 | 4.47 |
| Fluoride as F | mg/l | 1 | 84 | 68 | 50 | 0.37 | 0.81 | 0.79 | 0.58 | <1.0 | <1.0 | 0.89 | 0.87 | 0.63 |

| Chemical Parameter | Unit | Quaternary Catchments X32A, X32B, X32C, X32D | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X32A | X32B | X32C | X32D | X32A | X32B | X32C | X32D | | X32A | X32B | X32C | X32D |
| pH | | 22 | 12 | 91 | 25 | 7.56 | 7.55 | 7.96 | 7.55 | 5.0 – 9.5 | 8.31 | 8.31 | 8.76 | 8.31 |
| Electrical Conductivity | mS/m | 22 | 12 | 91 | 25 | 17.35 | 16.15 | 47.20 | 16.60 | <150 | 19.09 | 17.77 | 51.92 | 18.26 |
| Calcium as Ca | mg/l | 22 | 12 | 91 | 25 | 10.22 | 9.10 | 23.20 | 9.80 | <150 | 11.24 | 10.01 | 25.51 | 10.78 |
| Magnesium as Mg | mg/l | 22 | 12 | 91 | 25 | 4.05 | 2.65 | 10.53 | 3.54 | <100 | 4.46 | 2.92 | 11.58 | 3.90 |
| Sodium as Na | mg/l | 22 | 12 | 90 | 25 | 16.53 | 18.71 | 54.92 | 17.10 | <200 | 18.19 | 20.58 | 60.41 | 18.81 |
| Total Alkalinity as $CaCO_3$ | mg/l | 22 | 12 | 91 | 25 | 63.90 | 62.00 | 159.20 | 64.20 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 22 | 12 | 91 | 25 | 6.70 | 5.05 | 23.90 | 6.80 | <200 | 7.37 | 5.56 | 26.29 | 7.48 |
| Sulphate as $SO_4$ | mg/l | 22 | 12 | 90 | 25 | 3.00 | 2.00 | 7.38 | 2.00 | <400 | 3.30 | 2.20 | 8.12 | 2.20 |
| Nitrate as $NO_x$-N | mg/l | 22 | 12 | 91 | 25 | 1.10 | 1.53 | 1.80 | 1.15 | <10 | 1.21 | 1.68 | 1.98 | 1.27 |
| Fluoride as F | mg/l | 22 | 12 | 91 | 25 | 0.25 | 0.28 | 0.67 | 0.26 | <1.0 | 0.27 | 0.31 | 0.74 | 0.29 |

| Chemical Parameter | Unit | Quaternary Catchments X32E, X32F, X32G, X32H | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X32E | X32F | X32G | X32H | X32E | X32F | X32G | X32H | | X32E | X32F | X32G | X32H |
| pH | | 84 | 27 | 96 | 69 | 7.72 | 8.01 | 8.11 | 8.12 | 5.0 – 9.5 | 8.50 | 8.81 | 8.92 | 8.93 |
| Electrical Conductivity | mS/m | 84 | 27 | 96 | 69 | 37.80 | 65.90 | 123.55 | 162.00 | <150 | 41.58 | 72.49 | 135.91 | 178.20 |
| Calcium as Ca | mg/l | 84 | 27 | 96 | 69 | 20.94 | 35.25 | 52.75 | 55.30 | <150 | 23.03 | 38.78 | 58.03 | 60.83 |
| Magnesium as Mg | mg/l | 84 | 27 | 96 | 69 | 9.42 | 15.80 | 39.90 | 72.70 | <100 | 10.36 | 17.38 | 43.89 | 79.97 |
| Sodium as Na | mg/l | 84 | 27 | 96 | 69 | 31.45 | 85.60 | 143.07 | 226.60 | <200 | 34.60 | 94.16 | 157.38 | 249.26 |
| Total Alkalinity as $CaCO_3$ | mg/l | 84 | 27 | 96 | 69 | 142.77 | 219.90 | 379.15 | 591.90 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 84 | 27 | 96 | 69 | 16.95 | 72.60 | 125.10 | 140.70 | <200 | 18.65 | 79.86 | 137.61 | 154.77 |
| Sulphate as $SO_4$ | mg/l | 84 | 27 | 96 | 69 | 5.23 | 10.00 | 14.47 | 15.80 | <400 | 5.75 | 11.00 | 15.92 | 17.38 |
| Nitrate as $NO_x$-N | mg/l | 84 | 27 | 96 | 68 | 1.17 | 0.93 | 84 | 27 | <10 | 1.29 | 1.02 | 12.76 | 1.86 |
| Fluoride as F | mg/l | 84 | 27 | 96 | 69 | 0.42 | 0.82 | 84 | 27 | <1.0 | 0.46 | 0.90 | 0.77 | 0.64 |

| Chemical Parameter | Unit | Quaternary Catchments X32J, X33A, X33B, X33C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X32J | X33A | X33B | X33C | X32J | X33A | X33B | X33C | | X32J | X33A | X33B | X33C |
| pH | | 5 | 13 | 3 | 7 | 8.74 | 8.70 | 8.67 | 8.68 | 5.0 – 9.5 | 9.61 | 9.57 | 9.54 | 9.55 |
| Electrical Conductivity | mS/m | 5 | 13 | 3 | 7 | 172.00 | 320.00 | 416.00 | 141.00 | <150 | 189.20 | 352.00 | 457.60 | 155.10 |
| Calcium as Ca | mg/l | 5 | 13 | 3 | 7 | 42.00 | 51.20 | 74.00 | 57.70 | <150 | 46.20 | 56.32 | 81.40 | 63.47 |
| Magnesium as Mg | mg/l | 5 | 13 | 3 | 7 | 34.50 | 73.80 | 95.00 | 41.00 | <100 | 37.95 | 81.18 | 104.50 | 45.10 |
| Sodium as Na | mg/l | 5 | 13 | 3 | 7 | 309.60 | 597.90 | 627.60 | 220.00 | <200 | 340.56 | 657.69 | 690.36 | 242.00 |
| Total Alkalinity as $CaCO_3$ | mg/l | 5 | 13 | 3 | 7 | 569.80 | 714.70 | 584.50 | 542.60 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 5 | 13 | 3 | 7 | 223.40 | 634.90 | 1060.90 | 154.60 | <200 | 245.74 | 698.39 | 1166.99 | 170.06 |
| Sulphate as $SO_4$ | mg/l | 5 | 13 | 3 | 7 | 16.40 | 35.20 | 38.90 | 4.60 | <400 | 18.04 | 38.72 | 42.79 | 5.06 |
| Nitrate as $NO_x$-N | mg/l | 5 | 13 | 3 | 7 | 0.02 | 0.02 | 0.36 | 0.02 | <10 | 0.02 | 0.02 | 0.40 | 0.02 |
| Fluoride as F | mg/l | 5 | 13 | 3 | 7 | 0.97 | 1.34 | 1.60 | 1.18 | <1.0 | 1.07 | 1.47 | 1.76 | 1.30 |

| Chemical Parameter | Unit | Quaternary Catchments X33D, X40A, X40B, X40C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of Samples | | | | Ambient GW quality or median[1)] | | | | BHN Reserve[2)] | Groundwater Quality Reserve[3)] | | | |
| | | X33D | X40A | X40B | X40C | X33D | X40A | X40B | X40C | | X33D | X40A | X40B | X40C |
| pH | | 1 | 50 | 10 | 43 | 8.56 | 8.49 | 8.67 | 8.50 | 5.0 – 9.5 | 5.0 – 9.5 | 9.34 | 9.53 | 9.35 |
| Electrical Conductivity | mS/m | 1 | 51 | 10 | 43 | 154.00 | 124.40 | 152.50 | 199.00 | <150 | <150 | 136.84 | 167.75 | 218.90 |
| Calcium as Ca | mg/l | 1 | 46 | 10 | 43 | 107.30 | 54.10 | 69.75 | 50.54 | <150 | <150 | 59.51 | 76.73 | 55.60 |
| Magnesium as Mg | mg/l | 1 | 45 | 10 | 43 | 73.70 | 78.50 | 88.25 | 67.70 | <100 | <100 | 86.35 | 97.08 | 74.47 |
| Sodium as Na | mg/l | 1 | 43 | 10 | 42 | 118.90 | 76.75 | 178.35 | 338.95 | <200 | <200 | 84.43 | 196.19 | 372.85 |
| Total Alkalinity as $CaCO_3$ | mg/l | 1 | 44 | 10 | 43 | 499.70 | 446.35 | 565.30 | 616.90 | N/A | N/A | N/A | N/A | N/A |
| Chloride as Cl | mg/l | 1 | 46 | 10 | 43 | 209.50 | 159.28 | 211.10 | 288.60 | <200 | <200 | 175.21 | 232.21 | 317.46 |
| Sulphate as $SO_4$ | mg/l | 1 | 46 | 10 | 42 | 4.30 | 30.60 | 7.45 | 22.50 | <400 | <400 | 33.66 | 8.20 | 24.75 |
| Nitrate as $NO_x$-N | mg/l | 1 | 44 | 10 | 37 | 0.74 | 1.52 | 3.73 | 0.74 | <10 | <10 | 1.67 | 4.10 | 0.81 |
| Fluoride as F | mg/l | 1 | 42 | 10 | 43 | 0.87 | 0.73 | 1.12 | 0.74 | <1.0 | <1.0 | 0.81 | 1.23 | 0.81 |

| Chemical Parameter | Unit | Quaternary Catchments X40D | | | |
|---|---|---|---|---|---|
| | | No. of Samples | Ambient GW quality or median[1)] | BHN Reserve[2)] | Groundwater Quality Reserve[3)] |
| | | X40D | X40D | | X40D |
| pH | | 38 | 8.37 | 5.0 – 9.5 | 9.21 |
| Electrical Conductivity | mS/m | 39 | 192.50 | <150 | 211.75 |
| Calcium as Ca | mg/l | 34 | 68.78 | <150 | 75.66 |
| Magnesium as Mg | mg/l | 33 | 102.13 | <100 | 112.34 |
| Sodium as Na | mg/l | 32 | 183.93 | <200 | 202.32 |
| Total Alkalinity as $CaCO_3$ | mg/l | 33 | 513.50 | N/A | N/A |
| Chloride as Cl | mg/l | 34 | 312.94 | <200 | 344.24 |
| Sulphate as $SO_4$ | mg/l | 34 | 18.47 | <400 | 20.32 |
| Nitrate as $NO_x$-N | mg/l | 33 | 4.30 | <10 | 4.72 |
| Fluoride as F | mg/l | 32 | 0.95 | <1.0 | 1.04 |

**Table 7.3: Water Quality Class and parameters of concern**

| Quaternary | Class | Water Quality parameters of concern |
|---|---|---|
| X11A | 0 | |
| X11B | 0 | |
| X11C | 0 | |
| X11D | 0 | |
| X11E | 0 | |
| X11F | 0 | |
| X11G | 0 | |
| X11H | 0 | |
| X11J | 0 | |
| X11K | 0 | |
| X12A | 0 | |
| X12B | 0 | |
| X12C | 0 | |
| X12D | I | Cl, Na |
| X12E | 0 | |
| X12F | 0 | |
| X12G | I | Mg |
| X12H | I | F |
| X12J | 0 | |
| X12K | I | Mg |
| X13J | 2 | Na |
| X13K | 2 | Cl, Na, EC |
| X13L | 0 | No data |
| X14A | 0 | |
| X14B | 3 | Na, Cl |
| X14F | 0 | |
| X14G | I | EC |
| X14H | I | Na, EC, F |
| X21A | 0 | |
| X21B | 0 | |
| X21C | 0 | |
| X21D | 0 | |
| X21E | 0 | |
| X21F | 3 | F |
| X21G | 0 | |
| X21H | 0 | No data |
| X21J | I | Cl, EC |
| X21K | 0 | No data |
| X22A | 0 | |
| X22B | 0 | |
| X22C | 2 | F |
| X22D | 0 | |
| X22E | 2 | F |
| X22F | 0 | |
| X22G | 0 | |
| X22H | 0 | |
| X22J | I | F |
| X22K | 3 | F |
| X23A | I | F |

| Quaternary | Class | Water Quality parameters of concern |
|---|---|---|
| X23B | 0 | |
| X23C | 0 | |
| X23D | 0 | |
| X23E | 0 | |
| X23F | I | EC, Mg |
| X23G | 0 | |
| X23H | 0 | |
| X24A | 2 | F |
| X24B | 0 | |
| X24C | I | F |
| X24D | I | EC |
| X24E | I | Cl, EC, Na, F |
| X24F | I | Cl, EC, Na |
| X24G | I | EC, Na |
| X24H | I | Cl, EC |
| X31A | 0 | |
| X31B | 0 | |
| X31C | 0 | |
| X31D | 2 | EC |
| X31E | 0 | |
| X31F | 0 | |
| X31G | 0 | |
| X31H | 0 | |
| X31J | 0 | |
| X31K | I | F |
| X31L | I | Na, EC, Cl, Mg, NO3 |
| X31M | I | EC, Mg |
| X32A | 0 | |
| X32B | 0 | |
| X32C | 0 | |
| X32D | 0 | |
| X32E | 0 | |
| X32F | I | F |
| X32G | 2 | NO3 |
| X32H | 2 | EC, Na |
| X32J | 2 | Cl, EC, Na |
| X33A | 3 | Na, Cl |
| X33B | 3 | Cl, EC, Na, F |
| X33C | 2 | Na, F |
| X33D | 2 | Cl, EC |
| X40A | I | EC, Cl, Mg, F |
| X40B | 2 | Cl, EC, F |
| X40C | 2 | Cl, EC, Na |
| X40D | 2 | Cl, EC, Mg |

## 8. Desktop Wetland Typing and Ecoclassification

**Table 8.1:** Summary of Wetland Resource Units, associated wetlands and the Present Ecological Status (PES) and Ecological Importance and Sensitivity (EIS) results

| WRU | Quaternary Catchments | Description | Summarised PES and EIS | Impacts |
|---|---|---|---|---|
| 1 – Highveld Grasslands | Portions of catchments X11 and X12. | High density of large wetlands.<br><br>Very large pans (rare). The vegetation type is regarded as "Endangered". Assumed that the wetland - dependent species within this vegetation type are similarly threatened. | Moderate - estimates range from a C to C/D EC.<br><br>High EIS | Widespread agriculture (water quality impacts; trampling/grazing, erosion; encroachment into & channelization). Water quality impacts from mining.<br><br>Limited impacts from invasive alien plants and the effects of dams drowning some wetlands and reducing water availability. |
| 2 – Escarpment Grasslands | Portions of catchments X11, X12, X21, X23 and X14. | High density of very large wetlands. Vegetation types are "Vulnerable" - assumed that the wetland-dependent species are therefore similarly not critically threatened. | Mostly Moderate EIS scores.<br><br>X21A, X21B, X21C and X21F: High EIS scores. In these quaternary catchments diversity of wetland types is higher (number of large pans - rare). Density of wetlands is high. X21A adjacent to the RAMSAR-listed Verloren Vallei.<br><br>PES relatively High - estimates range from a B/C to C EC. | Trout farming - dams drowning wetlands & reducing water availability, water quality impacts and canalisation. Agricultural areas - runoff; trampling/grazing & erosion; encroachment & channelization.<br><br>Afforestation, invasive alien vegetation, mining. |
| 3 - Bushveld | X22 and portions of catchments X21, X31, X23 & X24. | Moderate (Mountain Bushveld) to low (Sour Bushveld) density. Wetland sites moderate to small. Density & diversity is low, density slightly higher in the Sour Bushveld area. Vegetation type endangered. Vegetation types in the Mountain Bushveld unit - "Least Threatened" - accounts for the slight differences in average EIS scores. | PES of the wetlands is relatively low - Range from a C to D EC.<br><br>Quaternary catchments within the Sour Bushveld WRU have Moderate EIS scores, whilst those in the Mountain Bushveld WRU tend to have Low EIS scores. | Extensive afforestation - reduced interflow, reducing water availability for wetlands. Forestry has encroached. Edge effects of forestry & roads disturb wetlands which result in degradation. Irrigation farming, peri-urban areas of the former homelands and invasive alien vegetation have also caused some wetland degradation. |

| WRU | Quaternary Catchments | Description | Summarised PES and EIS | Impacts |
|---|---|---|---|---|
| 4 – Granite Lowveld | Portions of catchments X31, X32, X40, X33, X24, X14 and X13. | Wetlands are small or cryptic.<br><br>Density & diversity is very low – few wetlands. Those that do occur are not rare or high diversity relative. The vegetation types are listed as "Vulnerable". Large areas of this section of the catchment are protected within significant conservation areas. | Low EIS scores.<br><br>A wide range of PES: D to A ECs - indicative of the diverse conditions. Entire catchments are impacted by urbanisation of former homeland areas, lower quaternary catchments within Kruger National Park and private conservation areas. Little change from reference conditions in these areas; albeit that very few wetlands are found here. | Afforestation, agriculture and peri-urban areas. Forestry and the extensive agricultural areas have reduced the area of wetlands and the water available. Both landuse activities have encroached in places on the wetlands; whilst peri-urban areas have caused erosion (though increased runoff, grazing pressures and confinement of the drainage lines associated with infrastructure development). |
| 5 – Basalt Lowveld | Portions of catchments X40, X33, X24 and X13. | Wetlands confined to valley bottom positions.<br><br>Density and diversity is very low. A few that do occur are not rare types or occur in high diversity relative to one another. The vegetation types are listed as "Least Threatened". | Low EIS scores.<br><br>PES very high – in A & B ECs.<br><br>Notable exceptions are the quaternaries X13J, X13K and X13L which have been heavily impacted by urban and peri-urban areas of the former homelands, as well as by extensive irrigation farming. | Most of the quaternaries are located within the Kruger National Park, and no significant impacts at a regional (catchment) scale are likely to have occurred. |
| 6 - Lebombo | Portions of catchments X40, X33 and X24. | No wetlands of any regional importance are expected due to steep slopes, shallow soils, low rainfall and high evaporation demands.<br><br>Diversity would be very low, and density/occurrence extremely low. | | |

**Table 8.2:** Estimated average PES, EIS and REC for the wetlands within the quaternary catchments of the Crocodile, Sabie and Sand River catchments

| Quaternary Catchment | Desktop PES | Desktop EIS | Desktop REC |
|---|---|---|---|
| X21A | C | High | B |
| X21B | C | High | B |
| X21C | C | High | B |
| X21D | B/C | Moderate | B/C |
| X21E | C | Moderate | C |
| X21F | B/C | High | B |
| X21G | C | Moderate | C |
| X21H | C/D | Moderate | C/D |
| X21J | D | Moderate | D |
| X21K | D | Moderate | D |
| X22A | C/D | Moderate | C/D |
| X22B | C/D | Low | C/D |
| X22C | D | Moderate | D |
| X22D | C/D | Moderate | C/D |
| X22E | C/D | Moderate | C/D |
| X22F | C | Moderate | C |
| X22G | C/D | Moderate | C/D |
| X22H | C | Moderate | C |
| X22J | D | Low | D |
| X22K | C | Low | C |
| X23A | C | Moderate | C |
| X23B | C | Moderate | C |
| X23C | C/D | Moderate | C/D |
| X23D | C | Moderate | C |
| X23E | C/D | Moderate | C/D |
| X23F | C | Moderate | C |
| X23G | C | Moderate | C |
| X23H | C | Low | C |
| X24A | D | Low | D |
| X24B | D | Low | D |
| X24C | B/C | Low | B/C |
| X24D | C | Low | C |

| Quaternary Catchment | Desktop PES | Desktop EIS | Desktop REC |
|---|---|---|---|
| X24E | **B** | Low | **B** |
| X24F | **B** | Low | **B** |
| X24G | A | Low | A |
| X31A | D | Low | D |
| X31B | D | Low | D |
| X31C | D | Moderate | D |
| X31D | C | Moderate | C |
| X31E | D | Moderate | D |
| X31F | C | Moderate | C |
| X31G | D | Low | D |
| X31H | C/D | Moderate | C/D |
| X31J | D | Low | D |
| X31K | D | Low | D |
| X31L | D | Low | D |
| X31M | **A** | Low | **A** |
| X32A | D | Moderate | D |
| X32B | D | Moderate | D |
| X32C | D | Low | D |
| X32D | D | Moderate | D |
| X32E | D | Moderate | D |
| X32F | D | Low | D |
| X32G | D | Low | D |
| X32H | C | Low | C |
| X32J | **A** | Low | **A** |
| X33A | **A** | Low | **A** |
| X33B | **A** | Low | **A** |
| X33C | **A** | Low | **A** |
| X33D | **A** | Low | **A** |
| X40A | **A** | Low | **A** |
| X40B | **A** | Low | **A** |
| X40C | C | Low | C |
| X40D | **A** | Low | **A** |

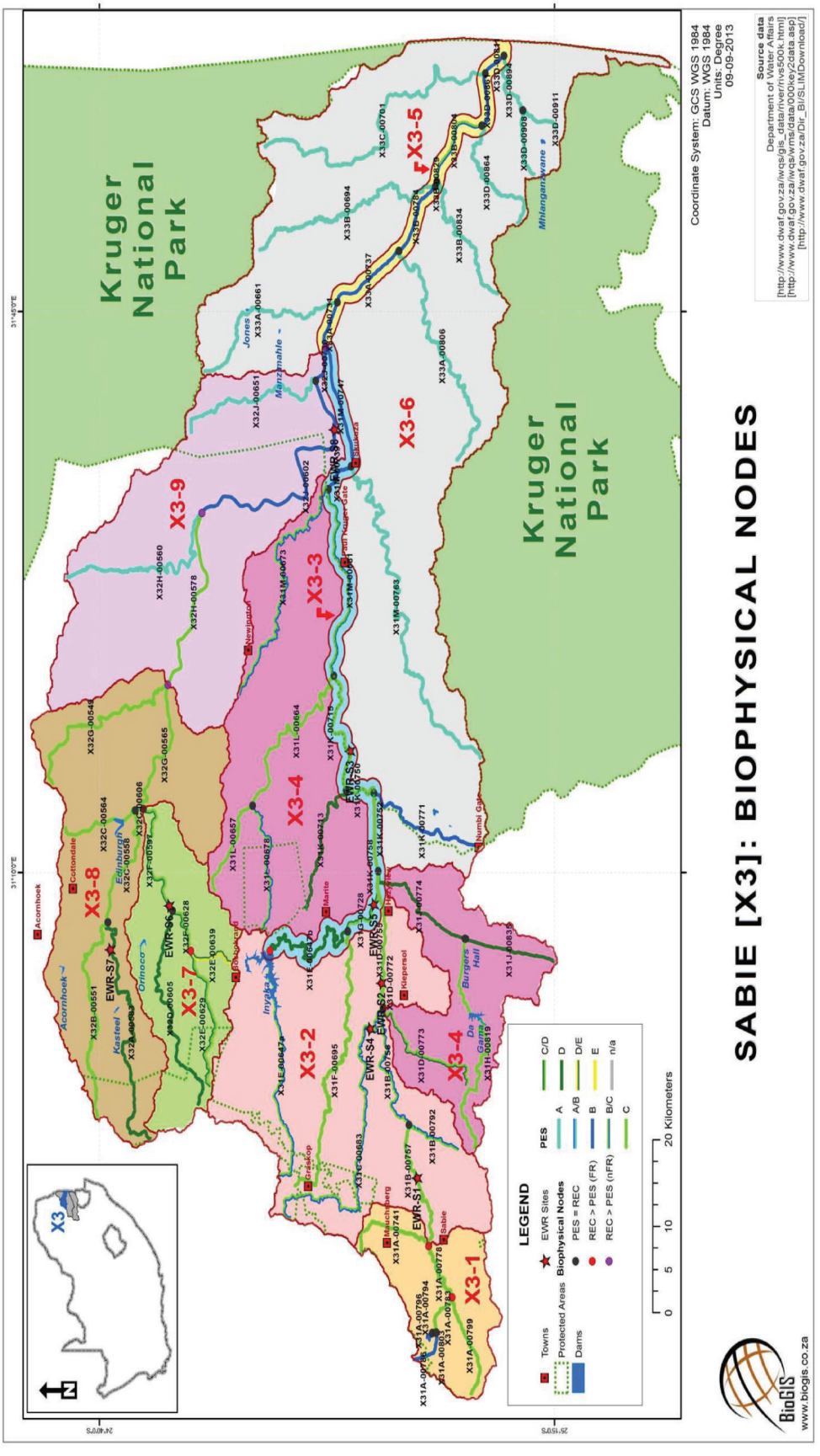


**Figure 1:** Locality of the selected EWR sites in the Sabie-Sand (X3) catchment

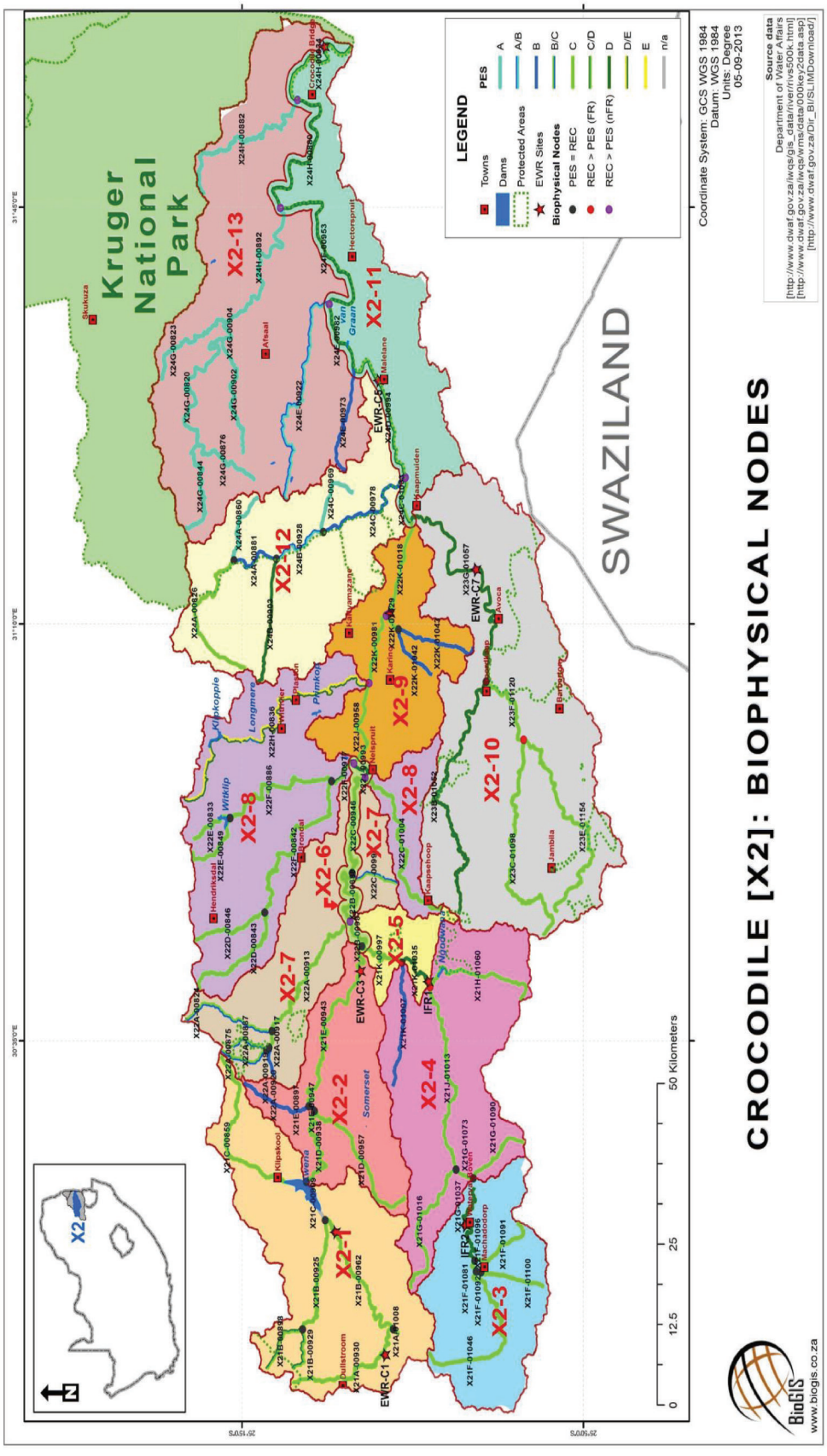


**Figure 2:** Locality of the selected EWR sites in the Crocodile (X2) catchment

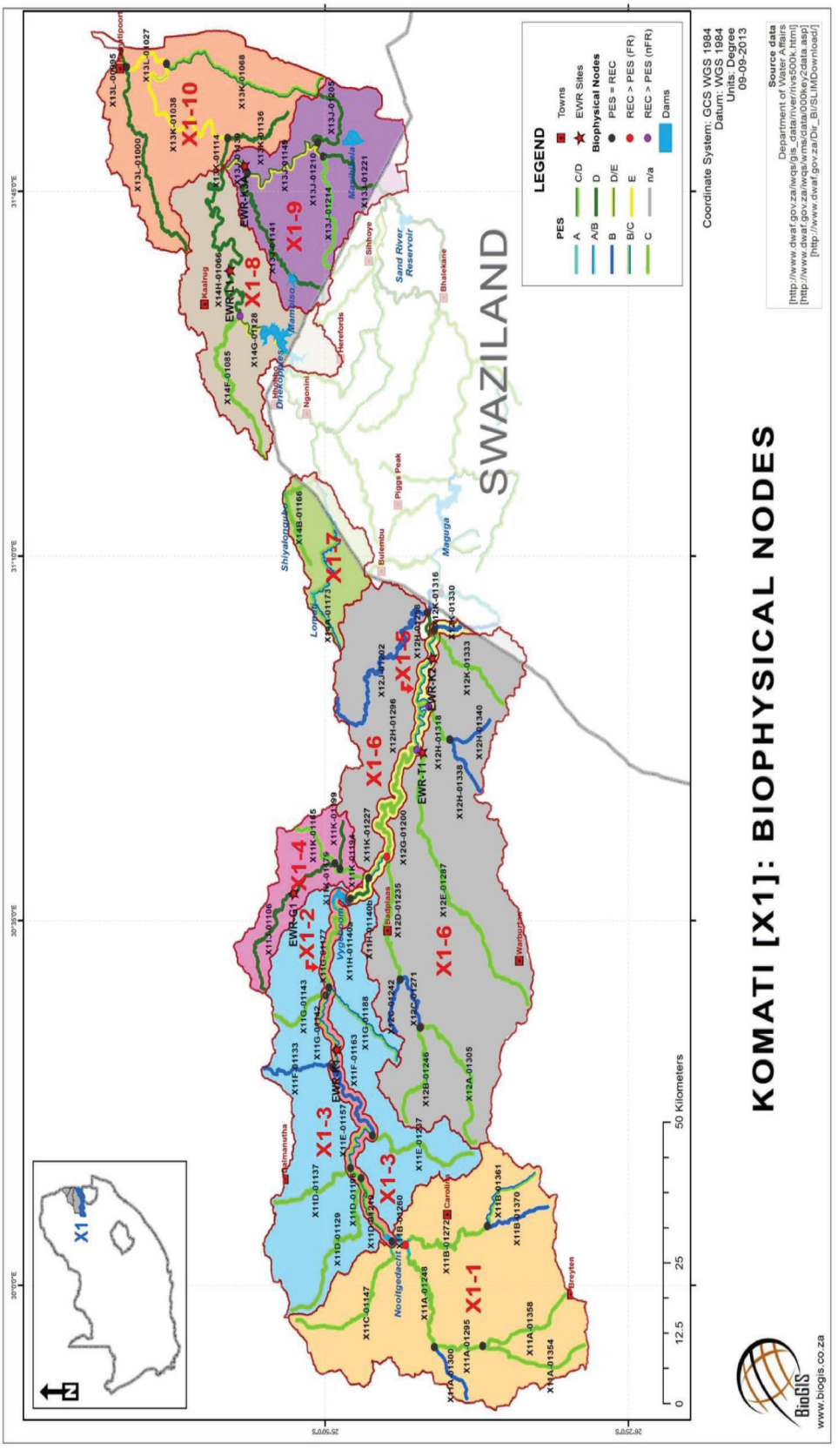


**Figure 3:** Locality of the selected EWR sites in the Komati (X1) catchment

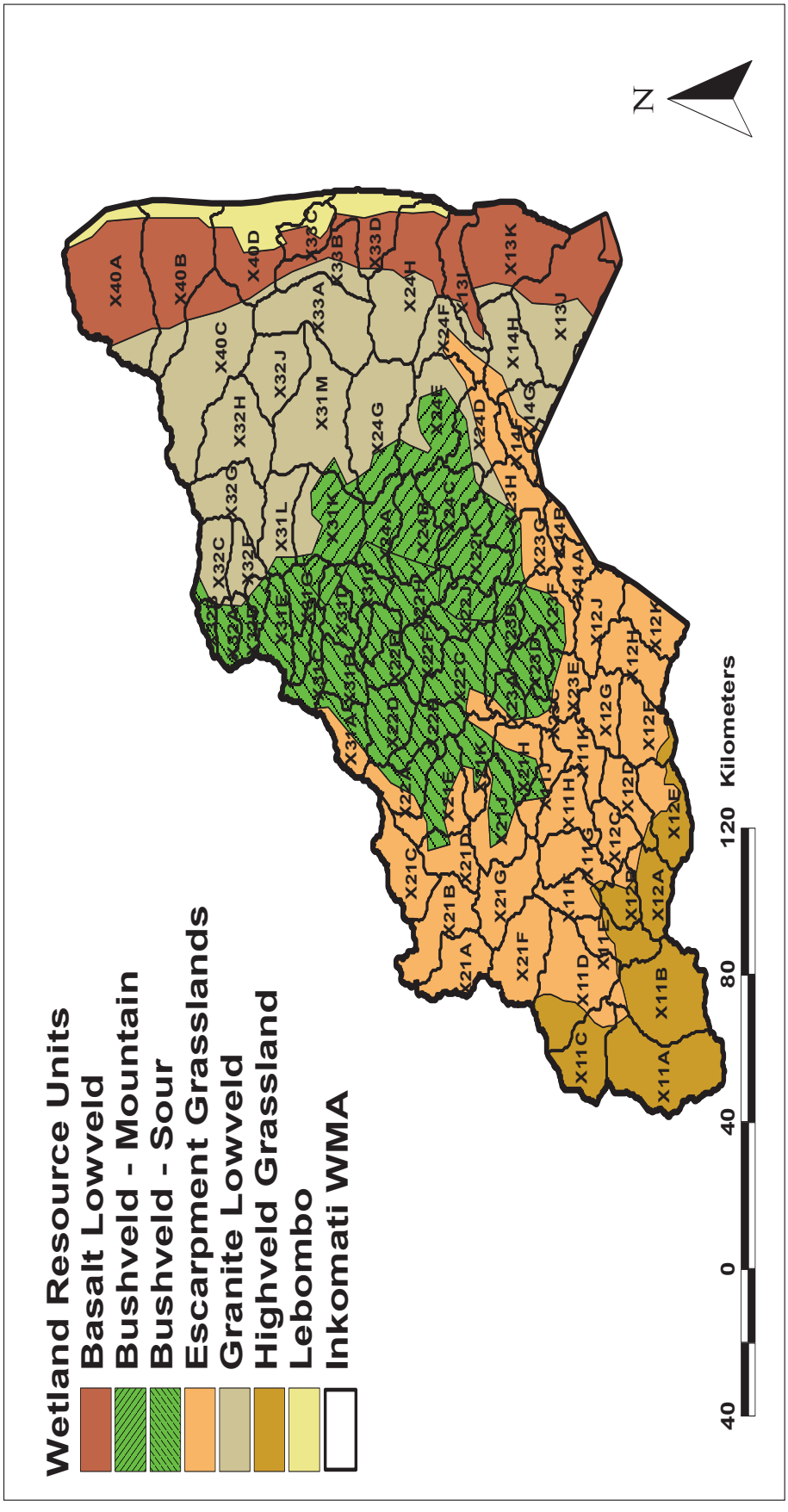


**Figure 4:** The distribution of quaternary catchments in relation to the Wetland Resource Units