# UGU DISTRICT MUNICIPALITY
# ENVIRONMENTAL MANAGEMENT FRAMEWORK

# DESKTOP HYDROLOGY STUDY
# REPORT

**April 2013**

**QUALITY VERIFICATION**

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2008 which has been independently certified by DEKRA Certification under certificate number 90906882

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## List of Abbreviations

| | |
|---|---|
| EC | Electrical Conductivity |
| EMF | Environmental Management Framework |
| KZN | KwaZulu-Natal |
| MAE | Mean Annual Evaporation |
| MAP | Mean Annual Precipitation |
| MAR | Mean Annual Naturalised Runoff |
| MCM | Million Cubic Metres |
| NFEPA | National Freshwater Ecosystem Priority Areas |
| PES | Present Ecological Status |
| UDM | Ugu District Municipality |

# EXECUTIVE SUMMARY

Mott MacDonald has been appointed to develop the Environmental Framework for the Ugu District Municipality (UDM). The project is currently in the Status Quo phase and as such, Jeffares & Green (Pty) Ltd were appointed to undertake the Hydrological Assessment for the municipal area.

***Methodology***

The report has been based on a desktop assessment of the hydrological features of the area, describing the physiographic and hydrological features identified within the project area. These features include:

- Rainfall;
- rivers;
- sensitive areas (National Freshwater Ecosystem Priority Areas (NFEPA));
- river ecological class;
- runoff potential; and
- groundwater.

***Results***

*Catchments*

The UDM contains four main river systems (Lovu Umkomaas, Mzimkhulu and Mtamvuna) as well as a number of smaller, but significant, rivers.

Within the UDM, the two Quaternary catchments of the Lovu River Catchment are reasonably undeveloped and have a lower proportion of alien invasive vegetation than the three Quaternary catchments falling outside of the UDM (which are also fairly well developed). These catchments have relatively low to no anthropogenic impacts and are in a good ecological state. There are two significant wetlands within the UDM catchment area, which are considered to be in good ecological condition.

Only a small portion of the Umkomaas River Catchment falls within the UDM. Only two of the 12 Quaternary Catchments fall partially/ within the UDM. Both are relatively undeveloped but with a relatively high proportion of alien invasive vegetation. These catchments have relatively low to no anthropogenic impacts and are in a good ecological state. There are extensive areas of significant wetlands which are considered to be in good ecological condition.

A small portion of the Mzimkhulu River Catchment falls within the UDM. The catchment is relatively well developed throughout and most of the Quaternary Catchments have a high proportion of alien invasive vegetation. These catchments have relatively low to no anthropogenic impacts and are in a good ecological state. However, more impact has been noted within T52K. There are extensive areas of significant wetlands which are considered to be in good ecological condition.

The Mtamvuna River Catchment falls mostly within the UDM. The inland portion of the catchment is relatively well developed, while the three Quaternary Catchments closer to the coast line have markedly less development. Most of the most of the Quaternary Catchments have a high proportion of alien invasive vegetation. These catchments have relatively low to no anthropogenic impacts and are in a good ecological state. There are extensive areas of significant wetlands which are considered to be in good ecological condition.

The remaining smaller but significant catchments vary in their levels of development and proportion of alien invasive vegetation. However, all, except the Mzinto River Catchment are classed as having relatively low to no anthropogenic impacts and are in a good ecological state. The Mzinto River Catchment is classed as having a higher level of impact. There are also significant wetlands within these catchments.

*Runoff Potential*

There is a trend of increasing runoff potential towards the southern section of the UDM. At this desktop level of study, it is unclear as to how best to access the available water resources, should they be required. If the streamflow is variable, then storage structures may be required to get specific demands at the required assurance of supply. Conversely, if the flow volumes are sufficient and the streamflow is not variable, then run-of-river abstractions may become plausible.

*Groundwater*

The geohydrological units underlying the Ugu District are classified as secondary aquifers (with the possible exception of the unconsolidated sediments, where they occur) with groundwater occurrence characterised either by aquifers with fractured flow or by aquifers with inter-granular and fractured flow. Borehole yields are expected to be satisfactory apart from a limited number of low yield areas (e.g. north of Umkomaas).

Due to the variability of the geology, groundwater levels and aquifer parameters such as hydraulic conductivity and transmissivity will differ across the Ugu District, and will be locally dependent on aquifer type, geological structure and topography.

Groundwater quality is generally good. However, groundwater quality will be heavily influenced by the depositional environment, proximity to the coast and industrial activities.

Due to the variation in elevation across the Ugu District, mean annual precipitation, and therefore potential groundwater recharge, is variable.

# 1 INTRODUCTION

Jeffares & Green (Pty) Ltd (J&G) was appointed by Mott MacDonald South Africa (Pty) Ltd to undertake a desktop *Status quo* hydrological assessment of the Ugu District Municipality (UDM) area as a specialist study for the Environmental Management Framework (EMF) that is currently being undertaken.

This study undertook a high level assessment of the current hydrological features within UDM, describing the physiographic and hydrological features identified within the project area. These features include:

- Rainfall;
- rivers;
- sensitive areas (National Freshwater Ecosystem Priority Areas (NFEPA));
- river ecological class;
- runoff potential; and
- groundwater.

# 2 SITE DESCRIPTION

The UDM is located in the southern part of KwaZulu-Natal (KZN), stretching from the Indian Ocean in the east to as much as 80 km inland (west). The area stretches from west of Harding inland on the National Road 2, down to Port Edward at its southernmost point on the KZN south coast and up to north of Scottburgh (cf. **Figure 1**). The UDM area spans approximately 5 048 km$^2$ containing numerous major river systems.

The UDM area falls with **Water Management Area 11: Mvoti to Mzimkhulu**, which consists of **Primary Catchments U** and a portion of **V** (as far south as the Mtamvuna River catchment; T40 Tertiary Catchment). Due to the nature of the UDM's location, i.e. that it is a coastal area, all of the rivers exit into the ocean flowing in an easterly direction. There are four main river systems that flow through the UDM, with several smaller, yet still significant, river systems located throughout the UDM. One of the main rivers (Mtamvuna River) and all of the listed significant smaller rivers have the majority of their catchment area within the UDM, whereas the remaining three main rivers have the bulk of their catchments upstream of the UDM. The four main river systems identified are as follows:

1. The Lovu River.
2. The Umkomaas River.
3. The Mzimkhulu River.
4. The Mtamvuna River.

The smaller significant rivers identified are as follows:

- Mbizana River.
- Mzinto River.
- Ufafa River.
- Vungu River.
- Mzumbe River.
- Mtwalume River.
- Mpambonyani River.

There are numerous smaller rivers that may have localised significance, however, at this high level of study, they have not been listed, nor discussed.

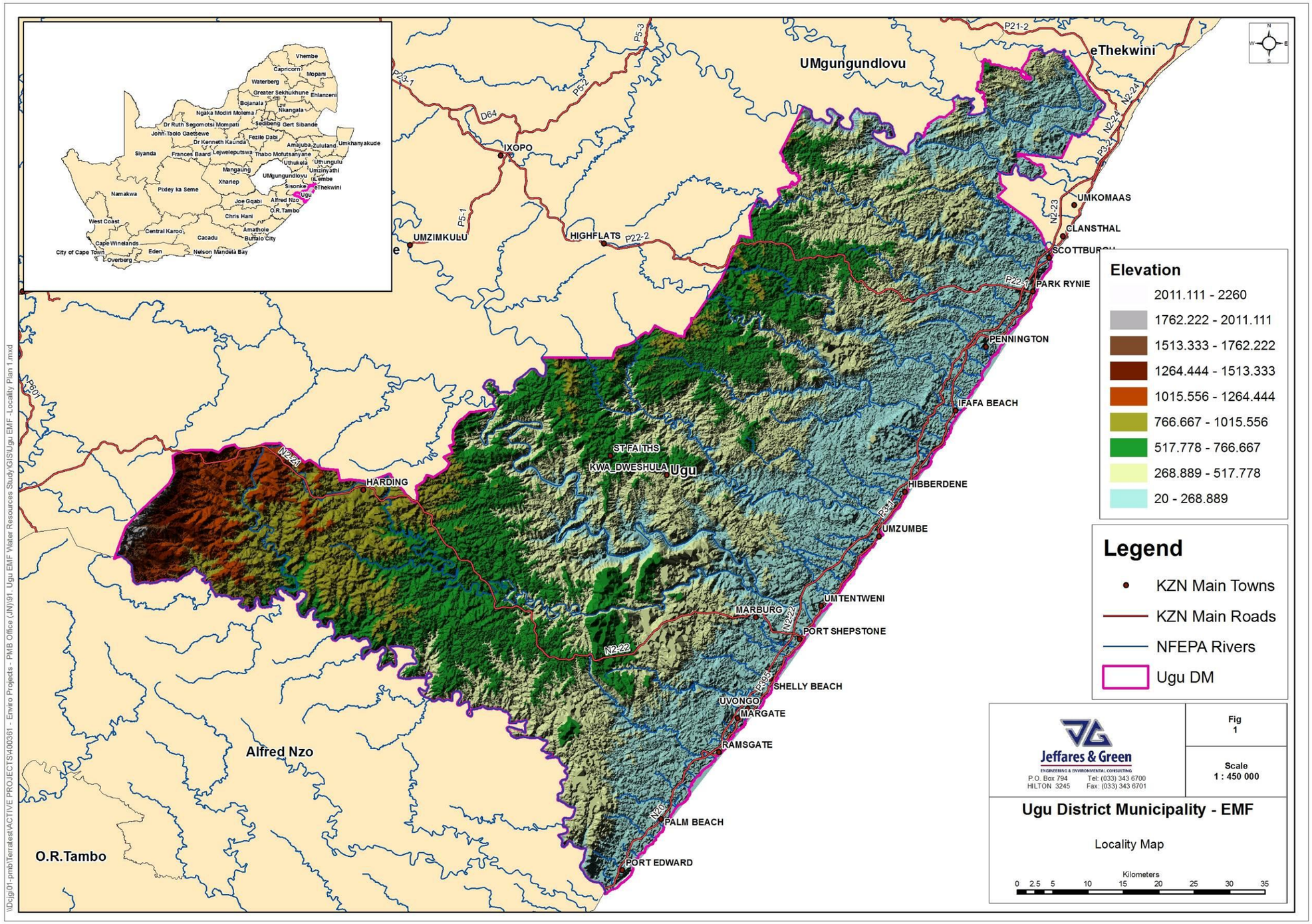


**Figure 1 Locality Plan for the Ugu District Municipality Environmental Management Framework**

# 3 MAJOR CATCHMENT DESCRIPTIONS

Due to the nature of a coastal area, there are a large number of catchments within the UDM, ranging from small localised catchments spanning a few square kilometres to the Mzimkhulu and Umkomaas Catchments stretching back to their headwaters in the Drakensberg Mountains. This section will provide a brief overview of the major catchments identified in **Section 2**. **Figure 2** presents an overview of the hydrological features (i.e. rivers, dams and sensitive wetlands) identified within the UDM. There is a common theme throughout the UDM in that there are no major dams or impoundments, only several small local supply dams. These impoundments are quantified in terms of volume and surface area within each sub-section to follow.

The majority of the area is characterised as moderately erodible, with a smaller portion characterised as highly erodible (Rooseboom, 1992). This was thought to be as a result of the moderate to high rainfall erosivity, based on the $EI_{30}$ (maximum rainfall intensity values for a 30 minute period) values for the area (Rooseboom, 1992).

## 3.1 Lovu River Catchment

The Lovu River Catchment extends up past the UDM boundary, beyond Richmond. This catchment is classified as Tertiary Catchment U70, which contains five Quaternary Catchments, namely U70A – U70E. The catchment has a contributing area of 1 031 $km^2$.

The Mean Annual Precipitation (MAP) across the catchment ranges from 1 040 mm in the headwaters to 849 mm to the south-east of Richmond, with the MAP rising to around 1 000 mm at the coast (WRC, 2009). The Mean Annual Evaporation (MAE) is constant across the catchment area, at approximately 1 200 mm (WRC, 2009). The two Quaternary Catchments that fall within, or partially within, the UDM area (U70D and U70E) are reasonably undeveloped. Whereas, the three Quaternary Catchments that lie outside of the UDM area (i.e. U70A – U70C) are fairly well developed, with high areas of afforestation and some irrigation application and farm dams. In addition, these three Quaternary Catchments have a relatively high proportion of alien invasive vegetation when compared to the two Quaternary Catchments that fall within, or partially within, the UDM area (WRC, 2009). A summary of these values is presented in **Table 1**. The Mean Annual Naturalised Runoff (MAR) of the Lovu River at its outlet is 142.06 MCM (WRC, 2009).

**Table 1 Hydrological Summary for the Lovu River Catchment (WRC, 2009)**

| | Catchment Area | Forestry | Alien Veg. | Irrigation | Farm dams | | S-pan evaporation | Rainfall | MAR |
|---|---|---|---|---|---|---|---|---|---|
| Quaternary | Gross | Area | Area | Area | Area | Volume | MAE WR2005 | MAP | |
| Catchment | ($km^2$) | ($km^2$) | ($km^2$) | ($km^2$) | ($km^2$) | (MCM) | (mm) | (mm) | (MCM) |
| | | | | | | | | | |
| U70A | 114 | 73.00 | 9.40 | 4.25 | 0.06 | 0.29 | 1200 | 1040 | 17.81 |
| U70B | 272 | 110.50 | 6.30 | 4.25 | 0.43 | 1.07 | 1200 | 849 | 24.63 |
| U70C | 350 | 22.80 | 2.70 | 4.25 | 0.32 | 1.07 | 1200 | 859 | 34.94 |
| U70D | 208 | 0.00 | 2.60 | 2.55 | | | 1200 | 938 | 28.46 |
| U70E | 87 | 0.00 | 1.20 | 0.85 | | | 1200 | 999 | 26.41 |
| | | | | | | | | | |
| **Tertiary U70** | **1031** | **206.30** | **22.20** | **16.15** | **0.80** | **2.43** | **1200** | **909** | **142.06** |

**Table 2** presents the results of a Present Ecological State (PES) analysis (DWAF, 2000), including a brief description, which shows that the Quaternary Catchments within the Lovu River Catchment of the UDM have an ecological class of an **A** or a **B**. This means that the catchments are have relatively low to no anthropogenic impacts and are in a good ecological state.

**Table 2 Present Ecological State of the Lovu River Quaternary Catchments (DWAF, 2000)**

| Name | Rivers | Description | Comments | PRESENT PESC |
|---|---|---|---|---|
| U70A | Richmond | Bed modification | Silting due to forest cutting | CLASS B |
| U70A | Richmond | Flow modification | Pine & saligna forest | |
| U70A | Richmond | Introduced instream biota | Trout | |
| U70A | Richmond | Inundation | | |
| U70A | Richmond | Riparian/bank condition | | |
| U70A | Richmond | Water quality modification | | |
| U70B | degrees south | Bed modification | | CLASS A |
| U70B | degrees south | Flow modification | Small holder agric - cane | |
| U70B | degrees south | Introduced instream biota | | |
| U70B | degrees south | Inundation | | |
| U70B | degrees south | Riparian/bank condition | | |
| U70B | degrees south | Water quality modification | | |
| U70C | Lovu | Bed modification | | CLASS A |
| U70C | Lovu | Flow modification | | |
| U70C | Lovu | Introduced instream biota | | |
| U70C | Lovu | Inundation | | |
| U70C | Lovu | Riparian/bank condition | | |
| U70C | Lovu | Water quality modification | | |
| U70D | Lovu Coastal | Bed modification | | CLASS A |
| U70D | Lovu Coastal | Flow modification | Mnungwe Dam on Tributary | |
| U70D | Lovu Coastal | Introduced instream biota | | |
| U70D | Lovu Coastal | Inundation | | |
| U70D | Lovu Coastal | Riparian/bank condition | | |
| U70D | Lovu Coastal | Water quality modification | Sugar cane farming | |
| U70E | Mgababa | Bed modification | | CLASS B |
| U70E | Mgababa | Flow modification | Mgababa Dam | |
| U70E | Mgababa | Introduced instream biota | Bass | |
| U70E | Mgababa | Inundation | Mgababa Dam | |
| U70E | Mgababa | Riparian/bank condition | | |
| U70E | Mgababa | Water quality modification | | |

There are only two National Freshwater Ecosystem Priority Area (NFEPA) wetlands that need noting, namely Indian Ocean Coastal Belt Group 2 wetlands (specifically wetland seeps) which are located in U70E (cf. **Figure 2**). In addition, the Lovu River is a NFEPA river. These hydrological features are classed as such due to their good PES (i.e. equivalent to a Class **A** or **B** according to DWA).

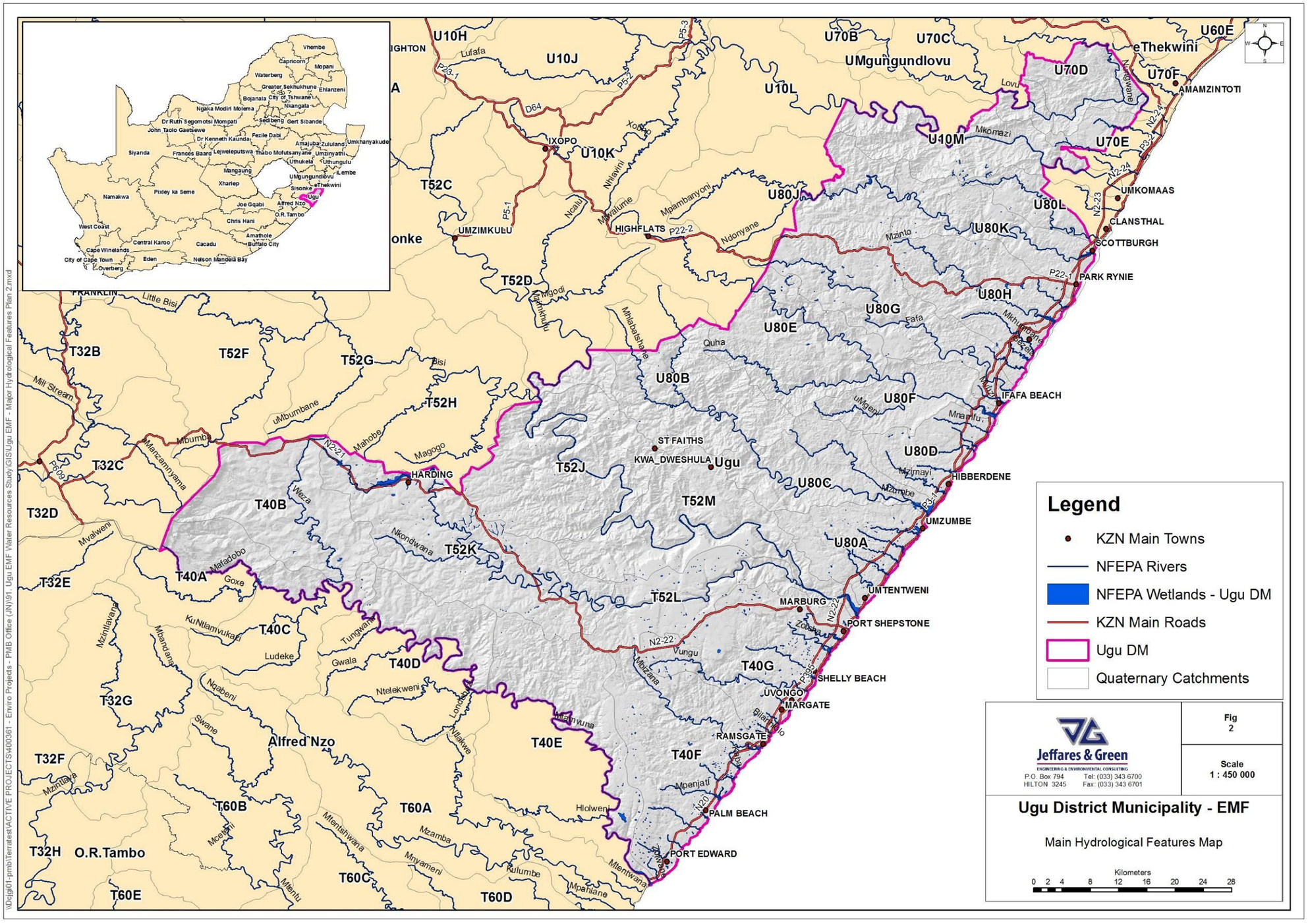


**Figure 2 Major Hydrological Features for the Ugu District Municipality Environmental Management Framework**

## 3.2 Umkomaas River Catchment

The Umkomaas River Catchment extends up past the UDM boundary, to its headwaters in the Drakensberg Mountains near Giants Castle. This catchment is classified as Tertiary Catchment U10, which contains 12 Quaternary Catchments, namely U10A – U10M. The catchment has a contributing area of 4 387 km$^2$, of which only a small portion is in the UDM (specifically a portion of U10M and a small part of U10L).

The MAP across the catchment ranges from 1 287 mm in the headwaters to 758 mm near the coast (WRC, 2009). The MAE ranges across the catchment area, with approximately 1 300 mm at the headwaters and 1 200 mm at the coast (WRC, 2009). The two Quaternary Catchments that fall within, or partially within, the UDM area (U10L and U10M) are reasonably undeveloped when considering the portion of each Quaternary Catchment that lies within the UDM. Whereas, some of the Quaternary Catchments that lie outside of the UDM area (U10E – U10K) are fairly well developed (which will have an impact on streamflows within the UDM), with high areas of afforestation and some irrigation application and farm dams (WRC, 2009). In addition, all of the Quaternary Catchments have a relatively high proportion of alien invasive vegetation (WRC, 2009). A summary of these values is presented in **Table 3**. The MAR (Naturalised) of the Umkomaas River at its outlet is 1 045.4 MCM (WRC, 2009).

**Table 3 Hydrological Summary for the Umkomaas River Catchment (WRC, 2009)**

| | Catchment Area | Forestry | Alien Veg. | Irrigation | Farm dams | | S-pan evaporation | Rainfall | MAR |
|---|---|---|---|---|---|---|---|---|---|
| Quaternary | Gross | Area | Area | Area | Area | Volume | MAE WR2005 | MAP | |
| Catchment | (km$^2$) | (km$^2$) | (km$^2$) | (km$^2$) | (km$^2$) | (MCM) | (mm) | (mm) | (MCM) |
| | | | | | | | | | |
| U10A | 418 | 0.00 | 1.40 | 5.20 | 0.51 | 1.07 | 1300 | 1287 | 204.74 |
| U10B | 392 | 0.00 | 6.50 | 5.03 | 0.32 | 0.68 | 1300 | 1176 | 160.29 |
| U10C | 267 | 0.00 | 4.10 | 3.63 | 0.11 | 0.27 | 1300 | 1091 | 93.06 |
| U10D | 337 | 0.80 | 4.50 | 4.58 | 0.69 | 1.56 | 1300 | 999 | 96.95 |
| U10E | 327 | 26.00 | 3.70 | 0.00 | 0.58 | 2.07 | 1300 | 1034 | 101.66 |
| U10F | 379 | 24.20 | 3.00 | 0.00 | | | 1300 | 963 | 63.20 |
| U10G | 353 | 26.20 | 2.90 | 8.93 | 1.32 | 3.20 | 1250 | 981 | 67.25 |
| U10H | 458 | 112.50 | 3.70 | 13.67 | 1.72 | 4.18 | 1200 | 924 | 78.54 |
| U10J | 505 | 99.60 | 4.20 | 15.09 | 1.91 | 4.63 | 1200 | 878 | 74.92 |
| U10K | 364 | 62.80 | 4.40 | 10.87 | 1.59 | 5.39 | 1200 | 793 | 38.80 |
| U10L | 307 | 12.50 | 2.70 | 9.20 | | | 1200 | 758 | 28.08 |
| U10M | 280 | 0.00 | 2.70 | 0.00 | 1.12 | 2.84 | 1200 | 858 | 37.91 |
| | | | | | | | | | |
| **Tertiary U10** | **4387** | **364.60** | **43.80** | **76.20** | **0.00** | **25.89** | **1252** | **981** | **1045.40** |

**Table 4** presents the results of a PES analysis (DWAF, 2000), including a brief description, which shows that the Quaternary Catchments within the Umkomaas River Catchment of the UDM have an ecological class of an **A** or a **B**. This means that the catchments have relatively low to no anthropogenic impacts and are in a good ecological state.

There are extensive areas of NFEPA wetlands that need noting, which consist of, Channel Valley Bottom, Flat and Seep wetlands, which are located in U10L and U10M (cf. **Figure 2**). In addition,

the Umkomaas River is a NFEPA river. These hydrological features are classed as such due to their good PES (i.e. equivalent to a Class **A** or **B** according to DWA).

**Table 4 Present Ecological State of the Mkomaas River Quaternary Catchments (DWAF, 2000)**

| Name | Rivers | Description | Comments | PRESENT PESC |
|---|---|---|---|---|
| U10A | MKOMZANA | Bed modification | SEDIMENTS IN LOWER REACHES | CLASS A |
| U10A | MKOMZANA | Flow modification | | |
| U10A | MKOMZANA | Introduced instream biota | TROUT | |
| U10A | MKOMZANA | Inundation | | |
| U10A | MKOMZANA | Riparian/bank condition | WATTLE ENCROACHMENT, EROSIONS? | |
| U10A | MKOMZANA | Water quality modification | | |
| U10B | MKOMAZI | Bed modification | SEDIMENTS IN LOWER REACHES | CLASS A |
| U10B | MKOMAZI | Flow modification | | |
| U10B | MKOMAZI | Introduced instream biota | TROUT | |
| U10B | MKOMAZI | Inundation | | |
| U10B | MKOMAZI | Riparian/bank condition | WATTLE ENCROACHMENT, EROSIONS? | |
| U10B | MKOMAZI | Water quality modification | | |
| U10C | MKOMAZANA | Bed modification | SEDIMENTS IN LOWER REACHES | CLASS A |
| U10C | MKOMAZANA | Flow modification | | |
| U10C | MKOMAZANA | Introduced instream biota | TROUT | |
| U10C | MKOMAZANA | Inundation | | |
| U10C | MKOMAZANA | Riparian/bank condition | WATTLE ENCROACHMENT, EROSIONS? | |
| U10C | MKOMAZANA | Water quality modification | | |
| U10D | INZINGA | Bed modification | SEDIMENTS IN LOWER REACHES | CLASS A |
| U10D | INZINGA | Flow modification | | |
| U10D | INZINGA | Introduced instream biota | TROUT | |
| U10D | INZINGA | Inundation | | |
| U10D | INZINGA | Riparian/bank condition | WATTLE ENCROACHMENT, EROSIONS? | |
| U10D | INZINGA | Water quality modification | | |
| U10E | MKUMAZI | Bed modification | SEDIMENTS | CLASS A |
| U10E | MKUMAZI | Flow modification | | |
| U10E | MKUMAZI | Introduced instream biota | BASS? | |
| U10E | MKUMAZI | Inundation | GAUGING WEIR PRESENT | |
| U10E | MKUMAZI | Riparian/bank condition | WATTLE OVERGRAZED, BURNED | |
| U10E | MKUMAZI | Water quality modification | TURBIDITY - OVERGRAZING | |
| U10F | MKUMAZI | Bed modification | SEDIMENTS | CLASS B |
| U10F | MKUMAZI | Flow modification | | |
| U10F | MKUMAZI | Introduced instream biota | CARP EXPECTED | |
| U10F | MKUMAZI | Inundation | | |
| U10F | MKUMAZI | Riparian/bank condition | WATTLE OVERGRAZED, BURNED | |
| U10F | MKUMAZI | Water quality modification | TURBIDITY - OVERGRAZING | |
| U10G | MKUMAZI | Bed modification | SEDIMENTS | CLASS B |
| U10G | MKUMAZI | Flow modification | | |
| U10G | MKUMAZI | Introduced instream biota | CARP EXPECTED | |
| U10G | MKUMAZI | Inundation | | |
| U10G | MKUMAZI | Riparian/bank condition | WATTLE OVERGRAZED, BURNED | |
| U10G | MKUMAZI | Water quality modification | TURBIDITY - OVERGRAZING | |
| U10H | MKUMAZI | Bed modification | BIT OF SEDIMENT | CLASS A |
| U10H | MKUMAZI | Flow modification | | |
| U10H | MKUMAZI | Introduced instream biota | CCAR | |
| U10H | MKUMAZI | Inundation | | |
| U10H | MKUMAZI | Riparian/bank condition | FEW EXOTICS | |
| U10H | MKUMAZI | Water quality modification | | |
| U10J | MKOMAZI | Bed modification | FINE SEDIMENT IN PLACES | CLASS A |
| U10J | MKOMAZI | Flow modification | SOME ABSTRACTION FOR IRRIGATION | |
| U10J | MKOMAZI | Introduced instream biota | CARP | |
| U10J | MKOMAZI | Inundation | | |
| U10J | MKOMAZI | Riparian/bank condition | INFLUENCED BY FLOODS | |
| U10J | MKOMAZI | Water quality modification | TURBDIDITY | |
| U10K | LUFAFA | Bed modification | SEDIMENTS FROM OP | CLASS A |
| U10K | LUFAFA | Flow modification | | |
| U10K | LUFAFA | Introduced instream biota | | |
| U10K | LUFAFA | Inundation | | |
| U10K | LUFAFA | Riparian/bank condition | GOOD DOWNSTREAM, BAD UPSTREAM | |
| U10K | LUFAFA | Water quality modification | TURBIDITY FROM SETTLEMENTS ON TOP | |
| U10L | MKUMAZI | Bed modification | SEDIMENT FARMING | CLASS A |
| U10L | MKUMAZI | Flow modification | SOME ABSTRACTION ON TOP | |
| U10L | MKUMAZI | Introduced instream biota | CARP | |
| U10L | MKUMAZI | Inundation | | |
| U10L | MKUMAZI | Riparian/bank condition | | |
| U10L | MKUMAZI | Water quality modification | SOME AGRIC INFLUENCE | |
| U10M | MKUMAZI | Bed modification | SEDIMENTS | CLASS B |
| U10M | MKUMAZI | Flow modification | ABSTRACTION FOR INDUSTRY | |
| U10M | MKUMAZI | Introduced instream biota | CARP | |
| U10M | MKUMAZI | Inundation | ABSTRACTION WEIRS | |
| U10M | MKUMAZI | Riparian/bank condition | REMOVED | |
| U10M | MKUMAZI | Water quality modification | TURBIDITY FROM FARMING | |

## 3.3 Mzimkhulu River Catchment

The Mzimkhulu River Catchment extends up past the UDM boundary, to its headwaters in the Drakensberg Mountains adjacent to Lesotho. This catchment is classified by Tertiary Catchments T51 and T52, which contains 21 Quaternary Catchments, namely T51A – T51J and T52A – T52M. The catchment has a contributing area of 6 678 km$^2$, of which only a small portion is in the UDM (specifically T52J – T52M).

The MAP across the catchment ranges from 1 260 mm in the headwaters to 900 mm near the coast (WRC, 2009). The MAE ranges across the catchment area, with approximately 1 350 mm below the escarpment and 1 150 mm at the coast (WRC, 2009). The catchment is relatively well developed throughout, as per **Table 5** (WRC, 2009). In addition, most of the Quaternary Catchments have a relatively high proportion of alien invasive vegetation, specifically T52L as it falls within the UDM area (WRC, 2009). A summary of these values is presented in **Table 5**. The MAR (Naturalised) of the Mzimkhulu River at its outlet is 1 372.6 MCM (WRC, 2009).

**Table 5 Hydrological Summary for the Mzimkhulu River Catchment**

| | Catchment Area | Forestry | Alien Veg. | Irrigation | Farm dams | | S-pan evaporation | Rainfall | MAR |
|---|---|---|---|---|---|---|---|---|---|
| Quaternary Catchment | Gross (km$^2$) | Area (km$^2$) | Area (km$^2$) | Area (km$^2$) | Area (km$^2$) | Volume (MCM) | MAE WR2005 (mm) | MAP (mm) | (MCM) |
| | | | | | | | | | |
| T51A | 328 | 2.00 | 0.00 | 2.81 | 1.91 | 1.29 | 1300 | 1260 | 156.41 |
| T51B | 210 | 2.80 | 1.80 | 1.73 | 4.04 | 3.07 | 1300 | 1180 | 87.41 |
| T51C | 462 | 26.80 | 3.30 | 3.63 | 2.79 | 1.72 | 1300 | 952 | 95.40 |
| T51D | 142 | 8.10 | 1.10 | 1.24 | 6.92 | 7.25 | 1300 | 1234 | 64.37 |
| T51E | 256 | 12.40 | 1.70 | 1.98 | 2.69 | 1.80 | 1300 | 957 | 53.59 |
| T51F | 307 | 0.00 | 1.90 | 1.90 | 0.17 | 0.10 | 1350 | 1142 | 99.50 |
| T51G | 256 | 2.00 | 1.80 | 1.57 | 2.54 | 1.84 | 1350 | 1087 | 73.55 |
| T51H | 520 | 17.90 | 8.40 | 4.04 | 0.95 | 0.49 | 1300 | 947 | 105.80 |
| T51J | 265 | 3.00 | 1.80 | 2.06 | | | 1300 | 912 | 48.62 |
| | | | | | | | | | |
| **Tertiary T51** | **2746** | **75.00** | **21.80** | **20.96** | **34.52** | **17.56** | **1310** | **1050** | **784.65** |
| | | | | | | | | | |
| T52A | 382 | 62.30 | 3.10 | 6.85 | 1.81 | 0.90 | 1200 | 906 | 74.67 |
| T52B | 256 | 6.80 | 3.00 | 4.53 | | | 1200 | 881 | 46.34 |
| T52C | 261 | 53.50 | 3.40 | 4.63 | | | 1200 | 836 | 40.71 |
| T52D | 531 | 67.90 | 4.80 | 11.47 | | | 1200 | 791 | 52.74 |
| T52E | 233 | 66.50 | 13.10 | 0.25 | | | 1200 | 903 | 45.71 |
| T52F | 418 | 113.80 | 83.70 | 0.50 | | | 1200 | 908 | 83.20 |
| T52G | 221 | 25.50 | 7.80 | 0.26 | | | 1200 | 903 | 43.33 |
| T52H | 344 | 5.20 | 10.10 | 0.56 | | | 1200 | 778 | 32.41 |
| T52J | 368 | 10.40 | 7.40 | 2.78 | | | 1150 | 826 | 44.52 |
| T52K | 426 | 98.90 | 63.60 | 3.24 | 2.59 | 1.80 | 1150 | 803 | 48.00 |
| T52L | 179 | 0.00 | 14.10 | 1.39 | 1.29 | 0.75 | 1150 | 893 | 27.41 |
| T52M | 313 | 0.00 | 52.70 | 2.38 | | | 1150 | 901 | 48.92 |
| | | | | | | | | | |
| **Tertiary T52** | **3932** | **510.80** | **266.80** | **38.84** | **5.69** | **3.45** | **1184** | **853** | **587.96** |

**Table 6** presents the results of a PES analysis (DWAF, 2000), including a brief description, which shows that the Quaternary Catchments within the Mzimkhulu River Catchment of the UDM have an ecological class of an **A** or a **B**, with the exception of T52K, which lies within the UDM area and has a PES Class **C**. This means that the catchments are have relatively low to no anthropogenic impacts and are in a good ecological state, with more impact noted in T52K.

There are extensive areas of NFEPA wetlands that need noting, which consist of, Channel Valley-Bottom, Unchannelled Valley-Bottom, Floodplain, Depression, Flat and Seep wetlands, which are located in T52J to T52M (cf. **Figure 2**). In addition, the Mzimkhulu River is a NFEPA river. These hydrological features are classed as such due to their good PES (i.e. equivalent to a Class **A** or **B** according to DWA).

## Table 6 Present Ecological State of the Mzimkhulu River Quaternary Catchments

| Name | Rivers | Description | Comments | PRESENT PESC |
|---|---|---|---|---|
| T51A | Mzinkulu conf | Bed modification | | CLASS A |
| T51A | Mzinkulu conf | Flow modification | FARM DAMS IN TRIBS | |
| T51A | Mzinkulu conf | Introduced instream biota | RAINBOW TROUT | |
| T51A | Mzinkulu conf | Inundation | | |
| T51A | Mzinkulu conf | Riparian/bank condition | | |
| T51A | Mzinkulu conf | Water quality modification | | |
| T51B | MZIMKULU | Bed modification | | CLASS B |
| T51B | MZIMKULU | Flow modification | direct irrigation to point of flow cessation | |
| T51B | MZIMKULU | Introduced instream biota | trout, bass | |
| T51B | MZIMKULU | Inundation | none | |
| T51B | MZIMKULU | Riparian/bank condition | | |
| T51B | MZIMKULU | Water quality modification | irrigation return flow | |
| T51C | Underberg to | Bed modification | | CLASS B |
| T51C | Underberg to | Flow modification | | |
| T51C | Underberg to | Introduced instream biota | Trout, bass | |
| T51C | Underberg to | Inundation | | |
| T51C | Underberg to | Riparian/bank condition | | |
| T51C | Underberg to | Water quality modification | | |
| T51D | POLELA | Bed modification | | CLASS A |
| T51D | POLELA | Flow modification | ABSTRACTION AND DAMS IRRIGATION | |
| T51D | POLELA | Introduced instream biota | RAINBOW TROUT | |
| T51D | POLELA | Inundation | | |
| T51D | POLELA | Riparian/bank condition | | |
| T51D | POLELA | Water quality modification | SOME RETURNS | |
| T51E | Umzimkulu confl. | Bed modification | | CLASS B |
| T51E | Umzimkulu confl. | Flow modification | Irrigation by direct abstraction | |
| T51E | Umzimkulu confl. | Introduced instream biota | Trout, bass | |
| T51E | Umzimkulu confl. | Inundation | | |
| T51E | Umzimkulu confl. | Riparian/bank condition | | |
| T51E | Umzimkulu confl. | Water quality modification | | |
| T51F | source to Ndow ane | Bed modification | | CLASS A |
| T51F | source to Ndow ane | Flow modification | Irrigation | |
| T51F | source to Ndow ane | Introduced instream biota | Trout | |
| T51F | source to Ndow ane | Inundation | | |
| T51F | source to Ndow ane | Riparian/bank condition | | |
| T51F | source to Ndow ane | Water quality modification | | |
| T51G | ngw angw ane | Bed modification | | CLASS B |
| T51G | ngw angw ane | Flow modification | LOCH Curragh | |
| T51G | ngw angw ane | Introduced instream biota | Trout and bass | |
| T51G | ngw angw ane | Inundation | Loch Curragh | |
| T51G | ngw angw ane | Riparian/bank condition | | |
| T51G | ngw angw ane | Water quality modification | | |
| T51H | Ngununu | Bed modification | | CLASS B |
| T51H | Ngununu | Flow modification | | |
| T51H | Ngununu | Introduced instream biota | | |
| T51H | Ngununu | Inundation | | |
| T51H | Ngununu | Riparian/bank condition | | |
| T51H | Ngununu | Water quality modification | | |
| T51J | Ngw agw ane | Bed modification | | CLASS B |
| T51J | Ngw agw ane | Flow modification | | |
| T51J | Ngw agw ane | Introduced instream biota | Bass | |
| T51J | Ngw agw ane | Inundation | | |
| T51J | Ngw agw ane | Riparian/bank condition | | |
| T51J | Ngw agw ane | Water quality modification | | |
| T52A | Cubane | Bed modification | | CLASS B |
| T52A | Cubane | Flow modification | | |
| T52A | Cubane | Introduced instream biota | Bass & ? carp | |
| T52A | Cubane | Inundation | | |
| T52A | Cubane | Riparian/bank condition | | |
| T52A | Cubane | Water quality modification | | |
| T52B | Mzimkulu | Bed modification | | CLASS B |
| T52B | Mzimkulu | Flow modification | | |
| T52B | Mzimkulu | Introduced instream biota | | |
| T52B | Mzimkulu | Inundation | | |
| T52B | Mzimkulu | Riparian/bank condition | | |
| T52B | Mzimkulu | Water quality modification | | |
| T52C | confl to Umzimkulu | Bed modification | | CLASS B |
| T52C | confl to Umzimkulu | Flow modification | | |
| T52C | confl to Umzimkulu | Introduced instream biota | Bass and carp | |
| T52C | confl to Umzimkulu | Inundation | | |
| T52C | confl to Umzimkulu | Riparian/bank condition | | |
| T52C | confl to Umzimkulu | Water quality modification | | |
| T52D | Bisi confl. | Bed modification | | CLASS B |
| T52D | Bisi confl. | Flow modification | | |
| T52D | Bisi confl. | Introduced instream biota | Bass and Carp | |
| T52D | Bisi confl. | Inundation | | |
| T52D | Bisi confl. | Riparian/bank condition | | |
| T52D | Bisi confl. | Water quality modification | | |
| T52E | Bisi confl | Bed modification | | CLASS B |
| T52E | Bisi confl | Flow modification | | |
| T52E | Bisi confl | Introduced instream biota | | |
| T52E | Bisi confl | Inundation | | |
| T52E | Bisi confl | Riparian/bank condition | | |
| T52E | Bisi confl | Water quality modification | | |
| T52F | Little Bisi to Bisi Confl. | Bed modification | | CLASS B |
| T52F | Little Bisi to Bisi Confl. | Flow modification | | |
| T52F | Little Bisi to Bisi Confl. | Introduced instream biota | | |
| T52F | Little Bisi to Bisi Confl. | Inundation | | |
| T52F | Little Bisi to Bisi Confl. | Riparian/bank condition | | |
| T52F | Little Bisi to Bisi Confl. | Water quality modification | | |
| T52G | 56 road | Bed modification | | CLASS B |
| T52G | 56 road | Flow modification | | |
| T52G | 56 road | Introduced instream biota | | |
| T52G | 56 road | Inundation | | |
| T52G | 56 road | Riparian/bank condition | | |
| T52G | 56 road | Water quality modification | | |
| T52H | | Bed modification | | CLASS B |
| T52H | | Flow modification | | |
| T52H | | Introduced instream biota | | |
| T52H | | Inundation | | |
| T52H | | Riparian/bank condition | | |
| T52H | | Water quality modification | | |
| T52J | Tengw e confl | Bed modification | | CLASS A |
| T52J | Tengw e confl | Flow modification | | |
| T52J | Tengw e confl | Introduced instream biota | Bass and Carp | |
| T52J | Tengw e confl | Inundation | | |
| T52J | Tengw e confl | Riparian/bank condition | | |
| T52J | Tengw e confl | Water quality modification | | |
| T52K | source to top of Oribi | Bed modification | | CLASS C |
| T52K | source to top of Oribi | Flow modification | Gilbert Eyles Dam | |
| T52K | source to top of Oribi | Introduced instream biota | Bass and Bluegill | |
| T52K | source to top of Oribi | Inundation | Gilbert Eyles Dam | |
| T52K | source to top of Oribi | Riparian/bank condition | | |
| T52K | source to top of Oribi | Water quality modification | | |
| T52L | Gorge | Bed modification | | CLASS A |
| T52L | Gorge | Flow modification | G Eyles Dam | |
| T52L | Gorge | Introduced instream biota | | |
| T52L | Gorge | Inundation | | |
| T52L | Gorge | Riparian/bank condition | | |
| T52L | Gorge | Water quality modification | | |
| T52M | confl to estuary | Bed modification | | CLASS B |
| T52M | confl to estuary | Flow modification | | |
| T52M | confl to estuary | Introduced instream biota | Carp | |
| T52M | confl to estuary | Inundation | | |
| T52M | confl to estuary | Riparian/bank condition | | |
| T52M | confl to estuary | Water quality modification | | |

## 3.4 Mtamvuna River Catchment

The Mtamvuna River Catchment extends up past the UDM boundary, to its headwaters located to the south of Kokstad. This catchment is classified by Tertiary Catchment T40, which contains nine Quaternary Catchments, namely T40A – T40J. The catchment has a contributing area of 2 737 $km^2$, of which most of the catchment area is in the UDM.

The MAP across the catchment is around 800 – 900 mm inland, with the Quaternary Catchments near the coast increasing to nearly 1 100 mm (WRC, 2009). The MAE ranges across the catchment area, with approximately 1 200 mm in the headwater area and 1 150 mm near the coast (WRC, 2009). The inland portion of the catchment is relatively well developed with the three Quaternary Catchments closest to the coastline (T40E – T40G) having a markedly lower development level, as per **Table 7** (WRC, 2009). In addition, most of the Quaternary Catchments have a relatively high proportion of alien invasive vegetation (WRC, 2009). A summary of these values is presented in **Table 7** (WRC, 2009). The MAR (Naturalised) of the Mtamvuna River at its outlet is 437.6 MCM (WRC, 2009). It should be noted that, although not currently completed, there is a dam being constructed on the Ludeke River, namely the Ludeke Dam.

**Table 7 Hydrological Summary for the Mtamvuna River Catchment**

| | Catchment Area | Forestry | Alien Veg. | Irrigation | Farm dams | | S-pan evaporation | Rainfall | MAR |
|---|---|---|---|---|---|---|---|---|---|
| Quaternary | Gross | Area | Area | Area | Area | Volume | MAE WR2005 | MAP | |
| Catchment | ($km^2$) | ($km^2$) | ($km^2$) | ($km^2$) | ($km^2$) | (MCM) | (mm) | (mm) | (MCM) |
| | | | | | | | | | |
| T40A | 208 | 9.00 | 12.80 | 0.37 | | | 1200 | 995 | 57.13 |
| T40B | 278 | 123.60 | 79.70 | 0.55 | | | 1200 | 979 | 73.63 |
| T40C | 237 | 5.10 | 4.00 | 0.43 | | | 1200 | 829 | 43.06 |
| T40D | 372 | 9.60 | 11.10 | 0.80 | 0.50 | 0.19 | 1150 | 814 | 41.94 |
| T40E | 486 | 1.50 | 6.00 | 0.98 | 0.30 | 0.12 | 1150 | 823 | 59.45 |
| T40F | 335 | 2.80 | 7.60 | 0.00 | 0.41 | 0.21 | 1150 | 1070 | 87.46 |
| T40G | 300 | 0.00 | 12.40 | 0.00 | 1.50 | 0.83 | 1150 | 1055 | 74.96 |
| | | | | | | | | | |
| **Tertiary T40** | **2216** | **151.60** | **133.60** | **3.13** | **12.51** | **1.35** | **1166** | **927** | **437.63** |

**Table 8** presents the results of a PES analysis (DWAF, 2000), including a brief description, which shows that the Quaternary Catchments within the Mtamvuna River Catchment of the UDM have an ecological class of an **A** or a **B**. This means that the catchments are have relatively low to no anthropogenic impacts and are in a good ecological state.

There are extensive areas of NFEPA wetlands that need noting, which consist of, Channel Valley-Bottom, Depression, Flat and Seep wetlands, which are located in within the UDM sections of T40 (cf. **Figure 2**). In addition, the Mtamvuna River is a NFEPA river. These hydrological features are classed as such due to their good PES (i.e. equivalent to a Class **A** or **B** according to DWA).

**Table 8 Present Ecological State of the Mtamvuna River Quaternary Catchments (DWAF, 2000)**

| Name | Rivers | Description | Comments | PRESENT PESC |
|---|---|---|---|---|
| T40A | MTAMVUNA | Bed modification | SEDIMENTS FROM | CLASS A |
| T40A | MTAMVUNA | Flow modification | PINE PLANTATIONS | |
| T40A | MTAMVUNA | Introduced instream biota | RAINBOW TROUT | |
| T40A | MTAMVUNA | Inundation | | |
| T40A | MTAMVUNA | Riparian/bank condition | | |
| T40A | MTAMVUNA | Water quality modification | SOME EFFECTS FROM PLANTATIONS | |
| T40B | WEZA | Bed modification | SEDIMENTS FROM PLANTATIONS | CLASS B |
| T40B | WEZA | Flow modification | PINE PLANTATIONS | |
| T40B | WEZA | Introduced instream biota | RAINBOW TROUT | |
| T40B | WEZA | Inundation | | |
| T40B | WEZA | Riparian/bank condition | EXOTICS | |
| T40B | WEZA | Water quality modification | SOME EFFECTS FROM PLANTATIONS? | |
| T40C | LUDEKE | Bed modification | CATCHMENT SEDIMENTS | CLASS B |
| T40C | LUDEKE | Flow modification | | |
| T40C | LUDEKE | Introduced instream biota | RAINBOW TROUT | |
| T40C | LUDEKE | Inundation | | |
| T40C | LUDEKE | Riparian/bank condition | OVERGRAZING, EROSION | |
| T40C | LUDEKE | Water quality modification | | |
| T40D | MTAMVUNA | Bed modification | SEDIMENTS FROM CATCHMENT | CLASS B |
| T40D | MTAMVUNA | Flow modification | | |
| T40D | MTAMVUNA | Introduced instream biota | | |
| T40D | MTAMVUNA | Inundation | | |
| T40D | MTAMVUNA | Riparian/bank condition | OVERGRAZING | |
| T40D | MTAMVUNA | Water quality modification | | |
| T40E | MTAMVUNA | Bed modification | SEDIMENTS | CLASS A |
| T40E | MTAMVUNA | Flow modification | PUMP STATION | |
| T40E | MTAMVUNA | Introduced instream biota | | |
| T40E | MTAMVUNA | Inundation | | |
| T40E | MTAMVUNA | Riparian/bank condition | EXOTICS - CROMMALINA | |
| T40E | MTAMVUNA | Water quality modification | | |
| T40F | MBIZANA | Bed modification | ASSESSED | CLASS B |
| T40F | MBIZANA | Flow modification | IRRIGATION SUSPECTED | |
| T40F | MBIZANA | Introduced instream biota | MSAL , TREN | |
| T40F | MBIZANA | Inundation | WEIRS? | |
| T40F | MBIZANA | Riparian/bank condition | LANDS | |
| T40F | MBIZANA | Water quality modification | BANANA | |
| T40G | ZOTSHA? | Bed modification | SAND WINNING ALGAE AND SEWAGE FUNGI | CLASS B |
| T40G | ZOTSHA? | Flow modification | AGRIC USE | |
| T40G | ZOTSHA? | Introduced instream biota | GUPPIES, SWORDTAILS, MSAL, TREN | |
| T40G | ZOTSHA? | Inundation | | |
| T40G | ZOTSHA? | Riparian/bank condition | EROSION | |
| T40G | ZOTSHA? | Water quality modification | SETTLEMENTS, EUTROPHICATION | |

## 3.5 Other Significant Catchments

This sub-section provides a brief summary of the remaining significant catchments that are smaller than the four main catchments listed about. These smaller significant catchments include the following:

- Mbizana River – Quaternary T40F.
- Mzinto River – Quaternary U80H.
- Ufafa River – Quaternary U80G.
- Vungu River – Quaternary T40G.
- Mzumbe River – Quaternary U80B and U80C.
- Mtwalume River – Quaternary U80E and U80F.

- Mpambonyani River – Quaternary U80J and U80K.

A summary of the results for these catchments is presented in **Table 9**. Similar to the general trend of the coastal Quaternary Catchments in the major river catchments presented above, the MAP ranges between 800 mm – 1 050 mm (WRC, 2009) and the MAE ranges from 1 200 mm – 1 250 mm (WRC, 2009). The catchment areas and the corresponding MAR values vary depending on the location and contributing catchment area. There are also varying levels of development and inundation by alien invasive species as listed in **Table 9** (WRC, 2009).

**Table 9 Significant Smaller Catchment in the Ugu District Municipality** (WRC, 2009)

| | Catchment Area | Forestry | Alien Veg. | Irrigation | Farm dams | | S-pan evaporation | Rainfall | MAR |
|---|---|---|---|---|---|---|---|---|---|
| Quaternary | Gross | Area | Area | Area | Area | Volume | MAE WR2005 | MAP | |
| Catchment | ($km^2$) | ($km^2$) | ($km^2$) | ($km^2$) | ($km^2$) | (MCM) | (mm) | (mm) | (MCM) |
| | | | | | | | | | |
| U40F | 290 | 116.10 | 15.10 | 13.40 | 1.38 | 2.83 | 1250 | 841 | 29.05 |
| U40G | 253 | 0.00 | 2.50 | 0.00 | | | 1250 | 898 | 31.24 |
| U80C | 202 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 1200 | 962 | 30.28 |
| U80D | 120 | 0.00 | 4.41 | 3.00 | 0.75 | 0.27 | 1200 | 1048 | 23.08 |
| U80E | 415 | 79.60 | 3.70 | 5.00 | | 1.55 | 1200 | 831 | 39.05 |
| U80F | 137 | 1.60 | 1.60 | 2.00 | 0.03 | | 1200 | 935 | 18.73 |
| U80G | 261 | 43.80 | 2.80 | 2.00 | 0.02 | 0.08 | 1200 | 939 | 49.94 |
| U80H | 243 | 30.16 | 2.19 | 0.00 | 0.05 | 0.34 | 1200 | 1013 | 42.11 |
| U80J | 371 | 36.32 | 3.70 | 0.00 | 0.02 | 0.13 | 1200 | 840 | 36.17 |
| U80K | 184 | 0.78 | 1.74 | 0.00 | | 0.06 | 1200 | 950 | 26.54 |
| U80L | 107 | 0.00 | 1.48 | 0.00 | | | 1200 | 983 | 16.79 |

Following a similar trend to the main catchments, the PES for each of the rivers is rated as class **A** or **B**, with the exception of the Mzinto River Catchment as it was classes as a **C** (cf. **Table 10**).

There are extensive areas of NFEPA wetlands that need noting, which consist of, Channel Valley-Bottom, Unchannelled Valley-Bottom, Floodplain, Depression, Flat and Seep wetlands, which are spread across the 11 Quaternary catchments (cf. **Figure 2**). In addition, these rivers are classed as NFEPA rivers.

## Table 10 Present Ecological State of the Other Significant Rivers Quaternary Catchments (DWAF, 2000)

| Name | Rivers | Description | Comments | PRESENT PESC |
|---|---|---|---|---|
| T40F | MBIZANA | Bed modification | ASSESSED | CLASS B |
| T40F | MBIZANA | Flow modification | IRRIGATION SUSPECTED | |
| T40F | MBIZANA | Introduced instream biota | MSAL , TREN | |
| T40F | MBIZANA | Inundation | WEIRS? | |
| T40F | MBIZANA | Riparian/bank condition | LANDS | |
| T40F | MBIZANA | Water quality modification | BANANA | |
| T40G | ZOTSHA? | Bed modification | SAND WINNING ALGAE AND SEWAGE FUNGI | CLASS B |
| T40G | ZOTSHA? | Flow modification | AGRIC USE | |
| T40G | ZOTSHA? | Introduced instream biota | GUPPIES, SWORDTAILS, MSAL, TREN | |
| T40G | ZOTSHA? | Inundation | | |
| T40G | ZOTSHA? | Riparian/bank condition | EROSION | |
| T40G | ZOTSHA? | Water quality modification | SETTLEMENTS, EUTROPHICATION | |
| U80B | Kw adeshula | Bed modification | | CLASS A |
| U80B | Kw adeshula | Flow modification | | |
| U80B | Kw adeshula | Introduced instream biota | | |
| U80B | Kw adeshula | Inundation | | |
| U80B | Kw adeshula | Riparian/bank condition | | |
| U80B | Kw adeshula | Water quality modification | | |
| U80C | kw adushula to sea | Bed modification | | CLASS A |
| U80C | kw adushula to sea | Flow modification | | |
| U80C | kw adushula to sea | Introduced instream biota | | |
| U80C | kw adushula to sea | Inundation | | |
| U80C | kw adushula to sea | Riparian/bank condition | | |
| U80C | kw adushula to sea | Water quality modification | | |
| U80E | Qaha confl | Bed modification | | CLASS A |
| U80E | Qaha confl | Flow modification | | |
| U80E | Qaha confl | Introduced instream biota | | |
| U80E | Qaha confl | Inundation | | |
| U80E | Qaha confl | Riparian/bank condition | | |
| U80E | Qaha confl | Water quality modification | | |
| U80F | confl to sea | Bed modification | | CLASS A |
| U80F | confl to sea | Flow modification | | |
| U80F | confl to sea | Introduced instream biota | | |
| U80F | confl to sea | Inundation | | |
| U80F | confl to sea | Riparian/bank condition | | |
| U80F | confl to sea | Water quality modification | | |
| U80G | FAFA | Bed modification | FARMING SEDIMENTS | CLASS B |
| U80G | FAFA | Flow modification | SUGAR CANE IRRIGATION, GUMS (SALIGNA) | |
| U80G | FAFA | Introduced instream biota | MSAL, TREN | |
| U80G | FAFA | Inundation | | |
| U80G | FAFA | Riparian/bank condition | SETTLEMENTS, AND LOCATIONS | |
| U80G | FAFA | Water quality modification | AGRIC RETURN FLOWS | |
| U80H | MKUMBANE | Bed modification | REGULATION RESULTED IN REED BEDS | CLASS C |
| U80H | MKUMBANE | Flow modification | SUGAR CANE IRRIGATION | |
| U80H | MKUMBANE | Introduced instream biota | MSAL, TREN | |
| U80H | MKUMBANE | Inundation | MZINTU DAM | |
| U80H | MKUMBANE | Riparian/bank condition | FARMING ACTIVITIES AND SALIGNA | |
| U80H | MKUMBANE | Water quality modification | | |
| U80J | source to Mquha | Bed modification | | CLASS A |
| U80J | source to Mquha | Flow modification | | |
| U80J | source to Mquha | Introduced instream biota | | |
| U80J | source to Mquha | Inundation | | |
| U80J | source to Mquha | Riparian/bank condition | | |
| U80J | source to Mquha | Water quality modification | Goats and laundry | |
| U80K | | Bed modification | | CLASS A |
| U80K | | Flow modification | | |
| U80K | | Introduced instream biota | | |
| U80K | | Inundation | | |
| U80K | | Riparian/bank condition | | |
| U80K | | Water quality modification | | |

# 4 UGU DISTRICT MUNICIPALITY – CATCHMENT RUNOFF POTENTIAL

The incremental catchment runoff potential is presented in **Figure 3**, highlighting areas with a high incremental volumetric runoff. These incremental runoff values were obtained from WR2005 (WRC, 2009). **Figure 3** indicates a trend of increasing runoff potential towards the southern section of the UDM.

U80F and U80L are depicted to have the lowest incremental mean annual catchment runoff potential (in Million Cubic Metres; MCM), being less than 20 MCM/annum. Quaternary Catchments T40B, T40F and F40G are shown to have the highest incremental catchment runoff potential, by volume, being between 60 and 90 MCM/annum, on average. At this desktop level of study, it is unclear as to how best to access the available water resources, should they be required. If the streamflow is variable, then storage structures may be required to get specific demands at the required assurance of supply. Conversely, if the flow volumes are sufficient and the streamflow is not variable, then run-of-river abstractions may become plausible.

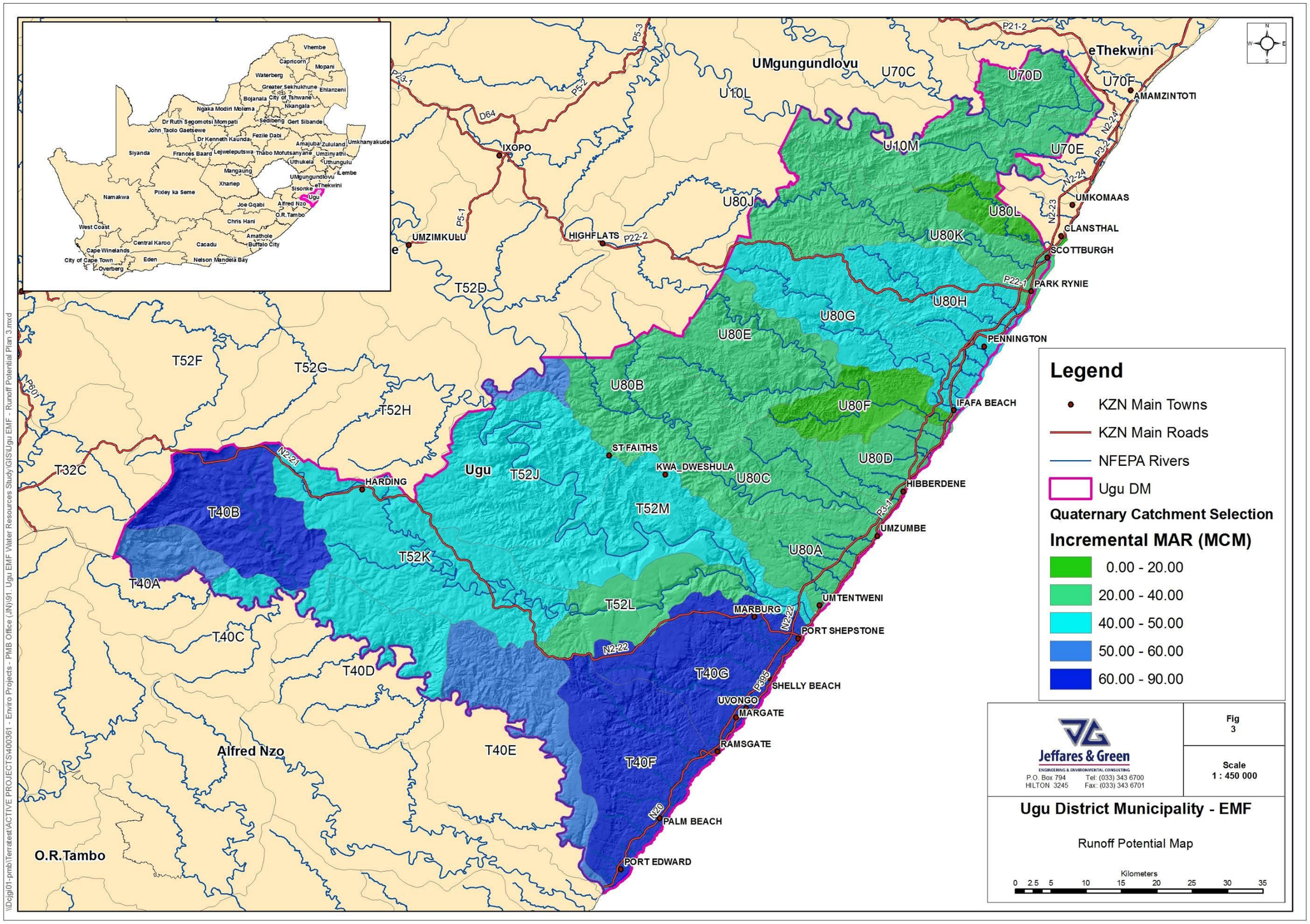


**Figure 3 Incremental Catchment Runoff Potential for the Catchment Areas within the Ugu District Municipality**

# 5 GROUNDWATER

The geohydrological map (cf. **Figure 4**) for the area identifies the materials underlying the Ugu District as highly variable. Rock types include diamictite (or tillite), arenaceous rocks (sandstone, feldspathic sandstone, arkose and sandstone becoming quartzitic in places) and meta-arenaceous rocks (quartzite, gneiss, migmatite and granulite). There are also some smaller areas of acid/intermediate/alkaline intrusive rocks (various granitoids) and undifferentiated coastal deposits (unconsolidated to semi-consolidated sediments including sand, calcarenite, conglomerate, clay and silcrete). Predominantly argillaceous rocks (shale, carbonaceous shale, mudstone and siltstone) and dolerite are present between Harding and Kokstad.

The geohydrological units underlying the Ugu District are classified as secondary aquifers (with the possible exception of the unconsolidated sediments, where they occur) with groundwater occurrence characterised either by aquifers with fractured flow or by aquifers with inter-granular and fractured flow. Median borehole yields are anticipated to be generally between 0.1 to 0.5 litres per second (l/s). Higher yields of between 0.5 to 2.0 l/s may be achieved in some areas. There are a limited number of areas within the Ugu District where low yields of 0.0 to 0.1 l/s may occur (e.g. north of Umkomaas).

Due to the variability of the geology, groundwater levels and aquifer parameters such as hydraulic conductivity and transmissivity will differ across the Ugu District, and will be locally dependent on aquifer type, geological structure and topography.

Groundwater quality is generally good with electrical conductivity (EC) between 0-70 mS/m. There are some areas where EC is higher (between 70-300 mS/m) south of the Umkomaas River and also near to Port Shepstone. However, groundwater quality will be heavily influenced by the depositional environment, proximity to the coast and industrial activities.

Due to the variation in elevation across the Ugu District, mean annual precipitation, and therefore potential groundwater recharge, is variable. Precipitation is anticipated to be between 600-800 mm/annum in inland areas, whereas in coastal areas it can be greater than 1,000 mm/annum.

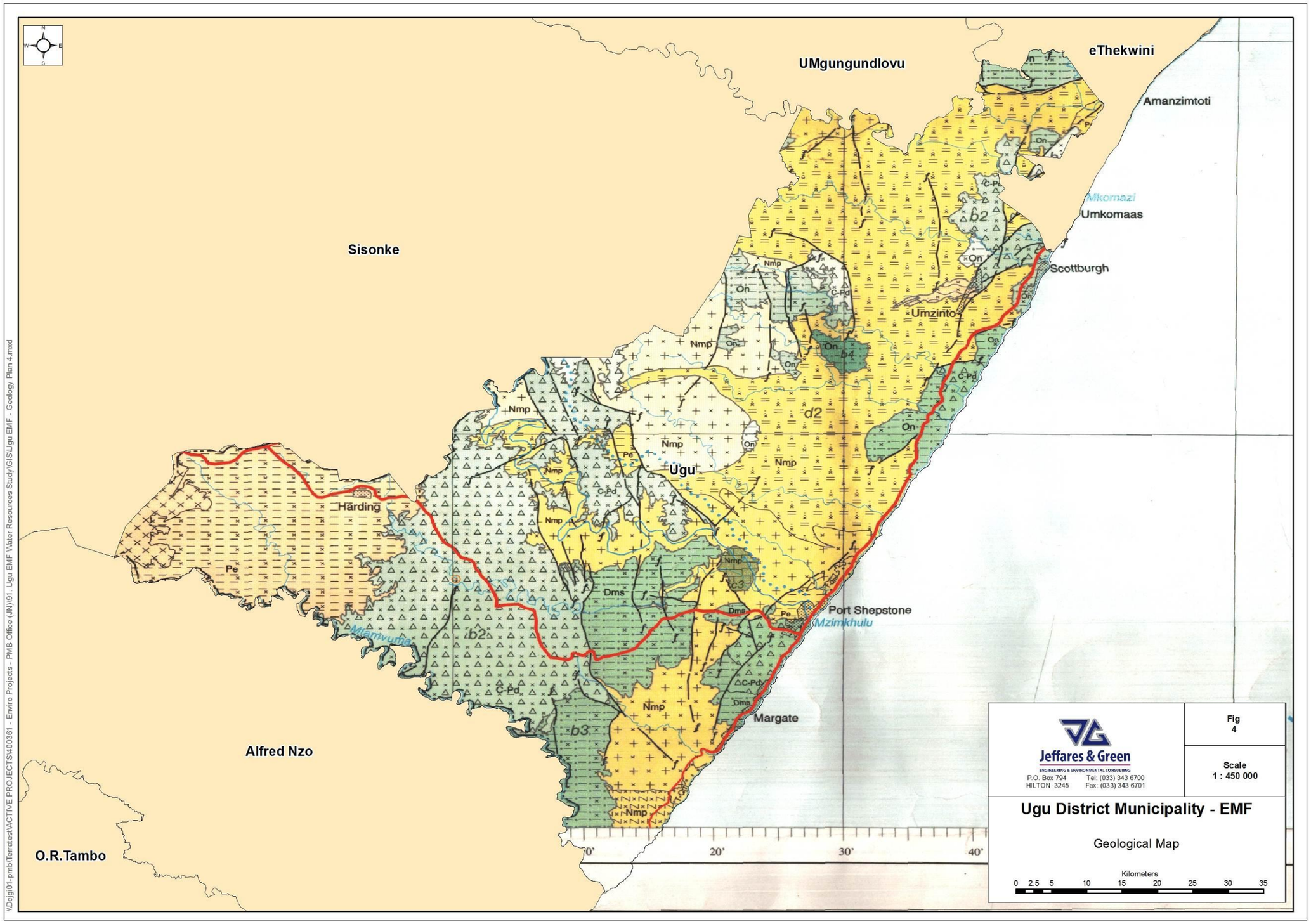


**Figure 4 Geological Map of the Ugu District Municipality, Indicating Underlying Geohydrological Conditions**

# 6 REFERENCES

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