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Co-operative Governance and Traditional Affairs
PROVINCE OF KWAZULU-NATAL

PROJECT: DEVELOP A UNIVERSAL ACCESS PLAN ACROSS FIVE DISTRICT MUNICIPALITIES IN KZN

FOCUS
A Division of the Crowie Property Group

[REPORT: DEVELOPMENT OF UNIVERSAL ACCESS PLAN FOR WATER SERVICES FOR ZULULAND DISTRICT MUNICIPALITY]

REPORT TITLE	Development of Universal Access Plan for Water Services in Zululand District Municipality		
CLIENT	Department of Cooperative Governance and Traditional Affairs		
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DESCRIPTION	**REVISION**	**DATE**
Zululand District Municipality Universal Access Plan	Final	02/10/2014

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GLOSSARY

COGTA	-	Department of Cooperative Governance and Traditional Affairs
DM	-	District Municipality
DRDLR	-	The Department of Rural Development and Land Reform
DWA	-	Department of Water Affairs
GIS	-	Geographical Information System
IDP	-	Integrated Development Plan
LM	-	Local Municipality
MIG	-	Municipal Infrastructure Grant
PIG	-	Provincial Infrastructure Grant
PMU	-	Project Management Unit
RWSS	-	Regional Water Supply Scheme
TA	-	Traditional Authorities
TOR	-	Terms of reference
UAP	-	Universal Access Plan
WARMS	-	Water Authorisation and Registration Management System
WSA	-	Water Services Authority
WSDP	-	Water Services Development Plan
WSP	-	Water Services Provider
WTW	-	Water Treatment Works
WWTW	-	Waste Water Treatment Works
WUA	-	Water User Association
ZDM	-	Zululand District Municipality

1. EXECUTIVE SUMMARY

The consortium consisting of Focus, Mott Macdonald PDNA,MHP GeoSpace and Sivuno Consulting were appointed to undertake the Universal Access Plan (UAP) for water in five of the District Municipalities in KwaZulu- Natal. The report was to focus on the following:

- Assessment of water planning status quo.
- Identify existing water supply schemes.
- Identify already proposed future water supply schemes (at a conceptual level).
- Existing and proposed water supply and demand options.
- An updated geo database.
- Preparation of a Universal Access Plan (UAP) which entails collection of infrastructure backlog, verification of existing data from the various municipalities and formulating a plan with relevant milestones and associated costs to achieve Universal Access.

The following documents were viewed for information regarding the water planning status quo and assessment of all existing supply schemes as well as proposed future supply options for each of the Local Municipalities and the District Municipality:

Documents	**Latest Report**
Zululand District Municipality Integrated Development Plan	2014
Edumbe Local Municipality Integrated Development Plan	2014
Uphongolo Local Municipality Integrated Development Plan	2014
Abaqulusi Local Municipality Integrated Development Plan	2014
Nongoma Local Municipality Integrated Development Plan	2014
Ulundi Local Municipality Integrated Development Plan	2014
Water Services Development Plan	2011
Development of Water Reconciliation Strategy for all towns in the Eastern Region for Zululand District Municipality	2011
Department of Water Affairs Priority Projects	2011

The methodology applied in the development of a Universal Access Plan for Water Services in Zululand District Municipality was as follows:-

- MM PDNA arranged meetings with the technical staff of the Zululand District Municipality in order to obtain GIS information and confirm the water backlog data, as well as confirm existing and proposed schemes in the Zululand District Municipality.

- MHP GeoSpace obtained Geographic Information System (GIS) spatial information from various sources, including the Zululand District Municipality and the Department of Water Affairs. All data has been stored in an ESRI ArcGIS 10.1 relational geodatabase, using a geographic co-ordinate system (decimal degrees). Metadata has been captured for all the data within the geodatabase. Domains or look-up tables have also been included to ensure consistency in data capture across all areas, and by all users.

- Draft water supply footprints were digitised off the latest colour aerial photography available from the Department of Rural Development and Land Reform. These were captured as polygons following settlement boundaries, and using existing water infrastructure where available. Settlement boundary datasets from the Department of Water Affairs and the Department of Rural Development and Land Reform, together with household points from Eskom (captured in 2011), were used as informants in this process. Outlying households were incorporated where possible but this was not always achievable in cases of isolated households that were located away from the more densely settled areas. In some cases these isolated households consisted of independent, privately owned farms which have their own local supply. These were excluded from the water supply footprint.

- A web mapping application was developed for the District, and served on the internet using ArcGIS Server, from the ESRI suite of GIS software products. This allowed users to view the data in their particular area, and where possible, to identify gaps in the data which could then be addressed by the project team. The engineering team had editing capabilities on this website and were able to identify and edit the attributes of any of the water supply footprints, to edit their shape if necessary, or to capture completely new water supply footprints in any area. Often these consisted of Independent farm houses with their own local supply, which were excluded from the water supply footprint.

- GIS analysis was used to calculate the high and low household numbers, as well as the high and low population counts, for each of the water supply footprints. Statistics SA were consulted on the best method in which to do this, and their census data was used to calculate the average growth rate per annum between 2001 and 2011. This data was applied to calculate the population in 2014 for each polygon. The same growth rate was applied to the number of households, which was calculated from the Eskom 2011 household point data. The table below indicates the growth rate for the Zululand District Municipality.

Census Year	**1996**	**2001**	**2011**	**% Growth from 1996 - 2001**	**% Growth from 2001 - 2011**	**% growth pa (1996 - 2001)**	**% growth pa (2001 - 2011)**
Zululand	691055	780069	803575	12.9	3.0	2.6	0.3

- The levels of service (LOS) points, supplied by the Department of Water Affairs, were mapped along with the water supply footprints. These were used to indicate which households were currently supplied with water services, and those which were not yet serviced and needed schemes to be implemented. The water backlogs in the Zululand District Municipality are presented in the table below.

Local Municipality	**Backlogs (Households)**
Edumbe	2061
Uphongolo	3528
Abaqulusi	6687
Nongoma	18995
Ulundi	13202
Zululand	44473

- The highest number of households for each water supply footprint (whether from 2011 or 2014) was used to calculate current, future and probable water demand requirements, measured in million m³ per annum.

- Map series at a scale of 1:20 000 were printed of the entire District Municipality, and these were given to MM PDNA so that conceptual water supply schemes could be designed. These designs were then returned to the GIS team, and captured into the geodatabase.

- Once the concept plans had been captured, they were checked for connectivity between adjacent municipalities. Attribute data, where available, was added to the geodatabase.

- Ownership information was added to each footprint polygon, using cadastral from the Surveyor-General and ownership data from the Deeds office. As the polygons did not follow cadastral boundaries, but rather the actual settlement points, the centroid of each footprint was used to determine the ownership of the property at that location. Ownership was divided into private, non-private (which included national, provincial and local municipal ownership) and land owned by the Ingonyama Trust Board.

- The Zululand District Municipality has ten regional schemes, which consist of further small stand-alone rural schemes.

  The next table gives a list of the regional water supply schemes in the Zululand District Municipality. These schemes, according to the Water Services Authority will be the source of supply to the proposed water supply footprints.

  Accordingly for example the Nkonjeni Regional Water Supply Scheme will supply 33 schemes proposed by the Water Service Authority.

Regional Water Supply Schemes (RWSS)	**Number of Proposed Water Supply Schemes**
Nkonjeni RWSS	33
Usuthu RWSS	39
Mandlakazi RWSS	31
Gumbi/Candover RWSS	2
Simdlangentsha East RWSS	20
Simdlangentsha Central RWSS	12
Simdlangentsha West RWSS	27
Coronation RWSS	2
Khambi RWSS	23
Hlahlindlela RWSS	23

Each water demand footprint was checked against existing water infrastructure data to determine whether there was, or was not, short term water supply in the area.

LOCAL MUNICIPALITY	NO OF WATER SUPPLY FOOTPRINTS	NO OF WATER SUPPLY FOOTPRINTS WITH SHORT TERM SUPPLY
Abaqulusi	335	126
Edumbe	133	50
Nongoma	385	278
Ulundi	422	259
Uphongolo	202	123
Zululand	1477	836

- MM PDNA undertook the conceptual design based on the water supply footprints provided by MHP GeoSpace. Where possible the concept designs were tied into the Zululand District Municipality's planned network to avoid any duplication of infrastructure and to reduce costs.

  The following assumptions were made in undertaking the conceptual designs for the un-serviced population:

  - Water consumptions were based in accordance to the table below:

Description of consumer category	Household Annual Income range	Per capita cons (l/c/d)		
		Min	Ave.	Max.
Very High Income; villas, large detached house, large luxury flats	>R1 228 000	320	410	500
Upper middle income: detached houses, large flats	153 601 – 1 228 000	240	295	350
Average Middle Income: 2 - 3 bedroom houses or flats with 1 or 2 WC, kitchen, and one bathroom, shower	38 401 – 153 600	180	228	275
Low middle Income: Small houses or flats with WC, one kitchen, one bathroom	9 601– 38 400	120	170	220
Low income: flatlets, bedsits with kitchen & bathroom, informal household	1- 9600	60	100	140
No income & informal supplies with yard connections		60	70	100
Informal with no formal connection		30	70	70
Informal below 25 l/c/d		0	70	70

- Each household has an average of 6 people
- Some of the existing boreholes are functional.
- The existing water reticulation schemes are operational.
- Some of the existing water reticulation schemes have spare capacity.
- Existing water treatment works have the potential to be upgraded or rehabilitated.
- Schemes have some form of power supply.
- General pipe size range is from 25 mm to 150 mm diameter.
- Peak factor - 1.5
- Water losses were considered to be 35%
- Where there is an existing bulk line, connections to the bulk were kept to a minimum
- Reticulation mains were placed in the road reserve for maintenance purposes.
- District and provincial road crossings were kept to a minimum

- In viewing the water supply footprints on the GIS mapping the following parameters were used by MM PDNA to determine the type of scheme applicable to the different water supply footprints. The following scheme types were considered in the conceptual designs:

  1. Tie into existing schemes
  2. Existing boreholes and standpipes that are non-functional to be rehabilitated.
  3. Existing boreholes with reticulation to be rehabilitated.
  4. Boreholes mechanically operated for settlements with a low population.
  5. Boreholes electronically operated for settlements with a high population.
  6. Package Plants for settlements which are densely populated.
  7. From existing scheme pumped to new reservoir and reticulated.

  Schematics and a detailed description of the various scheme types indicated above are indicated later in this document.

- The conceptual designs were quantified according to scheme types and the rates for various components of the water reticulation were provided by Umgeni Water and are stated in the document.

  The conceptual designs and cost estimates for each of the local municipalities as well as the district municipality and based on the various schemes are summarized in the following tables. The detailed costs for each scheme type are indicated in section 8.5 of this document.

Edumbe LM	
Scheme Type	**Total**
Link to existing scheme	R 170 181 504
Package Plants	R 107 057 651
Existing boreholes electronically operated	R 109 522 885
New boreholes electronically operated	R 106 224 113
TOTAL	**R 492 986 153**

Uphongolo LM	
Scheme Type	**Total**
Link to existing scheme	R 558 018 037
Existing boreholes electronically operated	R 21 228 981
Boreholes electronically operated with storage	R5 561 778
New boreholes mechanically operated	R 70 575 120
New boreholes electronically operated	R 77 425 000
TOTAL	**R 732 808 916**

Abaqulusi LM	
Scheme Type	**Total**
Link to existing scheme	R 689 283 553
Existing boreholes electronically operated	R 63 251 314
Existing boreholes electronically operated with storage	R 17 711 455
New boreholes mechanically operated	R 55 871 970
New boreholes electronically operated	R 29 031 594
New boreholes electronically operated with storage	R 8 449 846
TOTAL	**R963 599 732**

Nongoma LM	
Scheme Type	**Total**
Link to existing scheme	R 1 240 939 254
Existing boreholes electronically operated	R 184 211 522
Boreholes electronically operated with storage	R 39 421 532
New boreholes electronically operated	R 1 816 344
TOTAL	**R 1 466 388 651**

Ulundi LM	
Scheme Type	**Total**
Link to existing scheme	R 965 497 411
Existing boreholes electronically operated	R 32 729 836
Boreholes electronically operated with storage	R 73 648 431
New boreholes electronically operated	R 78 508 696
TOTAL	**R 1 150 384 374**

The following table is a summary of all the local municipalities in the Zululand District Municipality for the various scheme types, and illustrates the total estimated cost for the District Municipality.

Zululand DM	
Scheme Type	**Total**
Link to existing scheme	R 3 623 919 758
Package Plants	R 107 057 651
Existing boreholes electronically operated	R 410 944 538
Boreholes electronically operated with storage	R 136 343 195
New boreholes mechanically operated	R 126 447 090
New boreholes electronically operated	R 393 005 747
TOTAL	**R 4 797 717 979**

- The table below indicates the backlogs in the Zululand District Municipality and the cost per capita to eradicate the current backlog.

Local Municipality	Backlogs (Households)	Cost per capita
Edumbe	2061	R 77 923
Uphongolo	3528	R 23 289
Abaqulusi	6687	R 36 548
Nongoma	18995	R 10 094
Ulundi	13202	R 9 251
Zululand	44473	R 157 105

- The phasing of schemes is based on the proposed plans which cover all reticulation and bulk supplies to address the water backlogs. Potential funding such as Municipal Infrastructure Grant (MIG), Provincial Infrastructure Grant (PIG), Cooperative Governance and Traditional Affairs (COGTA), Department of Water Affairs and Forestry (DWAF) etc may be applied for to undertake these projects. The table below indicates the phasing.

  An average cost for each scheme type was compared with the cost estimate for an individual scheme. If the scheme was less than or equal to the average it was assumed that the project could be untaken over a year. If the cost ratio was higher than the average cost, the ratio was used to determine the duration of the project. However, this is flexible depending on the nature and type of project.

Implementation Year	LM	Total Cost
2015/16	eDumbe	R 263 230 967
	Uphongolo	R 506 563 737
	Abaqulusi	R 656 160 519
	Nongoma	R 816 980 579
	Ulundi	R 627 688 337
		R 2 870 624 139

Implementation Year	LM	Total Cost
2016/17	eDumbe	R 54 520 048
	Uphongolo	R 129 436 504
	Abaqulusi	R 45 040 700
	Nongoma	R 194 871 439
	Ulundi	R 193 448 726
		R 617 317 418

Implementation Year	LM	Total Cost
2017/18	eDumbe	R 175 235 139
	Uphongolo	R 38 096 821
	Abaqulusi	R 148 904 489
	Nongoma	R 99 278 443
	Ulundi	R 66 471 791
		R 527 986 683

Implementation Year	LM	Total Cost
2018/19	Uphongolo	R 58 711 854
	Abaqulusi	R 113 494 022
	Nongoma	R 355 258 190
	Ulundi	R 262 775 519
		R 790 239 585

- In the Zululand District Municipality, it is estimated that the existing water backlog of 44473 households can be eradicated by 2019 at a cost of R 4 797 717 979 to develop 589 schemes.

- All GIS data, including all current infrastructure, together with proposed schemes and the costs thereof have been incorporated into a structured geodatabase, with all relevant metadata. In some cases, metadata has also been captured for individual fields within particular datasets.

2. INTRODUCTION

2.1 Background of the study

In terms of the Department of Cooperative Governance and Traditional Affairs (COGTA) strategic priorities 2013/14 Programme 3 (Development Planning), the Department must prepare a UAP (Universal Access Plan) with a specific focus on water, sanitation and electricity as contained in the MEC's 2013/14 Vote 11 Budget Speech of the 30th of May 2013.

The intention of the UAP is to create service delivery liberated zones. A significant number of municipalities in KwaZulu-Natal are close to achieving universal access in key municipal infrastructure services such as water, sanitation and electricity.

Hence there is a need to formulate a plan to quantify remaining backlogs and the cost thereof.

As a result, the Municipal Infrastructure Development Business Unit of the KwaZulu - Natal Province Department of COGTA required the Focus Consortium to undertake the collection of infrastructure backlog data, verify data and compile a UAP document with relevant milestones and associated costs. The resources were selected in terms of the TOR (terms of reference) from all service providers from the PMU (Project Management Unit), provided that the requirements are met.

The consortium consisting of Focus, Mott Macdonald PDNA, MHP GeoSpace and Sivuno Consulting, and were appointed to undertake the UAP for water in five of the District Municipalities in KwaZulu-Natal. The report was to focus on the following:

- Assessment of water planning status quo.
- Identify existing water supply schemes.
- Identify already proposed future water supply schemes (at a conceptual level).
- Existing and proposed water supply and demand options.
- An updated geodatabase.
- Preparation of a UAP which entails collection of infrastructure backlog, verification of existing data from the various municipalities and formulating a plan with relevant milestones and associated costs to achieve a UAP.

2.2 Zululand District Municipality Overview

Zululand District Municipality (ZDM) is situated in the north-eastern part of KwaZulu-Natal. It is primarily a rural district. Swaziland and Mpumalanga are to the north of ZDM with Amajuba District Municipality (DM) to the west and Umkhanyakude DM to the east. Umzinyathi DM and Uthungulu DM lie to the south of ZDM.

The district comprises five local municipalities: Edumbe (KZ 261), Uphongolo (KZ 262), Abaqulusi (KZ 263), Nongoma (KZ 265) and Ulundi (KZ 266).ZDM has a total area of 14805 km^2 and has an approximate population of 803576 people according to the Eskom study undertaken in 2011.

Figure 1–ZDM Locality Map

2.2.1 Edumbe Local Municipality (KZ261)

Edumbe Local Municipality (LM) is situated in the north-western part of KwaZulu-Natal. It covers a geographical area of 1 947 km². It has a population of approximately 82053. Edumbe LM has Amajuba DM to the west with Mpumalanga to the north, Uphongolo LM to the east and Abaqulusi LM to the south.

The Edumbe municipal area comprises of 52 settlements in total, which includes 48 dispersed rural settlements, 3 urban areas and one major town. The Traditional Authorities (TA) within the LM includes: Dlamini TA and Mthetwa TA.

Figure 2–Edumbe Local Municipality

2.2.2 Uphongolo Local Municipality (KZ262)

The municipality is located in KwaZulu-Natal in the northern area of ZDM. The municipality consists of 14 wards and it has a geographical area of 3 239 km² with a population of 127238. The Uphongolo municipal area largely comprises of traditional areas with its tribal land patterns and high density rural settlements. The TA within the LM includes: Masidla TA, Msibi TA, Ntshangase TA and Simelane TA.

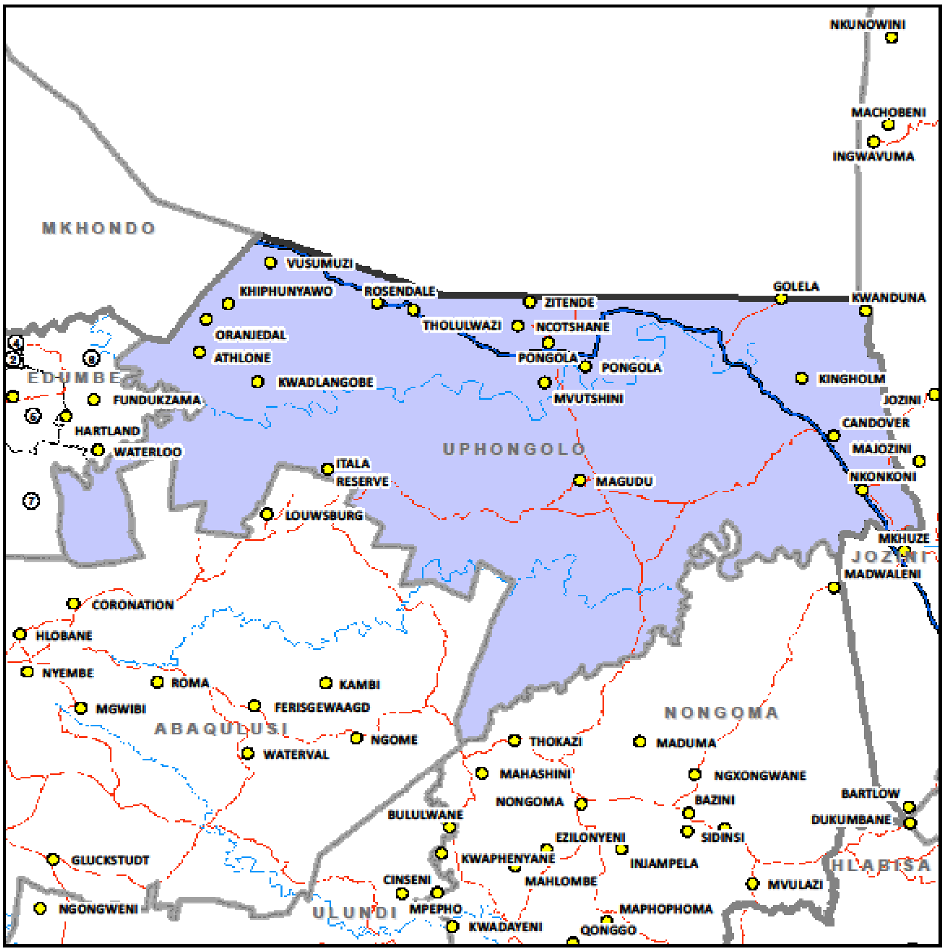


Figure 3–Uphongolo Local Municipality

2.2.3 Abaqulusi Local Municipality (KZ263)

Abaqulusi LM is located in the northern part of KwaZulu-Natal. It is approximately 4185km^2 and has a population of 211060. It is bordered by Amajuba DM to the west and Nongoma LM to the east. Edumbe LM and Uphongolo LM lie to the north and Ulundi LM to the south. Hlahlindhlela TA and Khambi TA fall within Abaqulusi LM.

Figure 4–Abaqulusi Local Municipality

2.2.4 Nongoma Local Municipality (KZ265)

The Nongoma Local Municipality covers an area of approximately 2 184 km^2 and has a population of 194908.

The area is made up of 21 wards and has 42 councilors. Nongoma LM has Abaqulusi LM to the west and UMkhanyakude DM to the east. Uphongolo LM and Ulundi LM lie to the north and south respectively. Nongoma is predominantly a rural municipality. It encompasses 363 settlements. It includes Mandhlakazi TA, Matheni TA and Usuthu TA.

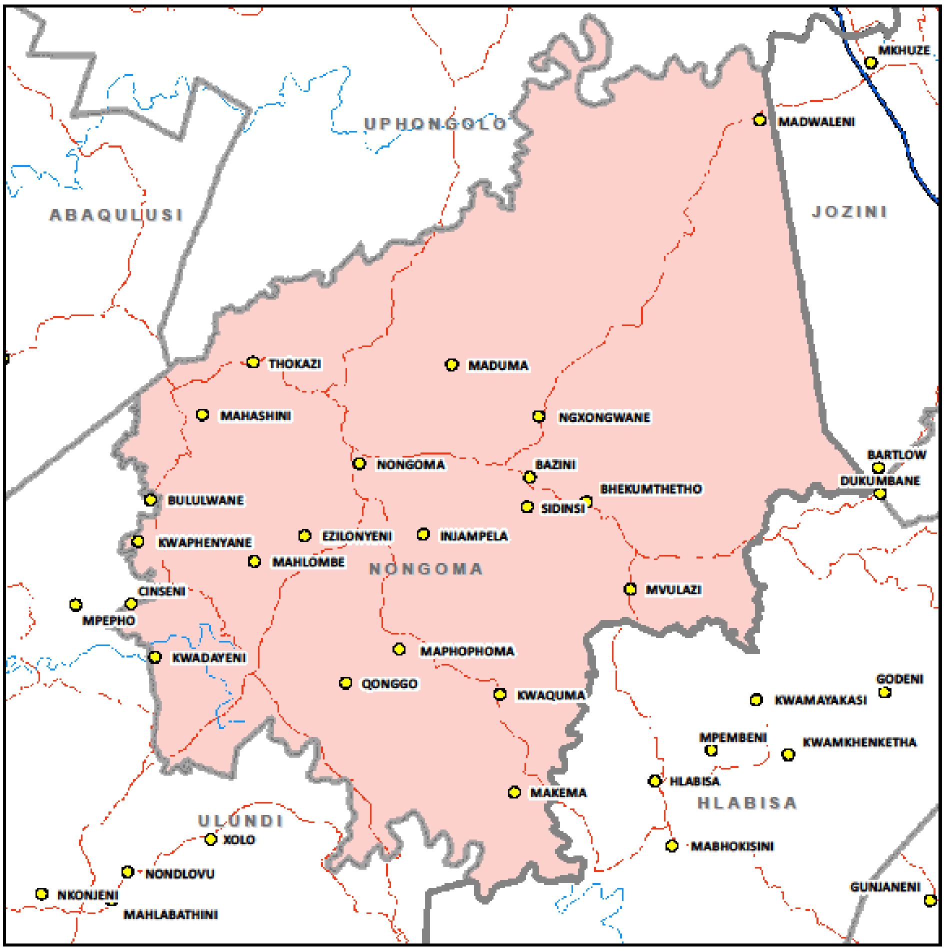


Figure 5 - Nongoma Municipality

2.2.5 Ulundi Local Municipality (KZ266)

The Ulundi LM is located on the southern boundary of the ZDM in north-eastern KwaZulu-Natal. The Ulundi municipal area is approximately 3,250 km^2 with a population of 188317. Abaqulusi LM and Nongoma LM are to the north of Ulundi LM with Umzinyathi DM and UMkhanyakude DM to the west and east respectively. Uthungulu DM lies to the south of Ulundi LM.

The TA's within the Ulundi LM includes: Empetempithini TA, Mbata TA, Mpungose TA, Ndebele TA, Nobamba TA, Ximba TA and Zungu TA.

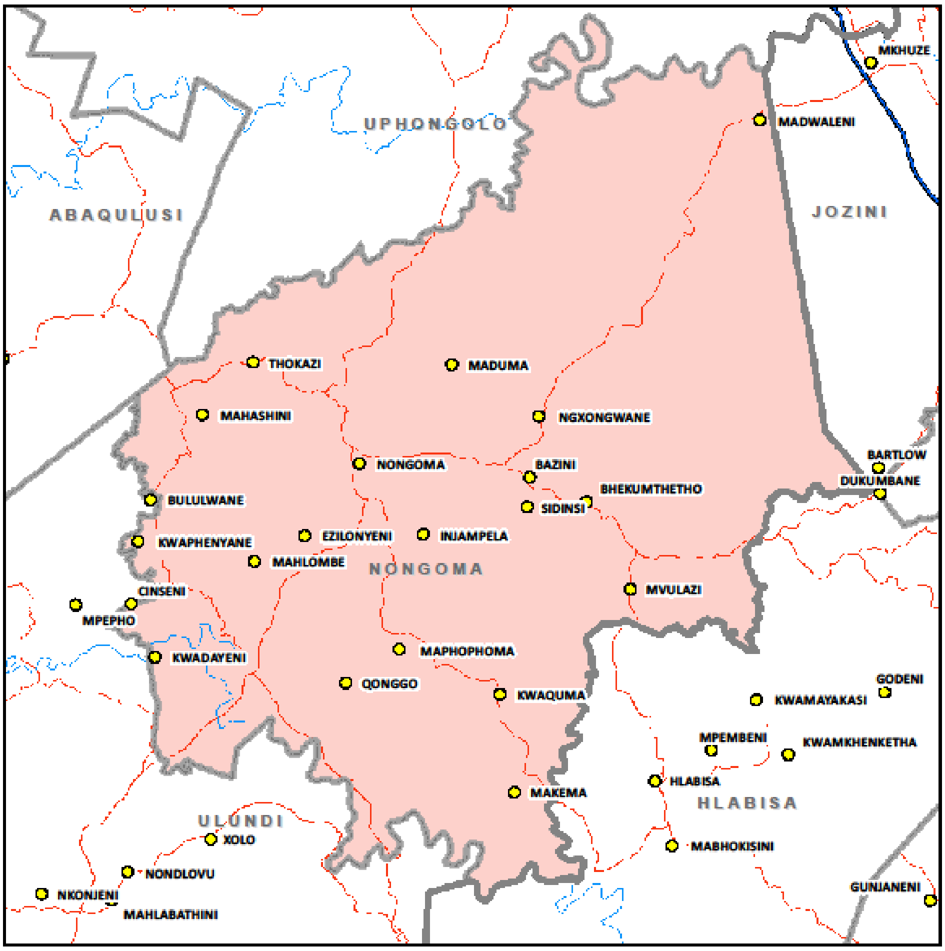


Figure 6 - Ulundi Local Municipality

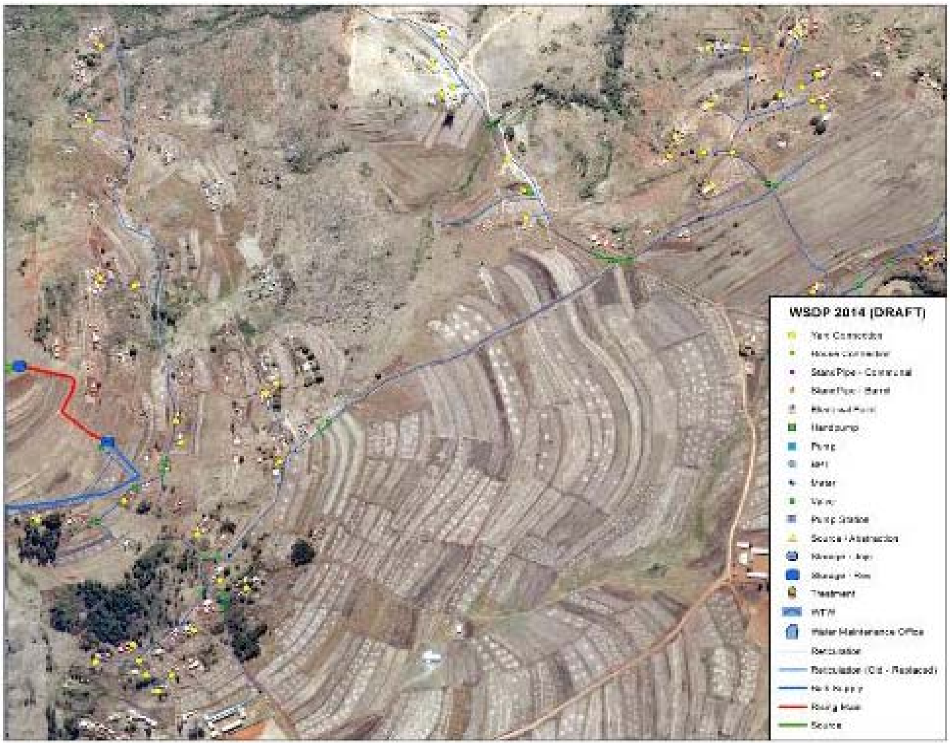
3. ASSESMENT OF WATER PLANNING STATUS QUO

In order to assess the current water and sanitation situation in ZDM, data in the form of Geographic Information System (GIS) spatial information was obtained from various sources, amongst them the Department of Water Affairs (DWA) and ZDM. Other documents are discussed in section 5 and section 7 of this report.

All spatial data has been stored in an ESRI ArcGIS 10.1 relational geodatabase. Due to the spatial location of the five District Municipalities in which work was undertaken and the requirement to provide, all data was stored in a geographic co-ordinate system i.e. decimal degree. Where necessary, source data has been projected to the required co-ordinate system. Metadata (information about the data – e.g. source, date, and capture method) has been captured within the geodatabase.

The geodatabase also includes base data such as boundaries, roads and place names, as well as household points from the Eskom study of 2011. Domains within the geodatabase behave as look-up tables, which allow the user to update the data using specific values. This ensured consistency in data capture across all team members and across all areas in terms of the manner in which data was captured, as well as the type of data captured.

Domains include the bulk water classification, type, and condition, together with the water scheme name and maintenance requirements. Domains were edited and updated to allow for changes in users and projects as well as additional data that the Project Steering Committee requested during the project period. Once all currently available data had been collated, the District Municipality was contacted to see if there was any additional data that could be obtained and added to the database. ZDM had just completed their draft 2014 Water Services Development Plan (WSDP), and this new data was also incorporated into the mapping and design of the proposed schemes.



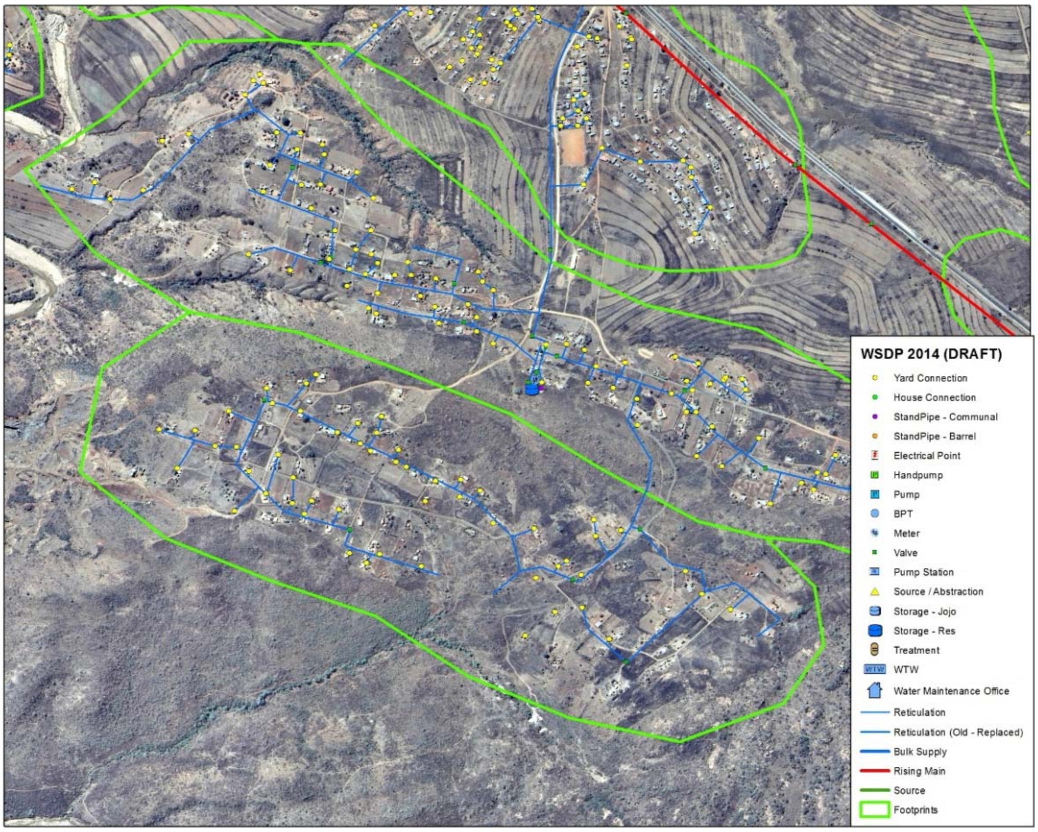
Map 1 - Example of draft WSDP data for Zululand District Municipality

4. DEVELOP CONTINUOUS SUPPLY FOOTPRINT AREAS

After consultation with Umgeni Water, water supply footprints in the District Municipality were captured as polygons tightly following the edge of settled areas. The data was captured on screen through heads-up digitising against the latest colour aerial photography (ranging from 2009 – 2011) available from the Department of Rural Development and Land Reform. The scale of capture was 1: 10 000, with 1: 5000 capture being utilised in dense areas.

Areas for capture were identified primarily using the Eskom 2011 household point data, together with additional settlement information (DWA settlements; Department of Rural Development and Land Reform settlements) and existing infrastructure data. These were overlaid onto aerial photography, and polygons were created around obvious settled areas. Outlying households were incorporated where possible but this was not always achievable, particularly in cases of isolated households that were located far away from the more densely settled areas.

These water supply footprints were captured over the whole district, including areas where there was existing infrastructure and/or supply.



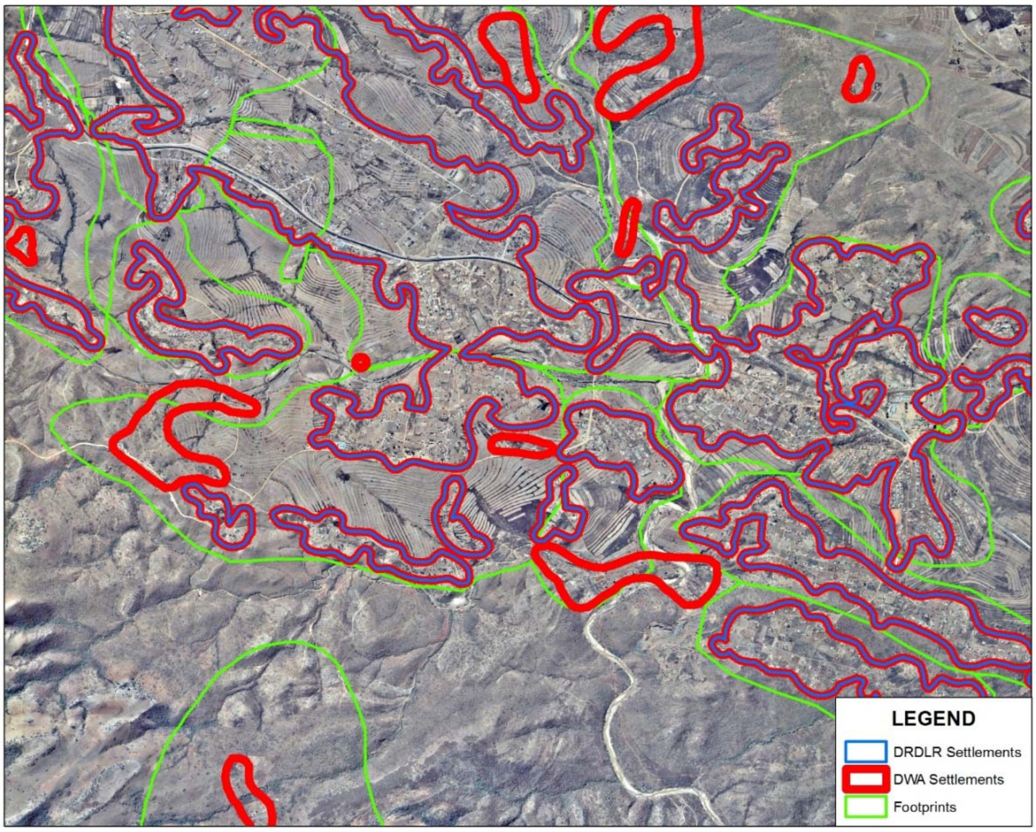
Map 2 – Water Supply Footprints with existing water reticulation

Map 3 – Water Supply Footprint were no existing water reticulation exists

Settlement areas were defined using the following datasets:

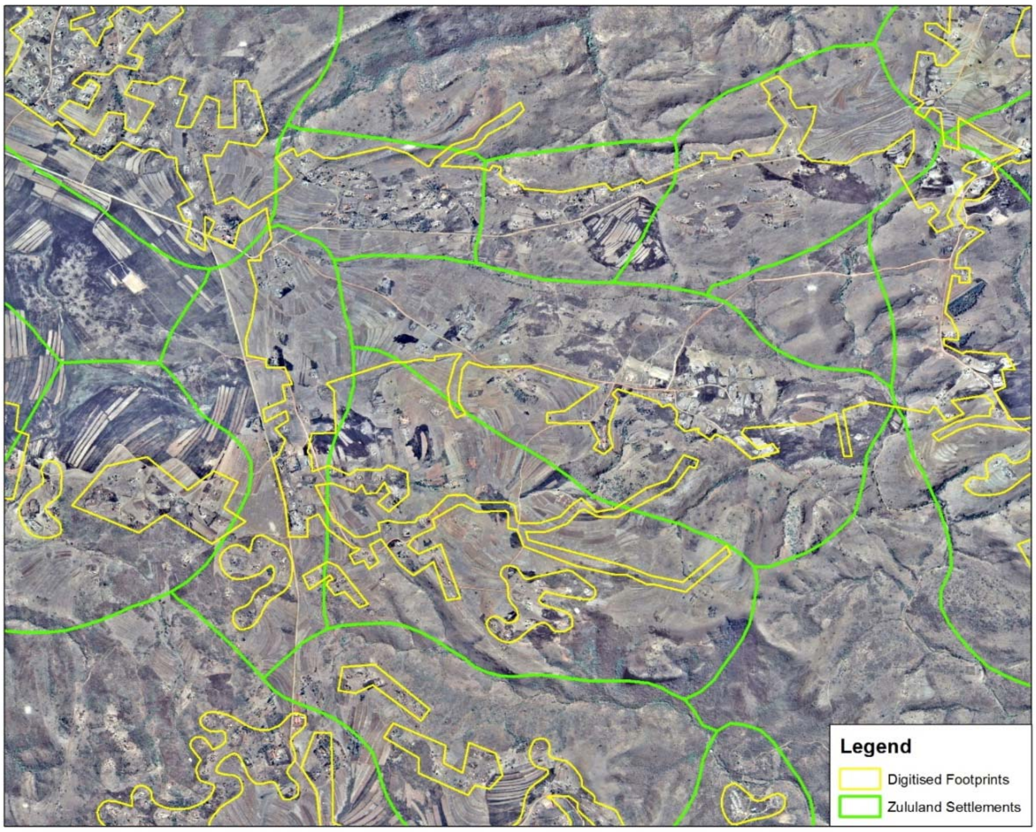
a. Existing services (pipelines etc.)
b. Eskom household points
c. DWA settlement boundaries
d. Department of Rural Development and Land Reform (DRDLR) settlement boundaries
e. Aerial photography – once the above data sources had been exhausted, the whole district was panned through and any additional settlements were picked up from the aerial photography.

An example of the differences between the settlement boundary datasets is illustrated in Map 4. There were areas where the boundaries between the datasets were co-incident (the blue lines lie over the red lines), as well as areas where the datasets differ.



Map 4 – Example of settlement boundary datasets

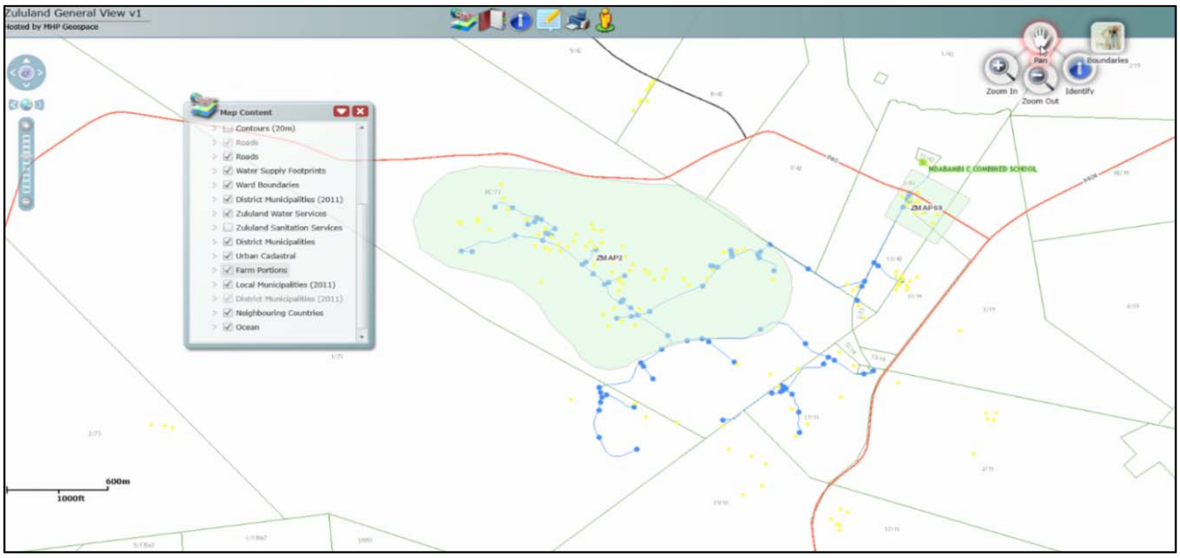
After meeting with officials from Zululand District Municipality, the project team was asked to use the Zululand settlement data as the base for the study. The municipality had information on water and sanitation levels of service that were linked to each settlement, and which would be invaluable in this study. The project team decided to use the Zululand settlement polygons, and to later draw down the information contained in them to the water supply footprints areas as captured off the aerial photography. These are illustrated in Map 5.



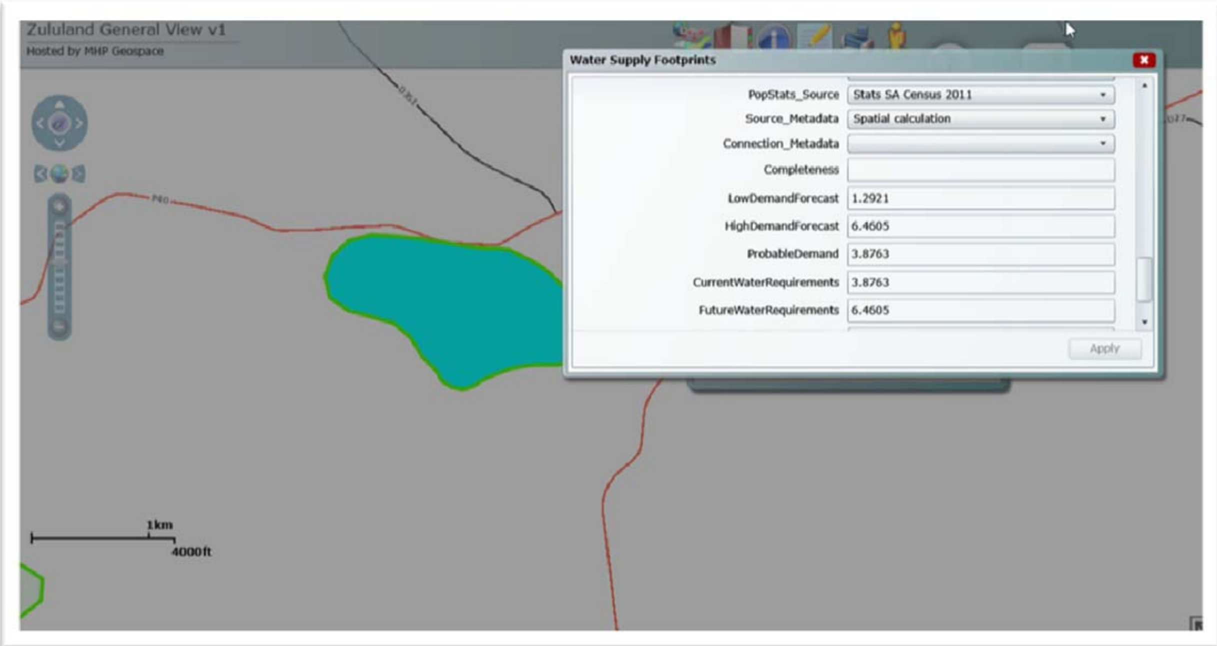
Map 5 – Digitised water supply footprints vs Zululand settlement boundaries

Database fields were added to the attribute listing as per the attributes stipulated by Umgeni Water. A detailed list and descriptions of these fields can be found in Annexure 1.

Due to the time constraints of this project and, in an effort to make as much data as possible available to the project team and to the District Municipality, a web mapping application was developed for the District and served on the internet using ArcGIS Server, (from the ESRI suite of GIS software products). This allowed users to view the data in their particular area, and where possible, to identify gaps in the data which could then be addressed by the project team.



Map 6 - Screenshot of the web mapping application



Map 7 - Screenshot of the editor capability on the web mapping application

The engineers from MM PDNA were given editing capabilities to the water supply footprints layer on the website. This allowed them to identify and edit the attributes of any of these areas, to edit their shape if necessary, or to capture completely new areas at any location. These online edits were written back to the base database, to be verified later in the office.

In conjunction with this data capture through the web application, visits to the District Municipality were undertaken to explain the steps of the project. A brief overview of the existing data was given, together with a short demonstration of the web mapping application, and an explanation of the reasoning behind this application, which is primarily that of onsite data capture by the municipal employees while working in particular areas.

4.1 Verification of existing information received from the ZDM

MM PDNA met with a representative from ZDM. The outcomes of this meeting are summarized below.

Date of meeting: 11/2/2014 – 12/2/2014

Officials:	Mandla Tengbeh	0829003204	mtengbeh@zululand.org.za
	Sphelele Ngcobo	0848726939	sngcobo@zululand.org.za

Comments:

The officials of the Zululand District Municipality viewed the GIS data that was generated by MHP GeoSpace and indicated that this data was correct.

In terms of the attribute tables the DM provided us with an Excel spreadsheet containing several of the fields that needed to be completed. This information was captured into the GIS database.

The officials from the District Municipality provided us with a layout plan which indicated the reticulation which is currently planned for the municipality. The drawing was utilised to determine the additional infrastructure that will be required over and above the municipality's proposed plans. Where data was not available the District Municipality referred us to their IDP and WSDP reports.

The confidence level for the information received is fair. The District Municipality indicated that the GIS information is the as-built record. No verification of their bulk water GIS and attributes were undertaken.

5. EXISTING WATER SUPPLY SCHEMES

5.1 ZDM Service Policy

The ZDM is designated as a Water Services Authority for its area of jurisdiction in terms of the Municipal Structures Act. The Water Services Authority (WSA) and Water Services Provider (WSP) for its region is the ZDM. The ZDM has adopted a Free Basic Water Services policy as part of their Water Service Development Plan (WSDP). Table 1 defines this policy further:

Service Level Number	Level of Service	Definition	Free Basic Water Policy
DW1	Full Pressure conventional house connection	Direct unrestricted full pressure (24m) connection to the reticulation system, metered and billed	Stepped block tariff (with first block at zero charge free to all households)
DW2	Yard Tank (RDP standard)	Restricted (to 200 l per household day) individual erf connection with tank in yard.	All water at no charge
DW3	Communal street taps (RDP standards)	Unrestricted full pressure standpipe not further than 200m from dwellings (shared by a number of consumers)	All water at no charge
DW4	Rudimentary	Formalised supply: Borehole equipped with hand pump Projected spring Communal standpipe further than 200m from dwellings	All water at no charge

Table 1 – Free Basic Water Policy

(Source: WSDP 2012/16)

The ZDM has adopted a Free Basic Sanitation policy as part of their Water Service Development Plan (WSDP). Table 2 defines this policy further:

Service Level Number	Level of Service	Definition	Free Basic Sanitation Policy
DS1	Water Borne Sewage	Unrestricted connection to municipal sewerage system	Included in free basic water allocation
DS2	Septic Tank or similar facility	On-site disposal (self-treatment)	No charge
DS3	Conservancy Tank	Localized sewage temporary storage facility	No charge to selected households in specific areas as determined by the municipality, aligned to free basic water policy for service level DW4.
DS4	Ventilated Improved Pit (VIP) Latrine	Dry pit with sufficient capacity on-site disposal based on set standards	No charge

Table 2 - Free Basic Sanitation Policy

(Source: WSDP 2012/16)

5.2 Water Resources

Table 3 outlines the summary of the number of households served by the various sources of water in the ZDM.

Source of Water	No of households	% of households
Regional/local water scheme	73 744	46.75
Borehole	17 734	11.24
Spring	5 364	3.40
Rain water tank	2 132	1.35
Dam/pool/stagnant water	9 874	6.26
River/stream	34 462	21.85
Water vendor	2 340	1.48
Water tanker	7 467	4.73
Other	4 630	2.94
Total	**157 748**	**100.00**

Table 3 - Source of water

(Source: IDP 2014)

5.2.1 Rivers

The District is endowed with natural water resources, notably:

- Pongola River
- Gologodo River, a tributary of the Mhlatuze River
  The natural Mean Annual Run-off (MAR) of the Gologodo River at the confluence with the Mhlatuze River has been estimated based on the catchment area to be 2.86 million m^3/a (WR90,1994), while the MAR at the outlet of the quaternary catchment W12A is 56.03 million m^3/a.
- Mozana River
  The storage capacity of the weir in the Mozana River is not known to be able to determine its net yield. From WR90 (1994) the natural MAR of quaternary catchment W42K & L where the weir and the small dam are located, is 99.8 million m^3/a.
- Sikwebezi River, Mfolozi River and Mona River
  The natural MAR of the Sikwebezi River at the confluence with the Black Mfolozi River is 84.33 million m^3/a (WR90,1994), while the upper catchments of the Black Mfolozi River (i.e. W22A,W22D) is 108.01 million m^3/a. The natural MAR of the Mona River at the outlet of quaternary catchment W22K is 35 million m^3/a.
- Mvunyana River
  The Mean Annual Runoff (MAR) of the quaternary catchment W21D is 32.7 million m^3/a.

5.2.2 Existing Dams

The major water bodies in the district are:

- Gologodo Dam - The storage capacity of the dam is not known. However, if it is estimated that the live storage capacity of the dam is 100% of the MAR at the dam outlet, the net yield of the dam would be 0.7 million m^3/a. Based on the information from the ZDM, the capacity of the dam is much smaller than the estimated storage capacity because of the frequent intermittent water supplies provided to the scheme area.

- Mvunyana Dam - The storage capacity of Mvunyana Dam is not known to be able to determine the net yield of the dam.

- Pongolapoort Dam and Bivane Dam both have a very high quality of water which is monitored through the National Water Resource Strategy (NWRS). There are 3 main catchments:

  1. Pongola catchment – the water resources in this catchment are fully developed through the Pongolapoort Dam.
  2. Mkhuze catchment – the water resources are mostly undeveloped, with only a number of farm dams for irrigation purposes. The major water users in these catchments are irrigation and commercial forestry.

3. Umfolozi catchment – There is a deficit in the lower White Mfolozi during the winter months and the Black Mfolozi catchments consist mostly of Traditional Authority land, with the main activity being cattle farming.

- Klipfontein Dam - The storage capacity of Klipfontein Dam is provided as 15.2 million m^3/a (Department of Water Affairs, 2010). The natural MAR of the quaternary catchments downstream of Klipfontein Dam (W21B to W21J) is 293.7 million m^3 (WR90, 1994), while the catchment of Klipfontein Dam (i.e. W21A) is 49.2 million m^3/a. Therefore the storage capacity of the Klipfontein Dam is very small compared with the MAR. Although there is a yield reduction due to commercial forestry upstream of the dam of 3.1 million m^3/a, there is significant potential of increasing the yield of Klipfontein Dam by raising the dam wall.

5.3 Existing Water Supply Schemes

In undertaking the design of new and additional reticulation for the various local municipalities the available capacities of the various treatment plants were required. With the growth in population there was a need to determine when interventions were required i.e. extension of existing water treatment works or construction of new plant to serve the new/additional demands.

The information indicated in the Department of Water Affairs Reconciliation Strategies undertaken in 2011, covers the identification of the different catchments in the water management areas that were experiencing water supply deficits and a reconciliation strategy was developed particularly for the major economic areas, as well as the growing non-agricultural sectors.

Another objective of the study was to develop a water reconciliation strategy to enable effective and efficient use of the water supplies, while determining optimal and sustainable ways to source additional water supply for selected towns.

The information indicated in the Zululand District Municipality Assessments undertaken in 2009 covers various types of components that comprises of the Water Treatment Works as well as the extensions and modifications that are in hand for the plant both the present state as well as the proposed modifications.

Hence this report has extracts and has made reference to both these documents.

According to reports outlining the reconciliation strategies for the various water schemes in the ZDM, the availability of water resources is outlined below.

5.3.1.1 Babanango Water Supply Scheme (Ulundi LM)

(Source: First Stage Reconciliation Strategy for Babanango Water Supply Scheme Area -Ulundi Local Municipality, 2011)

The main source of water supply for the Babanango Water Supply Scheme area is the Gologodo River. The scheme is also dependent on groundwater to supply potable water to the supplement the current surface water supplies. The overall scheme plan is indicated in Figure 7.

According to the reconciliation strategy plans there is no registered water use for domestic water in the Babanango Water Supply Scheme area.

The scheme is supplied by abstraction from a small dam in the Gologodo River. Based on the information from the ZDM the capacity of the dam is much smaller than the estimated storage capacity because of the frequent intermittent water supplies provided to the scheme area. The reliability of supply will progressively get worse as intermittent supplies increase, as the capacity of the dam is not sufficient to meet the water requirements. Therefore sufficient storage capacity will be required to meet the current and growing water requirements. The quality of the water resources of the Gologodo River is not known. However because of land use activities the quality of the raw water, particularly turbidity, is likely to be deteriorating.

The geology and the topography of the area are such that there is some potential for groundwater development. Currently there is supplementary groundwater use which has not been registered for the Babanango Water Supply Scheme. There are no reported water quality problems associated with the groundwater.

The Babanango Water Supply Scheme is supplied from the Babanango Water Treatment Works(WTW) which supplies the town, as well as the surrounding communities. The source of raw water supply for the treatment works is a small dam in the Gologodo River.

Water Treatment Works

The Babanango WTW is the main source of treated or potable water supply to the area, although groundwater is supplied to the outlying rural communities. The peak hydraulic design capacity of the Babanango WTW is estimated to be 0.33 ML/d. The average annual flow rate of the treatment works is estimated to be 0.25 ML/d.

Treatment Work Name	**Type of plant**	**Raw water source**	**Hydraulic design capacity (ML/d)**	**Average flow rate (ML/d)**	**Treated water production (ML/d)**	**Current utilisation (% of average design capacity)**
Babanago WTW	Conventional treatment	Gologodo River	0.33	0.25	0.41	162%

Table 4 - Water Treatment Works in operation in the Babanango Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Babanango Water Supply Scheme Area -Ulundi Local Municipality, 2011)

The 2008 average treated water production for Babanango and the surrounding areas is 0.42 ML/d (0.15 million m^3/a). The current raw water abstraction was estimated to be 0.48 ML/d (0.18 million m^3/a) assuming water losses from the raw water abstraction works, pumping main as well as the treatment water losses.

The Babanango WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels*: The raw water is supplied by pumping from a dam in the Gologodo River. Chemicals are added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Filtration*: The clarified water is then filtered through a set of rapid gravity filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoir in the Babanango Water Supply Scheme area for distribution.

The average annual flow rate of the water treatment works is not sufficient to meet the immediate future treated water requirements of the scheme. Currently the scheme is supplemented with groundwater in some of the communities which are not reticulated. It is not known whether there are any water quality problems in the Gologodo River catchment. However, due to the land use practices in the catchment, the small dam supplying the rural town may be silting up which would affect the storage requirements to meet the current and future raw water requirements particularly during the low flow periods.

Treated Water Bulk Supply Infrastructure

The treated water from the Babanango WTW is pumped from the clearwater tanks to the service reservoirs in the rural town from which the potable water is then distributed into the scheme area. The capacity of the treated bulk water supply is not sufficient to meet current water requirements of the area at the current operating practices of the scheme area.

Bulk Storage

The Babanango Water Supply Scheme area has a service reservoir storage capacity of 0.65 ML reinforced concrete (RC) reservoir (see Table 5). The service storage capacity provides for a 1.6-day or 38-hour storage based on the current treated water production, but in summer months this reduces to approximately a 25-hour or 1.1-day storage capacity, based on water requirements.

The reservoir storage capacity of Babanango is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- Balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- Provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- Provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the immediate future to meet the current and future summer peak requirements.

Parameters	Babanango Water Supply Scheme area
Total Storage capacity (ML)	0.65
Storage Ratio on present annual average consumption (Hours)	38
Storage Ratio on present average peak week consumption (Hours)	25

Table 5 - Water Treatment Works serving the Babanango Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Babanango Water Supply Scheme Area -Ulundi Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted:

List of emergency work

It is recommended that the following emergency work be carried out:

- Replace sand filter media

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir
- General maintenance and building repair work including painting etc.
- Installation of a similar packaged water treatment works to increase capacity to 1030 m^3/day.

List of long term improvements

No long term improvements are recommended. The shortfall on demand will be covered by Mpunghomhlophe WTW.

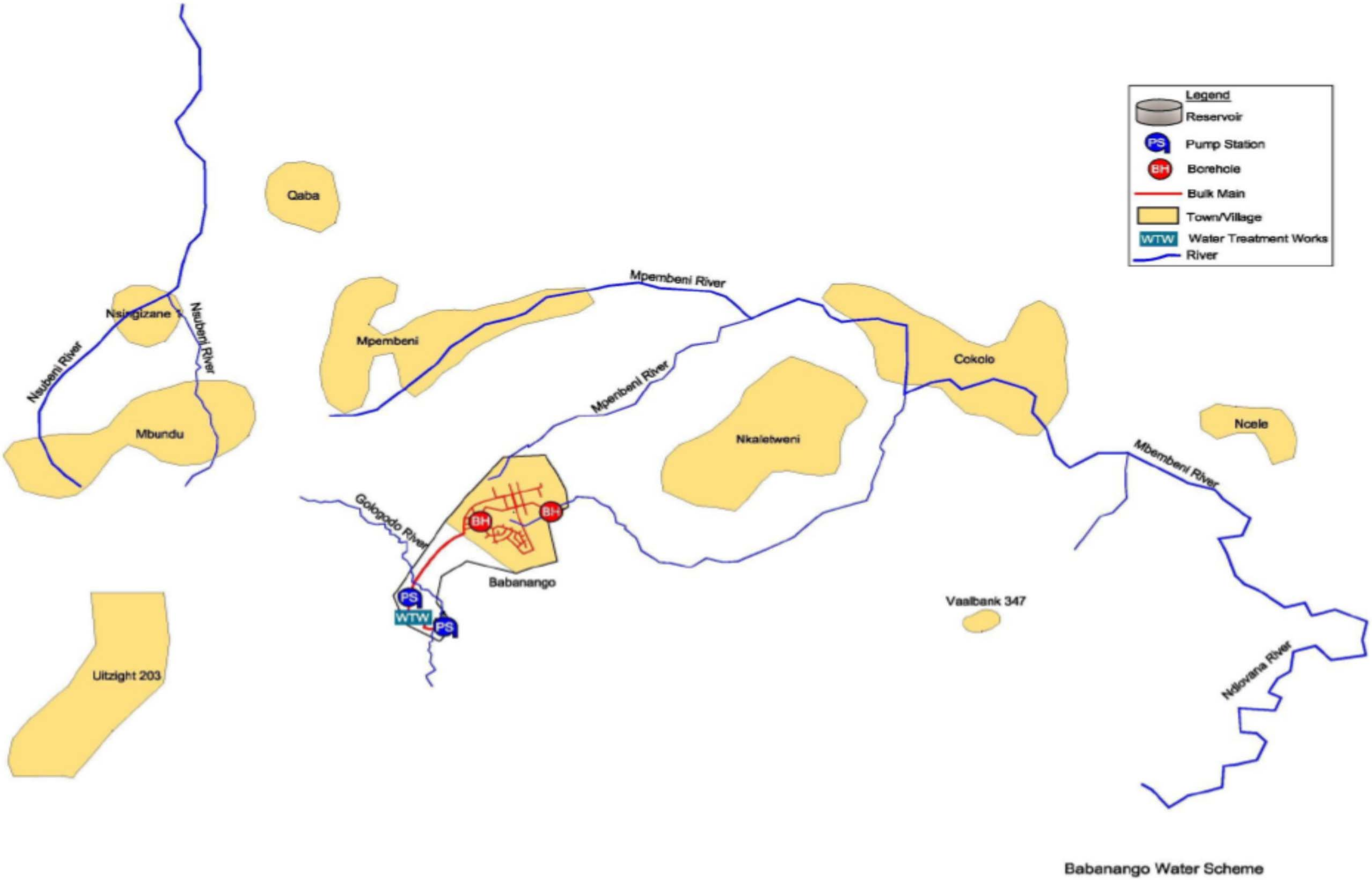


Figure 7 – Schematic layout of Babanango Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Babanango Water Supply Scheme Area -Ulundi Local Municipality, 2011)

5.3.1.2 Belgrade Water Supply Scheme (Uphongolo LM)

(Source: First Stage Reconciliation Strategy for Greater Simdlangentsha Central (Belgrade) Water Supply Scheme Area - Uphongolo Local Municipality, 2011)

The Simdlangentsha Central (Belgrade) Water Supply Scheme is supplied from two sources namely a weir in the Mozana River and a small dam in the tributary of Mozana River near the water treatment works. The schematic layout of the infrastructure to supply treated water from the Simdlangentsha Central (Belgrade) Water Supply Scheme area for residential and non-residential consumption in the Belgrade and surrounding communities, is shown in Figure 8.

The groundwater use is currently not registered and there are no yield estimates available for the boreholes supplying the area. Based on the current raw abstraction estimates, the registered water is sufficient to meet the current raw water requirements.

The available water supplies are also sufficient to meet the current water requirements and the registered water use. The quality of the resource upstream of the Mozana River is not known. However, because of land use activities, the quality of the raw water, particularly turbidity, is likely to be deteriorating. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is supplementary groundwater use which has not been registered for the Simdlangentsha Central (Belgrade) Water Supply Scheme.

There are no reported water quality problems associated with the groundwater.

The Simdlangentsha Central (Belgrade) Water Supply Scheme is supplied by the Belgrade WTW as well as some groundwater. The weir situated in the Mozana River to the west of Belgrade was built to supply domestic water to the township and the surrounding communities.

Water Treatment Works

The Belgrade WTW supplies treated water to the area. The total peak hydraulic design capacity of the Belgrade WTW is estimated to be 1.5 ML/d. The average annual flow rate of the plant is estimated to be 1.2 ML/d.

Treatment Work Name	Type of plant	Raw water source	Hydraulic design capacity (ML/d)	Average Flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of average flow rate)
Belgrade WTW	Pressure filtration	Tributary & Mozana River	1.5	1.2	1.22	106%

Table 6 - Water Treatment Works serving Simdlangentsha Central (Belgrade) Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Greater Simdlangentsha Central (Belgrade) Water Supply Scheme Area - Uphongolo Local Municipality, 2011)

The 2008 average treated water production for Belgrade and the surrounding areas is estimated at 1.22 ML/d (0.45 million m^3/a). The current raw water abstraction from the Mozana River was estimated to be 1.36 ML/d (0.5 million m^3/a) assuming water losses from the raw water abstraction works pumping main as well as the water treatment losses.

The Belgrade WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels*: The raw water is supplied by pumping from the Mozana River and the dam in the tributary. Chemicals are added as the water flows into flocculation channels, where coagulation after polyelectrolyte dosing takes place to form the flocs

(ii) *Clarification (sedimentation) tanks:* The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Pressure Filtration:* The clarified water is then filtered through a set of pressure filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoir in the Simdlangentsha Central (Belgrade) Water Supply Scheme area for distribution.

The average annual flow rate of the water treatment works is insufficient to meet the treated water requirements of the scheme in the immediate future. Currently the scheme is supplemented with groundwater in some of the unreticulated communities. It is not known whether there are any water quality problems in the Mozana River catchment. However due to the land use practices in the Mozana River catchment, the weir may be silting up which would adversely affect the storage requirements to meet the current and future raw water requirements.

Treated Water Bulk Supply Infrastructure

The treated water from the Belgrade WTW is pumped from the clearwater tanks to the service reservoir east of Belgrade where water is then distributed to the town and the surrounding communities.The capacity of the treated water bulk supply is not sufficient to meet current water requirements of the area at the current operating rules of the town. The bulk water is then distributed to the various supply areas in the Belgrade and the surrounding areas of Highlands B and Manyandeni.

Bulk Storage

The Simdlangentsha Central (Belgrade) Water Supply Scheme area has a total service reservoir storage capacity of 6.4 ML. The service storage capacity provides for a 5.2-day or 126-hour storage based on the current treated water production, but in summer months this reduces to approximately 3.5-day or an 84-hour storage capacity, based on present water requirements (see Table 7).

The reservoir storage capacity of Simdlangentsha Central (Belgrade) is therefore significantly more than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore not required immediately to meet the current and future summer peak requirements.

Parameters	**Simdlangetsha Central (Belgrade)Water Supply Scheme area**
Total Storage capacity (ML)	2
Storage Ratio on present annual average consumption (Hours)	126
Storage Ratio on present average peak week consumption (Hours)	84

Table 7 - Service Storage Reservoir in Simdlangetsha Central (Belgrade) Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Greater Simdlangentsha Central (Belgrade) Water Supply Scheme Area - Uphongolo Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted:

Emergency repairs
It is recommended that the following emergency work be carried out for the protection of equipment and occupational safety of operating staff:

- The sand filters are leaking and require repairs/replacement as these are pressure vessels and failure of the vessels poses an occupational safety threat.
- Standby dosing systems are required for dosing of polymer and hypochlorite solutions.
- The raw water inlet requires replacement.

List of short term improvements
It is recommended that the following work be carried out in the short term to improve the working conditions of the plant staff and increase the quality of the treated water:

- Install isolation valves for the outlet of the dam.
- Install a non-return valve in the main pump line to protect the pumps.
- Install a drain valve and 15m of drainage piping for cleaning of the water reservoir.
- Install a standby booster pump for the package plant.
- Clean and disinfect treated water reservoir.

Medium to long term improvements

It is recommended that the following work be carried out in the long term:

- Increase plant capacity by constructing a conventional water treatment works sized for 150 m^3/h to provide the required total capacity of 240 m^3/h to fulfil the future daily requirement of approximately 5.6 ML/day.

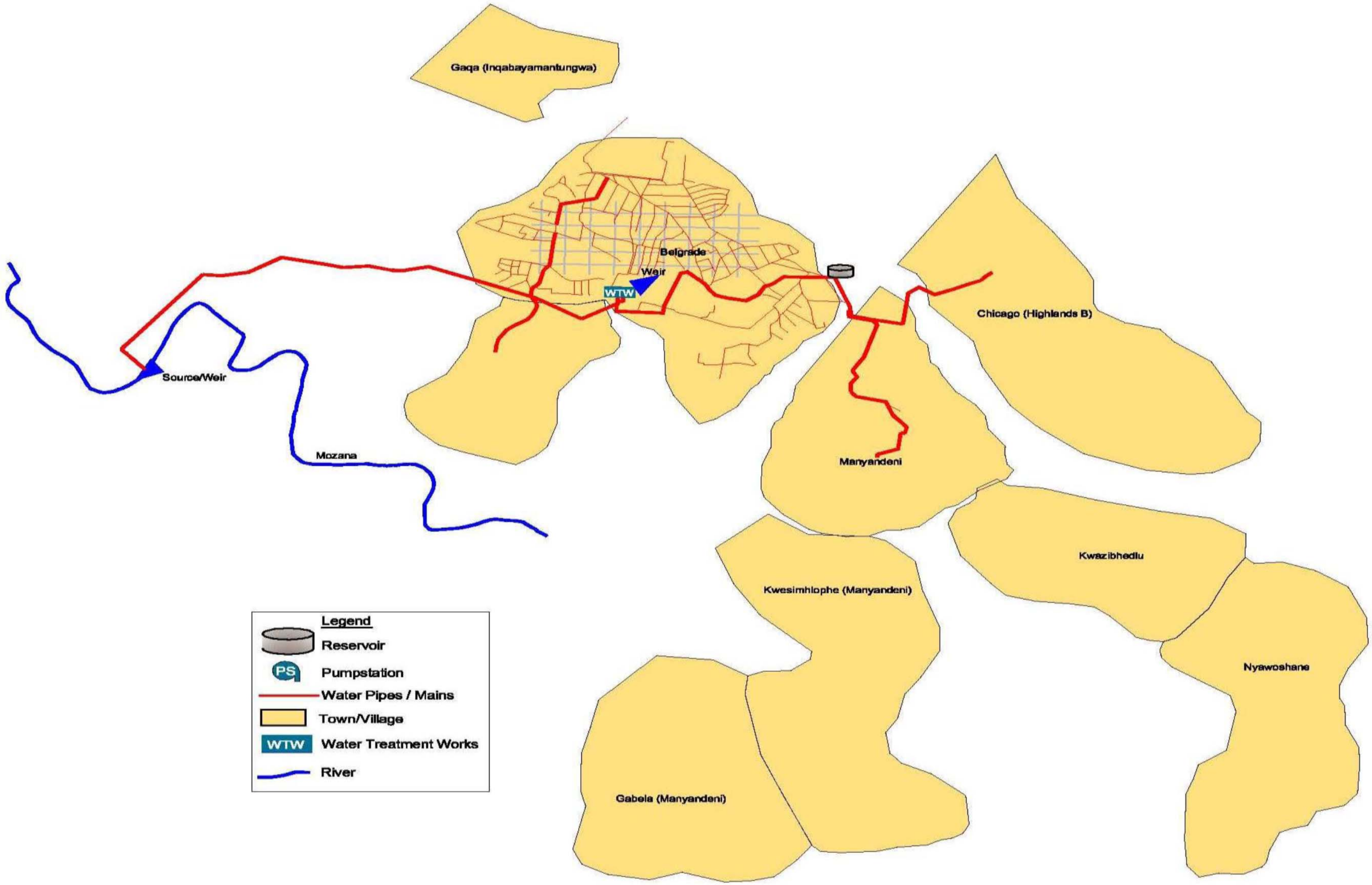


Figure 8 - Schematic layout of Simdlangentsha Central (Belgrade) Water Supply Scheme

Source: First Stage Reconciliation Strategy for Greater Simdlangentsha Central (Belgrade) Water Supply Scheme Area - Uphongolo Local Municipality, 2011)

5.3.1.3 Ceza Water Supply Scheme (Ulundi LM)

(Source: First Stage Reconciliation Strategy for Ceza Water Supply Scheme Area -Ulundi Local Municipality, 2011)

The Usuthu (Ceza) Regional Water Supply Scheme (see Figure 9) is supplied from the Ceza WTW, which primarily supplies the hospital, as well as boreholes supplying the communities. There is also a small water treatment works known as Thulasizwe WTW supplying an area to the north of the scheme as well as the communities as well as the hospital.

The main sources of water supply for the Usuthu (Ceza) Regional Water Supply Scheme area are the Vungu and Sikwebezi Rivers, both tributaries of the Black Mfolozi River. The scheme is also dependent on groundwater to supply potable water to the outerlying communities.

The required storage capacity will be need to meet the current and growing water requirements. The quality of the water resources of the Sikwebezi River is not known. However because of land use activities, the quality of the raw water, particularly turbidity, is likely to deteriorate.

The geology and the topography of the area are such that there is some potential for groundwater development. Currently there is supplementary groundwater use which has not been registered for the Usuthu (Ceza) Regional Water Supply Scheme.

There are no reported water quality problems associated with the groundwater.

Ceza WTW is supplied from the Vungu River, a tributary of the Black Mfolozi River, which is located to the south east of the water treatment works. Raw water supply for the Ceza WTW is pumped from the abstraction works at the Vungu River through a raw water pumping main to the Ceza WTW.

Water Treatment Works

The Ceza and Thulasizwe WTW are the main sources of treated or potable water supply to the area, although groundwater is supplied to the outerlying rural communities. The total peak hydraulic design capacity of the Ceza and Thulasizwe WTW is estimated to be 0.60 ML/d. The average annual flow rate of the treatment works is estimated to be 0.46 ML/d.

Treatment Work Name	Type of plant	Raw water source	Hydraulic design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Ceza WTW	Conventional treatment	Vungu River	0.40 (1)	0.31	1.50	488%
Thulasizwe WTW	Filtration	Sikwebezi River	0.20 (2)	0.15	0.79	533%
Total			**0.60**	**0.46**	**2.29**	**502.2%**

Table 8 - Water Treatment Works serving Usuthu (Ceza) Regional Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Ceza Water Supply Scheme Area -Ulundi Local Municipality, 2011)

The total raw water abstraction for treatment at the Ceza WTW in 2008 was estimated as 1.85 million m^3/a (5.06 ML/d) with the treated water production estimated to be 1.62 million m^3/a (4.45 ML/d). The losses therefore amount to 12% of the total raw water abstraction.

The Ceza WTW is conventional treatment plant comprising of the following process components:

(i) *Flocculation channels:* The raw water is supplied by pumping from the weir on the Vungu River. Chemicals are added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs;

(ii) *Clarification (sedimentation) tanks:* The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Filtration:* The clarified water is then filtered through a set of rapid gravity filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoir in the Usuthu (Ceza) Regional Water Supply Scheme area for distribution.

The average annual flow rate of the water treatment works is insufficient to meet the treated water requirements of the scheme in the immediate future.

It is not known whether there are any water quality problems in the Sikwebezi River catchment. However due to the land use practices in the catchment, the weirs may be silting up which would affect the storage requirements to meet the current and future raw water requirements particularly during the low flow periods.

Treated Water Bulk Supply Infrastructure

The treated water from the Ceza and Thulasizwe WTW is pumped from the clearwater tanks to the service reservoirs in the various villages from which the potable water is then distributed into the scheme area. The capacity of the treated bulk water supply is insufficient to meet current water requirements of the area at the current operating practices of the scheme area. The bulk water is then distributed to the various supply areas in the Ceza supply area.

Bulk Storage

The Usuthu (Ceza) Regional Water Supply Scheme area has a total service reservoir storage capacity of 7 ML ranging from 0.25 ML to 0.5 ML reinforced concrete reservoirs.
The service storage capacity provides for 1.6-day or 38-hour storage, based on the current treated water production, but in summer months this reduces to approximately a 1.1-day or 25-hour storage capacity, based on present water requirements (see Table 9).

The reservoir storage capacity of Usuthu (Ceza) is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the immediate future to meet the current and future summer peak requirements.

Parameters	**Usuthu (Ceza) Regional Water Supply area**
Total Storage capacity (ML)	7
Storage Ratio on present annual average consumption (Hours)	38
Storage Ratio on present average peak week consumption (Hours)	25

Table 9 - Service Storage Reservoirs in the Usuthu (Ceza) Regional Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Ceza Water Supply Scheme Area -Ulundi Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted for the Thulasizwe WTW:

List of emergency work
It is recommended that the following emergency work be carried out:
- Replace sand filter media
- Install an additional sodium hypochlorite dosing station

List of short term improvements
It is recommended that the following work be carried out in the short term:
- Clean and disinfect storage reservoir
- General maintenance and building repair work including painting etc.

List of medium to long term improvements
The current treatment capacity is sufficient in supplying potable water to the estimated 54 patients and 135 staff members at the Thulasizwe Clinic at a daily consumption rate of 700 l/day.

List of long term improvements
It is recommended that the following work be carried out in the long term:
- Refurbishment and replacement of old mechanical equipment.

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted for the Ceza WTW:

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Installation of a similar packaged water treatment works to increase capacity to 900 m^3/day.

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted for the Ceza WTW.

List of emergency work

It is recommended that the following emergency work be carried out:

- Replace sand filter media

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir
- General maintenance and building repair work including painting etc.
- Installation of a similar packaged water treatment works to increase capacity to 900 m^3/day.

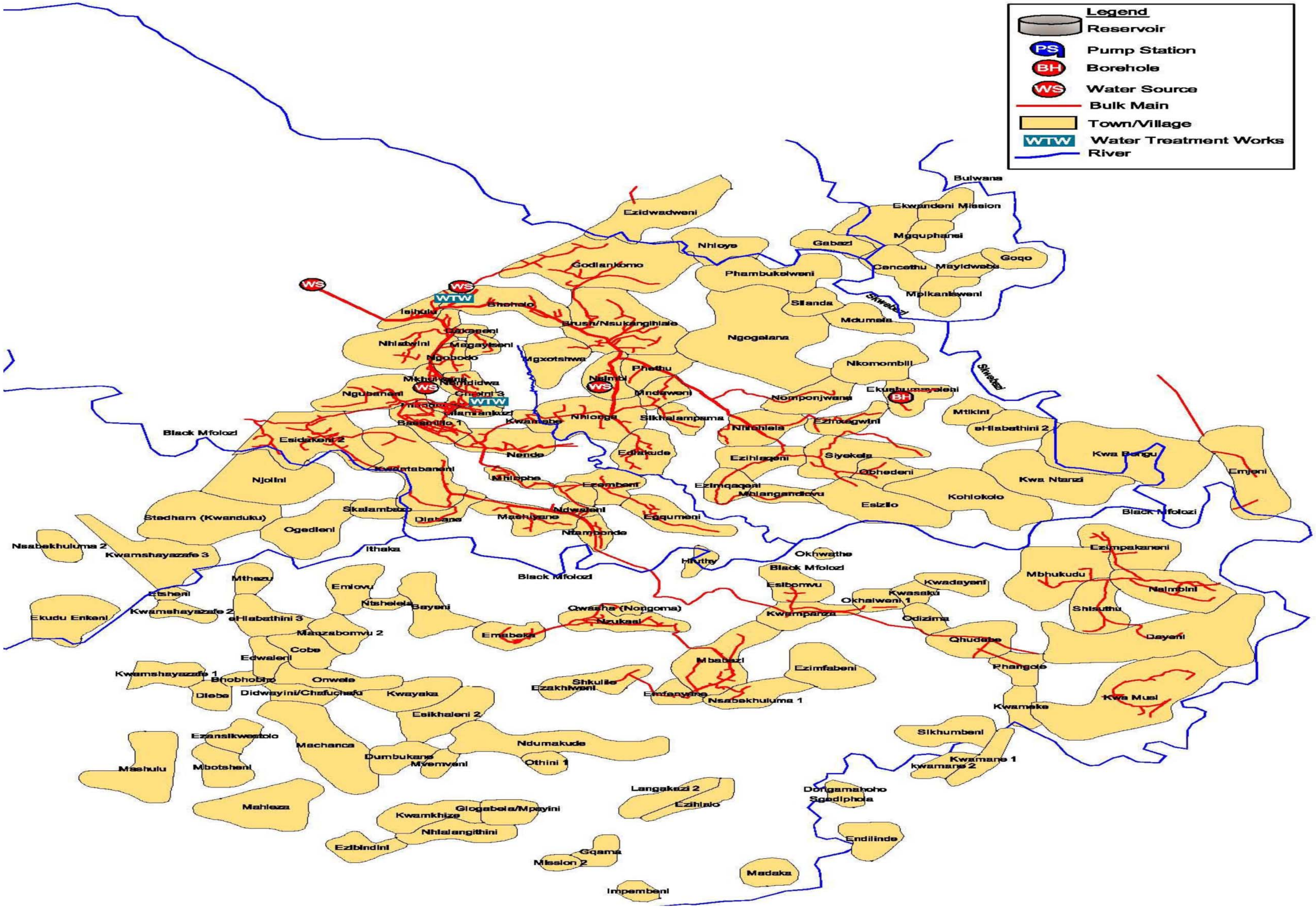


Figure 9 - Schematic layout of Usuthu (Ceza) Regional Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Ceza Water Supply Scheme Area -Ulundi Local Municipality, 2011)

5.3.1.4 Emondlo Water Supply Scheme (Abaqulusi LM)

(Source: First Stage Reconciliation Strategy for Greater Emondlo Water Supply Scheme Area - Abaqulusi Local Municipality, 2011)

The main source of water supply for the Emondlo (Hlahlindlela) Water Supply Scheme area(see Figure 10) is the Mvunyana Dam situated in the Mvunyane River, as well as direct abstraction from the Mvunyane River, with the boreholes supplementing the water treatment works in some of the surrounding areas. The groundwater use is currently not registered and there are no yield estimates available on the boreholes linked to the water supply system.

Based on the current raw abstraction estimates, the available water supplies are sufficient to meet the current raw water requirements. The quality of the resource upstream of the Mvunyana Dam is not of good quality because of the wastewater return flows from Emondlo as well as the land use activities.

The geology and the topography of the area are such that there is potential for significant groundwater development. Currently, there is supplementary groundwater use, which has not been registered for the Emondlo (Hlahlindlela) Water Supply Scheme. There are no reported water quality problems associated with the groundwater.

Raw water supply for the Emondlo WTW is pumped from the abstraction works at Mvunyana Dam through a raw water pumping main to the WTW. The maximum capacity of the raw water supply main from the Mvunyana Dam is however unknown.

Water Treatment Works

The Emondlo and Mvuzini WTW are the two water treatment works supplying treated water to the area including groundwater. The total peak hydraulic design capacity of the Emondlo and Mvuzini WTW is estimated to be 5.0 ML/d. The average annual flow rate of the two plants is estimated to be 3.7 ML/d.

Treatment Work Name	Type of plant	Raw water source	Hydraulic design capacity (ML/d)	Average Design capacity (ML/d)	Treated water production (ML/d)	Current utilisation (% of average flow rate)
Emondlo WTW	Conventional treatment	Mvunyane River	2.5	1.85	5.8	112%
Mvuzini WTW	Conventional treatment	Mvunyane River	2.5	1.85	2.22	150%
Total			5.00	3.70	8.02	120%

Table 10 - Water Treatment Works serving Emondlo (Hlahlindlela) Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Greater Emondlo Water Supply Scheme Area - Abaqulusi Local Municipality, 2011)

The total raw water abstraction for treatment at the Emondlo WTW in 2008 was estimated as 3.3 million m^3/a (9.0 ML/d) with the treated water production estimated to be 3.0 million m^3/a (8.1 ML/d). The losses therefore amount to 10% of the total raw water abstraction.

The Emondlo WTW and Mvuzini WTW are conventional treatment plants comprising of the following process components:

(i) *Flocculation channels:* The raw water is supplied by pumping from the Mvunyane River with chemicals added in as the water flows into flocculation channels, where coagulation, after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks:* The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried, while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid Gravity Sand Filtration:* The clarified water is then filtered through a set of slow sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in the Emondlo (Hlahlindlela) Water Supply Scheme area for distribution.

The average annual capacity of the water treatment works is insufficient to meet the immediate future treated water requirements of the scheme area. Currently the scheme is supplemented with groundwater in some of the communities, which are not reticulated as indicated in the table above. It is not known whether there are any water quality problems in the Mvunyana Dam or the Mvunyane River catchment. However, due to the high silt load in the Mvunyane River, the Mvunyana Dam is silting up, which affects the storage requirements to meet the current and future raw water requirements.

Treated Water Bulk Supply Infrastructure

The treated water from the Emondlo WTW is pumped from the clearwater tanks to the various service reservoirs in Emondlo, Hlahlindlela and Ehlahlene. The treated water from the Mvuzini WTW is distributed into the main reticulation networks from the clearwater tanks at the plant. The two plants have cumulative storage capacities of 15 ML. The capacity of the treated water bulk supply is barely sufficient to meet current water requirements of the area at the current operating rules of the town. The bulk water is then distributed to the various supply areas in the Emondlo and the surrounding areas of Ehlahlene and Nceceni.

Bulk Storage

The Emondlo (Hlahlindlela) Water Supply Scheme area has a total service reservoir storage capacity of 15 ML including the smaller reservoirs supplying the various water supply areas including Hlahlindlela and Ehlahlene. The capacities of the reservoirs range from 1 ML tanks to a 5 ML reservoir, and are distributed throughout the various water supply areas. The service storage capacity provides for a 1.9-day or 45-hour storage based on the current treated water production, but in summer months this reduces to approximately a 1.3-day or 30-hour storage capacity, based on present water requirements.

The reservoir storage capacity of Emondlo (Hlahlindlela) is therefore significantly less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required immediately and further into the future to meet the current and future summer peak requirements.

Parameters	**Emondlo (Hlahlindlela) Water Supply Scheme area**
Total Storage capacity (ML)	15
Storage Ratio on present annual average consumption (Hours)	45
Storage Ratio on present average peak week consumption (Hours)	30

Table 11 - Service Storage Reservoirs in the Emondlo (Hlahlindlela) Water Supply Scheme
(Source: First Stage Reconciliation Strategy for Greater Emondlo Water Supply Scheme Area - Abaqulusi Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted for the Emondlo and Mvuzini WTW:

Emergency Work Required
The treatment works is in need of upgrading to meet the shortfall in treatment capacity. A Flocculation Chamber and mixer should be installed as soon as possible together with necessary remedial work.

Short term improvements
The following work is recommended to be carried out in the short term which is not covered by the refurbishment currently undertaken:

- Access control appeared to be quite relaxed. This together with site security should be investigated, and the gates and boundary fencing should be repaired or renewed to render the site secure.
- The solids from the clarifiers and the backwash from the filters are at present discharged to storm water drain. Due to the limited site area any improvement in the system will probably require the installation of mechanical dewatering.

In the short term it was recommended constructing an additional clarifier and filter. One would also need to construct proper floc conditioning facilities before the clarifiers at the end of this exercise the plant capacity would be about 12 ML/d.

Longer Term Upgrading

Based on the understanding that the sludge disposal takes place from the works, it was therefore assumed that the sludge is discharged into the adjacent storm water drains. This is in direct conflict with the regulations for the disposal of solids from waterworks and it would therefore be recommended that the sludge disposal facilities be formalised. This could be achieved by recycling the backwash water to the Head of works and sending the sludge from the clarifiers to thickening tanks and drying beds. The derelict old slow sand plant is located on a portion of the site and it could be utilised for sludge drying beds.

Future capacity increases would require major extensions to the works with a new inlet works, new clarifiers, new filters, as well as further upgrading of the chemical dosage systems. The site is fairly restrictive in terms of space and it may be more prudent to build an additional works near the dam and to pump the treated water.

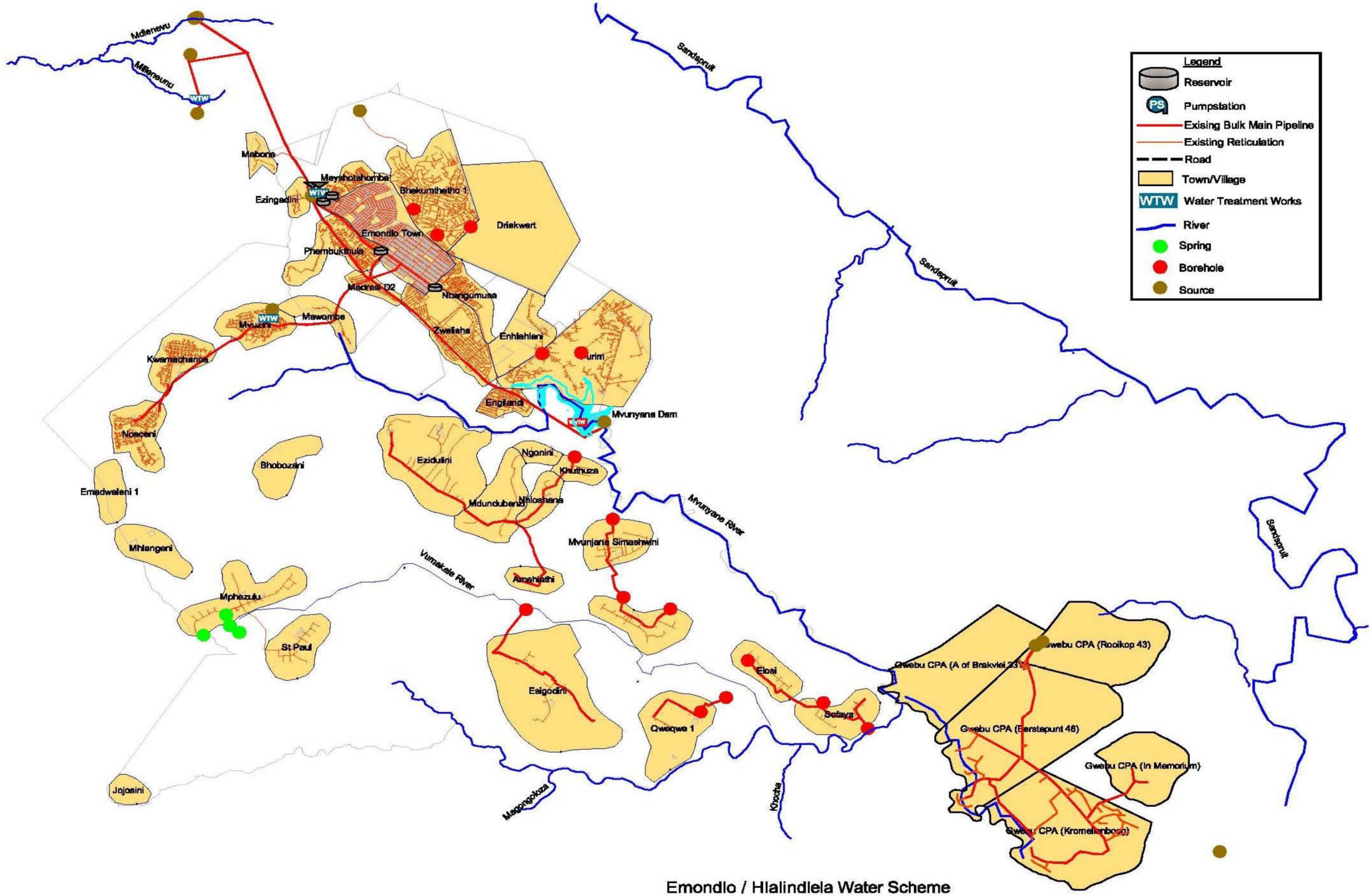


Figure 10 - Schematic layout of Emondlo (Hlahlindlela) Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Greater Emondlo Water Supply Scheme Area - Abaqulusi Local Municipality, 2011)

5.3.1.5 Mpungamhlope Water Supply Scheme (Ulundi LM)

(Source: First Stage Reconciliation Strategy for Mpungamhlope Water Supply Scheme Area - Ulundi Municipality, 2011)

The schematic layout of the infrastructure to supply treated water from the Mpungamhlope Water Supply Scheme for residential and non-residential consumption in the water supply area is shown in Figure 11. Mpungamhlope WTW is the main source of domestic water supply to Mpungamhlope and surrounding areas while Makhosini has a chlorine system that supplies the village and surrounding areas.

The Klipfontein Dam situated near Vryheid was built to supply both domestic water supply to Vryheid and Ulundi as well as irrigation water for the farmers downstream of the dam including the Gluckstadt Irrigation Scheme. Due to Mpungamhlope being located between the dam and Ulundi it also benefits from the available water supply of the dam.

The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is supplementary groundwater use, which has been registered for the Mpungamhlope Water. There are no reported water quality problems associated with the groundwater.

Raw water supply for the Mpungamhlope treatment works is pumped from the White Mfolozi River through a raw water pumping plant and rising main to the WTW. The maximum capacity of the raw water supply main from the White Mfolozi River is however unknown.

Water Treatment Works

The Mpungamhlope WTW is the only plant which supplies treated water to the area. The total peak hydraulic design capacity of the Mpungamhlope WTW is 0.8 ML/d. The average annual flow rate of the WTW is estimated to be 0.6 ML/d.

In 2008, the total raw water abstraction for treatment at the Mpungamhlope WTW as well as for Makhosini, including the groundwater used to supplement the scheme, was estimated to be 0.69 million m^3/a (1.9 ML/d) with the treated water production estimated to be 0.61 million m^3/a (1.67 ML/d). The estimated raw water losses in the raw water abstraction works and pipeline, as well as in the treatment processes, are therefore as high as 12% of the total raw water abstraction.

The Mpungamhlope WTW is a conventional treatment plant comprising the following process components:

(i) *Flocculation channels:* The raw water is supplied by pumping from the White Mfolozi River. Chemicals are added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks:* The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried, while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Slow sand filtration:* The clarified water is then filtered through a set of slow sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place, before pumping the water to the command reservoirs in the Mpungamhlope Water Supply Scheme area for distribution.

The treatment plant at Makhosini is a chlorination plant. This may present water quality problems of the treated water particularly during high flow periods when the turbidity of the Mbembeni River water is high.

The average annual capacity of the water treatment works is insufficient to meet the immediate water requirements of the scheme given the high system losses. Currently the scheme is supplemented with groundwater in some of the communities to meet the deficits in the requirements. It is not known whether there are any water quality problems downstream of Klipfontein Dam in the White Mfolozi River. However, due to the high silt load in the White Mfolozi River, the chances of the abstraction works silting up are very high.

Treated Water Bulk Supply Infrastructure

The treated water from the Mpungamhlope WTW is pumped from the clearwater tanks to the various service reservoirs in Mpungamhlope and surrounding communities. In Hlungulwane, water is pumped from the existing boreholes to a service reservoir from where it is then distributed.

In Makhosini the chlorinated water is pumped to a service reservoir from which it is then distributed into the village as well as the surrounding communities. It is not known whether the existing treated water bulk water supply infrastructure (clearwater pumping stations, bulk water mains) has sufficient capacity to meet the current water requirements. It is unlikely however to meet the future water requirements of the water supply area as the water supply system is extended.

Bulk Storage

The Mpungamhlope Water Supply Scheme area has a total service reservoir storage capacity of 3 ML including the smaller reservoirs supplying the various water supply areas of the including Makhosini and Hlungulwane (see Table 12). The service storage capacity provides for a 1.8-day or 43-hour storage based on the current treated water production, but in summer months this reduces to approximately a 1.2-day or 29-hour storage capacity, based on present water requirements.

The reservoir storage capacity of Mpungamhlope is therefore significantly less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water for other emergency demands such as to provide tankered water to the surrounding communities.

Additional service storage capacity is therefore required for both the immediate and longer term future to meet the current and future summer peak requirements.

Parameters	**Mpungamhlope Water Supply Scheme area**
Total Storage capacity (ML)	3
Storage Ratio on present annual average consumption (Hours)	43
Storage Ratio on present average peak week consumption (Hours)	29

Table 12 - Service Storage Reservoirs

(Source: First Stage Reconciliation Strategy for Mpungamhlope Water Supply Scheme Area - Ulundi Local Municipality, 2011)

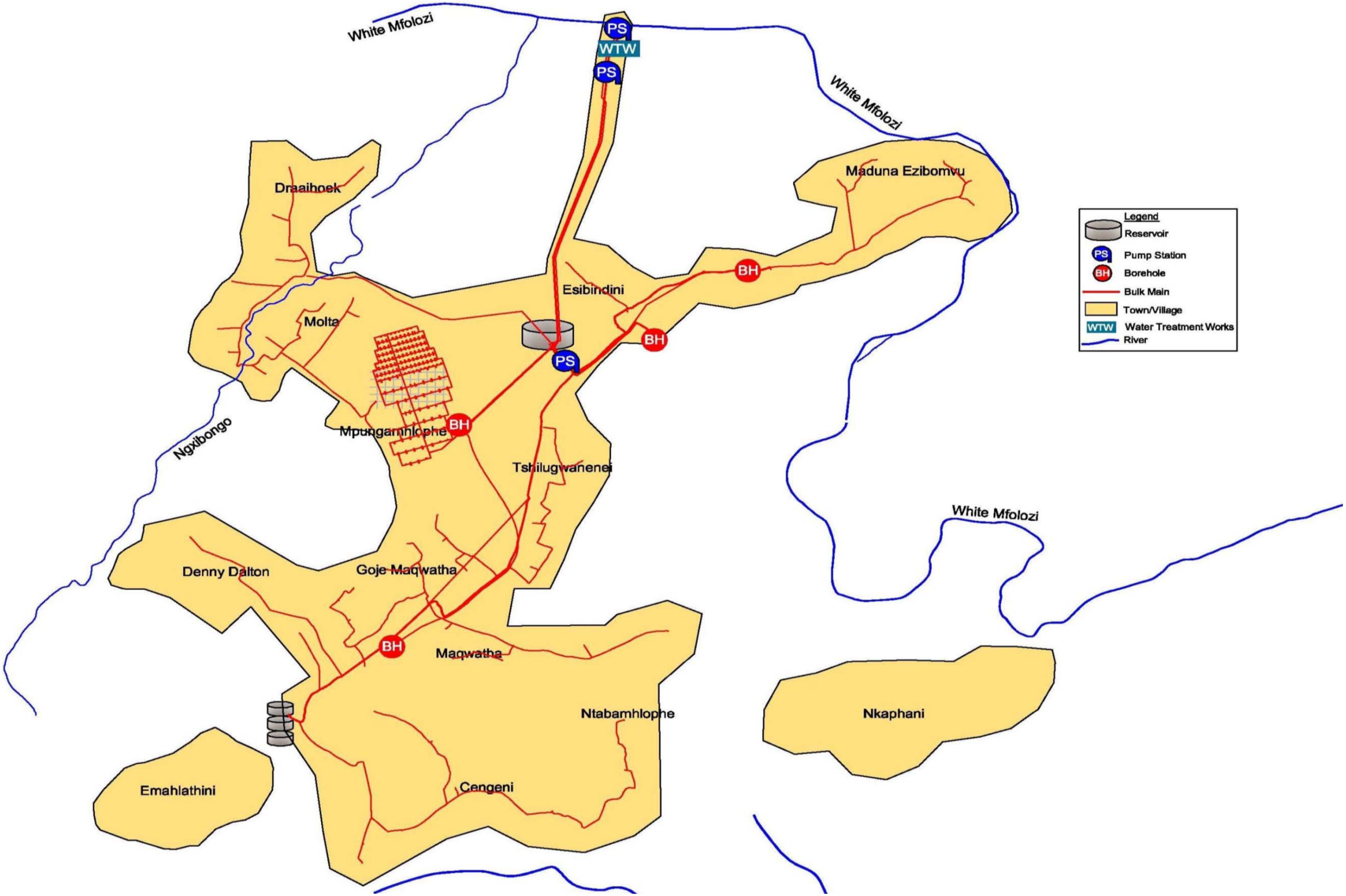


Figure 11 - Schematic layout of Mpungamhlope Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Mpungamhlope Water Supply Scheme Area - Ulundi Local Municipality, 2011)

5.3.1.6 Khiphunyawo Water Supply Scheme (Uphongolo LM)

(Source: First Stage Reconciliation Strategy for Khiphunyawo Water Supply Scheme Area - Uphongolo Local Municipality, 2011)

The schematic layout of the infrastructure to supply treated water from the Simdlangentsha Central (Khiphunyawo) Water Supply Scheme area, for residential and non-residential consumption in the township and surrounding communities, is shown in Figure 12.

The Simdlangentsha Central (Khiphunyawo) Water Supply Scheme is supplied by the Khiphunyawo WTW as well as some groundwater. The Khiphunyawo weir, situated in the tributary of the Mozana River to the south of Khiphunyawo and Luphiso, was built to supply domestic water supply for the township and the surrounding communities. The quality of the water resources of the Mozana River is not known. However because of land use activities the quality of the raw water, particularly turbidity, is likely to be deteriorating.

The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is supplementary groundwater use which has not been registered for the Simdlangentsha Central (Khiphunyawo) Water Supply Scheme.

There are no reported water quality problems associated with the groundwater.

The Khiphunyawo WTW is supplied from the Khiphunyawo weir, which is located to the south of the water treatment works in the tributary of the Mozana River. Raw water supply for the Khiphunyawo WTW is pumped from the abstraction works at the Khiphunyawo weir through a raw water pumping main to the Khiphunyawo WTW, located in the rural town. The maximum capacity of the raw water supply main from the weir to the treatment works is however unknown.

Water Treatment Works

The Khiphunyawo WTW is the main source of treated or potable water supply to the area although groundwater is supplied to the outlying rural communities. The total peak hydraulic design capacity of the Khiphunyawo WTW is estimated to be 0.37 ML/d. The average annual flow rate of the treatment works is estimated to be 0.28 ML/d.

Treatment Work Name	Type of plant	Raw water source	Hydraulic design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Khiphunyawo WTW	Conventional treatment	Khiphunyawo /Luphiso weir	0.37	0.28	0.34	119%

Table 13 - Water Treatment Works serving Simdlangentsha Central (Khiphunyawo) Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Khiphunyawo Water Supply Scheme Area -Uphongolo Local Municipality, 2011)

In 2008 the total raw water abstraction for treatment at the Khiphunyawo and Luphiso WTW was estimated to be 0.14 million m^3/a (0.38 ML/d) with the treated water production estimated to be 0.12 million m^3/a (0.34 ML/d). The estimated raw water losses in the raw water abstraction works and pipeline as well as in the treatment processes are therefore as high as 10% of the total raw water abstraction.

The Khiphunyawo WTW is a conventional treatment plant comprising the following process components:

(i) *Flocculation channels:* The raw water is supplied by pumping from the Khiphunyawo weir on a tributary of the Mozana River. Chemicals are added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks:* The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid gravity filtration:* The clarified water is then filtered through a set of rapid gravity filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoir in the Simdlangentsha Central (Khiphunyawo) Water Supply Scheme area for distribution.

The average annual flow rate of the water treatment works is insufficient to meet the treated water requirements of the scheme for the immediate future. Currently the scheme is supplemented with groundwater in some of the communities which are not reticulated, as indicated in Figure 12.

It is not known whether there are any water quality problems in the Mozana River catchment. However, due to the land use practices in the Mozana River catchment, theKhiphunyawo weir maybe silting up which affects the storage requirements to meet the current and future raw water requirements, particularly during the low flow periods.

Treated Water Bulk Supply Infrastructure

The treated water from the Khiphunyawo WTW is pumped from the clearwater tanks to the service reservoirs in the various villages served by the scheme, from which the potable water is then distributed into scheme area. The capacity of the treated bulk water supply is insufficient to meet current water requirements of the area at the current operating practices of the scheme area.

Bulk Storage

The Simdlangentsha Central (Khiphunyawo) Water Supply Scheme area has a total service reservoir storage capacity of 0.75 ML. The service storage capacity provides for a 2.2-day or 53-hour storage based on the current treated water production, but in summer months this reduces to approximately a 1.48-day or 35-hour storage capacity, based on present water requirements (Table 14).

The reservoir storage capacity of Simdlangentsha Central (Khiphunyawo) is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the immediate and long-term future to meet the current and future summer peak requirements.

Parameters	**Simdlangetsha Central (Khiphunyawo) Water Supply Scheme area**
Total Storage capacity (ML)	0.75
Storage Ratio on present annual average consumption (Hours)	53
Storage Ratio on present average peak week consumption (Hours)	35

Table 14 - Service Storage Reservoirs in the Simdlangetsha Central (Khiphunyawo) Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Khiphunyawo Water Supply Scheme Area -Uphongolo Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted:

List of emergency work

It is recommended that the following emergency work be carried out:

- Install a new non-return valve at the weir
- Install new dosing systems for sodium hypochlorite and polymer/coagulant.

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir
- Supply a shelter for staff and mobile toilet or pit latrine.
- Supply galvanised access ladders
- Installation of a new packaged water treatment works to increase the capacity to 900 m^3/day. A packaged plant could make use of an existing sand filter and supplement this with additional sedimentation processes. A detailed plant assessment and investigation will be required to optimise the plant and ensure an integrated design.

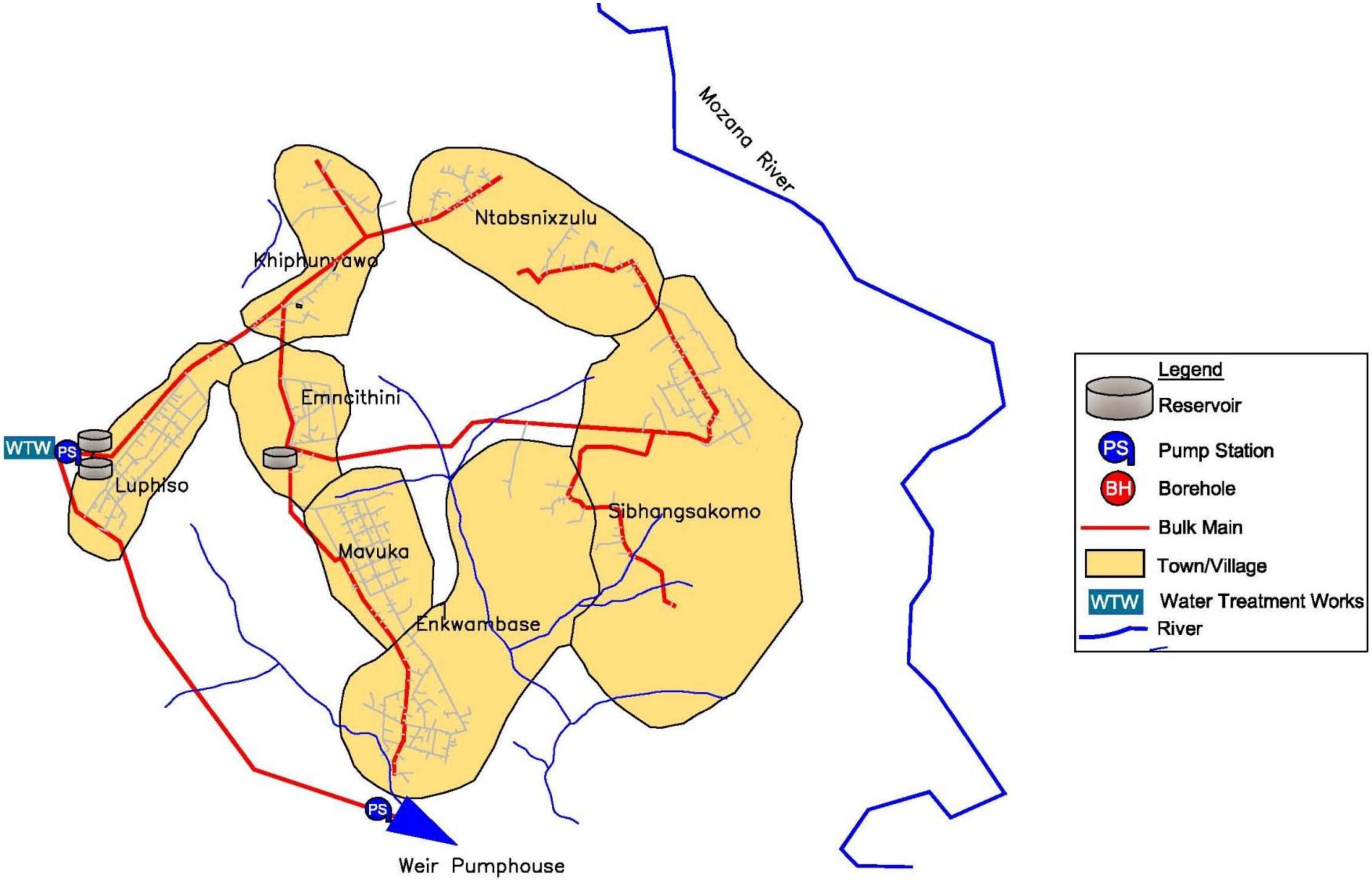


Figure 12 - Schematic layout of Simdlangentsha Central (Khiphunyawo) Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Khiphunyawo Water Supply Scheme Area -Uphongolo Local Municipality, 2011)

5.3.1.7 Mandlakazi Water Supply Scheme (Nongoma LM)

(Source: First Stage Reconciliation Strategy for Mandlakazi Water Supply Scheme Area - Nongoma Local Municipality, 2011)

The schematic layout of the infrastructure to supply treated water from the Mandlakazi Water Supply Scheme area for residential and non-residential consumption in the surrounding communities is shown in the Figure 13.The Mandlakazi Water Supply Scheme is supplied by the Mandlakazi WTW as well as several groundwater supply systems. Furthermore, there is a package plant supplying the areas of KwaMpanza in the south, while a small treatment works supplies the Khangela Palace.

The source of raw water supply for the Mandlakazi WTW is the bulk purchase of Pongolapoort raw water supplied through the Charl Senekal Trust bulk pipeline. KwaMpanza WTW gets its raw water supplies from the Mona River. There is sufficient water available to allocate for domestic water use purposes. The quality of the water resources in the supply area of Mandlakazi is not known. However because of land use activities such as :the quality of the raw water, particularly turbidity, is likely to be deteriorating. The geology and the topography of the area are such that there is potential for groundwater development. Currently there is significant groundwater use which has not been registered for the Mandlakazi Water Supply Scheme.

There are no reported water quality problems associated with the groundwater.

Raw water is currently being purchased from the Charl Senekal Trust for treatment at Mandlakazi WTW. Raw water supply for the Mandlakazi WTW is pumped from the weir upstream of Blackie Dam through a raw water pumping main to the Mandlakazi WTW located in Madulaleni village, which is in the supply area. The maximum capacity of the raw water supply main from the dam to the treatment works is however unknown.

Water Treatment Works

The Mandlakazi and KwaMpanza WTW are the main source of treated or potable water supply to the area; although groundwater is supplied to the rest of the rural communities the total peak hydraulic design capacity of the Mandlakazi and KwaMpanza WTW is estimated to be 2.1 ML/d. The average annual flow rate of the treatment works is estimated to be 1.6 ML/d.

Treatment Work Name	Type of plant	Raw water source	Hydraulic Design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Mandlakazi WTW	Conventional treatment	Charl Senekal Trust purchase	1.50	1.15	1.45	126%
Khangela Palace WTW	Filtration plant	Stream	0.10	0.07	0.08	108%
KwaMpanza WTW	Filtration plant	Mona River	0.50	0.37	0.40	108%
Borehole schemes	N/A	Groundwater	1.44	1.44	1.44	
Total			**3.54**	**3.04**	**3.37**	**110.9%**

Table 15 - Water Treatment Works serving Mandlakazi Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Mandlakazi Water Supply Scheme Area - Nongoma Local Municipality, 2011)

The total raw water abstraction (both surface and groundwater) in 2008 was estimated to be 1.4 million m^3/a (3.82 ML/d) with the treated water production estimated to be 1.23 million m^3/a (3.37 ML/d). It is estimated that the water losses amount to 12% of the total raw water abstraction.

The Mandlakazi WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels:* The raw water is supplied by pumping from the weir upstream of Blackie Dam. Chemicals are added in as the water flows into flocculation channels, where coagulation after polyelectrolyte dosing takes place to form the flocs.

(ii) *Clarification (sedimentation) tanks:* The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

(iii) *Rapid gravity filtration:* The clarified water is then filtered through a set of rapid gravity filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoir in the Mandlakazi Water Supply Scheme area for distribution.

The KwaMpanza WTW is a filtration plant where water is filtered through a set of rapid gravity filters before chlorine is added in the chlorine contact tank. From there the treated water is the pumped to the service reservoir in the Sindinsi village for distribution. The average annual flow rate of the water treatment works is insufficient to meet the treated water requirements of the scheme in the immediate future.

Currently the scheme is supplemented with groundwater in some of the communities which are not reticulated. It is not known whether there are any water quality problems in the Mandlakazi River catchment. However, due to the land use practices in the catchment, the quality of the raw water in the rivers may be deteriorating particularly during the high flow periods.

Treated Water Bulk Supply Infrastructure
The treated water from the Mandlakazi and KwaMpanza WTW is pumped from the clearwater tanks to the service reservoirs in the various villages making up the scheme, from which the potable water is then distributed into scheme area. The bulk water is then distributed to the various supply areas in the Mandlakazi supply area. The capacity of the treated bulk water supply is not sufficient to meet current water requirements of the area at the current operating practices of the scheme area.

Bulk Storage

The Mandlakazi Water Supply Scheme area has a total service reservoir storage capacity of 6 ML (see figure below) ranging from 0.25 ML to 1.0 ML reinforced concrete reservoirs. The service storage capacity provides for a 1.8-day or 43-hour storage based on the current treated water production, but in summer months this reduces to approximately a 29-hour or 1.2-day storage capacity, based on present water requirements (see Table 15).

The reservoir storage capacity of Mandlakazi is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the immediate and the long-term future to meet the current and future summer peak requirements.

Parameters	**Mandlakazi Water Supply Scheme Area**
Total Storage capacity (ML)	6
Storage Ratio on present annual average consumption (Hours)	43
Storage Ratio on present average peak week consumption (Hours)	29

Table 16 - Service Storage Reservoirs

(Source: First Stage Reconciliation Strategy for Mandlakazi Water Supply Scheme Area -Nongoma Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted regarding the Khangela Palace Water Treatment Works:

List of emergency work

It is recommended that the following emergency work be carried out:

- Replace sand filter media

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Installation of a similar packaged water treatment works to increase capacity to 40 m^3/day.

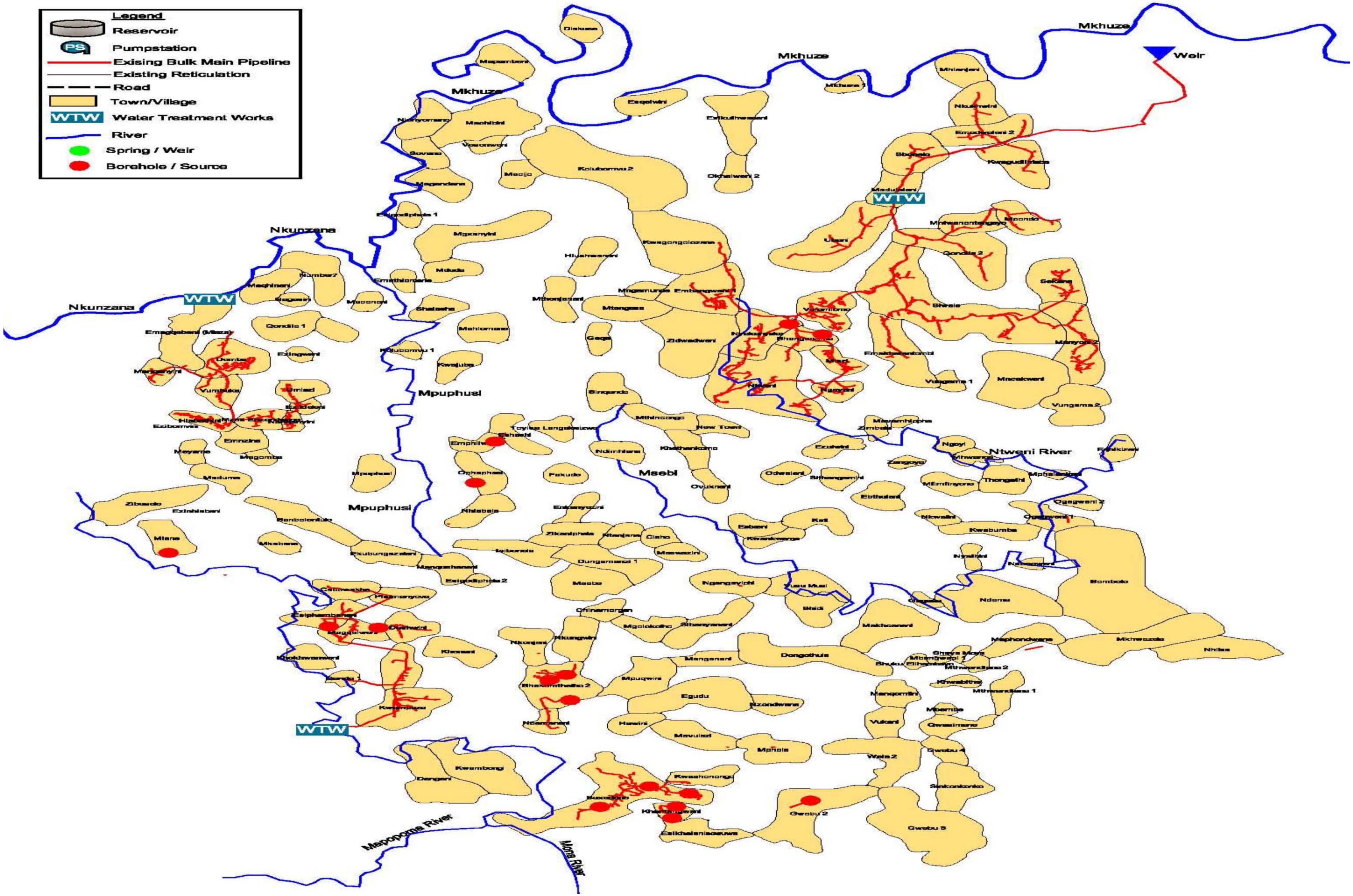


Figure 13 - Schematic layout of Mandlakazi Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Mandlakazi Water Supply Scheme Area - Nongoma Municipality, 2011)

5.3.1.8 Ulundi Water Supply Scheme (Ulundi LM)

(Source: First Stage Reconciliation Strategy for Ulundi Water Supply Scheme Area -Ulundi Local Municipality, 2011)

The schematic layout of the infrastructure to supply treated water from the Ulundi Water Supply Scheme for residential and non-residential consumption in Ulundi and the towns and settlements in the water supply scheme area is shown in the figure below.

The main source of water supply for the Ulundi Water Supply Scheme is the White Mfolozi River, of which is augmented from the Klipfontein Dam, situated in the White Mfolozi River. Boreholes supplement the supply from the water treatment works in some of the surrounding areas.

There are increasing water quality problems at the Ulundi WTW. These problems are arising downstream of the Klipfontein Dam in the White Mfolozi River as a result of agricultural activities, such as irrigation and other seasonal changes in the quality of the water in the White Mfolozi River, including the turbidity that can be high in summer.

The quality of water upstream of the Klipfontein Dam is poor because of the wastewater return flows from Vryheid, as well as the land use activities, including commercial forestry. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is some supplementary groundwater use taking place in the Ulundi Water Supply Scheme area. There are no reported water quality problems associated with the groundwater.

The raw water supply for the Ulundi WTW is pumped from the Ulundi Weir in the White Mfolozi River by means of a raw water pumping plant and through a rising main directly to the WTW. The maximum capacity of the raw water supply main from the White Mfolozi River is however unknown.

Water Treatment Works

The Ulundi WTW is the only plant which supplies treated water to the area. The total peak hydraulic design capacity of the Ulundi WTW is 26.4 ML/d. The design average annual capacity of the WTW is estimated to be 20.3 ML/d (7.4 million m^3/a)

The total raw water abstracted for treatment at the Ulundi WTW in 2008 was estimated to be 8.01 million m^3/a (21.94 ML/d) based on historical raw water releases from Klipfontein Dam. The treated water production was provided as measured to be 6.6 million m^3/a (18.10 ML/d). There are significant raw water losses owing to river and transmission losses between the Klipfontein Dam and Ulundi Weir. It is estimated that the river losses can be as high as 17.5% of the raw water abstraction.

The Ulundi WTW is a conventional treatment plant comprising of the following process components:

(i) *Flocculation channels:* The raw water is supplied by pumping from the White Mfolozi River with chemicals added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs;

(ii) *Clarification (sedimentation) tanks:* The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater;

(iii) *Slow sand filtration:* The clarified water is then filtered through a set of slow sand filters as a final polishing before chlorination of the treated water.

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in the Ulundi Water Supply Scheme area for distribution.

The average annual capacity of the water treatment works is insufficient to meet the immediate water requirements of the scheme, given the high system losses. Currently the scheme is supplemented with groundwater in some of the communities to meet the deficits in the requirements. Water quality is of concern downstream of Klipfontein Dam in the White Mfolozi River, mainly owing to turbidity problems from land-use activities. Due to the high silt load in the White Mfolozi River, the Ulundi weir, which has “fish belly flaps”, needs to be operated optimally to minimise silting up, which affects the balancing storage requirements from the Klipfontein Dam, thereby increasing the transmission losses and decreasing the available utilisable water.

Treated Water Bulk Supply Infrastructure

The treated water from the Ulundi WTW is pumped from the clearwater tanks to the various command reservoirs in Ulundi, Nkonjeni and Zihlabeni, with a cumulative storage capacity of 27 ML. The bulk water is then distributed to the various supply areas in the town and the surrounding townships of Nkonjeni and Zihlabeni (see Figure 14). The capacity of the Treated Water Bulk Supply Infrastructure and the bulk supply itself are insufficient to meet the current water requirements of the Ulundi Water Supply Scheme area at the current water use practices in the supply area.

Bulk Storage

The Ulundi Water Supply Scheme area has a total service reservoir storage capacity of 27 ML including the smaller reservoirs supplying the various water supply areas of the town including Nkonjeni and Zihlabeni. The capacities of the reservoirs range from 1 ML tanks to a 10 ML reservoir and are distributed throughout the various water supply areas. The service storage capacity provides for a 1.5-day or 36-hour storage based on the current treated water production, but in summer months this reduces to approximately or 1.0-day or a 24-hour storage capacity, based on present water requirements.

The reservoir storage capacity in the Ulundi Water Supply Scheme area is therefore significantly less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- ➢ balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- ➢ provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- ➢ provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the immediate and long-term future to meet the current and future summer peak requirements.

Parameters	Ulundi supply area
Total Storage capacity (ML)	27.0
Storage Ratio on present annual average consumption (Hours)	35.8
Storage Ratio on present average peak week consumption (Hours)	23.9

Table 17 - Service Storage Reservoirs in Ulundi Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Ulundi Water Supply Scheme Area -Ulundi Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted.

List of emergency work

The plant is in a very good condition and no immediate work is required.

List of short term improvements

It is recommended that the following work be carried out in the short term:

- General maintenance and building repair work including painting etc.

List of medium to long term improvements

The current plants design capacity is adequate to meet the demands of the current service area until 2030. However, if the service area is enlarged, the plant will have to be upgraded and extended.

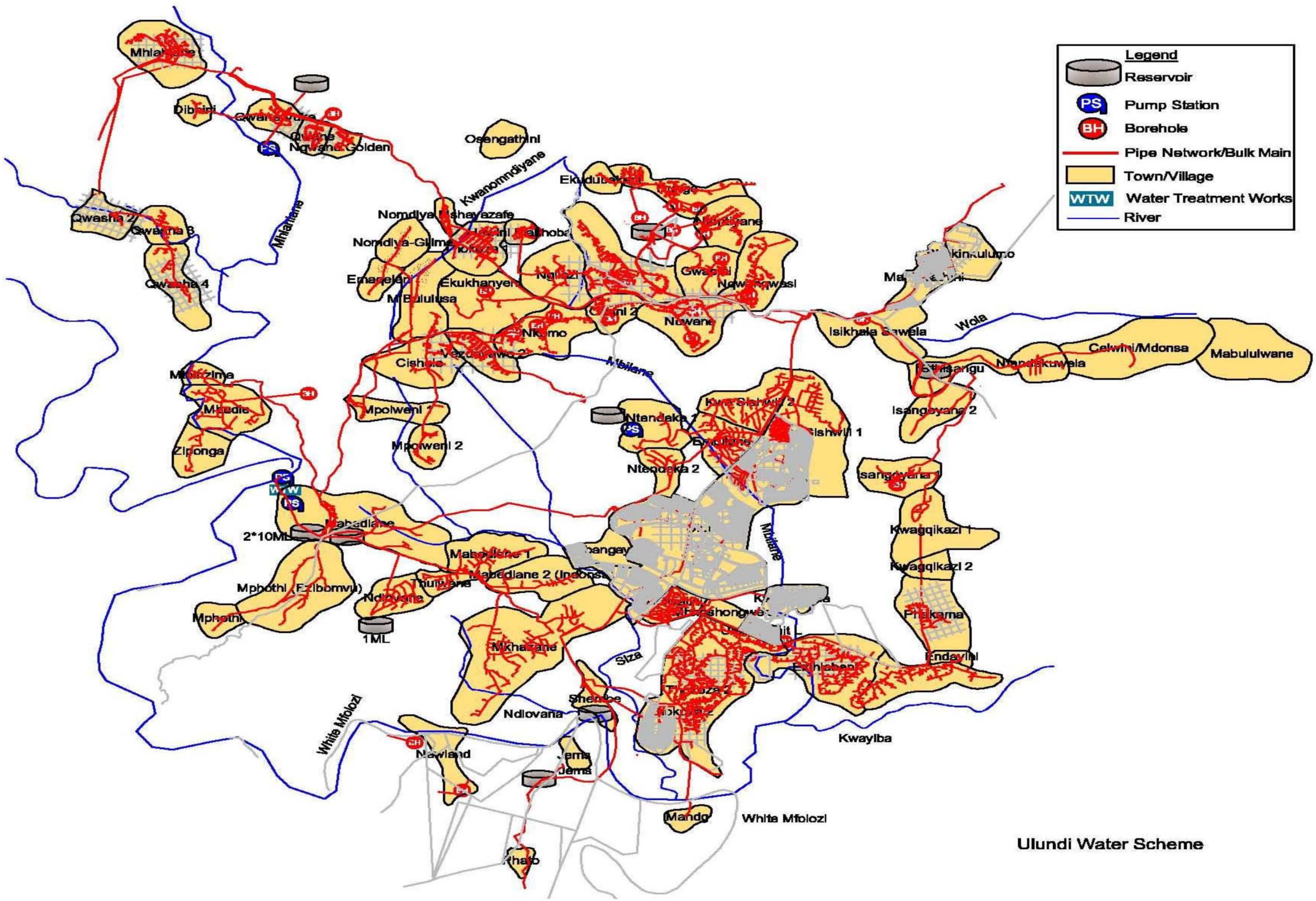


Figure 14 - Schematic layout of Ulundi Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Ulundi Water Supply Scheme Area Ulundi Municipality)

5.3.1.9 Vryheid Water Supply Scheme (Abaqulusi LM)

(Source: First Stage Reconciliation Strategy for Vryheid Water Supply Scheme Area -Abaqulusi Local Municipality, 2011)

The main source of water supply for the Vryheid Regional Water Supply Scheme is the White Mfolozi River. The supply is supported by the Klipfontein Dam, which is situated 5 km south of Vryheid, on the White Mfolozi River.

The main function of this dam is to supplement the water supplies of Bloemveld and Grootegewaagd Dams which were previously the main sources of supply. Over the years Vryheid's dependence on Klipfontein Dam has increased with the increase in water requirements. There are no major water quality problems at the Bloemveld WTW and the Klipfontein WTW. Because the Vryheid town and Bhekuzulu Township and also the Vryheid WWTW are situated in the catchment area of the Klipfontein Dam, the water quality from the dam may deteriorate if the effluent quality standards from the plant are not being complied with and there is uncollected litter and waste that can enter the dam through the stormwater system.

It appears that the capacity of the WWTW is being addressed in the short to medium term by the upgrading the Vryheid waste water treatment works (WWTW). Besides upgrading the WWTW there is a continuous need to ensure that the existing WWTW are being operated correctly. As the flows through the WWTW increase with time, the yield of the Klipfontein Dam will be enhanced. The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently, there is no groundwater that has been registered for the Vryheid Water Supply Scheme. There are no reported water quality problems associated with the groundwater.

The Bloemveld WTW is gravity fed with raw water from both the Bloemveld and Grootegewaagd Dams. The capacity of the gravity main is not known but it is likely that it is sufficient to meet the capacity requirements of the water treatment works. Because the Bloemveld WTW is operated by gravity, it is the preferred option. This is however not necessarily the best mode of operation for the three dams as it is possible that the Klipfontein Dam spills when the Grootgewaagd and Bloemveld Dams are not full. The Klipfontein WTW abstracts raw water from the Klipfontein Dam through a rising main. The capacity of the raw water pumping infrastructure is not known but is likely to be sufficient to meet the design capacity of the Klipfontein WTW of 16 ML/d. This will be insufficient to meet the future water requirements after 2015 for the high growth scenario. Therefore steps need to be taken to increase the raw water abstraction capacity in order to meet the high growth future water requirements of the Vryheid Regional Water Supply Scheme area.

Water Treatment Works

There are two (2) water treatment works currently in operation that are supplying treated water to Vryheid Regional Water Supply Scheme area. The details of the treatment plants are indicated in the table below. The design capacity of the Bloemveld Water Treatment Works (WTW) is for a maximum daily demand of 7.5 ML/d. The average flow rate is provided as 5.6 ML/d. The design capacity of the Klipfontein WTW is for a maximum daily demand of 16 ML/d with an average flow rate of 11.85 ML/d. Therefore the total treatment capacity of the Vryheid Regional Water Supply Scheme is for a plant hydraulic capacity of 23.5 ML/d (8.58 million m^3/a).

Both the WTW are conventional plants comprising flash mixing chambers, flocculation chambers, sedimentation tanks and rapid gravity sand filters. Chemical dosing takes place at a number of points along the treatment process. After treatment, the treated water is then stored in the chlorine contact and clearwater tank where the water is finally sterilized with chlorine.

As illustrated in Table 15 below, the total capacity of the two treatment works is sufficient to meet the current water requirements and is estimated to be sufficient until 2015 for the high growth scenario and later for the other growth scenarios.

Treatment Work Name	Type of plant	Raw water source	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Bloemveld WTW	Conventional treatment	aMagoda River	7.5	7.5	85%
Klipfontein WTW	Conventional treatment	White Mfolozi River	16	10.73	67%
Total			23.5	18.23	78%

Table 18 - Water Treatment Works in operation in Vryheid area

(Source: First Stage Reconciliation Strategy for Vryheid Water Supply Scheme Area -Abaqulusi Local Municipality, 2011)

Treated Water Bulk Supply Infrastructure

The treated water from the Vryheid WTW is pumped from the clearwater tanks to three command reservoirs before distribution to Vryheid town and Bhekuzulu township. The clearwater pumping station comprises two main pumping stations. There is a highlift pumpstation which pumps water to Reservoir No.1 through a 250 mm diameter AC/steel pipeline. The second high lift pumping station pumps water to the two other reservoirs near Bhekuzulu before water is distributed to the various supply zones in the township and surrounding areas. All pumping systems have standby capacity.

Bulk Storage

Vryheid has a total reservoir capacity of 15.5 ML supplying the town, the industrial area and Bhekuzulu Township. The configuration of the storage comprises of two 2.5 ML Reinforced Concrete (RC) service reservoirs at Berea, a 2.5 ML RC reservoir at Wildpark, a 2.5 ML service reservoir supplying Bhekuzulu and a 5 ML RC Industrial Reservoir supplying the industrial supply zone. The capacity of the elevated pressed steel storage tank is 0.5 ML. These service reservoirs supply the different pressure zones of the town.

The service storage capacity provides for a 0.85 day or 20.5 hours storage based on the current gross average annual daily demand, but in summer months this reduces to approximately 13.6 hours storage capacity. The storage capacity of Vryheid is therefore far below the accepted norm of 48 hours storage capacity for average daily demand. Additional service storage capacity is required in order to:

- ➢ balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output
- ➢ give a suitable pressure for the distribution system and reduce pressure fluctuations
- ➢ provide a supply during a failure or shutdown of treatment plant, pumps or bulk mains leading to the reservoir
- ➢ provide a reserve of water to meet fire and other emergency demands

Parameters	**Vryheid Water Supply Scheme Area**
Total Storage capacity (ML)	15.5
Storage Ratio on annual average consumption (Hours)	20.5
Storage Ratio on average peak month consumption (Hours)	13.60

Table 19 - Service Storage Reservoirs in Vryheid Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Vryheid Water Supply Scheme Area -Abaqulusi Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted for Klipfontein WTW.

Emergency Work Required

There is no true emergency work required at this plant. The works is coping with the required demand and is producing water of the required quality. The plant has a neglected appearance but appears to be in adequate condition to continue operating, provided refurbishment is not unduly delayed. However the chlorination facilities are barely adequate and should be given early priority in the short term.

Short Term Interventions

The following work is recommended to be carried out in the short term:

- The chlorine house needs major refurbishment. There should be four cylinders in the chlorine room connected in pairs with an auto-changeover valve, and this room should be suitably vented. There should also be two complete chlorinators (duty+standby) with interconnection, so that either float tube or control can be used with either booster pump or ejector. These should be housed in a separate room. The installation should have all the required safety devices including a self-contained breathing apparatus.
- The chemical house requires that old equipment be stripped out and removed. New equipment for coagulant dosage comprising day tanks with manifolds connecting to duty and standby dosage pumps, and a new lime feeder are necessary. Also the streaming current dosage control device should be repaired or replaced
- The head of works (Inlet works) requires installation of new flocculation facilities. The flow meter should also be repaired or recalibrated
- The rapid gravity filters need to be duplicated. The existing filters should also be taken off line one by one and refurbished with new nozzles and media if necessary. The valves and controls are of robust design and may only need minor refurbishment. However all valves, blowers and pumps should be checked, and refurbished or replaced if necessary.

- Access control appeared to be quite relaxed. This, together with site security, should be investigated, and the gates and boundary fencing should be repaired or renewed to render the site secure.
- The appearance of the plant equipment and buildings would be much improved with a complete re-painting.

Longer Term Upgrading

It was assumed that the sludge from the works is disposed of by discharge into the adjacent veld. This is in conflict with the regulations for solids disposal from waterworks and it would be appropriate to formalise the sludge disposal facilities. This could be done by recycling the backwash water to the head of works, and sending the sludge from the clarifiers to thickening tanks and drying beds. The derelict old slow sand plant is located on a portion of the site and could possibly be utilised for sludge drying beds.

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted for Bloemveld WTW.

Emergency Work Required

There is no true emergency work required at this plant. The works is coping with the required demand and is producing water of the required quality. The plant has a neglected appearance but the older side appears to be in adequate condition to continue operating, provided refurbishment is not unduly delayed. However the chlorination facilities are barely adequate and should be given early priority in the short term.

Short Term Interventions

The short term interventions required are the same as for the Klipfontein WTW.

Longer Term Upgrading

The following work is recommended to be carried out in the medium to long term:

- The rapid gravity filters and clarifiers on the Newer side of the plant do not appear to have been used for some time and all the equipment may have been standing which can lead to deterioration. Although this section of the works appears to be of more recent design, the filters are of an old pattern and about 30 years old. They are in need of maintenance and refurbishment, although the basic design seems to be sound in terms of functionality. All blowers, pumps and valves should be checked, and refurbished or replaced if necessary. The media did not appear to be in good condition and refurbishment of the filters including nozzle and media replacement is likely to be needed.
- It was assumed that the sludge is from the works is disposed by means of discharge into the adjacent veld. This is in conflict with the regulations for solids disposal from waterworks and it would be appropriate to formalise the sludge disposal facilities. This could be achieved by recycling the backwash water to the Head of works, and sending the sludge from the clarifiers to thickening tanks and drying beds. The derelict old slow sand plant is located on a portion of the site and could possibly be utilised for sludge drying beds.

Figure 15 - Schematic layout of Vryheid Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Vryheid Water Supply Scheme Area -Abaqulusi Local Municipality, 2011)

5.3.1.10 Simdlangetsha East Water Supply Scheme (Uphongolo LM)

(Source: First Stage Reconciliation Strategy for Simdlangetsha East Water Supply Scheme Area - Uphongolo Municipality, 2011)

The main source of water supply for the Simdlangetsha East Regional Water Supply Scheme is the Pongola River, via the Impala Water User Association's main canal. The supply is supported indirectly by the Bivane Dam which is situated on the Bivane River, a major tributary of the Pongola River system. The dam was built by the Impala Water User Association (WUA). Water is abstracted from the large Grootdraai Weir some 20 km upstream of the town and supplies water to an estimated 16 700 hectares of irrigation via a system of approximately 145 km of canals.

There are also some springs which are supplying communities in the Simdlangentsha East Regional Water Supply Scheme area. There have been reported cases of water quality problems in the Pongola River, usually during times of low flow due to salinity leaching out from the irrigated lands as well as due to effluent from the sugar mill.

However, the quality is adequate at the diversion weir, which supplies the canal. There may be a need to address the compliance issues of the existing wastewater treatment works, as the return flows increase in the medium to long term. Hence there is a need to ensure that the existing WWTW are being operated correctly a need to maintain and upgrade the existing WWTW and to possibly construct additional WWTW.

There can often be a high risk of microbial contamination in springs and small tributaries near areas with high population concentrations if the sanitation facilities are inadequate. Currently there is no registered allocation from groundwater to the Simdlangentsha East Regional Water Supply Scheme area.

The geology and the topography of the area is such that there is limited potential for significant groundwater development. The presence of springs indicates a high connectivity between groundwater and surface water in particular areas and therefore the use of groundwater in those areas is likely to reduce the surface water flows by an equal amount until the springs have dried up. There is nevertheless some potential for the use of small amounts of groundwater. However, care must be taken to account for the reduction in surface water supplies in those areas of high connectivity, particularly in those areas where springs occur. There are no reported groundwater quality problems, but there can often be a high risk of microbial contamination in areas with high population concentrations if the sanitation facilities are inadequate, as mentioned above.

It is intended to develop the Simdlangentsha East Regional Water Supply Scheme as the main source of domestic water supplies to the towns/villages which will cover the area stretching from the border with Swaziland in the north, the communities of Manyandeni and Highlands to the east and the Pongola River to the south. The raw water for the treatment plant is obtained by means of abstraction, via a calibrated sluice from the Impala irrigation primary canal, which passes above the Pongola WTW. Water is gravitated directly into the works or into one of three balancing dams. Water can also be pumped directly from the Pongola River into the same delivery canal, as an alternative.

The schematic layout of the planned and existing infrastructure to supply treated water for domestic use from the Simdlangentsha East Regional Water Supply Scheme for domestic use to the towns/villages is shown in the Figure 16.

Raw Water Pumping Plant

For approximately four weeks of the year, when the canal is undergoing planned maintenance, raw water is pumped from a pump station which abstracts water from the Pongola River and delivers directly into the canal, just upstream of the gauging sluice. The pump station and rising main only supply when the main irrigation canal is not operational.

The capacity of the existing raw water pumping plant is estimated at only 8.5 ML/d by the plant operator, which is sufficient to meet Pongola's current average annual daily water treatment capacity of 8 ML/d but not the peak requirements.

Water Treatment Works

There is one water treatment works, the Pongola Regional WTW, currently in operation that is supplying treated water to the Simdlangentsha East Regional Water Supply Scheme area, which includes Pongola. The design capacity of the Pongola Water Treatment Works (WTW) is for an average annual daily flow rate of 8 ML/d. The maximum flow rate of the treatment plant is 12 ML/d. The current treated water production from the Pongola Regional WTW alone was 8.37 ML/d (3.05 million m^3/a) in 2008, which represents 105% of its design capacity.

The Pongola Regional WTW is now being over-utilised. This is due to the communities south west of the scheme area being connected to the scheme. These supply areas were largely dependent on the local water supplies which were unreliable.

Pongola WTW is a conventional plant comprising of flocculation chambers, coagulation and sedimentation tanks and rapid gravity sand filters. The water is finally sterilised with chlorine in a chlorine contact tank. The treated water is then pumped from the clearwater pumping station at the WTW to a command reservoir before distribution to Pongola town, Ncotshane township and to all the communities supplied by the Simdlangentsha East Water Supply Scheme, to the west of Pongola (see Figure 16).

It is the intention of the Zululand District Municipality to develop the Simdlangentsha East Regional Water Supply Scheme to supply water for domestic use to the whole of the Simdlangentsha East area including the communities currently supplied from springs or not supplied at all. The current capacity of the Pongola WTW alone is insufficient to meet the future water requirements of the villages and rural towns in its intended supply area.

The capacity of the Pongola WTW will need to be upgraded in the near future if it is to supply the whole of the Simdlangentsha East Regional Water Supply Scheme area.

Bulk Storage

The total storage capacity for the Simdlangentsha East Regional Water Supply Scheme area could not be determined from the available information.

It is however likely that the current storage capacity may insufficient particularly for the summer peak requirement as some of the villages do not have any service storage. Additional storage capacity is therefore required for the areas which do not already have storage as well as the other additional communities which are to be linked to the regional scheme. The additional storage capacity will be required to meet the standard of 2 days summer peak requirement, which is the recommended standard to balance the fluctuating requirements from the distribution system, permitting the source to provide a steady weekly output, as well as providing emergency storage to supply water during a failure or shutdowns of the water treatment works or clear water pump stations.

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted.

List of emergency work

It is recommended that the following emergency work be carried out:

- Replace sand filter media
- Supply of fire extinguishers and fire prevention equipment

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir underneath water treatment works station
- Supply and install new wooden doors with locks
- Supply stop/start station for dosing unit
- Supply and install a standby air blower for backwashing
- Service and do general maintenance on existing air blower
- General maintenance and building repair work including painting etc.

List of medium to long term improvements

It is recommended that the following work be carried out in the long term:

- Increase plant capacity for future demand to fulfil the daily requirement of approximately 12 000 m^3/day and upgrade existing structures including dosing facilities and rapid mixing cascades and flocculation channels.

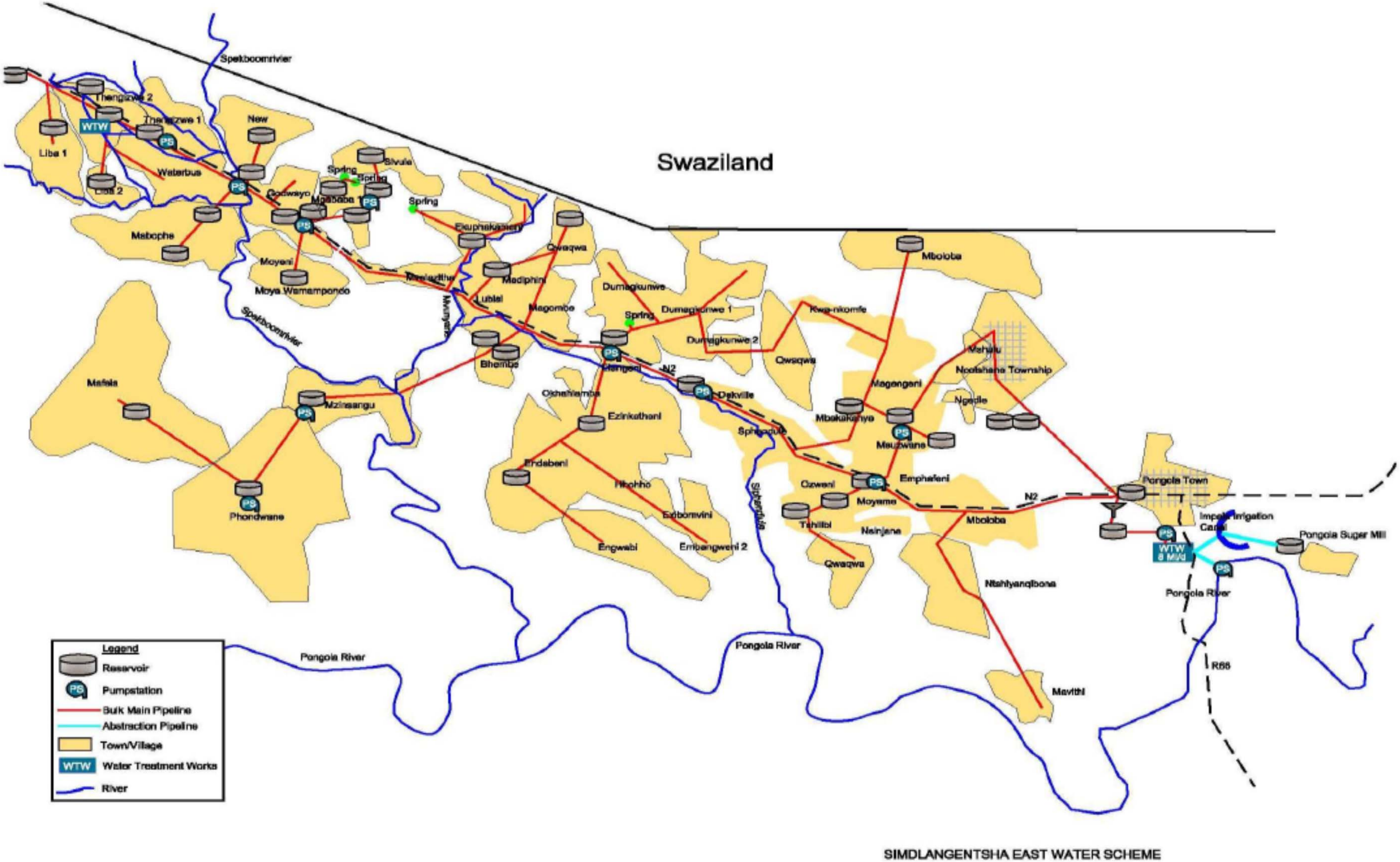


Figure 16 - Schematic layout of Simdlangentsha East Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Simdlangetsha East Water Supply Scheme Area -Uphongolo Municipality, 2011)

5.3.1.11 Simdlangetsha West Water Supply Scheme (Edumbe LM)

(Source: First Stage Reconciliation Strategy for Simlangetsha East Water Supply Scheme Area Edumbe Municipality, 2011)

The main sources of water supply for the Simdlangentsha West Regional Water Supply Scheme are the Phongolo and Bivane Rivers as well as groundwater and springs. Furthermore Bivane Dam, situated to the south of the supply area and built by the Impala Water User Association (WUA) is the source of the raw water supply for the Bivane WTW. There have been reported cases of water quality problems in the Phongolo River, usually during times of low flow due to salinity leaching out from the irrigated lands as well as due to the effluent from the sugar mill. However, the quality is acceptable at the diversion weir, which supplies the canal.

The geology and the topography of the area is such that there is potential for groundwater development as illustrated by the current groundwater usage for domestic supply. The presence of springs indicates a high connectivity between groundwater and surface water in particular areas and therefore the use of groundwater in those areas is likely to reduce the surface water flows by an equal amount until the springs have dried up. However, care must be taken to account for the reduction in surface water supplies in those areas of high connectivity between the groundwater and surface water, particularly in those areas where springs occur. There are no reported groundwater quality problems, but there can often be a high risk of microbial contamination in areas with high population concentrations, if the sanitation facilities are inadequate.

It is intended to develop the Simdlangentsha West Regional Water Supply Scheme as the main source of domestic water supplies to the towns/villages which will cover the area stretching from the border with Mkhondo Local Municipality in the north, Simdlangentsha Central to the east, Paulpietersburg water supply scheme to the west and the Bivane Dam and Coronation regional scheme to the south.

There are three water treatment works supplying the area, as well as groundwater which are used conjunctively in the scheme area. These supply areas of each of the three WTW are interlinked which is the reason why the area has been treated as one for the purpose of developing the reconciliation strategy for the Simdlangentsha West communities.
The schematic layout of the planned and existing infrastructure to supply treated water from the Simdlangentsha West Regional Water Supply Scheme for domestic use to the towns/villages is shown in Figure 17.

Water Treatment Works

The Frischgewaagd WTW is a conventional rapid gravity filtration works. The peak hydraulic design capacity of the WTW was determined to be 2 ML/d based on the registered volume of water for the plant. The average annual capacity is 1.48 ML/d.

The required total water abstraction for treatment at the three WTW as well as for the small schemes in the of Simdlangentsha West Regional Water Supply Scheme area in 2008 was estimated as 1.7 million m^3/a (4.6 ML/d) with the required treated water production estimated to be 1.5 million m^3/a (4.1 ML/d) which is 12% of the total raw water in abstraction.

The Frischgewaagd WTW treatment plant comprises of the following process components:

(i) *Flocculation channels*: The raw water is pumped from the Phongolo River with chemicals added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater.

The Tholakela WTW is also a conventional water treatment works. The maximum hydraulic capacity of the plant is estimated to be 1.0 ML/d with an average flow rate of 0.77 ML/d. Bivane WTW is also a conventional plant comprising of flocculation chambers, coagulation and sedimentation tanks and rapid gravity sand filters. The peak hydraulic capacity of the WTW is 1.0 ML/d with and average flow rate of 0.77 ML/d.

In all three WTW, the filtered water is sterilised with chlorine in a chlorine contact tank. The treated water is then pumped from the clearwater pumping station at each WTW reservoirs in the area, for distribution. Other than Frischgewaagd which is supplied up to house connections, most of the communities in the Simdlangentsha West Water Supply Scheme are provided with yard connections or to RDP standard, with the exception of approximately 1 879 households which are not served to at least RDP standards.

As illustrated in the table below, the total average annual capacity of the three water treatment works is not sufficient to meet the current water requirements. The boreholes and springs are currently utilised to provide potable water to the communities not connected to the three water treatment works and is also used conjunctively as the bulk water supply infrastructure is interlinked. It is estimated from the groundwater database provided for the area, that a total of approximately 25 l/s (1.98 ML/d assuming 20-hours pumping) is supplied from groundwater and springs.

Treatment Work Name	Type of plant	Raw water source	Hydraulic design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of ave. design capacity)
Frischewaagd WTW	Conventional	Pongolo River	2.00	1.54	1.50	98%
Tholakela WTW Capacity	Filtration Plant	River	1.00	0.77	0.65	85%
Bivane WTW Capacity	Filtration Plant	Bivane Dam	1.00	0.77	0.47	61%
Boreholes		Groundwater	1.43	1.43	1.43	100%
Total			5.43	4.50	4.05	89.9%

Table 20 - Water Treatment Works in operation in Vryheid area

(Source: First Stage Reconciliation Strategy for Simlangetsha East Water Supply Scheme Area – Edumbe Local Municipality, 2011)

Treated Water Bulk Supply Infrastructure

The treated water from the three WTW is pumped from the clearwater tanks to various command reservoirs before distribution to Frischgewaagd rural town, Opuzane, Tholakela and the rural villages (see figure Figure 17). The configuration of the clearwater pumping system is unknown as well as the total water produced at each of the water treatment works.

The Frischgewaagd and Tholakela WTW do encounter operational problems from time to time because of seasonal changes to the quality of the river water, particularly the high turbidity levels that are experienced in summer.

According to the Comprehensive Infrastructure Plan Cycle 1 of Zululand District Municipality (2009), the condition of the water treatment works infrastructure is not known. However, based on the budget for refurbishment of the WTW, the condition of the existing WTW can be considered to be average.

Bulk Storage

The total storage capacity for the Simdlangentsha West Regional Water Supply Scheme area could not be determined from the available information.

It is however, likely that the current storage capacity may be insufficient, particularly for the summer peak requirement, as some of the villages do not have any service storage. Additional storage capacity is therefore required for the areas which do not have storage, as well as the other communities which are being linked to the regional scheme. The additional storage capacity will be required to meet the standard of two days summer peak requirement, which is the accepted norm for urban areas.

This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted for the Frischewaagd WTW:

<u>Short Term Improvements</u>

The following work is recommended to be carried out in the short term:-

- The addition of five (minimum) or seven (recommended) pressure filters as existing is necessary to raise the capacity to balance with the clarifiers' capacity of 3 ML/d
- The chemical dosage system needs upgrading with full duty and standby pumps and day tank
- The chlorination (sodium hypochlorite dosage) system needs to be upgraded with day tank and duty and standby pumps.

Longer Term Upgrading

After the short term upgrading has been carried out there would not appear to be any pressing need to extend the capacity of the works. The plant does not lend itself to piecemeal extension readily. It will be recommended to move the works to the abstraction works at the Pongola river, due to a shortage of space and sludge facilities.

Long Term Improvements

The following work is recommended to be carried out in the long term:-

- Move the treatment works to the abstraction point at the Pongola River.
- Size the abstraction works for a total capacity of 15 ML/day to supply the entire Simdlangentsha West Regional Supply scheme with treated water.

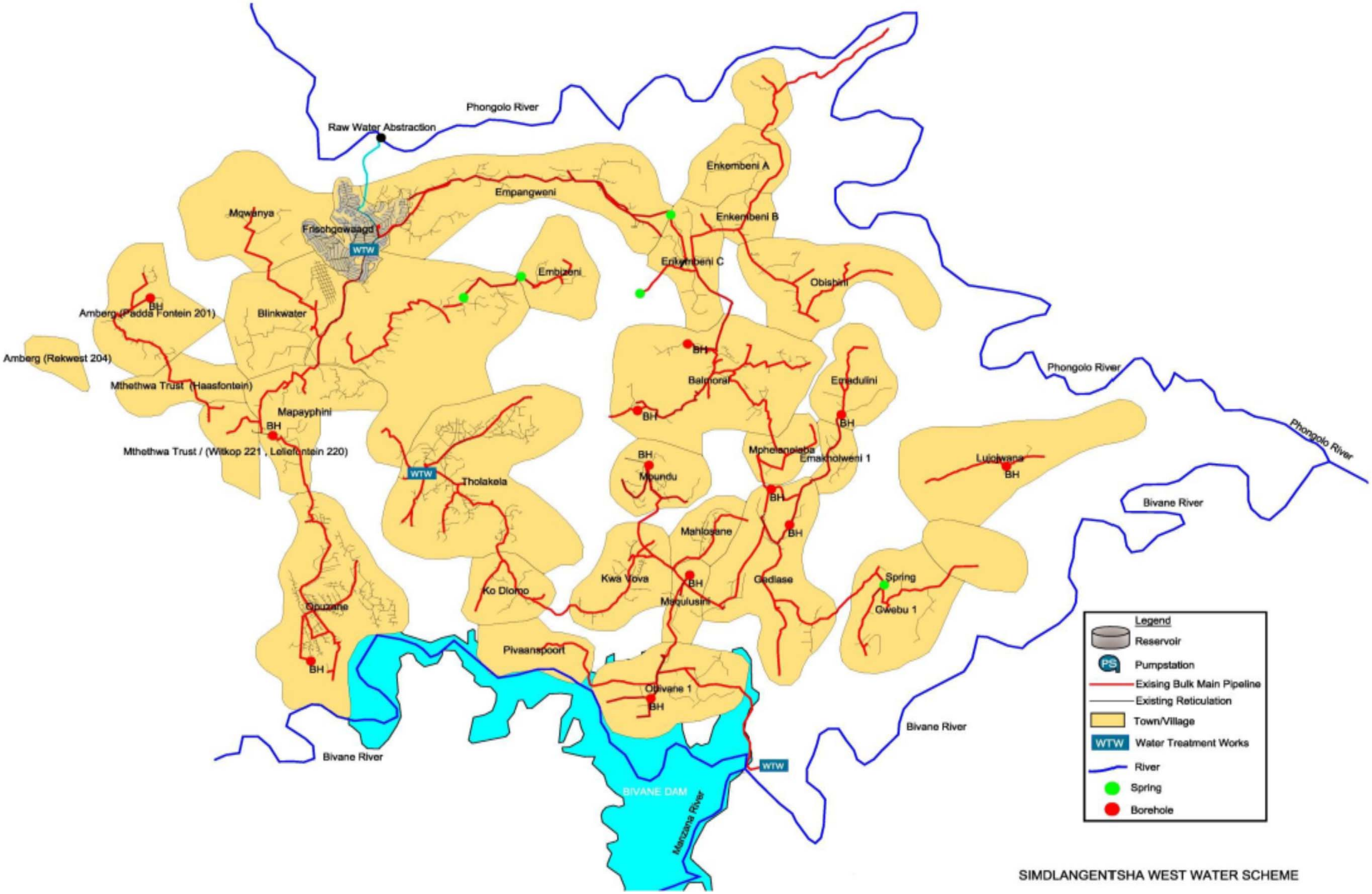


Figure 17 - Schematic layout of Simdlangentsha West Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Simdlangenthsha Water Supply Scheme Area-Edumbe Local Municipality, 2011)

5.3.1.12 Nongoma Water Supply Scheme (Nongoma LM)

(Source: First Stage Reconciliation Strategy for Nongoma Water Supply Scheme Area - Nongoma Local Municipality, 2011)

Nongoma WTW is supplied from the Vukwana Dam which is located to the south of the water treatment works in the Vuna River, a tributary of the Black Mfolozi River (see figure below). Raw water supply for the Nongoma WTW is pumped from the abstraction works at the Vukwana Dam through a raw water pumping main to the Nongoma WTW located near the Vuna River. The maximum capacity of the raw water supply main from the dam to the treatment works is however unknown.

The other treatment works is Osingisingini WTW, which supplies the communities south of the town. This treatment works is supplied with raw water from Nhlekisa River where it is pumped to the works. The maximum capacity of the raw water supply main is not known.

The design capacity of the raw water abstraction works for the two treatment works may be sufficient to meet the capacity of the existing water treatment works. However, the capacity of the bulk water infrastructure from the two plants cannot meet the current and future raw water abstraction requirements of Nongoma (Vuna) Water Supply Scheme, as the scheme is extended to supply the areas currently not being serviced or with limited borehole capacity (see Figure 18). Currently the outlying villages are supplied by boreholes, which in some cases do not meet the basic levels of service of 25 l/c/d. The Nongoma and Osingisingini WTW are the main source of treated or potable water supply to the area, although groundwater is supplied to the outlying rural communities.

The total peak hydraulic design capacity of the Nongoma and Osingisingini WTW is estimated to be 4.5 ML/d. The average annual flow rate of the treatment works is estimated to be 3.5 ML/d. The quality of the water resources of the Vuna River is not known. However, because of land use activities the quality of the raw water, particularly turbidity, is likely to be deteriorating. The geology and the topography of the area are such that there is some potential for groundwater development. Currently there is supplementary groundwater use which has not been registered for the Nongoma (Vuna) Water Supply Scheme area. There are no reported water quality problems associated with the groundwater.

The schematic layout of the infrastructure to supply treated water from the Nongoma (Vuna) Water Supply Scheme area for residential and non-residential consumption in the township and surrounding communities is shown in the Figure 18.

The 2008 average treated water production for the Nongoma (Vuna) Water Supply Scheme area is 6.39 ML/d (2.33 million m^3/a). The current raw water abstraction from the tributaries of the Black Mfolozi River, was estimated to be 7.27 ML/d (2.65 million m^3/a), assuming water losses from the raw water abstraction works, pumping main as well as the treatment water losses.

A review of the WARMS database, indicated that the total registered water use for municipal water use for the Nongoma town and surrounding areas is 1.59 million m^3/a. There is also groundwater use in the Nongoma (Vuna) Water Supply Scheme area but this is not registered.

Water Treatment Works

The Nongoma and Osingisingini WTW are the main sources of treated of potable water supply to the area, although groundwater is supplied to the outlying rural communities. The total peak hydraulic design capacity of the Nongoma and Osingisingini WTW is estimated to be 4.5 ML/d. The average annual flow rate of the treatment works is estimated to be 3.5 ML/d.

Treatment Work Name	Type of plant	Raw water source	Hydraulic design capacity (ML/d)	Average flow rate (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Vuna WTW	Conventional treatment	Vuna River	4.50	3.46	4.85	140%
Osingisingini WTW	Filtration	Nhlekisa River	0.06	0.04	0.10	225%
Total			4.56	3.51	4.95	141.3%

Table 21 - Water Treatment Works Nongoma in operation in Nongoma area

(Source: First Stage Reconciliation Strategy for Nongoma Water Supply Scheme Area - Nongoma Local Municipality, 2011)

The Nongoma WTW is conventional treatment plant comprising of the following process components:

(i) *Flocculation channels*: The raw water is supplied by pumping from the Vukwana Dam. Chemicals are added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs;

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater;

(iii) *Rapid gravity filtration*: The clarified water is then filtered through a set of rapid gravity filters as a final polishing before chlorination of the treated water;

(iv) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks where chlorination takes place, before pumping the water to the command reservoir in the Nongoma (Vuna) Water Supply Scheme area for distribution.

The Osingisingini WTW is a filtration plant where water is filtered through a set of rapid gravity filters before chlorine is added in the chlorine contact tank. From there, the treated water is the pumped to the service reservoir in Emanqomfini village for distribution.

The average annual flow rate of the water treatment works is insufficient to meet the immediate future treated water requirements of the scheme in the immediate future. Currently the scheme is supplemented with groundwater in some of the communities which are not reticulated as indicated in Figure 18.

It is not known whether there are any water quality problems in the Vuna River catchment. However due to the land use practices in the catchment, the Vukwana Dam may be silting up which affects the storage requirements to meet the current and future raw water requirements particularly during the low flow periods.

Treated Water Bulk Supply Infrastructure
The treated water from the Nongoma and Osingisingini WTW is pumped from the clearwater tanks to the service reservoirs in the various villages making the scheme from which the potable water is then distributed into scheme area (see Figure 18).

The capacity of the treated bulk water supply is insufficient to meet current water requirements of the area at the current operating practices of the scheme area.

Bulk Storage
The Nongoma (Vuna) Water Supply Scheme area has a total service reservoir storage capacity of 12 ML (see figure below) ranging from 0.5ML to 5ML reinforced concrete reservoirs.
The service storage capacity provides for a 1.9-day or 45-hour storage based on the current treated water production, but in summer months this reduces to approximately 1.3-day storage or a 30-hour capacity, based on present water requirements (see Table 22).

The reservoir storage capacity of the Nongoma (Vuna) Water Supply Scheme area is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required in the immediate and long term future to meet the current and future summer peak requirements.

Parameters	Nongoma (Vuna) Water Supply Scheme area
Total Storage capacity (ML)	12
Storage Ratio on present annual average consumption (Hours)	45
Storage Ratio on present average peak week consumption (Hours)	30

Table 22 - Service Storage Reservoirs in Nongoma Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Nongoma Water Supply Scheme Area - Nongoma Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted with regards to Vuna WTW:

List of emergency work

The plant is in a very good condition and no immediate work is required.

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Investigate the condition of the sand filter media and replace if necessary.
- General maintenance and building repair work including painting etc.
- General refurbishment work on packaged plant to enable operation of plant, including but not limited to: Replacement of Lamella packing/honeycomb in settlers (a small portion is damaged)
- General upgrading and maintenance work including corrosion protection, sandblasting and painting).

List of medium to long term improvements

No long term improvements are required.

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted with regards to Osingisingini WTW:

List of emergency work

It is recommended that the following emergency work be carried out:

- Install new dosing systems for sodium hypochlorite and polymer/coagulant

List of short term interventions

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir
- Supply a shelter for staff and mobile toilet or pit latrine.
- Supply galvanised access ladders
- Installation of a new packaged water treatment works to increase capacity to 185 m^3/day. A packaged plant could make use of the existing sand filter and supplement this with additional sedimentation process. A detailed plant assessment and investigation will be required to optimise the plant and ensure an integrated design.

List of medium to long term improvements

No medium or long term improvements are required.

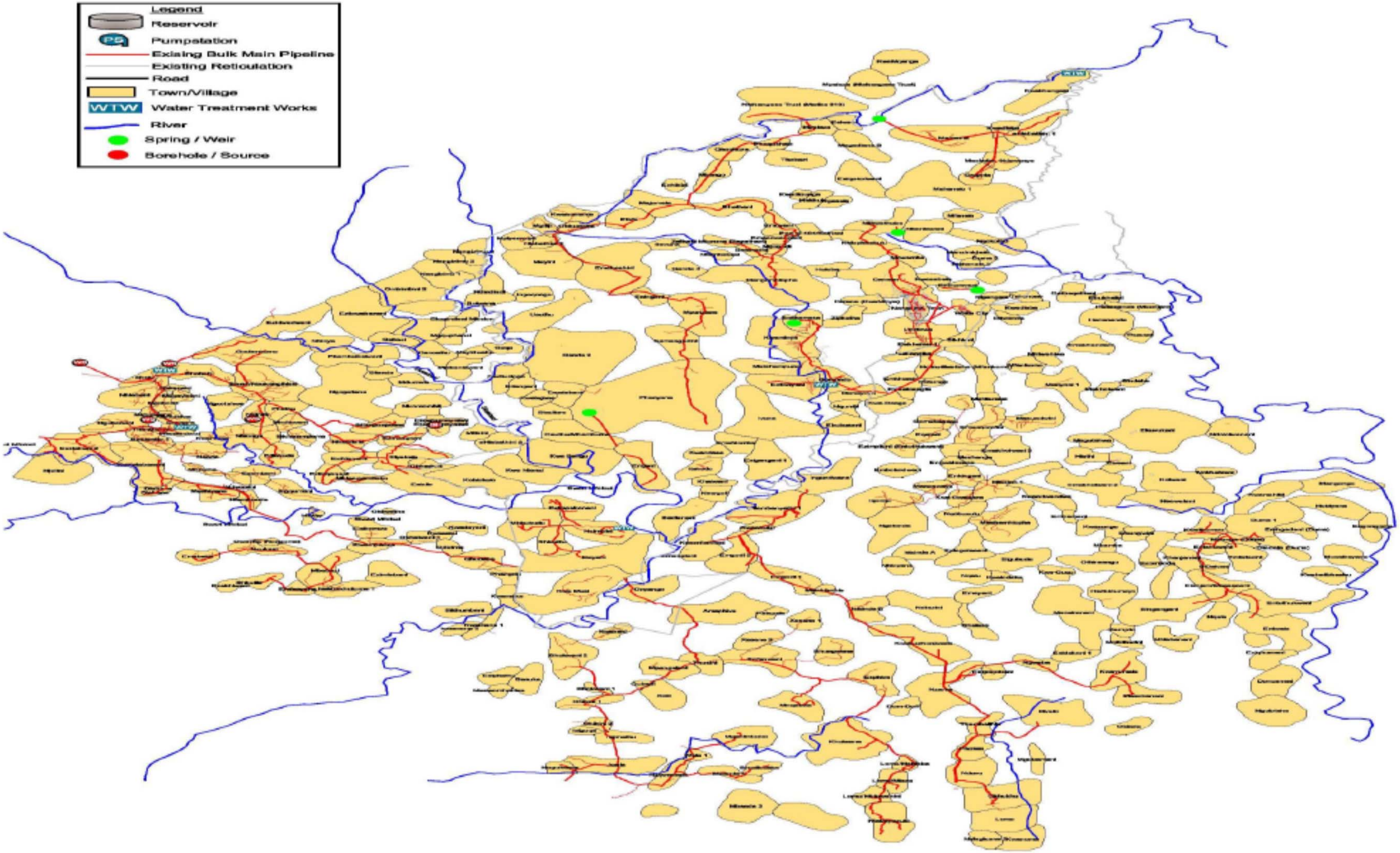


Figure 18 - Schematic layout of Nongoma Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Nongoma Water Supply Scheme Area -Nongoma Local Municipality, 2011)

5.3.1.13 Paulpietersburg Water Supply Scheme (Edumbe LM)

(Source: First Stage Reconciliation Strategy for Paulpietersburg Water Supply Scheme Area – Edumbe Local Municipality, 2011)

The main source of water supply for the Paulpietersburg Water Supply Scheme is the Dumbe Dam situated in the headwaters of the Egoda River, a tributary of the Phongolo River in quaternary catchment W42D. The registered municipal water use for the Paulpietersburg Water Supply Scheme from the system comprising the Dumbe Dam, is 0.53 million m^3/a according to the WARMS records. There are no other downstream users that depend on Dumbe Dam.

The water allocation for this scheme is registered in the name of Edumbe Local Municipality which is the Water Service Provider (WSP). As Zululand District Municipality is the WSA, the registered water use for the scheme should be transferred to the District Municipality. There are no known water quality problems at the Paulpietersburg WTW. The quality of the resource upstream of the Dumbe Dam is appears to be of a good quality because of the limited land use, with the exception of commercial forestry. It is not known whether there are any water quality problems downstream of Dumbe Dam in the Phongolo River.

The geology and the topography of the area are such that there is limited potential for significant groundwater development.

Currently there is no groundwater use which has been registered for the Paulpietersburg Water Supply Scheme area. There are no reported water quality problems associated with the groundwater.

The schematic layout of the infrastructure to supply treated water from the Paulpietersburg Water Supply Scheme for residential and non-residential consumption in Paulpietersburg and Edumbe Township is shown in Figure 19.

The main source of domestic water supplies to Paulpietersburg and Edumbe Township is the Paulpietersburg WTW. The Dumbe Dam situated just over 1km south west of the town was built in 1961 to supply domestic water supply to Paulpietersburg and Edumbe Township.

The 2008 average treated water production for Paulpietersburg and the surrounding areas is 2.7 ML/d (1.0 million m^3/a). The current raw water abstraction from the Edumbe Dam, was estimated to be 3.0 ML/d (1.1 million m^3/a) assuming water losses in the raw water abstraction works and pumping main as well as the water treatment losses.

A review of the WARMS database indicated that the registered municipal water use for the town of Paulpietersburg and Edumbe township is 0.53 million m^3/a (0.87 ML/d). The current registered water use is insufficient to meet the current raw water abstraction requirements for the Paulpietersburg WTW, although the firm yield of the dam is sufficient to meet the current raw water abstraction requirements. However, this is insufficient to meet the future raw water requirements, depending on the actual increase in water requirements.

Water Treatment Works

The Paulpietersburg WTW is the only plant which supplies treated water to the Paulpietersburg Water Supply Scheme area. The total peak hydraulic design capacity of the Paulpietersburg WTW is 3.5 ML/d. The average annual capacity of the WTW is estimated to be 2.7 ML/d. The average annual capacity of the WTW is insufficient to meet the immediate water requirements of the Paulpietersburg Water Supply Scheme area.

The Paulpietersburg WTW is a conventional treatment plant comprising of the following process components:

(iii) *Flocculation channels*: The raw water is supplied by pumping from the Dumbe Dam with chemicals added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs;

(iv) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater;

(v) *Rapid gravity sand filtration*: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water;

(vi) *Chorine contact tank*: The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoir in the Paulpietersburg Water Supply Scheme area for distribution.

Treated Water Bulk Supply Infrastructure

The treated water from the Paulpietersburg WTW is pumped from the clearwater tank at the plant to the main service reservoirs in Paulpietersburg. These, together with the elevated tank in Edumbe Township, have a total storage capacity of 5 ML. The capacity and the treated water bulk supply is insufficient to meet current water requirements of the Paulpietersburg Water Supply Scheme area. The bulk water is then distributed to the various supply areas in Paulpietersburg town and Edumbe Township (see Figure 19).

Besides the clearwater pump station there is also a pump station which pumps water from the main reservoir in Paulpietersburg to an elevated tank supplying the low pressure sections of Edumbe township. All pumping systems have standby capacity.

Bulk Storage

The Paulpietersburg Water Supply Scheme area has a total service reservoir storage capacity of 5 ML, including the smaller reservoirs supplying the various water supply areas of Paulpietersburg town and Edumbe Township. From the service storage reservoirs water is distributed throughout the various water supply areas of the scheme.

In order to determine whether the service storage capacity is sufficient, a peaking factor of 1.5 has been used on the treated water production. The service storage capacity provides for 1.9-day or 46-hour storage, based on the current treated water production, but in summer months this reduces to approximately a 30-hour or 1.3-day storage capacity based on present water. (See Table 23).

The reservoir storage capacity of Paulpietersburg is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required immediately to meet the current and future summer peak requirements.

Parameters	**Paulpietersburg Water Supply Scheme Area**
Total Storage capacity (ML)	5
Storage Ratio on present annual average consumption (Hours)	46
Storage Ratio on present average peak week consumption (Hours)	30

Table 23 - Service Storage Reservoirs in Paulpietersburg Water Supply Scheme area

(Source: First Stage Reconciliation Strategy for Paulpietersburg Water Supply Scheme Area – Edumbe Local Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted.

<u>Emergency Work Required</u>

There is no true emergency work required at this plant. The works is coping with the required demand and is producing water of the required quality. The plant has a neglected appearance but is in adequate condition to continue operating, provided refurbishment is not unduly delayed. However the chlorination facilities are barely adequate and should be given early priority in the short term, as well as the construction of a third filter which is also urgent.

<u>Short Term Improvements</u>

The following work is recommended to be carried out in the short term:

- The chlorine house needs major refurbishment. There should be four cylinders in the chlorine room connected in pairs with an auto-changeover valve, and this room should be suitably vented. There should also be two complete chlorinators (duty + standby) with interconnection, so that either float tube or control can be used with either booster pump or ejector. These should be housed in a separate room. The installation should have all the required safety devices including a self-contained breathing apparatus.

- The chemical house requires that old equipment be stripped out and removed. New equipment for coagulant dosage comprising day tanks with manifolds connecting to duty and standby dosage pumps, as well as a new lime feeder are necessary. Also the streaming current dosage control device should be repaired or replaced
- The head of works (Inlet works) requires removal of redundant equipment and installation of new coagulation and flocculation facilities. A new flowmeter should also be installed
- The rapid gravity filters are functioning and the filtered water appears to be of a good clarity despite the presence of cracks in the media and possible mudballing. Construction of a third filter as per existing is recommended which will raise plant capacity and put the units into balance. As part of this project the existing filters should be taken off line one by one and refurbished with new nozzles and media if necessary. All valves, blowers and pumps should be checked, and refurbished or replaced if necessary.
- Access control appeared to be quite relaxed. This, together with site security, should be investigated, and the gates and boundary fencing should be repaired or renewed to render the site secure.
- The appearance of the plant equipment and buildings would be much improved with cleaning and a complete re-painting.

Longer Term Upgrading – After the short term upgrading has been carried out there would not appear to be any pressing need to extend the capacity of the works. The plant is a compact design which does not lend itself to piecemeal extension readily. For future capacity increases it might therefore be appropriate to build a second works alongside the existing. As long as the golf course can utilize the backwash water and sedimentation tank underflow there is also no great need to design and construct sludge disposal facilities. A second Water Treatment works will be required over the long term. The works should be able to treat at least an additional 3 ML/day.

Figure 19 - Schematic layout of Paulpietersburg Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Paulpietersburg Water Supply Scheme Area-Edumbe Local Municipality, 2011)

5.3.1.14 Msibi Water Supply Scheme (Simdlandentsha Central) (Uphongolo LM)

(Source: First Stage Reconciliation Strategy for Msibi Water Supply Scheme Area-Uphongolo Municipality, 2011)

The main source of water supply for the Simdlangentsha Central (Msibi) Water Supply Scheme area is the Msibi weir in a tributary of the Mozana River. There are also some small weirs on tributaries of the Mozana River in certain of the communities.

The quality of the water resources of the Mozana River is not known. However because of land use activities the quality of the raw water, particularly turbidity, is likely to be deteriorating.

The geology and the topography of the area are such that there is limited potential for significant groundwater development. Currently there is supplementary groundwater use which has not been registered for the Simdlangentsha Central (Msibi) Water Supply Scheme. There are no reported water quality problems associated with the groundwater.

The schematic layout of the infrastructure to supply treated water from the Simdlangentsha Central (Msibi) Water Supply Scheme area, for residential and non-residential consumption in the township and surrounding communities, is shown in the Figure 20.

The Simdlangentsha Central (Msibi) Water Supply Scheme is supplied by the Msibi WTW as well as some groundwater. The Msibi weir, situated in the tributary of the Mozana River to the north east of Msibi, was built to supply domestic water supply for the township and the surrounding communities. Two additional smaller weirs also supply water to areas within the scheme.

The 2008 average treated water production for Msibi and the surrounding areas is 1.51 ML/d (0.55 million m^3/a). The current raw water abstraction from the Mozana River tributary, was estimated to be 1.67 ML/d (0.61 million m^3/a), assuming water losses from the raw water abstraction works, pumping main as well as the treatment water losses.

A review of the WARMS database indicated that there is no registered water use for municipal water use for the Msibi Township and surrounding areas. The only registered water use according to the WARMS database is that of Belgrade Water Supply Scheme which is a total of 1.23 million m^3/a, comprising of 0.94 million m^3/a from a weir in the Mozana River and 0.29 million m^3/a from a tributary of the Mozana River traversing Belgrade.

Water Treatment Works

The Msibi WTW is the main source of treated or potable water supply to the area although groundwater is supplied to the outlying rural communities. The total peak hydraulic design capacity of the Msibi WTW is estimated to be 2.0 ML/d. The average annual flow rate of the plant is estimated to be 1.3 ML/d.

The average annual flow rate of the water treatment works is insufficient to meet the immediate treated water requirements of the scheme. Currently the scheme is supplemented with groundwater in some of the communities which are not reticulated as indicated in Figure 20.

Treatment Work Name	Type of plant	Raw water source	Hydraulic design capacity (ML/d)	Average design capacity (ML/d)	Treated water production (ML/d)	Current utilisation (% of average design capacity)
Msibi WTW	Convention al treatment	Msibi weir	2.00	1.33	1.51	113%

Table 24 - Water Treatment Works in Msibi operation in uPhongola area

(Source: First Stage Reconciliation Strategy for Msibi Water Supply Scheme Area-Uphongolo Municipality, 2011)

The Msibi WTW is a conventional treatment plant, comprising the following process components:

(i) *Flocculation channels:* The raw water is supplied by pumping from the tributary of the Mozana River. Chemicals are added in as the water flows into flocculation channels where coagulation after polyelectrolyte dosing takes place to form the flocs;

(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is frequently removed by de-sludging the tanks and sent to the sludge lagoons where the sludge is dried while the supernatant water is discharged back into the river. The plant was not designed for recycling of the wastewater;

(iii) *Rapid gravity filtration:* The clarified water is then filtered through a set of rapid gravity filters as a final polishing before chlorination of the treated water;

(iv) *Chorine contact tank:* The filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoir in the Simdlangentsha Central (Msibi) Water Supply Scheme area for distribution.

It is not known whether there are any water quality problems in the Mozana River catchment. However due to the land use practices in the catchment, the Msibi weir may be silting up which affects the storage requirements to meet the current and future raw water requirements.

Treated Water Bulk Supply Infrastructure

The treated water from the Msibi WTW is pumped from the clearwater tanks to the service reservoirs in the various villages, from which the potable water is then distributed into the scheme area. There are three main boreholes that are linked to the bulk water supply scheme, which pump into the bulk mains for distribution into the surrounding communities of Newstand, Altona and others, up to Gesi (See Figure 20).

The capacity of the treated water bulk supply system is insufficient to meet current water requirements of the Simdlangetsha Central (Msibi) Water Supply Scheme area at the current operating rules of the town.

Bulk Storage
The Simdlangentsha Central (Msibi) Water Supply Scheme area has a total service reservoir storage capacity of 3 ML (see Table 25).

The service storage capacity provides for a 2.0-day or 48-hour storage based on the current treated water production, but in summer months this reduces to approximately a 32-hour or 1.3-day storage capacity, based on present water requirements (see table below).

The reservoir storage capacity of the Simdlangentsha Central (Msibi) Water Supply Scheme is therefore less than the accepted norm of 48 hours of summer peak requirement for urban areas. This norm has been determined to meet the following requirements:

- balance the fluctuating demands from the distribution system, permitting the source to give a steady or differently phased output;
- provide a supply during a failure or shutdown of the treatment plant, pumps or bulk mains leading to the reservoirs; and
- provide a reserve of water to meet fire and other emergency demands.

Additional service storage capacity is therefore required immediately to meet the current and future summer peak requirements.

Parameters	**Msibi Water Supply Scheme area**
Total Storage capacity (ML)	3
Storage Ratio on present annual average consumption (Hours)	48
Storage Ratio on present average peak week consumption (Hours)	32

Table 25 - Service Storage Reservoirs in Msibi Water Supply Scheme area
(Source: First Stage Reconciliation Strategy for Msibi Water Supply Scheme Area-Uphongolo Municipality, 2011)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted.

List of emergency work
It is recommended that the following emergency work be carried out:
- Install a standby high lift pump to pump to Magiqeni
- Install a submersible pump for raw water abstraction
- Install a standby coagulant dosing system
- Install a dosing system for sodium hypochlorite

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir
- Supply a shelter for staff and mobile toilet or pit latrine.
- Installation of a new packaged water treatment works to increase capacity to 700 m^3/day. A Packaged plant could make use of existing sand filter and supplement this with additional sedimentation processes. A detailed plant assessment and investigation will be required to optimise the plant and ensure an integrated design.

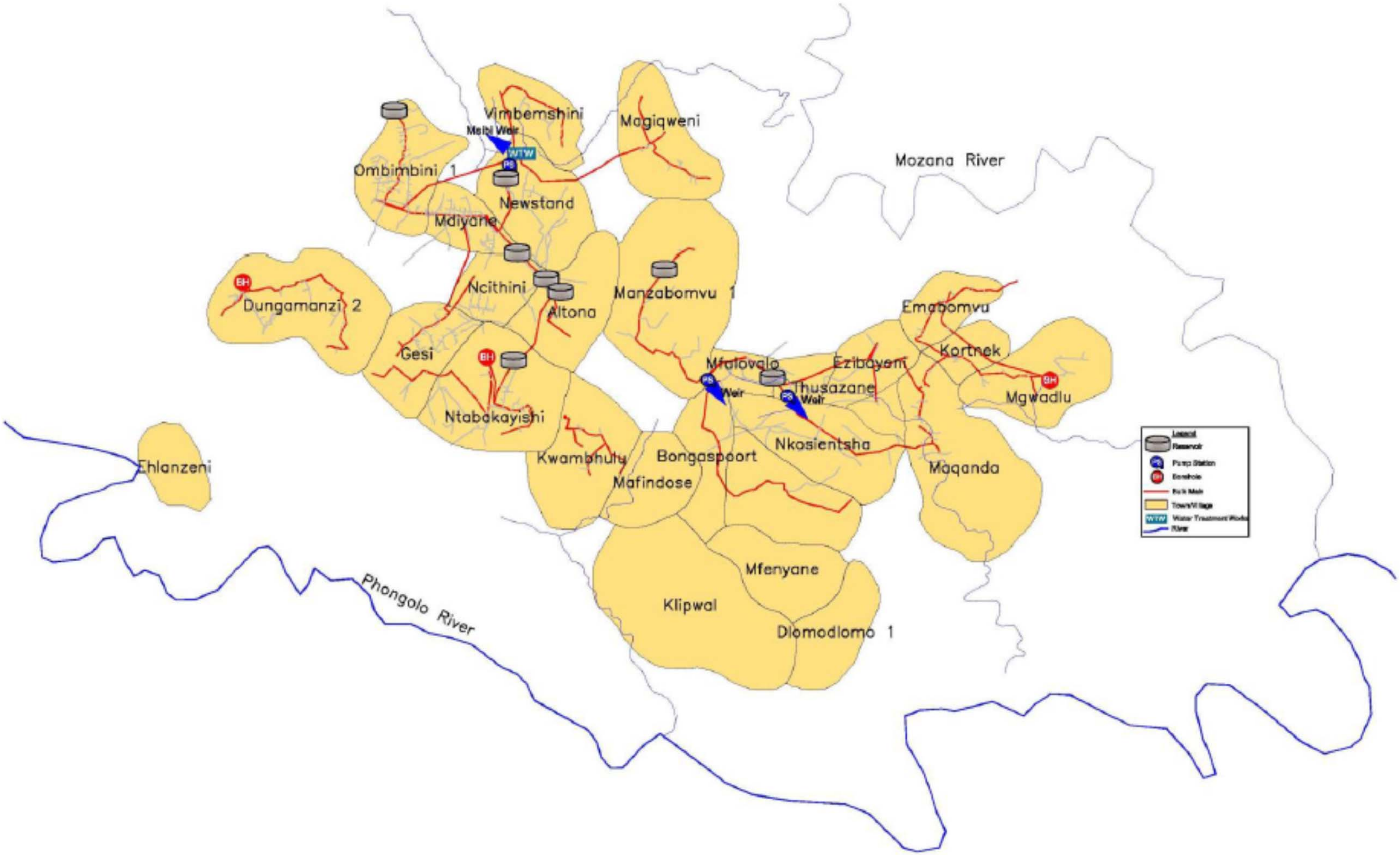


Figure 20 - Schematic layout of Msibi (Simdlangentsha Central) Water Supply Scheme

(Source: First Stage Reconciliation Strategy for Msibi (Simdlangetsha Central) Water Supply Scheme Area -Uphongolo Local Municipality, 2011)

5.3.1.15 Purim (Abaqulusi LM)

According to the ZDM Water Treatment Works Assessments undertaken in 2009 the following information was extracted:

The Purim waterworks is situated South of Vryheid in the Mondlo area. The waterworks draws water from the nearby Mondlo dam.

The works is a package plant and comprises of the following processes:

- coagulant dosage,
- settling and
- filtration.

The treatment capacity is about 240 kl/d (8.3 l/s for an 8 hour operating day).If operation over the full 24 hours is required it is recommended that two more filters similar to the existing be installed.

In future the Purim Water works will not be required, as water will be supplied by Vryheid Water Works to these settlements as part of the Hlahlindlela Regional Water Supply scheme.

The works is new having been built in 2008 and has been designed to recommended criteria. No upgrading is required unless operation for 24h/d is contemplated in which case the filters would need to be upgraded. As the works is only running at about 33%capacity no long term upgrade would be expected, although it would be readily possible to install another package plant alongside.

Current Delivery

Current delivery is approximately 240 kl/d.

Estimated Current Capacity

The estimated current capacity is about 360 kl/d (operating 12 h/d).

Estimated Design Capacity

The works design capacity is 240 kl/d (operating an 8 hour day).

Estimated Capacity with short term Improvements

The estimated capacity with short term improvements is about 360 kl/d (moving from 8 hours operating to 12 h/d).

Estimated Capacity with long term improvements

The works design does not readily lend itself to piecemeal upgrading. However if 24h/d operation is contemplated two additional filters will be required which would raise the works capacity to about 720 kl/d.

Future increases would not be required as treated water will be supplied to Purim from Vryheid Waterworks in future.

Medium to Long Term Improvements
In the long term it is recommended to add two filters to give 24 hour operation.

5.3.1.16 Hlobane (Abaqulusi LM)

Hlobane is situated slightly north east about 25 km from Vryheid on the road to Louwsburg and Pongola. The water works is a conventional process with flocculant dosage, sedimentation, and filtration. However it is unusual in that it comprises elevated steel tanks rather than concrete structures.

The works is not a package plant but all the units are free-standing tanks prefabricated in steel with the larger tanks welded together on site. The incoming water is pumped to the elevated clarifiers from where it flows by gravity to the filters and from there is chlorinated and flows to the treated water sump. It is then pumped again to the high level storage reservoir which is also a steel tank in prefabricated sections.

The existing treatment facility consists of the following unit processes:

(i) *Inlet Works* – There is no formal inlet works. Coagulant (a synthetic polyelectrolyte) is dosed into the main entering the plant but there is no flash mixing via static mixers in the rising main. This is inadvisable as the radial mixing in pipelines is generally poor and is probably leading to dosage variation between the clarifiers. There is also no formal floc conditioning, and the water passes to the clarifiers without proper flow splitting control. The installation of static mixers in the rising main immediately after coagulant dosage, properly designed flow splitting, and a floc column were recommended.

(ii) *Clarifiers*–The water then passes to a six steel circular clarifiers. The tanks appeared to be in reasonable condition but draining and an internal inspection of each unit would be advisable.

(iii) *Filters* –After settling, the water is filtered in four 3.5 m diameter circular rapid gravity filters.

(iv) *Disinfection* –The water is then chlorinated with gas chlorine and discharged. However the installation does not comply with the recommendations for gaseous chlorine which is regarded as a major hazard installation. As it is an urban area it would be prudent to comply with the general requirements. It is recommend two cylinders in the chlorine room connected with an auto-changeover valve, and this room should be suitably vented. There should be two complete chlorinators (duty+ standby), and these should be housed in a separate room. The installation should have all the required safety devices including a self-contained breathing apparatus.

(v) *Sludge* –The works is provided with three sludge dams or beds each 1 0 x 5 m or 150 m^2 in total. Assuming 50 mg/1 of suspended solids in the raw water for a flow of 3 ML/d it was estimated that a sludge drying area of 150m_2 would give about a 15 day turnover. This is probably adequate as the suspended solids would usually be lower than assumed.

The works is old and needs major refurbishment. The high level final reservoir is quite badly corroded and failure of this unit would have serious consequences as the town would have no water supply. The alternative discussed at the time of inspection of pressurising the main with transfer pumps may be the simplest solution. All pumps and blowers should be inspected and refurbished or replaced as necessary as well as the upgrade on the chlorine system.

Current Delivery

The plant is treating an average of about 1.6 to 2 ML/d.

Estimated Current Capacity

The works is limited by the clarifiers to about 4 to 4.5 ML/d capacity. The filters have a similar capacity.

Estimated Design Capacity

The original works design capacity is about 3.6ML/d.

Estimated capacity with Long Term Improvements

Capacity increases would entail major extensions to the works with a new inlet works, clarifiers, and filters, as well as further upgrading of the chemical dosage systems. The site is fairly restricted and it might be preferable to build another works at a suitable point if this ever proves necessary

Emergency Work Required

The works is in urgent need of either having a new high level reservoir constructed, or being provided with a pump station to pressurise the reticulation system. These are presented as alternatives.

Medium to Long Term Upgrading

Capacity increases would entail major extensions to the works with a new inlet works, clarifiers, and filters, as well as further upgrading of the chemical dosage systems. The site is fairly restricted and it might be preferable to build another works at a suitable point if this ever proves necessary.

The ZDM water treatment works assessment indicates that the water demand is no longer near the capacity of the works and that capacity upgrading will probably not be necessary in the foreseeable future.

5.3.1.17 Louwsburg (Abaqulusi LM)

Louwsburg is situated roughly east of Vryheid and about 70 km from Vryheid on the road to Pongola. The town is a small country town and is formally laid out.

The water works is a conventional process with flocculant dosage, sedimentation, and filtration. However it is unusual in that it comprises an elevated steel tank for sedimentation and pressure filters, rather than concrete structures

Current Delivery

The plant is treating an average of about 600 to 720 kl/d.

Estimated Current Capacity

The works is limited by the clarifiers to about 720 kl/d capacity. The filters have a similar capacity.

Estimated Design Capacity

The original works design capacity is not known but was probably about 600 kl/d.

Estimated Capacity with Short Term Improvement

The works is having difficulty in coping with the present demand and we were given to understand that the demand may increase further. It is therefore necessary to extend the works in the short term. The present plant is out-dated,and in somewhat run-down condition and has a number of shortcomings. Due to the untidy layout it would be difficult to extend it whilst maintaining production. The ZDM WTW assessment recommends the installation of a package plant alongside the existing works which if properly designed would eliminate the shortcomings existing at present. It was also recommended that the chlorine installation be upgraded to comply with all applicable safety standards. This could readily be incorporated into the proposed package plant.

Estimated capacity with Long Term Improvements

The installation of a package plant in the short term would cover the long term requirements as well. The capacity of the raw water dams should be investigated and the possibility of upgrading and increasing the capacity of the raw water dams should be investigated in future. A water loss management system should also be implemented.

Emergency Work Required

It is recommended that the chlorine installation be upgraded to comply with all applicable safety standards.

Short Term Upgrading

In the short term it is recommended to install a package plant of 1 ML/d capacity.

Long Term Upgrading

In the long term a second package plant could be added to operate in parallel with the existing unit.

5.3.1.18 Coronation (Abaqulusi LM)

Coronation is situated east and about 40 km from Vryheid on the road to Louwsburg and Pongola. The water works is a conventional process with flocculent dosage, sedimentation, and filtration. However the plant is in poor condition and not all units are functional.
This Water Treatment Works will supply both Coronation and Khambi Regional Water Supply Schemes (8MI/day). The sustainability of the Boulder Dam (Coronation Dam) must be investigated

The works is a conventional plant with concrete tanks. The incoming water is pumped to an elevated storage tank from where it overflows to an elevated clarifier and then flows via gravity to the elevated rapid gravity filter. From there the water is chlorinated and flows to the treated water reservoir.

The works is old and needs major refurbishment. The filter is in need of emergency repair and the chlorine house needs upgrading. The clarifier should be drained and inspected and the dosing equipment properly designed with adequate flash mixing and flocculation facilities.

Current Delivery
The plant is treating an average of about 400 kl/d

Estimated Current Capacity
The works is limited by the clarifier to about 2 ML/d capacity. The filter has a similar capacity.

Estimated Design Capacity
The original works design capacity is approximately 8 ML/d.

Estimated Capacity with Short Term Improvement
Coronation village is no longer an active mining village and the population would appear to be only a fraction of its previous level. The focus therefore should be on securing reliable and efficient operation rather than extending works capacity. The only filter, which is a rapid gravity unit, has blown its floor and is non-functional. As an emergency intervention it is necessary to repair this unit. At present unfiltered (partially treated) water is entering the reticulation system. In the short term the assessment reports undertaken by ZDM also recommend refurbishing the clarifier. A proper floc conditioning facility would need to be constructed before the clarifier. At the end of this exercise the plant capacity would still be about 2 ML/d. It is also recommended that the chlorine installation be upgraded to comply with all applicable safety standards.

Estimated capacity with Long Term Improvements
Capacity increases would entail major extensions to the works with a new inlet works, clarifier, and filter, as well as further upgrading of the chemical dosage systems. This Water Treatment Works will supply Coronation Regional Water Supply Scheme with water in future (7MI/day) and also the Khambi Regional Water Supply Scheme (1 ML/day)**. A m**ajor extension to the existing Water Treatment Works will be needed.

Emergency Work Required

The works, particularly the rapid gravity filter, which at present is off line with unfiltered water entering the reticulation system, is in urgent need of repair.

Short Term Upgrading

In the short term a recommendation was made to construct a proper inlet works with flash mixing and a floc tower, as well as refurbishment of the clarifier. At the end of this exercise the plant capacity would still be about 2 ML/d. It was also recommended that the chlorine installation be upgraded to comply with all applicable safety standards. The works is also in somewhat of a run-down state and refurbishment of buildings and security (fencing) would also be necessary.

Medium to Long Term Upgrading

Capacity increases would entail major extensions to the works with a new inlet works, clarifier, and filter, as well as further upgrading of the chemical dosage systems.

5.3.1.19 Ophuzane (Edumbe LM)

The waterworks draws its water from a perennial stream and provides minimal treatment.
The plant is in a relatively inaccessible position at the bottom of the river valley.
Access road improvements would be necessary if any significant upgrading with chemical dosage were to be undertaken. The scope to increase the capacity of the works is limited by the rising main line. The rising main line is limited to 6 l/s. If the capacity of the works is to be increased the rising main will also have to be upgraded. In future treated water will be supplied from Frichgewaagd Water Works to Opuzane.

The works consists of a small building and a reservoir. Two positive displacement pumps deliver water from the river at 1500 Kpa to the service reservoir which is remote from the works and entails a high lift. The water in the rising main is dosed with sodium hypochlorite for disinfection purposes. The works was operating at 6 l/s or approximately 500 kl/d at the time of inspection. Increased capacity would be limited by the rising main and KVA of the income supply. According to the ZDM WTW assessments, the sodium hypochlorite dosing pump appeared to have spare capacity but would not be expensive to replace if necessary. The water is only chlorinated and can therefore be expected to have a higher than desired turbidity for much of the time. If the water quality were required to be improved, another set of pumps would be necessary as the delivery pressure would be too high for pressure filters.

Current Delivery

Current delivery is about 500 kl/d

Estimated Current Capacity

The plant operates continuously so that the current capacity is also about 500 kl/d.

Estimated Design Capacity

The works is operating at its design capacity of 500 kl/d

Estimated Capacity with Short Term Improvements

If an improvement in water quality is desired it would be necessary to add a pressure filter and two transfer pumps.

Estimated Capacity with Long Term Improvements

The scope to increase the capacity of the works is limited by the rising main line. The rising main line is limited to 6 l/s. In future treated water will be supplied from Frichgewaagd Water Works.

Short Term Improvements

The short term interventions include:

- Installation of pressure filtration
- Minor capacity upgrade

Long Term Improvements

Upgrade using Package Plant

5.3.1.20 Khambi (Abaqulusi LM)

Khambi is situated east and about 60 km from Vryheid on the road to Nongoma.
The area is a rural settlement and is provided with a water works of recent construction. The water works is a conventional process with flocculant dosage, sedimentation, and filtration. It is of good recent design with proper flash mixing and flocculation facilities, and is still in good condition. In future water would be supplied from Coronation Regional Water Supply Scheme to the Khambi area and the Khambi treatment works will only be used for emergency supply.

Current Delivery

Current delivery is about 200 kl/d.

Estimated Current Capacity

The estimated current capacity is about 400 kl/d (operating 12 h/d) and 850 kl/d (continuous).

Estimated Design Capacity

The works design capacity is 720 kl/d (operating 24 h/d).

Estimated Capacity with Short Term Improvement

The works design does not readily lend itself to piecemeal upgrading. However if demand increases and 24 h/d operation is contemplated the addition of one more filter would increase the works capacity to about 1100 kl/d.

Estimated Capacity with Long Term Improvements

Future increases in capacity would depend on the assured yield of the source. The works layout also does not lend itself readily to extension.

Short Term Improvements

There are no short term improvements necessary.

Medium to Long Term Improvements

In the medium to long term, and depending on water demand, an additional filter will be required to raise the works capacity to approximately 1100 kl/d. The additional capacity would however only be available during the wet weather periods as flow in the Kwamtanzi River (source) is limited during dry periods. In future water would be supplied from Coronation Regional Water Supply to the Khambi area.

5.3.1.21 Mountain View (Abaqulusi LM)

Mountain View is situated east and about 80 km from Vryheid on the road to Nongoma. The works serves a clinic, schools and small settlement. The water works is an in-line filtration process with high lift pumps from the river to a raw water storage tank. It is then dosed with a flocculant and sodium hypochlorite and passed through a pressure filter to a clean water storage tank.

Current Delivery

Current delivery is estimated at about 30 to 50 kl/d.

Estimated Current Capacity

It appears that the plant operates on day shift only so that the current capacity is about 80 kl/d. Over 24 hours it would be about 200 kl/d.

Estimated Capacity with short term Improvements

If there is pressure on the works capacity and assuming the present water quality is acceptable it would be possible to install a second pressure filter and double the plant capability. If an improvement in water quality is desired it would be necessary to add coagulant dosing. This could be done for the present or the upgraded capacity.

Estimated Capacity with long term improvements

Future increases in capacity would depend on the assured yield of the river. Assuming this is adequate, it may be necessary to build a weir or small dam for better assurance of supply. Further upgrade could then consist of additional pressure filtration, with or without chemical dosage, followed by chlorination. Ultimately, if the catchment deteriorates, clarification may also be necessary. All of this could be accomplished readily simply by installation of a package plant. The works capacity could be raised to the desired level quite readily.

Estimated Capacity with short term Improvements

If there is pressure on the works capacity and assuming the present water quality is acceptable, it would be possible to install a second pressure filter and double the plant capability. The raw water transfer pump would be adequate for this. If an improvement in water quality is desired it would be necessary to add coagulant dosing. This could be done for the present or the uprated capacity.

Medium to Long Term Improvements

The treated water from the works is of fair quality although the turbidity and colour could be above the Class 1 limits on occasions. If compliance is required, it would be necessary to install optional chemical dosing for in-line filtration. A second filter should be installed only when the existing spare capacity has been fully utilised. The coagulant dosing would only be added if the treated water quality becomes unsatisfactory.

5.3.1.22 Nkosentsha Water (Uphongolo LM)
(Source: Nkosentsha Water Treatment Works, Technical Assessment Report, 2009)

Nkosentsha WTW supplies potable water to approximately 5475 people. It has a capacity of 0.13 ML/d and receives raw water from an unnamed tributary of the Pongola River. The expected future population in 2030 is estimated at 6883, resulting in a total demand of approximately 0.5 ML/d.

The existing treatment facility consists of the following unit processes:

(i) *Raw water abstraction* – raw water is pumped from the weir in the Speekboom River using a dedicated raw water pump.

(ii) *Coagulation* – as the raw water enters the plant the coagulant is dosed into the raw water and coagulation is enhanced by means of hydraulic mixing in a baffled channel that feeds the flocculation basin. The plant is equipped with a single dosing facility.

(iii) *Flocculation* – Flocculation occurs immediately after coagulation and flocs are formed by slow mixing of coagulated raw water. The inlet column in the center of the sand filter serves as flocculation basin.

(iv) *Sand filtration* – Flocculated water flows to the sand filter where all the flocs and suspended particles are removed physically by straining through the filter bed. Gravity filtration in a round concrete sand filter is employed to remove the particulates.

(v) *Disinfection* – Chlorine tablets are used to disinfect the treated water.

(vi) *Distribution* – Treated water is temporarily stored in a treated water reservoir from where it is distributed to the community.

Current flow

The current flow was estimated based on the supply data given as 130 m^3/day.

Estimated design capacity

The maximum processing capacity of the existing plant is 130 m^3/day.

Estimated current capacity

130m^3/day

Estimated capacity with short term improvements

430m^3/day

Estimated capacity with long term improvements

No long term improvements required.

List of emergency work

It is recommended that the following emergency work be carried out:

- Install a new high lift pump for potable water
- Install a new raw water pump
- Install a dosing system for sodium hypochlorite
- Replace the existing water meter that is not in a working condition

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir
- Supply a shelter for staff and mobile toilet or pit latrine.
- A new standby pump shelter is required
- Supply galvanised access ladders
- Supply a new diesel generator for plant power
- Installation of a new packaged water treatment works to increase capacity to 300 m^3/day. A packaged plant can make use of the existing sand filter and supply additional sedimentation processes. A detailed plant assessment and investigation will be required to optimise the plant and ensure an integrated design.

5.3.1.23 Spekboom (Uphongolo LM)

Spekboom WTW is located approximately 25 km west of Pongola and supplies treated potable water to the settlement of Spekboom. Raw water is pumped from the Spekboom River and treatment takes place in a packaged plant consisting of a sedimentation tank and two pressure filters. Treated water is stored in a concrete reservoir on site before it is pumped to the reticulation system.

The existing treatment facility is a package plant. The main components of the existing Works include the following:

- A chemical dosing unit
- One stainless steel flocculation and sedimentation tank
- Two pressure filters
- A pump station
- A clean water reservoir.

Not all water is treated in the packaged water treatment works. The daily treated water requirement is greater than the plant capacity and a portion of the water bypasses the treatment plant and is pumped directly to the reservoirs. Although it seems that an additional chlorine dosing facility exists in the pump station that ensures disinfection of all the water, the inlet water is turbid and requires treatment. Removal of suspended solids reduces the chlorine demand and ensures a safer treated water quality with less regrowth potential in the reservoirs. The plant capacity needs to be increased to ensure treatment of the entire water inventory.

Current flow

The current flow was determined from treated water flow meter readings as varying between 65 and 74m^3/h. This is the total flow from treated water from the packaged plant and river water that bypasses the treatment plant.

Estimated design capacity
The maximum processing capacity of the packaged water treatment works is 50 m^3/h (and dependent on water quality).

Estimated current capacity
50 m^3/h

Estimated capacity with short term improvements
50 m^3/h

Estimated capacity with long term improvements
The capacity can be doubled by installing another similar packaged water treatment works or by installing a smaller packaged treatment plant of 25 m^3/h, to provide the required 75m^3/h to fulfil the daily requirement of approximately 1 780 m^3/day.

List of emergency work
It is recommended that the following emergency work be carried out:
- Pump cage protection to be provided at abstraction point
- Provide an access ladder to the reservoir
- Refurbishment of the valve chamber manhole

List of short term improvements
It is recommended that the following work be carried out in the short term:
- Provide a structure for sanitation on site
- Provide a small shelter building for plant operators
- Install a standby dosing system for coagulant/polymer dosing as well as disinfectant
- Provide sufficient access to the bridge and abstraction pumps
- Increase plant capacity by adding an additional packaged plant sized for 25 m^3/h to provide the required total capacity of 75 m^3/h to fulfil the daily requirement of approximately 1780 m^3/day.

5.3.1.24 Enyokeni Palace (Nongoma LM)

The treatment plant supplies potable water to the settlement of Enyokeni Palace and raw water is abstracted from the Sikwebezi Spring. The existing plant has a reported design capacity of 21.6 kl/day.

The existing treatment facility consists of the following unit processes:
- Raw water abstraction
- Fluoride removal with activated alumina
- Sand filtration
- Disinfection
- Distribution

Current flow
The current flow was estimated based on the design capacity of the plant at 21.6 m^3/day.

Estimated design capacity
The maximum processing capacity of the existing plant is 21.6 m^3/day (and dependent on regeneration time required and working hours of staff).

Estimated current capacity
21.6 m^3/day

Estimated capacity with short term improvements
21.6 m^3/day

Estimated capacity with long term improvements
The capacity of the plant is sufficient to meet future demands.

List of emergency work
It is recommended that the following emergency work be carried out:

- Replace sand filter media
- Replace activated alumina

List of short term improvements – It is recommended that the following work be carried out in the short term:

- Clean and disinfect raw water storage reservoirs
- General maintenance and building repair work including painting etc.

5.3.1.25 Mpungamhlope (Ulundi LM)

Mpungamhlope WTW is situated approximately 22 km north west of the town of Ulundi on the P705 and supplies treated potable water to the urban and rural settlements around Mpungamhlope. The existing plant has a reported design capacity of 633 kl/day and receives raw water from the White Mfolozi River.

The existing treatment facility consists of the following unit processes:

- Raw water abstraction
- Coagulation
- Flocculation
- Sedimentation
- Rapid sand filtration
- Disinfection
- Distribution

Current flow
The current flow was estimated based on meter readings at 633 m^3/day.

Estimated design capacity
The maximum processing capacity of the existing plant is 792 m^3/day.

Estimated current capacity
792m^3/day

Estimated capacity with short term improvements
792m^3/day

Estimated capacity with long term improvements

The capacity will need to be increased to accommodate the future demand. The long term capacity required is 3.9 ML/day.

List of emergency work

It is recommended that the following emergency work be carried out:

- Replace sand filter media
- Install an additional sodium hypochlorite dosing station

List of short term improvements

It is recommended that the following work be carried out in the short term:

- Clean and disinfect storage reservoir
- Supply fencing around the site
- General maintenance and building repair work including painting etc.

List of medium to long term improvements

It is recommended that the following work be carried out in the long term:

- Increase plant capacity for future demand to fulfil the daily requirement of approximately 3.9 ML/day and include sludge handling facilities for complete plant.

5.3.1.26 Sidinsi (Nongoma LM)

The Sidinsi Water Treatment Works is situated east of Nongoma on the road to Hlabisa. Raw water is abstracted from the Mona River. The water is then pumped from the booster installation to the water treatment works. From the WTW the water gravitates to three (3) bulk storage reservoirs and supplies the Sidinsi community.

Emergency Work Required

- Replacement of raw water pump
- Installation and construction of dosing system
- Replacement of bulk meters

Short Term Improvements

- Repair leaking structures
- Raise all structures (manholes) to be at least 200mm above ground
- Construct new chlorine dosing building and storage facility
- Install chlorine dosing facilities
- Construction operators office and toilet
- Cleaning of bulk storage facilities
- Refurbish tank stand at booster installation
- Upgrade abstraction arrangement at river to prevent blocking and ingress of sand and silt and to secure pipes and pumps to prevent wash away and damage to pipes
- Install raw water meter at booster pumpstation arrangement.

Long Term Improvements

The following long term improvements were recommended:

- Upgrade treatment facilities for future demand to include settling and sludge handling facilities
- Replace rudimentary equipment with a packaged water treatment works
- Construction of weir in river

6. RECONCILIATION OF EXISTING AND PROPOSED WATER SUPPLY AND DEMAND OPTIONS

GIS analysis was used to calculate both high and low household counts, as well as high and low population counts, for each potential water supply footprint. While the calculation of the household counts for each area was a simple GIS query, the compilation of population statistics, and the projection thereof, required more detailed analyses.

Household Counts:

Unique ID numbers were given to all the supply areas, which could then be used to link data from other sources. A spatial join was performed on the Eskom 2011 household points falling within each polygon. This gave each household point the unique ID of the footprint polygon in which it fell. This data could then be summarised and a count done of the number of households in each footprint. This count was then added to the water supply footprint attribute table.

Table

hholds_with_UID_pop_growth_hhold_size

Id	DM	UID	GrPA_2	Pop2012	Pop2013	Pop2014	Av_HHSize	OH_Cmmts	HH_2012	HH_2013	HH_2014
111	Zululand	Zululand_1111	0.5	6294.315	6325.786575	6357.415508	16.72		16.8	16.88	16.96
111	Zululand	Zululand_1111	0.5	6294.315	6325.786575	6357.415508	16.72		16.8	16.88	16.96
111	Zululand	Zululand_1111	0.5	6294.315	6325.786575	6357.415508	16.72		16.8	16.88	16.96
111	Zululand	Zululand_1111	0.5	6294.315	6325.786575	6357.415508	16.72		16.8	16.88	16.96
111	Zululand	Zululand_1111	0.5	6294.315	6325.786575	6357.415508	16.72		16.8	16.88	16.96
111	Zululand	Zululand_1111	0.5	6294.315	6325.786575	6357.415508	16.72		16.8	16.88	16.96
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49
858	Zululand	Zululand_858	-0.35	7882.315	7854.726897	7827.235353	3.52		3.51	3.5	3.49

Table 26 - Example of household data with unique footprint identifier Existing Proposed Water Supply and Demand Options

OID	UID	Cnt_UID	Sum_HH_2014
6203	Zululand_15	73	414.35
6204	Zululand_150	22	134.86
6205	Zululand_151	16	98.08
6206	Zululand_152	118	820.03
6207	Zululand_153	102	625.26
6208	Zululand_154	60	417
6209	Zululand_155	134	828.24
6210	Zululand_156	13	81.64
6211	Zululand_157	59	370.52
6212	Zululand_158	19	119.32
6213	Zululand_159	52	321.12
6214	Zululand_16	125	798.75
6215	Zululand_160	18	83.88
6216	Zululand_161	64	299.98
6217	Zululand_162	155	1156.78
6218	Zululand_163	69	515.43
6219	Zululand_164	100	655.92
6220	Zululand_165	114	748.6
6221	Zululand_166	34	188.7
6222	Zululand_167	33	183.15
6223	Zululand_168	29	160.33
6224	Zululand_169	57	283.7
6225	Zululand_17	51	277.44
6226	Zululand_170	66	361.02

Table

footprint_pop_2014

Table 27 - Example of the summarized data for each water supply footprint

These figures were used as the "Low" count, until the "High" count had been calculated. The high count was obtained by extrapolating the growth rate for each ward from the Census 2001/2011 figure through to 2014. This information was obtained using the online Statistics SA Superweb application. Statistics SA was consulted on the best method in achieving these projected calculations. The 89 wards falling within Zululand District Municipality were selected, and the population figures for both 2001 and 2011 were added to the table. These two figures were used to calculate the percentage growth over that ten year period. The result was then divided by 10 to get an average growth rate per annum for each ward.

This growth rate was then applied to the household count for each subsequent year (2012, 2013, 2014), and the result was used to populate the "High" values for both population and number of households in the attribute table. Once the high count had been completed, the two figures could be compared. Where "Low" > "High", the figures were swapped. Since the calculations for high and low demand for water were based on the required million m³ per annum, the number of decimal places in the household count was significant, and the project team made the decision to use two decimal places as the standard throughout.

Population Numbers:

Census 2011 data was used for the population figures. The Supercross programme was used to extract the household sizes and the total population counts for each sub place within the District. The total population was divided by the number of households (from the Eskom 2011 point data) to get the average household size.

This household size data was then linked to the household points, again using a spatial join in ArcGIS. Using the unique ID, the data was summarised and the number of people (a sum of the household size in each demand area) was calculated. This was joined to the demand area attribute table, and used as the low population count. In the same way as the growth of the number of households was calculated, the growth rate was applied to the population figures, and the result was again summarised, population figures summed, and this data added as the high population figure.

DM	HH_Low	HH_High	Pop_Low	Pop_High
Zululand	61	63	413	423
Zululand	38	39	256	262
Zululand	116	119	653	670
Zululand	85	87	478	490
Zululand	77	78	540	551
Zululand	21	22	153	163
Zululand	73	75	405	415
Zululand	4	4	24	25
Zululand	45	46	261	266
Zululand	132	135	713	729
Zululand	150	162	944	1019
Zululand	4	4	24	26
Zululand	39	41	243	257
Zululand	10	11	65	69
Zululand	27	28	146	149
Zululand	15	15	81	83
Zululand	207	223	1116	1201
Zululand	87	89	471	483
Zululand	111	114	690	705
Zululand	118	121	765	782
Zululand	27	28	175	179
Zululand	49	50	238	244
Zululand	66	68	337	345
Zululand	37	38	176	183
Zululand	8	8	47	50
Zululand	22	23	143	149
Zululand	23	24	152	159
Zululand	9	9	49	51
Zululand	126	132	602	631
Zululand	141	152	676	731
Zululand	104	112	543	587
Zululand	867	876	3057	3084
Zululand	175	185	1014	1075
Zululand	122	129	1274	1348

Table 28 - Example of low and high household and population statistics

Water Demand Forecasts

The higher of the two household counts was used to calculate the low demand forecast (million m^3 pa), using the figures supplied by the Department of Water Affairs using the All Town Study. The high demand forecast (million m^3 pa) was calculated in the same way. The probable demand forecast (million m^3 pa) was the average of these two figures.

Water Supply Status and Water Source

The supply status of each area was assessed using all available spatial water infrastructure data (boreholes, reservoirs, springs, pipelines etc.) and intersections with the water supply footprint polygons. Where there were intersections (i.e. there was some form of water supply within, or very close to a water supply footprint) it was assumed that there was short term supply to that area. Assessments were checked manually to ensure that very close water supplies to settlement boundaries were taken into account.

Similarly, analysis using existing mapped boreholes and other water sources was used to populate the existing water source field.

LOCAL MUNICIPALITY	NO OF WATER SUPPLY FOOTPRINTS	NO OF WATER SUPPLY FOOTPRINTS WITH SHORT TERM SUPPLY
Abaqulusi	335	126
Edumbe	133	50
Nongoma	385	278
Ulundi	422	259
Uphongolo	202	123
Zululand	1477	836

Table 29 – Number of Water Supply footprints with short term supply in ZDM

6.1 Existing Water and Sanitation Infrastructure

Table 30 provides a summary of the number of households with access to piped water within the ZDM. The table was obtained from the IDP which was undertaken in 2014.

Access to Piped Water	No of households	% of household
Piped (tap) water inside dwelling/institution	35 165	22.29
Piped (tap) water inside yard	48 813	30.94
Piped (tap) water on community stand: less than 200m from dwelling	14 425	9.14
Piped (tap) water on community stand: between 200m and 500m from dwelling	5 704	3.62
Piped (tap) water on community stand: between 500m and 1000m from dwelling	3 352	2.12
Piped (tap) water on community stand: more than 1000m from dwelling	1 939	1.23
No access to piped (tap) water	48 350	30.65
Total	157 749	100.00

Table 30–Access to piped water

(Source: IDP 2014, based on census 2011)

Table 31 is a summary of the water infrastructure components available in ZDM. The table was obtained from the WSDP which was undertaken in 2012.

Group	Components	Total
Pipelines	Bulk	937.9 km
	Reticulation	4255.5 km
Installations	Yard Connection	21085
	Standpipe – Barrel	302
	Standpipe - Communal	3681
	Electrical Point	77
	Valve	7820
	Meter	522
	Bulk Metering Points	58
	Handpump	17
	Pump	19
	Pump Station	104
	Source/Abstraction	441
	Break-pressure Tank	168
	Storage – Jojo	181
	Storage – Reservoir	613
	Treatment (Sand filters etc.)	11
Replacement Value	Civil	R 194,556,800
	Mechanical	R 56,821,050
	Electrical	R 22,493,900
	Telemetry	R 1,199,000

Table 31 - Summary of water infrastructure components

(Source: WSDP 2012/16)

Table 32 indicates the capacities of the Water Treatment Works in the various municipalities. This table was extracted from the WSDP which was undertaken in 2012.

Water Treatment Works			Plant Capacity
			ML/d
1	Edumbe	Frischgewaagd	2
2		Edumbe	3
3		Ophuzana	0.5
4		Tholakele	0.5
5	Abaqulusi	Klipfontein	10
6		Bloemveld	5
7		Mondlo	9
8		Mvuzini	0.5
9		Purim	0.24
10		Hlobane	2
11		Louwsburg	0.72
12		Coronation	0.4
13		Khambi	0.2
14		Mountain View	0.05
15		Enyathi	0
16	Uphongolo	Belgrade	1.1
17		Msibi	0.03
18		Khiphunyawo	0.37
19		Nkosentsha	0.13
20		Spekboom	1.8
21		Pongola	6.3
22	Nongoma	Osinisingini	0.04
23		Mandlakazi	0.75
24		Sidinsi	0.28
25		Kombusi	0.2
26		Embile	0.3
27		Vuna	4.2
28		Khangela Palace	0.01
29		Enyokeni Palace	0.02
30	Ulundi	Thulasizwe Hospital	0.2
31		Ceza	0.4
32		Ulundi	18
33		Mpungamhlope	0.63
34		Babanango	0.33
35		Masokaneni	0.1
36		Nkonjeni Hospital	0.1
37		Usuthu	0

Table 32 - Assessment of Water Treatment Works
(Source: WSDP 2012/16)

Table 33 indicates the capacities of the various Waste Water Treatment Works in ZDM. This table was extracted from the WSDP which was undertaken in 2012.

Waste Water Treatment Works		Plant Capacity ML/d
1	Frischgewaagd	0.08
2	Paulpieterburg	0.30
3	Vryheid Town	9.00
4	eMondlo	2.40
5	Nkongolwane	0.25
6	Alpha Mine	0.00
7	Hlobane	0.35
8	Coronation	1.00
9	Itshelejuba Hospital	0.09
10	Pongola Town	2.50
11	Thulazizwe Hospital	0.03
12	Holinyoka/Nongoma	1.80
13	Ceza	0.14
14	James Nxumalo	0.08
15	Nkonjeni Hospital	0.20
16	St Francis Hospital	0.06
17	Ulundi Town	2.70
18	Enyathi	0.00

Table 33 - Assessment of Waste Water Works

(Source: WSDP 2012/16)

6.2 Water and Sanitation Backlogs

Table 34 indicates the total number of households as well as water backlogs within the various local municipalities in the ZDM.

Water	Total Households	Backlogs (households)
Edumbe LM	40302	2061
Uphongolo LM	16880	3528
Abaqulusi LM	38171	6687
Nongoma LM	37365	18995
Ulundi LM	25136	13202
Total	157854	44473

Table 34 - Water Backlogs

(Source: Eskom study 2011 and Stats SA)

Table 35 indicates the total number of households as well as sanitation backlogs within the various local municipalities in the ZDM.

Sanitation	Total Households	Backlogs
Abaqulusi LM	40302	14440
Edumbe LM	16880	607
Nongoma LM	38171	16242
Ulundi LM	37365	14548
Uphongolo LM	25136	10920
Total	157854	56757

Table 35 - Sanitation Backlogs

(Source: WSDP 2012/16 and Stats SA)

7. ALREADY PROPOSED FUTURE SUPPLY OPTIONS

7.1 Existing proposals for future supply

The ZDM has ten regional schemes which are still in progress in terms of construction. Within these regional schemes there are further small stand-alone rural schemes which are indicated in Table 36.

Regional Water Supply Schemes (RWSS)	Number of Proposed Water Supply Schemes
Nkonjeni RWSS	33
Usuthu RWSS	39
Mandlakazi RWSS	31
Gumbi/Candover RWSS	2
Simdlangentsha East RWSS	20
Simdlangentsha Central RWSS	12
Simdlangentsha West RWSS	27
Coronation RWSS	2
Khambi RWSS	23
Hlahlindlela RWSS	23

Table 36 - Regional Schemes
(Source: IDP 2014)

A roll-out map of Regional Water Schemes is shown on Figure 21 on page 127.

The ZDM has numerous projects which are currently being implemented and also has a number of schemes to be implemented over a 5 year period (2013-2017) as illustrated in Figure 22 on page 128. The table below shows the cost of implementing each of these schemes.

According to the IDP (2014) and WSDP (2012-2016) the ZDM has indicated a list of projects for water supply up to the year 2017. Refer to figure 22 on page 128 for the roll out schemes.

The maps on pages 129-133 indicate the various projects in each Local Municipality, the funding agent, status of the projects and total project cost. These drawings were sourced from Bigen Africa

The GIS provided by the ZDM indicated their proposed water supply schemes. Where possible the concept designs were tied into the ZDM's planned network to avoid any duplication of infrastructure and reduce costs.

The quantification and pricing undertaken in this report is based on UAP proposals only and does not take into consideration the future infrastructure already planned by the ZDM as it is assumed that funding for these proposals have already been secured by ZDM.

Table 37 contains information on the local municipalities and the supply footprints for water and sanitation. It also states whether it is bulk water, secondary bulks and reticulation mains with the associated cost for each of them. This table was obtained from the WSDP which was undertaken in 2012.

LM	Supply Footprint	Water		Sanitation
Ulundi	Nkonjeni	Bulks	R 176230685	
		Sec Bulks	R 112270118	
		Retics	R 11057860	R 50256000
	Usuthu	Bulks	R 722413527	
		Sec Bulks	R 581903799	
		Retics	R 70176040	R 108126000
Nongoma	Mandlakhazi	Bulks	R 177088917	
		Sec Bulks	R 204297897	
		Retics	R 26294320	R 46350000
	Mkhuze	Bulks	-	
		Sec Bulks	R 7780575	
		Retics	R 393720	R 3876000
Uphongolo	Simdl East	Bulks	R 37779025	
		Sec Bulks	-	
		Retics	-	R 18612000
	Simdl Central	Bulks	R 40618922	
		Sec Bulks	R 37675266	
		Retics	R 2 536020	R 20508000
Edumbe	Simd West	Bulks	R 166812793	
		Sec Bulks	R 19805195	
		Retics	R 1976320	R 2058000
Abaqulusi	Khambi	Bulks	R 63 388 736	
		Sec Bulks	R 29 633 516	
		Retics	R 3 219 240	R 11 580 000
Abaqulusi	Coronation (Enyathi)	Bulks	R 86 460 980	
		Sec Bulks	R 77 132 759	
		Retics	R 11 429 260	R 14 100 000
	Hlahlindlela	Bulks	R 273 464 377	
		Sec Bulks	R 17 874 998	
		Retics	R 3 539 620	R 40 344 000

Table 37 – Cost of new infrastructure to be built

(Source: WSDP 2012/16)

Table 38 indicated the phasing over the capital works over a 5 year period from the year 2013 to 2018 for the following bulk water projects: regional bulk pipes, regional bulk components, secondary bulk and reticulation components. The table was obtained from the WSDP which was undertaken in 2012.

Water	Total Capital Requirements	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
Regional Bulk Pipes	R 1 136 675 096	R 81 618 822	R 11 584 808	R 76 405 893	R 127 159 412	R 839 906 161
Regional Bulk Components	R 763 556 689	R 138 002 602	R 97 645 428	R 45 699 845	R 44 267 521	R 437 941 293
Secondary Bulk	R 1 315 814 251	R 95 981 010	R 57 291 804	R 44 491 516	R 26 385 475	R 1 091 664 446
Reticulation Components	R 137 022 280	R 6 666 220	R 8 939 760	R 8 484 820	R 10 699 920	R 102 231 560
Total capital	**R 3 353 068 316**	**R 322 268 654**	**R 175 461 800**	**R 175 082 074**	**R 208 512 328**	**R 2471 743 460**

Table 38 – Capital Requirements for Water from 2013/2014 – 2017/2018

(Source: WSDP 2012/16)

Table 39 contains information on the various sources of funding together with the phasing over 5 years starting in the year 2013 to 2018. It also indicated the capital requirements and the shortfall. This information was obtained from the WSDP which was undertaken in 2012.

Water	Expected Funding	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
MIG	R 883 622 400	R 220 905 600	R 220 905 600	R 220 905 600	R 220 905 600	R 220 905 600
DWA (RBIG)	R 110 341 000	R 55 341 000	R 55 000 00	UNKOWN	UNKNOWN	UNKOWN
Other Grant Funding (MWIG)	R 156 000 000	R 37 000 000	R 37 000 000	R 80 000 000	-	-
Total	**R 1 149 963 400**	**R 313 246 600**	**R 313 246 600**	**R 300 905 600**	**R 220 905 600**	**R 220 905 600**
Capital Requirements	R 2 935 500 657					
Shortfall	**R – 1 785 537 257**					

Table 39 – Cost of new infrastructure to be built

(Source: WSDP 2012/16)

Table 40 provides a summary of the implementing years for each of the local municipalities and the budget tentatively allocated for sanitation, rudimentary schemes, rural water service schemes and it also covers the number of households that will be served. This information was obtained from the IDP which was undertaken in 2014.

Implementation Year	LM	Sanitation		Rudimentary Schemes		Rural Water Services Schemes
		Cost	HH served	Cost	HH served	Cost
In Progress	Abaqulusi					
	Edumbe	R 1 393 600.00	418			
	Nongoma	R 10 438 600.00	3002			
	Ulundi	R 2 579 500.00	769			
	Uphongolo	R 12 971 200.00	3875			
2013/2014	Abaqulusi	R 5 862 500.00	847	R 35 674 718.00	1151	R 40 140 731.00
	Edumbe			R 18 836 921.00	536	R 26 456 000.00
	Nongoma	R 24 367 900.00	3637	R 7 452 576.00	245	R 147 939 647.00
	Ulundi	R 22 873 800.00	3414	R 35 479 645.00	966	R 40 348 971.00
	Uphongolo	R 5 862 500.00	875	R 7 600 146.00	173	R 25 249 647.00
2014/2015	Abaqulusi	R 8 817 200.00	1316	R 19 900 873.00	643	R 4 192 650.00
	Edumbe	R 25 171 900.00	3757	R 1 470 996.00	30	R 92 440 257.00
	Nongoma	R 19 302 700.00	2881			R 19 867 399.00
	Ulundi	R 3 296 400.00	492	R 19 142 467.00	571	R 2 291 296.00
	Uphongolo					R 50 000 000.00
2015/2016	Abaqulusi	R 5 976 400.00	892	R 3 417 285.00	89	R 43 885 632.00
	Edumbe					
	Nongoma	R 25 379 600.00	3788			R 94 180 931.00
	Ulundi	R 13 212 400.00	1971	R 16 228 318.00	462	
	Uphongolo	R 4 247 800.00	634			
2016/2017	Abaqulusi	R 8 609 500.00	1289			R 67 497 607.00
	Edumbe					
	Nongoma	R 25 339 400.00	3782	R 34 736 466.00	1765	R 139 824 715.00
	Ulundi	R 194 300.00	29	R 23 951 229.00	755	R 22 602 601.00
	Uphongolo	R 57 279 600.00	796	R 4 739 876.00	145	R 26 291 538.00
2017/2018	Abaqulusi	R 8 535 800.00	1276			R 16 044 765.00
	Edumbe			R 1 685 043.00	89	
	Nongoma	R 8 790 400.00	1312	R 270 419 474.00	10039	R 127 797 300.00
	Ulundi			R 103 437 276.00	3284	R 18 773 674.00
	Uphongolo	R 5 889 300.00	879			R 6 950 884.00
> 2018	Abaqulusi					R 216 630 517.00
	Edumbe					R 168 573 081.00
	Nongoma					R 753 549 704.00
	Ulundi					R 510 722 866.00
	Uphongolo					R 100 746 853.00

Table 40 – Capital Expenditure
(Source : IDP 2014)

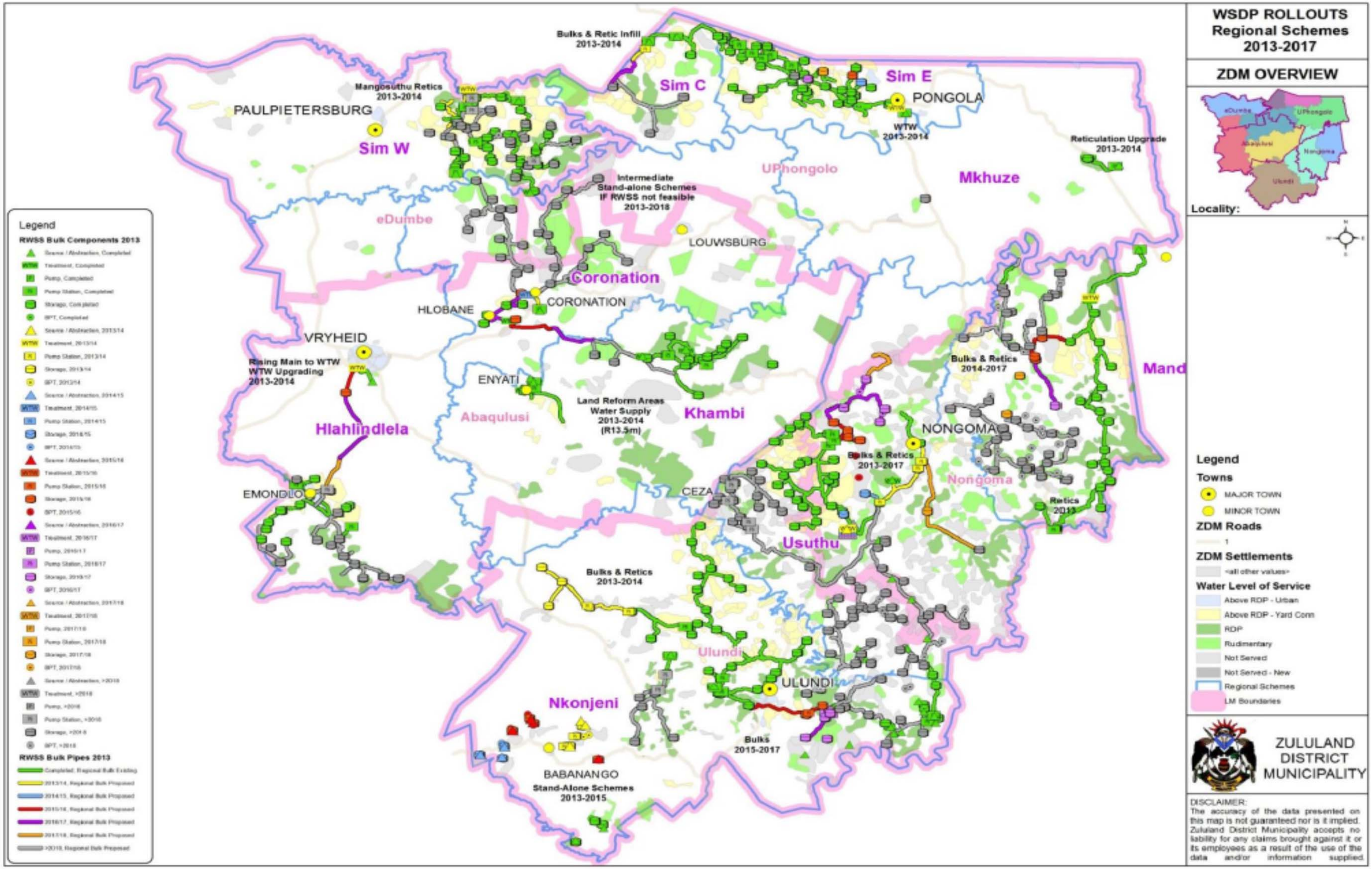


Figure 21 – Regional Schemes Rollout 2013-2017

Source (IDP 2014)

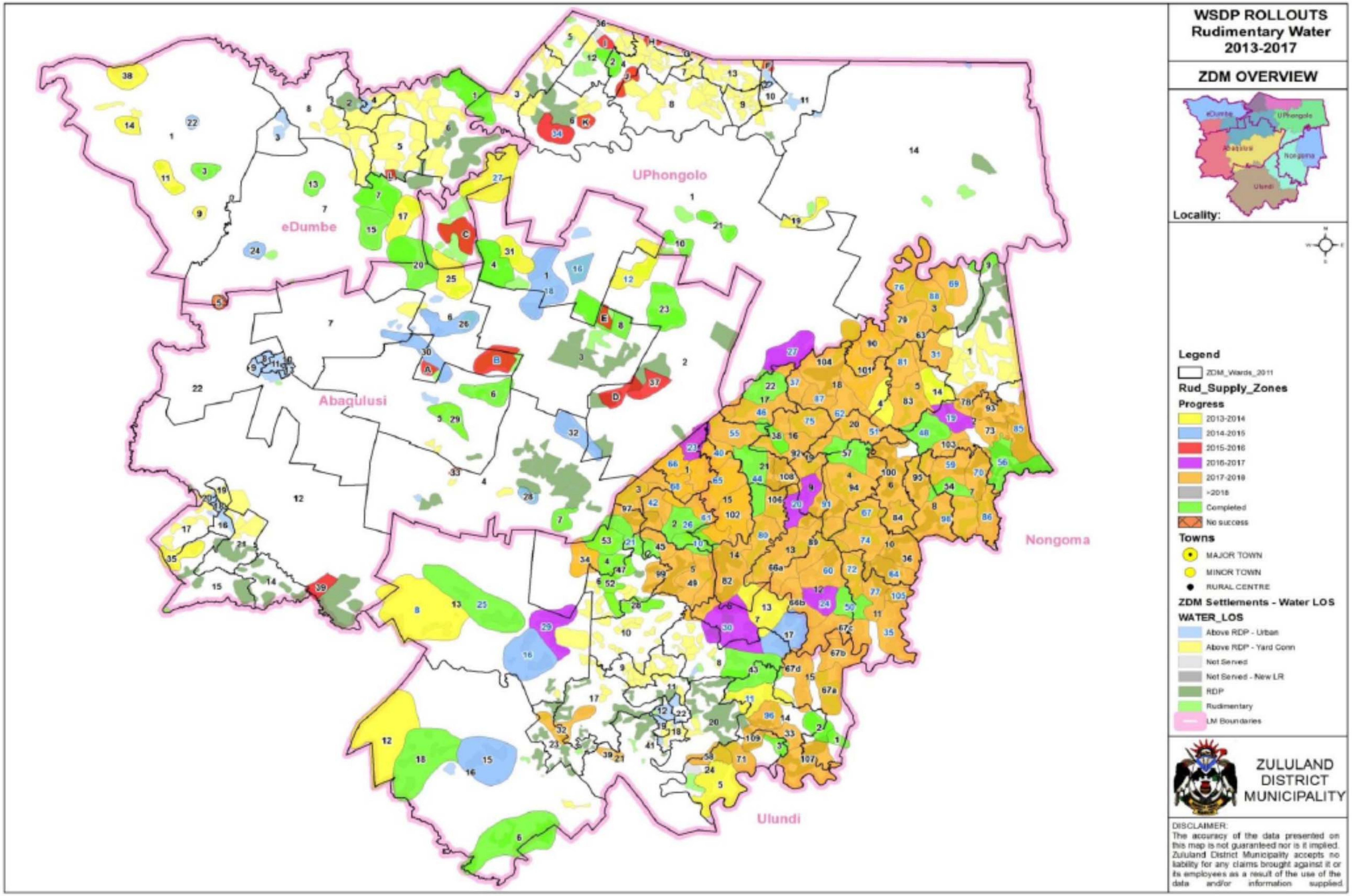
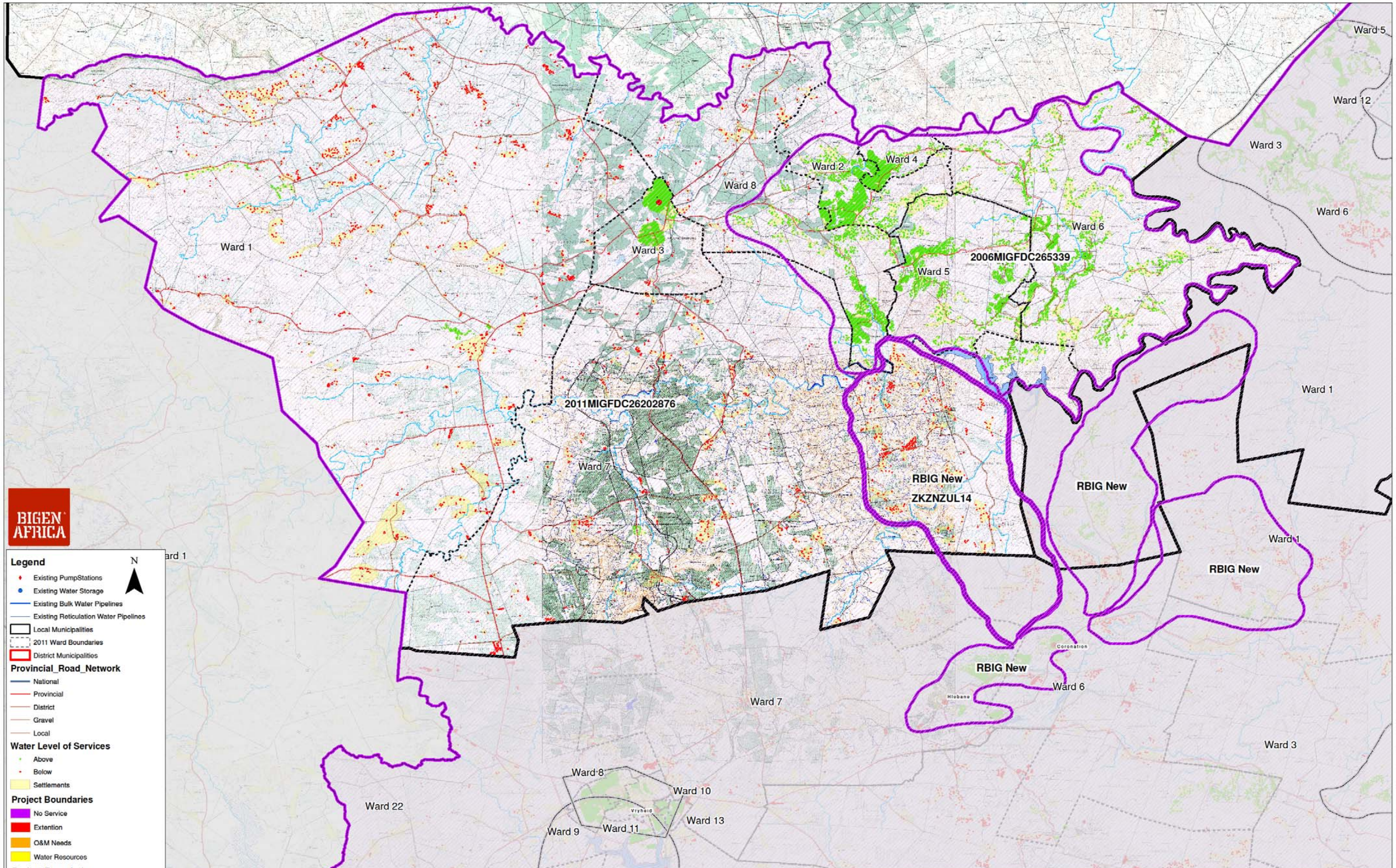


Figure 22 – Rudimentary Rollout 2013-2017

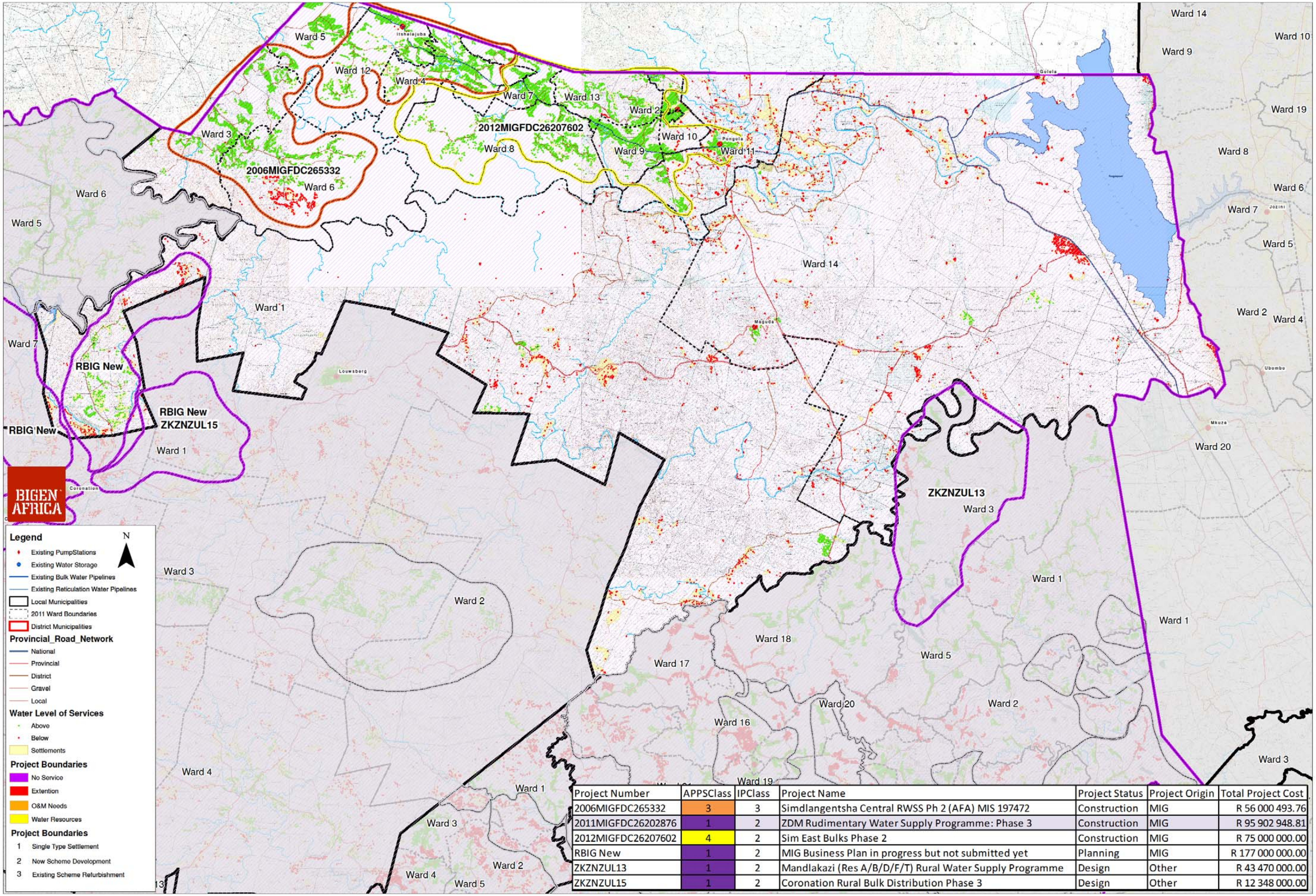
(Source: IDP 2014)

ZULULAND - EDUMBE



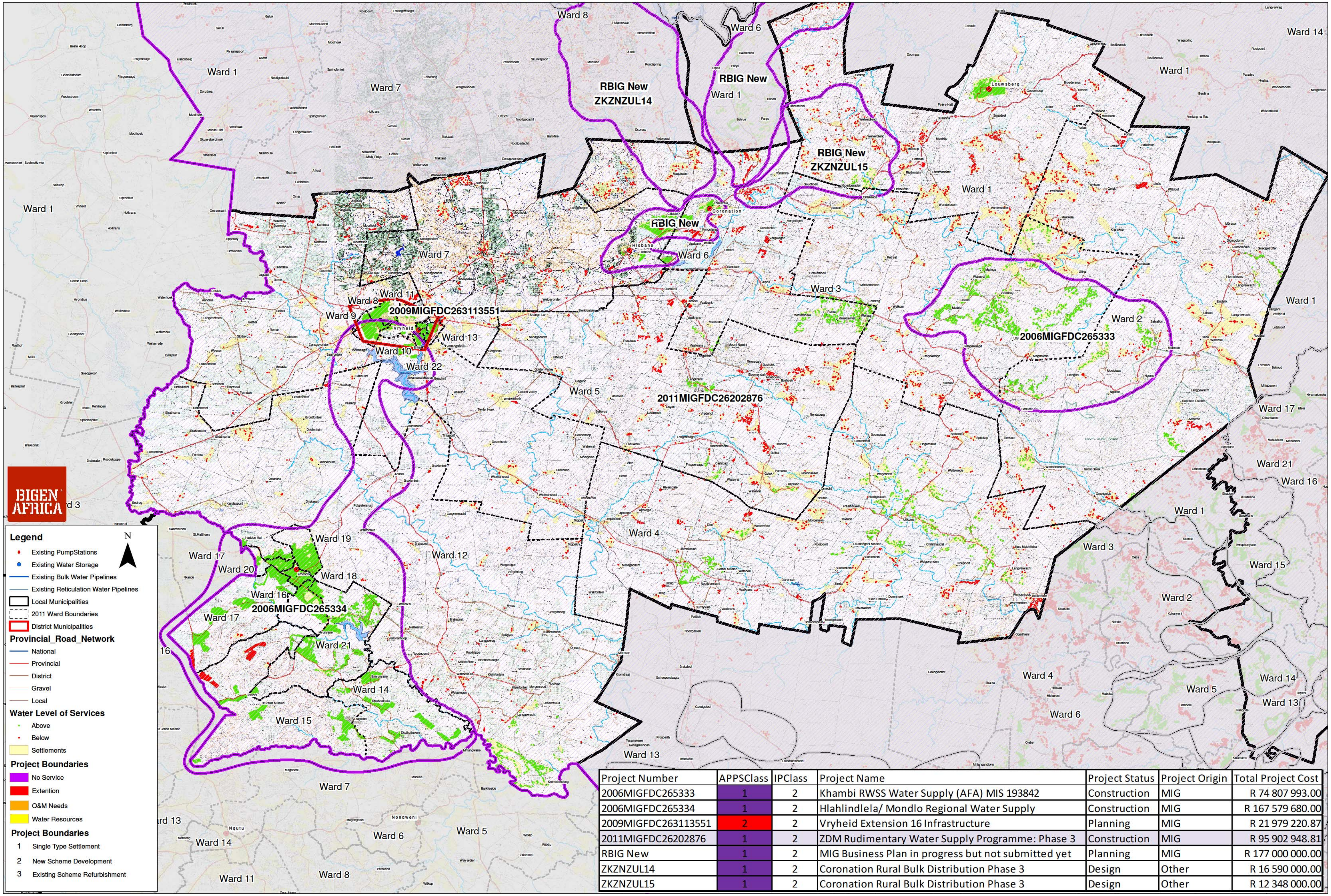
Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC265339	1	2	Simdlangetsha West RWSS Phase 2.1 (AFA) MIS 210576	Construction	MIG	R 229 829 490.00
2011MIGFDC26202876	1	2	ZDM Rudimentary Water Supply Programme: Phase 3	Construction	MIG	R 95 902 948.81
RBIG New	1	2	MIG Business Plan in progress but not submitted yet	Planning	MIG	R 177 000 000.00
ZKZNZUL14	1	2	Coronation Rural Bulk Distribution Phase 3	Design	Other	R 16 590 000.00

ZULULAND - UPHONGOLO



Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC265332	3	3	Simdlangentsha Central RWSS Ph 2 (AFA) MIS 197472	Construction	MIG	R 56 000 493.76
2011MIGFDC26202876	1	2	ZDM Rudimentary Water Supply Programme: Phase 3	Construction	MIG	R 95 902 948.81
2012MIGFDC26207602	4	2	Sim East Bulks Phase 2	Construction	MIG	R 75 000 000.00
RBIG New	1	2	MIG Business Plan in progress but not submitted yet	Planning	MIG	R 177 000 000.00
ZKZNZUL13	1	2	Mandlakazi (Res A/B/D/F/T) Rural Water Supply Programme	Design	Other	R 43 470 000.00
ZKZNZUL15	1	2	Coronation Rural Bulk Distribution Phase 3	Design	Other	R 12 348 000.00

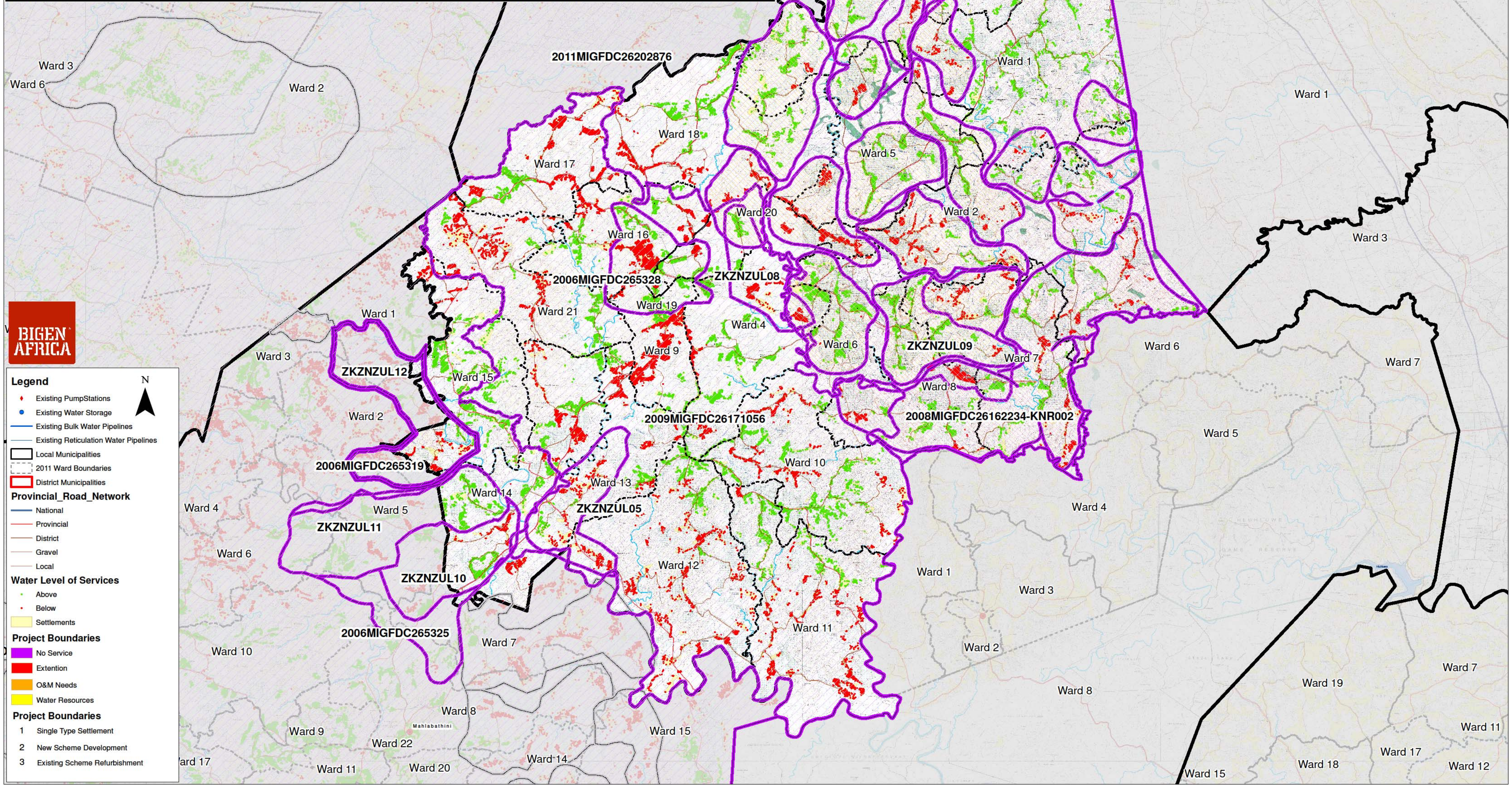
ZULULAND - ABAQULUSI



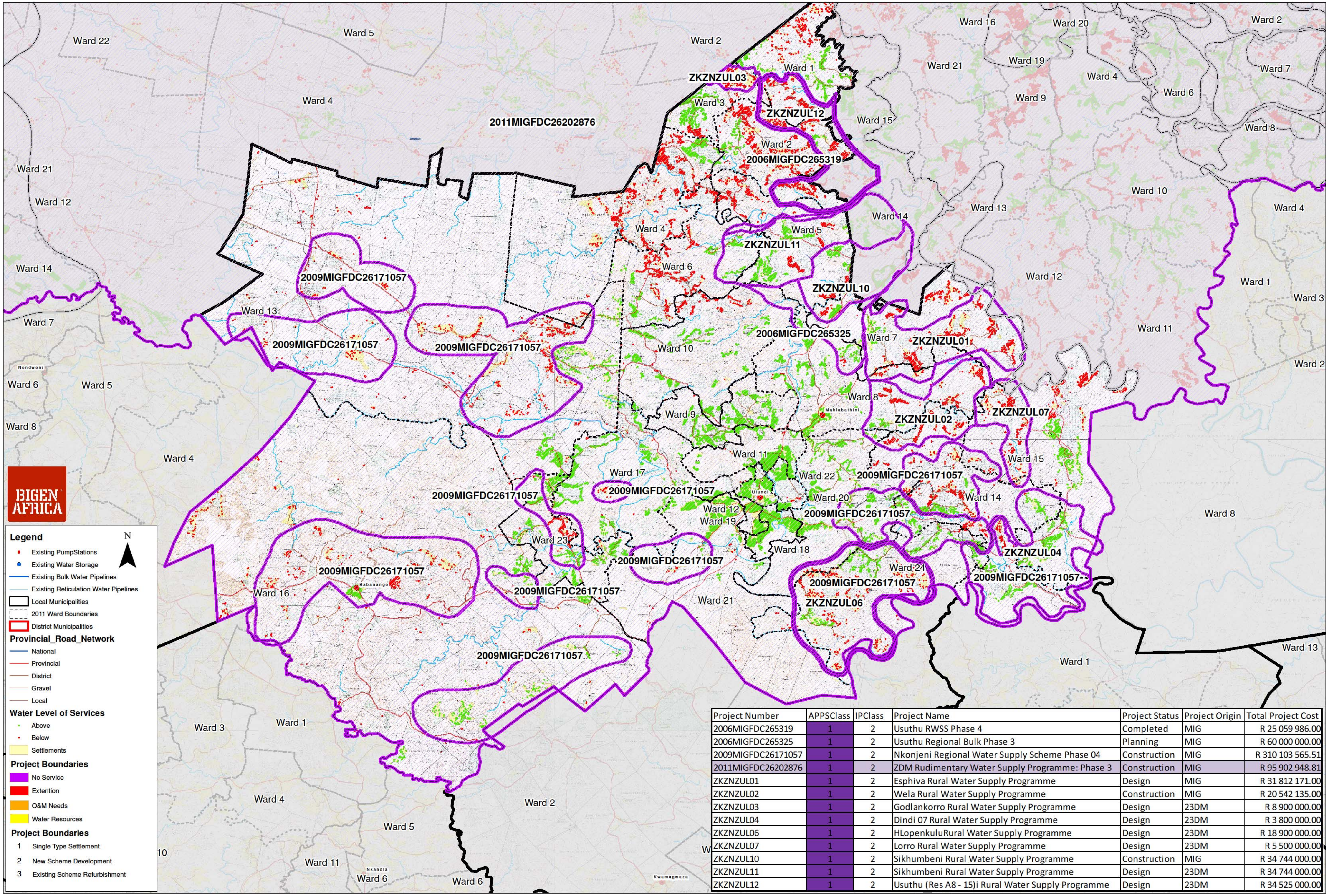
Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC265333	1	2	Khambi RWSS Water Supply (AFA) MIS 193842	Construction	MIG	R 74 807 993.00
2006MIGFDC265334	1	2	Hlahlindlela/ Mondlo Regional Water Supply	Construction	MIG	R 167 579 680.00
2009MIGFDC263113551	2	2	Vryheid Extension 16 Infrastructure	Planning	MIG	R 21 979 220.87
2011MIGFDC26202876	1	2	ZDM Rudimentary Water Supply Programme: Phase 3	Construction	MIG	R 95 902 948.81
RBIG New	1	2	MIG Business Plan in progress but not submitted yet	Planning	MIG	R 177 000 000.00
ZKZNZUL14	1	2	Coronation Rural Bulk Distribution Phase 3	Design	Other	R 16 590 000.00
ZKZNZUL15	1	2	Coronation Rural Bulk Distribution Phase 3	Design	Other	R 12 348 000.00

ZULULAND - NONGOMA

Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC265319	1	2	Usuthu RWSS Phase 4	Completed	MIG	R 25 059 986.00
2006MIGFDC265325	1	2	Usuthu Regional Bulk Phase 3	Planning	MIG	R 60 000 000.00
2006MIGFDC265328	1	2	Usuthu Regional Bulk Phase 2	Planning	MIG	R 44 000 000.00
2008MIGFDC26162234-KNR002	1	2	Mandlakazi Regional Water Supply Scheme (Ph 4)	Construction	MIG	R 170 793 219.00
2009MIGFDC26171056	1	2	Usuthu Regional Water Supply Scheme Phase 05	Construction	MIG	R 665 847 909.96
2011MIGFDC26202876	1	2	ZDM Rudimentary Water Supply Programme: Phase 3	Construction	MIG	R 95 902 948.81
DWA Approved Feb2013	1	2	Mandhlakazi Regional Scheme Phase 5	Planning	MIG	R 450 000 000.00
ZKZNZUL05	1	2	Kwakulu Rural Water Supply Programme	Design	23DM	R 13 800 000.00
ZKZNZUL08	1	2	Henende Rural Water Supply Programme	Design	23DM	R 17 500 000.00
ZKZNZUL09	1	2	Bhekumthethu Rural Water Supply Programme	Design	23DM	R 22 400 000.00
ZKZNZUL10	1	2	Sikhumbeni Rural Water Supply Programme	Construction	MIG	R 34 744 000.00
ZKZNZUL11	1	2	Sikhumbeni Rural Water Supply Programme	Design	23DM	R 34 744 000.00
ZKZNZUL12	1	2	Usuthu (Res A8 - 15)i Rural Water Supply Programme	Design	23DM	R 34 525 000.00
ZKZNZUL13	1	2	Mandlakazi (Res A/B/D/F/T) Rural Water Supply Programme	Design	Other	R 43 470 000.00



ZULULAND - ULUNDI



Project Number	APPSClass	IPClass	Project Name	Project Status	Project Origin	Total Project Cost
2006MIGFDC265319	1	2	Usuthu RWSS Phase 4	Completed	MIG	R 25 059 986.00
2006MIGFDC265325	1	2	Usuthu Regional Bulk Phase 3	Planning	MIG	R 60 000 000.00
2009MIGFDC26171057	1	2	Nkonjeni Regional Water Supply Scheme Phase 04	Construction	MIG	R 310 103 565.51
2011MIGFDC26202876	1	2	ZDM Rudimentary Water Supply Programme: Phase 3	Construction	MIG	R 95 902 948.81
ZKZNZUL01	1	2	Esphiva Rural Water Supply Programme	Design	MIG	R 31 812 171.00
ZKZNZUL02	1	2	Wela Rural Water Supply Programme	Construction	MIG	R 20 542 135.00
ZKZNZUL03	1	2	Godlankorro Rural Water Supply Programme	Design	23DM	R 8 900 000.00
ZKZNZUL04	1	2	Dindi 07 Rural Water Supply Programme	Design	23DM	R 3 800 000.00
ZKZNZUL06	1	2	HLopenkuluRural Water Supply Programme	Design	23DM	R 18 900 000.00
ZKZNZUL07	1	2	Lorro Rural Water Supply Programme	Design	23DM	R 5 500 000.00
ZKZNZUL10	1	2	Sikhumbeni Rural Water Supply Programme	Construction	MIG	R 34 744 000.00
ZKZNZUL11	1	2	Sikhumbeni Rural Water Supply Programme	Design	23DM	R 34 744 000.00
ZKZNZUL12	1	2	Usuthu (Res A8 - 15)i Rural Water Supply Programme	Design	23DM	R 34 525 000.00

7.2 Cost Estimates for Upgrading/Refurbishment of Existing Water Treatment Works

The information indicated in the Zululand District Municipality Assessments undertaken in 2009 covers various types of components that constitute the Water Treatment Works and also covers the extensions and modifications that are in hand for the plant both in the present state as well as for the proposed modifications.

According to these reports, the total cost for the emergency and short term works is estimated in year 2009 is indicated in Table 41. These costs were determined by escalating the initial cost at 8% per annum to give the current cost of construction. The cost includes engineering fees (15%) and contingencies (10%). Detailed investigations will be required to accurately determine costs.

Emergency intervention is needed to attend to problem areas such as settlements consuming raw untreated water, sewer water spilling directly into rivers and structures that are almost collapsing.

Short term refurbishment (not critical work) is needed to refurbish and upgrade the existing works in order to meet the current demands and also to enable the works to function at their design capacities. Short term refurbishment will also include the upgrading of works to improve the quality of water and effluent to meet the Department of Water Affairs standards. The short term refurbishments were prioritised using criteria such as cost per capita, current demand versus current capacity and current water quality.

Medium to long term upgrading (not critical work) is needed to upgrade the existing works in order to meet the future demands. These long term refurbishments were prioritised using criteria such as cost per capita and future demand versus the capacity after short term refurbishment. Some of these works will become redundant in future.

Water Treatment Works	Emergency Work	Short Term	Medium to Long Term
Frischewaagd	**-**	R 1 528 101	**-**
Edumbe	-	R 4 011 266	R 29 386 562
Ophuzane	-	R 1 821 967	-
Klipfontein	-	R 13 032 940	R 6 487 083
Bloemveld	-	R 5 348 354	R 7 640 506
Ulundi	-	R 1 083 622	-
Mondlo	R 705 277	R 264 479	R 3 526 387
Purim	-	-	R 367 332
Hlobane	R 1 190 156	R 2 336 232	-
Louwsburg	R 470 185	R 3 673 320	-
Coronation	R 1 248 929	R 1 675 034	R 32 325 218
Khambi	-	-	R 220 399
Mountain View	-	-	R 389 372
Belgrade	R 462 073	R 194 848	R 25 557 125
Msibi	R 151 298	R 4 201 591	-
Khiphunyawo	R 36 802	R 8 325 489	-
Nkosentsha	R 157 432	R 3 434 878	-
Spekboom	R 683 909	R 3 286 033	-
Pongola	R 439 583	R 225 312	R 40 891 400
Osinisingini	R 28 624	R 1 373 951	-
Ceza	R 4 089	R 4 150 477	R 2 938 656
Khangela Palace	R 1 636	R 4 774 071	-
Enyokeni Palace	R 75 036	R 57 248	-
Nongoma (Vuna)	-	R 661 418	-
Mpungamhlope	R 35 984	R 71 560	R 38 722 378
Babanango	R 6 950	R 4 774 071	-
Thulasizwe Hospital	R 32 918	R 85 872	-
Sidinsi	R 117 546	R 815 477	R 3 673 320
Total	**R 5 848 425**	**R 69 679 509**	**R 192 125 739**

Table 41 - Cost estimates for upgrading/refurbishment of existing water treatment works

8. DEVELOPMENT OF CONCEPTUAL PLANS

8.1 Water Treatment Works Situation Analysis

Reconciliation Strategies undertaken in 2011 indicated the capacities of the WTW within the various local municipalities. These capacities were used to determine how many of the backlogs could be alleviated based on the UAP intent of delivering at least 70l/c/d of water.

The calculations indicated below were undertaken to determine if the existing WTW within the various local municipalities can meet the demand of the backlogs. In addition, these calculations provide an indication that the link to existing scheme type can be undertaken immediately as the need for elaborate infrastructure is minimal.

Edumbe Local Municipality

Current Population	= 82053
Consumption based on 70l/c/d	= 5.74 ML/d

Edumbe is served by Frischgewaagd WTW (2 ML/d), Edumbe WTW (3 ML), Ophuzana WTW (0.5 ML/d) and Tholakele WTW (0.5 ML/d).

Total Capacity of existing water treatment works	= 6 ML/d

Hence the calculation above indicates that there is sufficient water treatment capacity in the Edumbe Municipality currently.

Abaqulusi Local Municipality

Current Population	=211060
Consumption based on 70l/c/d	= 14.44 ML/d

Abaqulusi is served by Klipfontein WTW (10 ML/d), Mondlo WTW (9 ML/d), Mvuzini WTW (0.5 ML/d), Purim WTW (0.24 ML/d), Hlobane WTW (2 ML/d), Louwsburg WTW (0.72 ML/d), Coronation WTW (0.4 ML/d), Khambi WTW (0.2 ML/d) and Mountain View WTW (0.05 ML/d).

Total Capacity of existing water treatment works	= 28.11 ML/d

Hence the above calculation indicates that there is sufficient water treatment capacity in the Abaqulusi Municipality currently.

Uphongolo Local Municipality

Current Population	= 127238
Consumption based on 70l/c/d	= 8.90ML/d

Uphongolo is served by Belgrade WTW (1.10 ML/d), Msibi WTW (0.03 ML/d), Khiphunyawo WTW (0.37 ML/d), Nkosentsha WTW (0.13 ML/d), Spekboom WTW (1.80 ML/d), Pongola WTW (6.30 ML/d).

Total Capacity of existing water treatment works = 9.73 ML/d

Hence the above calculation indicates that there is sufficient water treatment capacity in the Uphongolo Municipality currently.

Nongoma Local Municipality

Current Population = 194908

Consumption based on 70l/c/d = 13.64 ML/d

Nongoma is served by Osinisingini WTW (0.04 ML), Vuna WTW (4.20 ML), Khangela Palace WTW (0.01 ML), Enyokeni Palace (0.02 ML/d), Mandlakazi WTW (0.75 ML/d), Sidinsi WTW (0.28 ML/d), Kombusi (0.20 ML/d), Embile WTW (0.30 ML/d).

Total Capacity of existing water treatment works = 6.05ML/d

Hence the above calculation indicates that there is insufficient water treatment capacity in the Nongoma Municipality currently.

Ulundi Local Municipality

Current Population = 188317

Consumption based on 70l/c/d = 13.18 ML/d

Ulundi is served by Thulasiswe Hospital WTW (0.20 ML/d), Ceza WTW (0.40 ML/d), Ulundi WTW (18 ML/d), Mpungamhlope WTW (0.63 ML/d), Babanango WTW (0.33 ML/d), Masokaneni WTW (0.1 ML/d), Nkonjeni Hospital WTW (0.1 ML/d).

Total Capacity of existing water treatment works = 19.56 ML/d

Hence the above calculation indicates that there is sufficient water treatment capacity in the Ulundi Municipality currently.

8.2 Design Parameters

MM PDNA undertook the conceptual design for the entire District Municipality and divided this into each Local Municipality. The following assumptions were made in undertaking the conceptual design:

- Water consumptions were based in accordance to the Table 42 below:

Description of consumer category	Household Annual Income range	Per capita cons (l/c/d)		
		Min	Ave.	Max.
Very High Income; villas, large detached house, large luxury flats	>R1 228 000	320	410	500
Upper middle income: detached houses, large flats	153 601 – 1 228 000	240	295	350
Average Middle Income: 2 - 3 bedroom houses or flats with 1 or 2 WC, kitchen, and one bathroom, shower	38 401 – 153 600	180	228	275
Low middle Income: Small houses or flats with WC, one kitchen, one bathroom	9 601– 38 400	120	170	220
Low income: flatlets, bedsits with kitchen & bathroom, informal household	1- 9600	60	100	140
No income & informal supplies with yard connections		60	70	100
Informal with no formal connection		30	70	70
Informal below 25 l/c/d		0	70	70

Table 42 - Water Consumptions

- Each household has an average of 6 people
- Some of the existing boreholes are functional.
- The existing water reticulation schemes are operational.
- Some of the existing water reticulation schemes have spare capacity.
- Existing water treatment works have the potential to be upgraded or rehabilitated.
- Schemes have some form of power supply.
- General pipe size range is from 25 mm to 150 mm diameter.
- Peak factor - 1.5
- Water losses were considered to be 35%
- Where there is an existing bulk line, connections to the bulk were kept to a minimum
- Reticulation mains were placed in the road reserve for maintenance purposes
- District and provincial road crossings were kept to a minimum

8.3 Scheme Types

MM PDNA assessed some of the existing water supply options that the ZDM currently implements and applied the same scheme types to supply the un-serviced polygons. The following schemes were adopted by MM PDNA to determine the scheme type applicable to the different settlements and their associated. These costs were was provided by Umgeni Water.

- Tie into existing schemes
- Existing boreholes and standpipes that are non-functional to be rehabilitated.
- Existing boreholes with reticulation to be rehabilitated.
- Boreholes mechanically operated for settlements with a low population.
- Boreholes electronically operated for settlements with a high population.
- Package Plants for settlements which are densely populated.
- From existing scheme pumped to new reservoir and reticulated.
- Where the existing borehole schemes are indicated but the settlement households are still indicated as un-serviced. It was assumed that there was an issue with the existing boreholes; therefore it was linked to the contiguous water supply schemes. Figure 23 below indicates this principle.

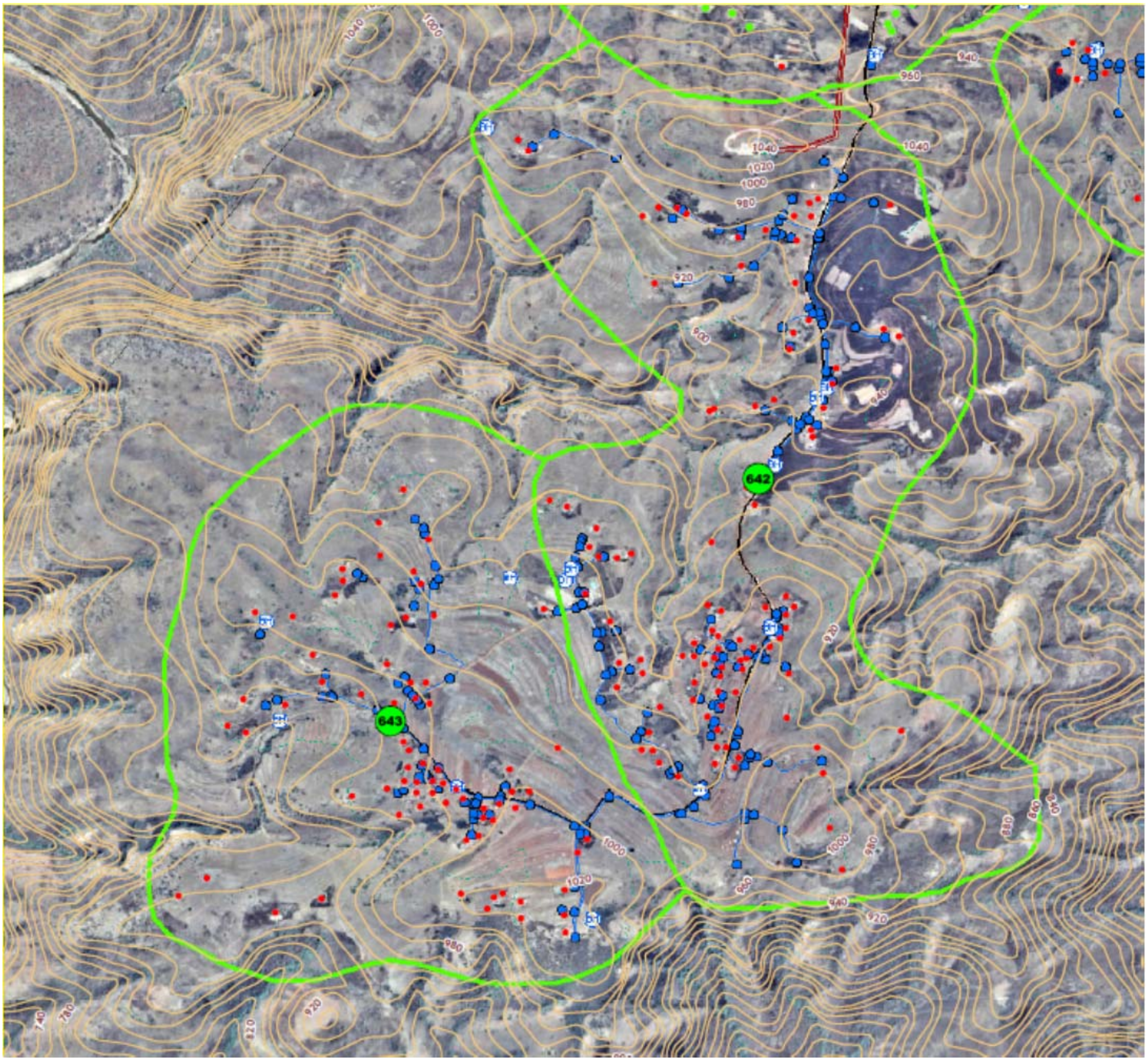


Figure 23 - Existing Borehole Schemes not in operation

8.3.1 Link to existing scheme

Areas currently without supply that are located adjacent to existing water mains could be supplied by extending the existing reticulation to the adjacent, currently unserviced area.

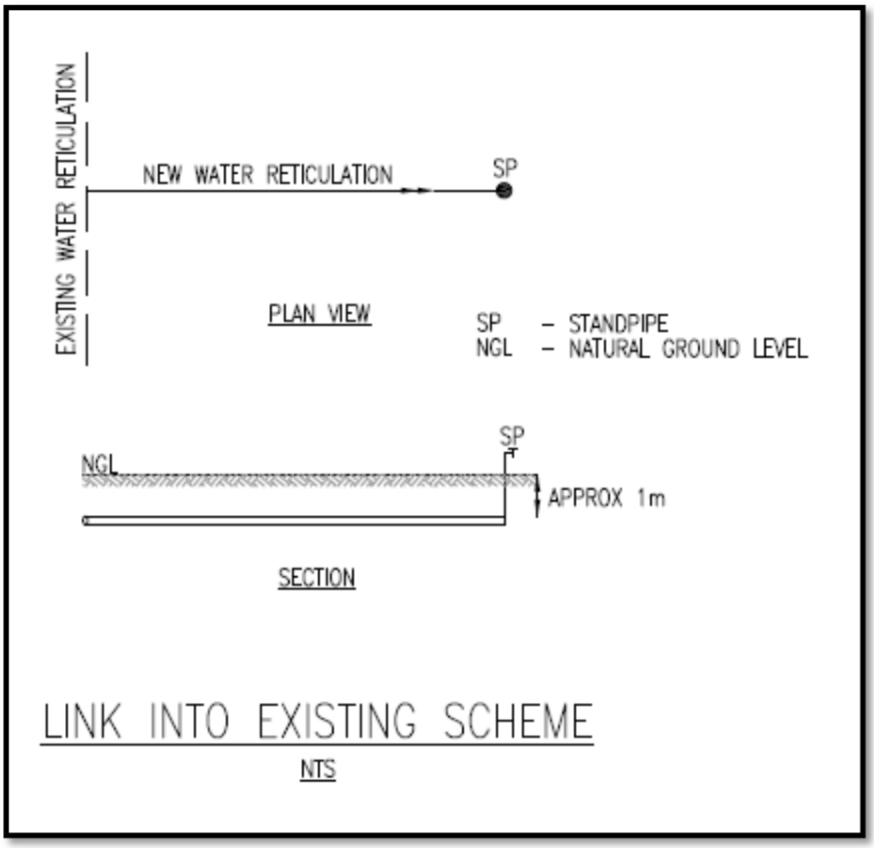
- During the assessment of the reticulation needs for the polygons, it was noted that several of the schemes contain boreholes which are not currently supplying the surrounding households. It was therefore assumed that these particular boreholes are non-functional and as such MM PDNA provided alternative supply sources to these schemes.

  The GIS information indicated a bulk supply line indicated contiguous to the community which was used to supply the area.

- In some cases the GIS information indicates that there is an existing bulk line, however there are un-serviced households contiguous to the bulk line. It was assumed that they are un-serviced due to the households being at a higher elevation.

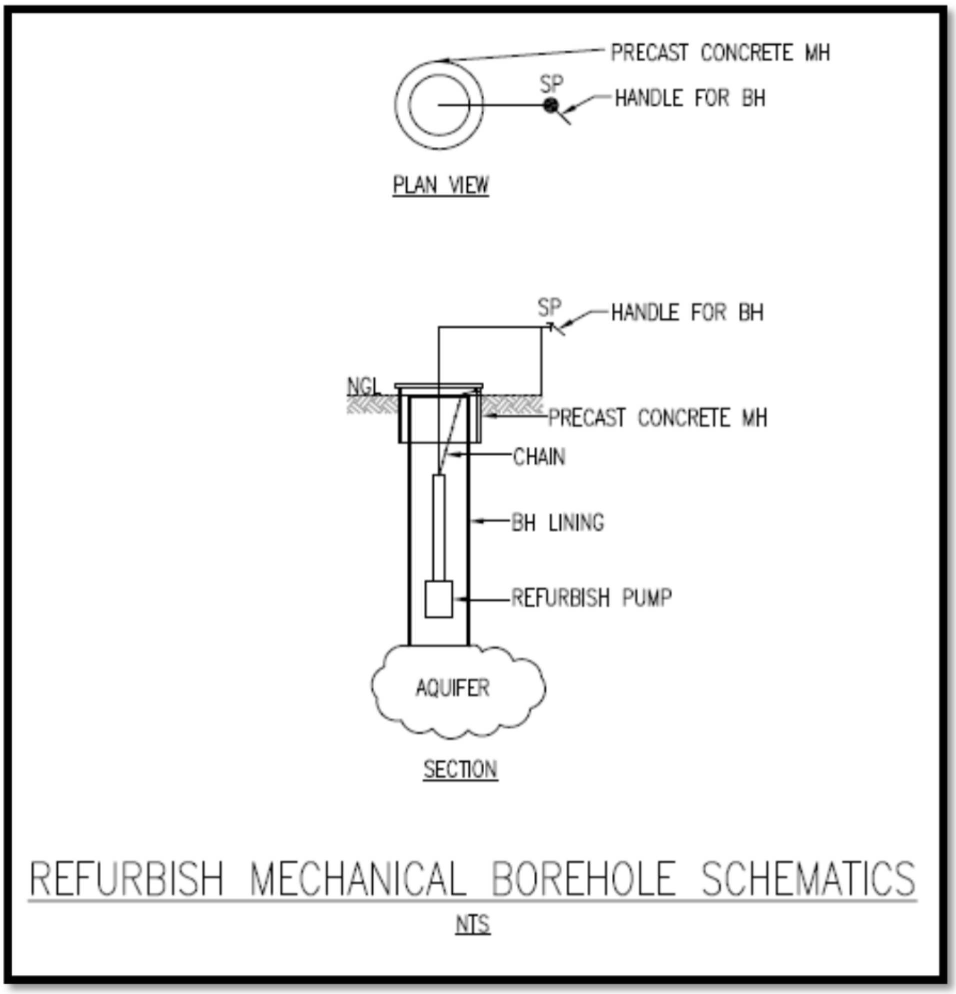
  These households were serviced by undertaking a pumping main from the existing bulk to a new reservoir at a higher elevation where it can be gravity fed to the households. This was deemed to be the cost effective option.

  In areas where the static head exceeds 100m, break pressure tanks should be constructed to reduce the pressure and also create additional storage.



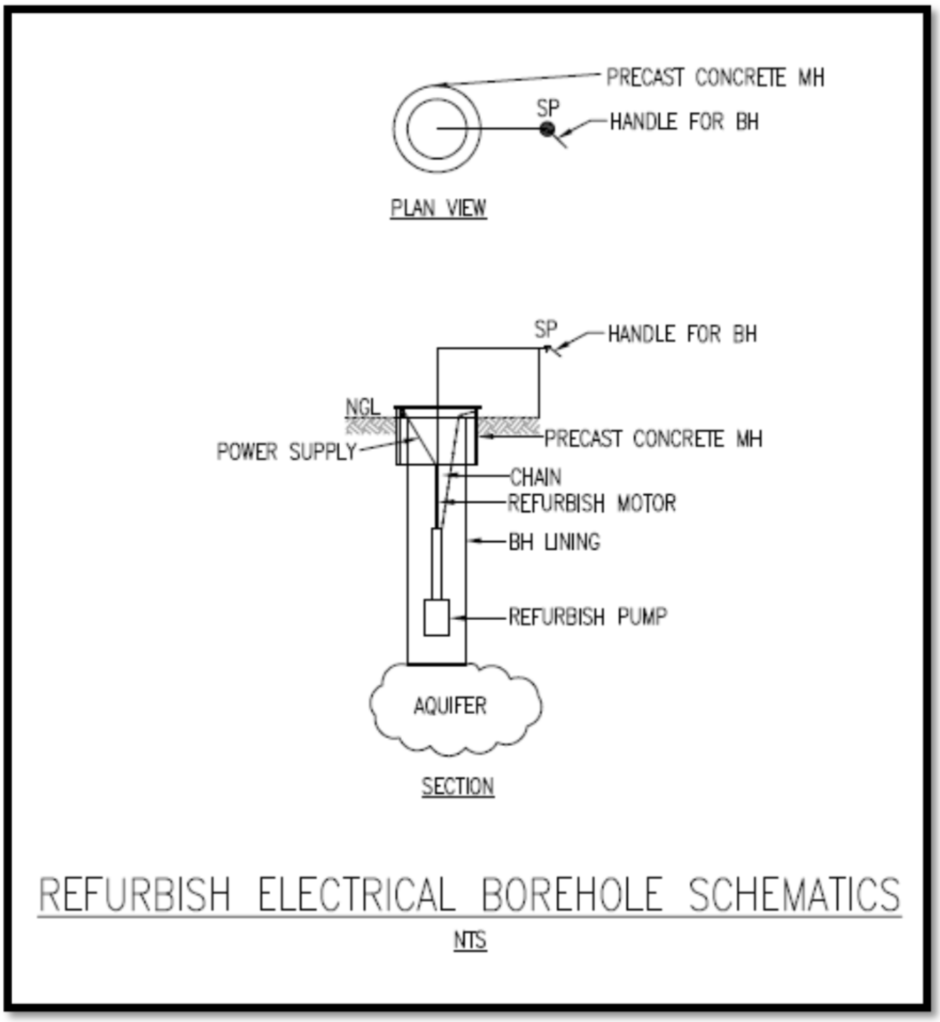
8.3.2 Refurbishment of Mechanical Boreholes

The existing mechanical boreholes that previously supplied water to a community are now defunct as the pumps are no longer functioning. Hence a replacement pump needs to be installed to ensure the continued delivery of water.



8.3.3 Refurbishment of Electrical Boreholes

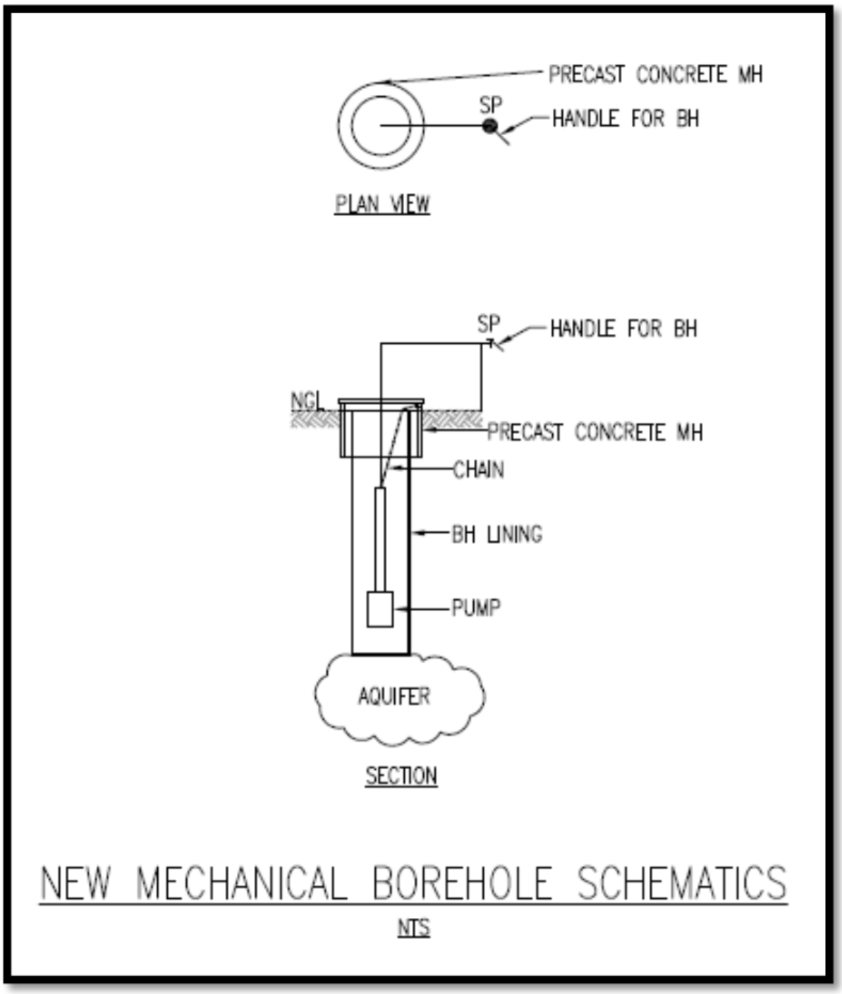
The existing electrical boreholes that previously supplied water to a community are now defunct as the pumps or motors are no longer functioning. Hence replacement pumps or motors need to be installed to ensure the continued delivery of water.



8.3.4 New Mechanical Boreholes

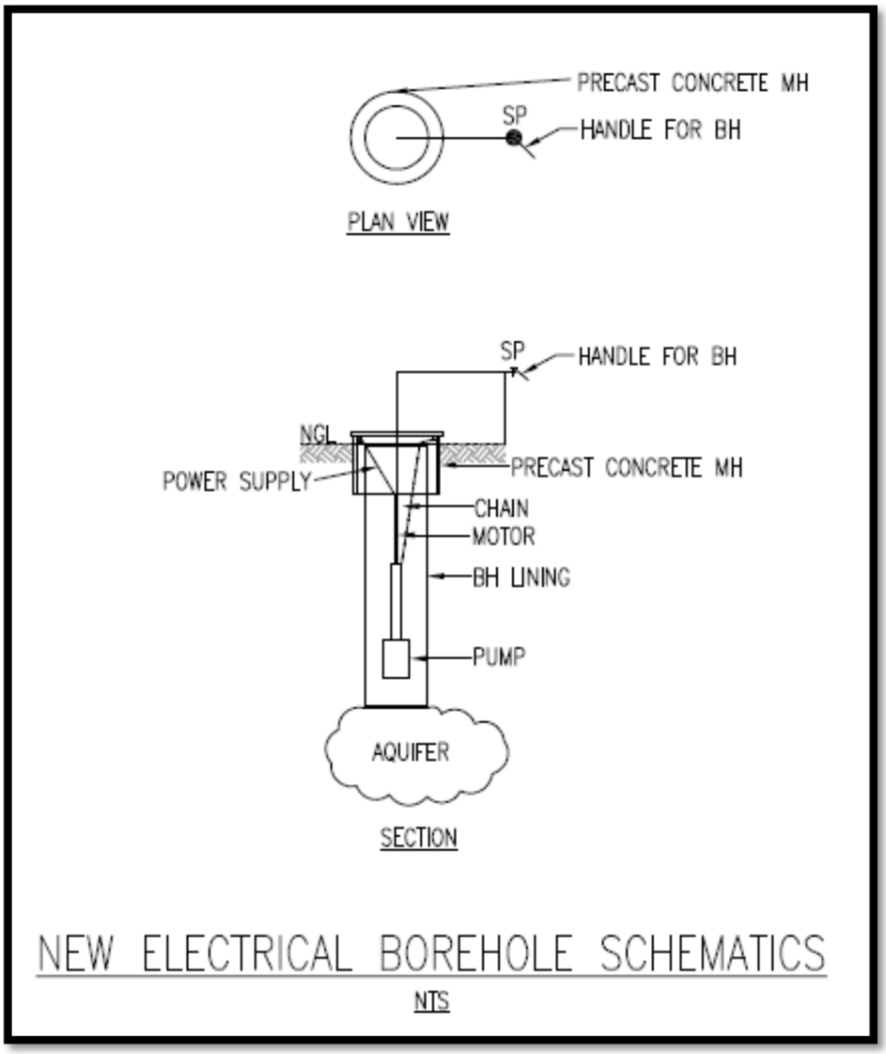
Mechanical boreholes are installed in remote rural areas where there is no available water reticulation and electrical supply.

The view adopted by MM PDNA was, where the population was in the region of 20-30 people mechanical boreholes would be the most cost effective supply of water. The alternative considered to a mechanical borehole system was the installation of a wind powered borehole system.



8.3.5 New Electrical Boreholes

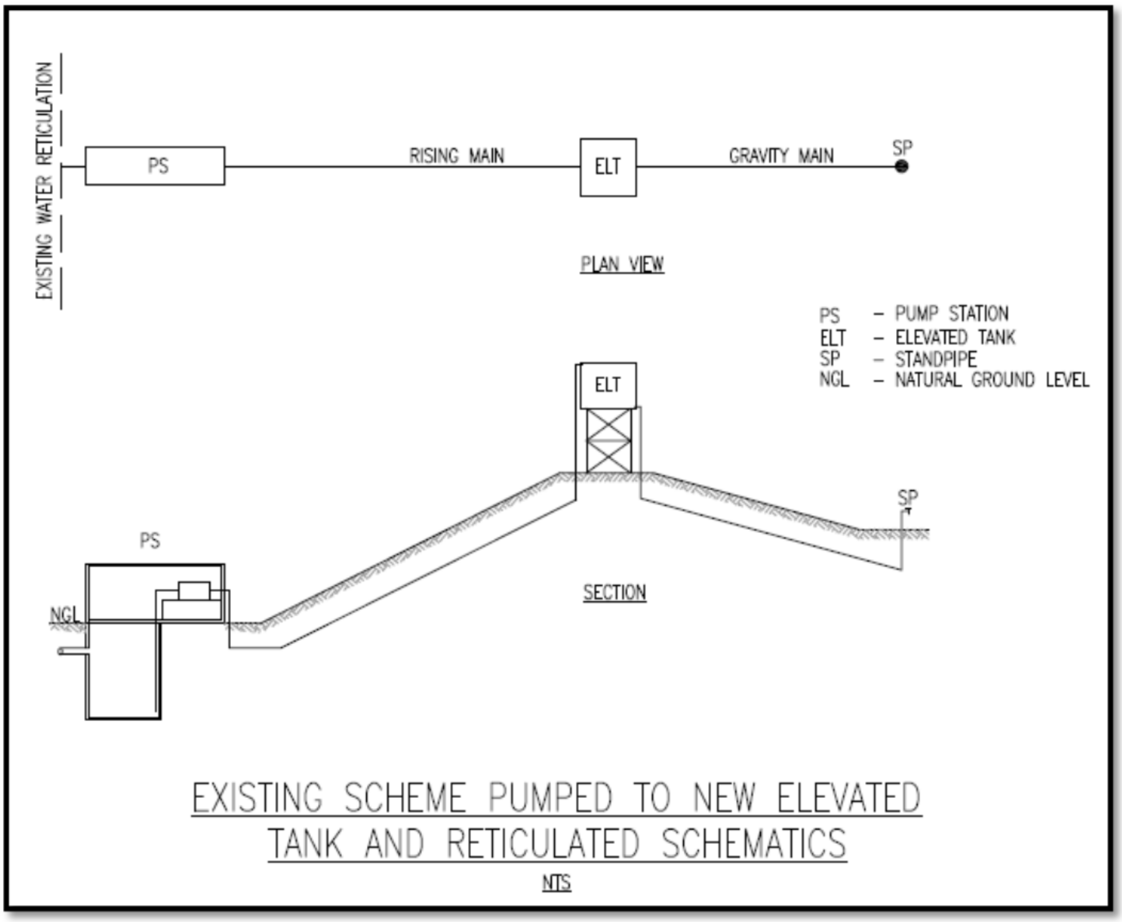
Electrical boreholes are installed in remote rural areas where there is no available water reticulation, but where electrical supply is available.



8.3.6 Existing Scheme Pumped to New Elevated Tank and Reticulated

There are areas at elevations higher than the existing reticulation without supply, which cannot be supplied by the existing reticulation due to the height difference.

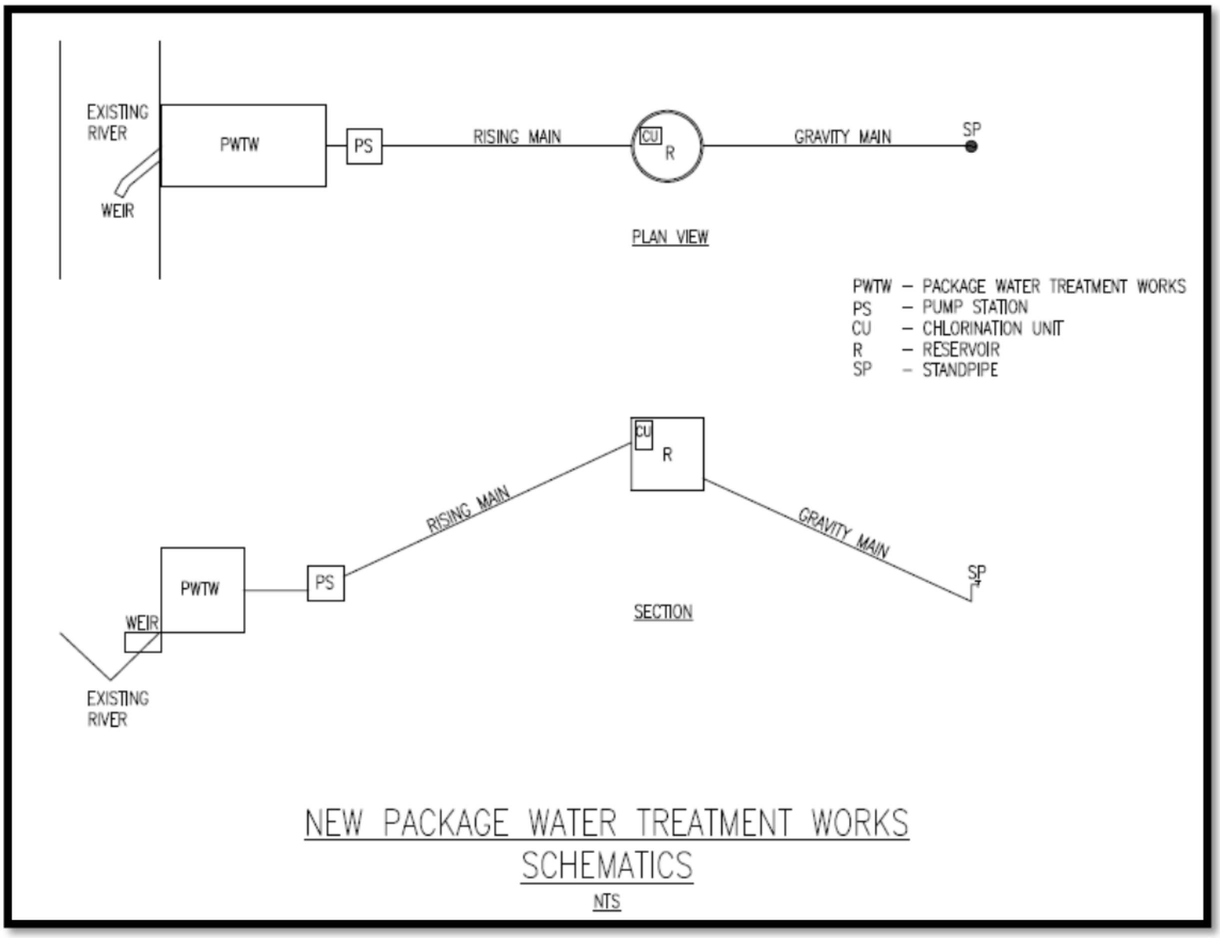
This alternative proposes to supply the houses at these higher elevations by obtaining water from the existing mains and installing a wet well and a pump station as well as an elevated reservoir.



8.3.7 New Package Water Treatment Works

Areas which are located close to a river source can be supplied by a containerized package treatment plant, which could abstract water from the river.

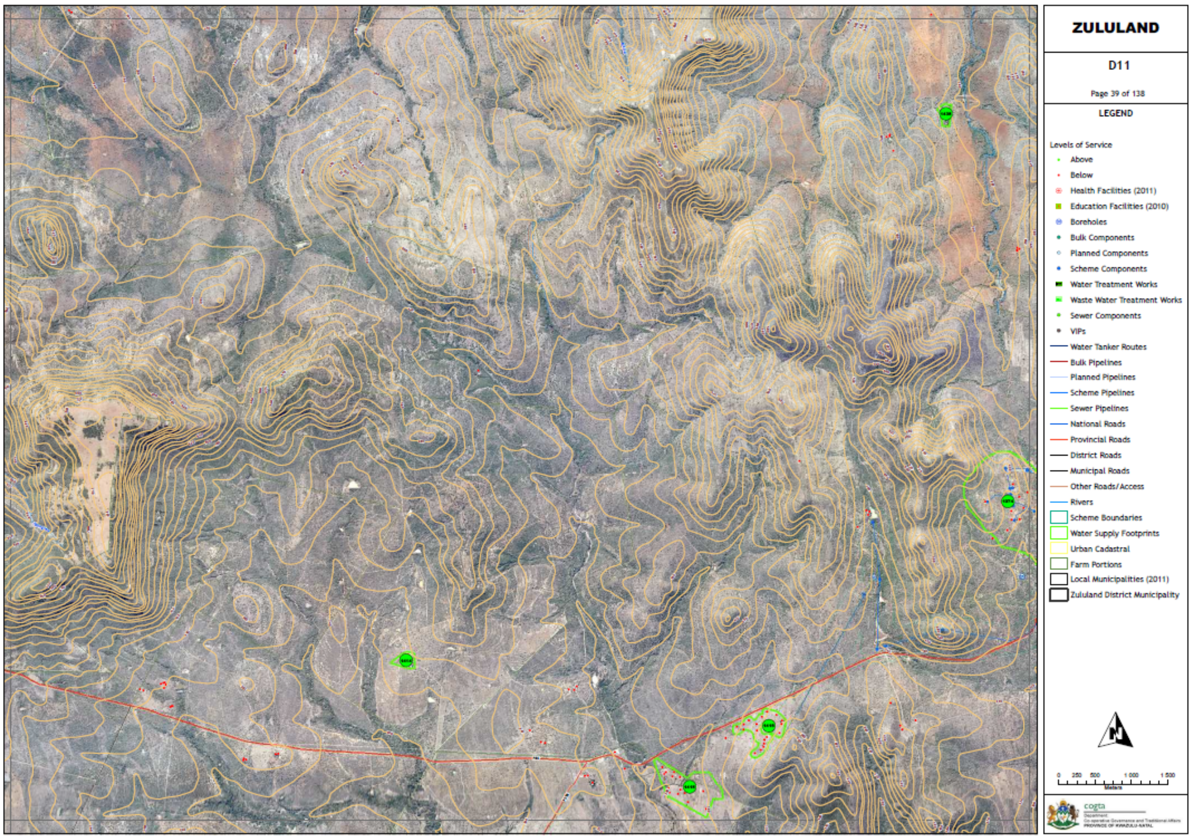
This alternative proposes to abstract water from the river through the package plant which has flocculation units, clarification units and filtration units. The water would then be pumped via a pump station to the storage reservoir which will require a chlorination unit to be installed.


EXISTING RIVER
PWTW
PS
RISING MAIN
CU
R
GRAVITY MAIN
SP
WEIR
PLAN VIEW
PWTW – PACKAGE WATER TREATMENT WORKS
PS – PUMP STATION
CU – CHLORINATION UNIT
R – RESERVOIR
SP – STANDPIPE
SECTION
NEW PACKAGE WATER TREATMENT WORKS SCHEMATICS
NTS

8.4 Description and Mapping of Supply Schemes

Concept layouts of the proposed infrastructure have been included in the GIS database. The names and costs of the schemes are indicated in the tables in section 8.5. These tables refer to individual water supply footprints and have been indicated on the aforementioned database. A detailed description of the geodatabase is continued in section 9 of the report.

The Zululand District Municipality area was plotted in a map series at a scale of 1:20 000. Existing and proposed infrastructure, together with the footprints and contour information (20m intervals) were overlaid onto aerial photography and both exported to pdf and plotted.



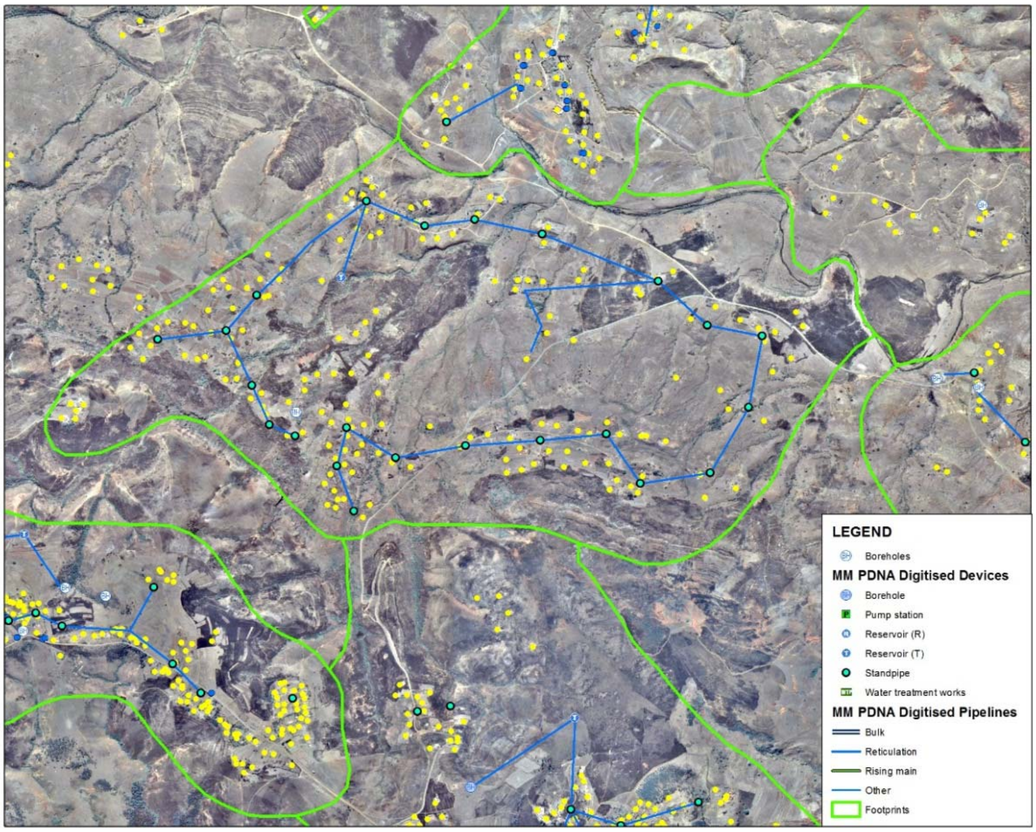
Map 8 - Example of map series sheet

These maps were used, together with the population statistics already calculated, by the engineers at MM PDNA, to design conceptual water supply schemes directly onto the hard copy maps. These maps were returned to MHP GeoSpace, and the concept water pipelines and other infrastructure (standpipes, boreholes, reservoirs etc.) were digitised into the GIS.

New feature classes were added to the geodatabase and lookup tables assigned to fields within the feature classes. This ensured consistency throughout the data capture process, as it meant that there would be no difference in the type of features captured by different users.

The digitised infrastructure was checked to ensure that there was consistency between and across the different map sheets, as well as between the adjacent district municipalities in our project area, namely Amajuba to the west and Umkhanyakude to the east. Each individual map sheet was also checked to ensure that all data had been captured.

Where the conceptual water infrastructure was designed and captured (i.e. where there was no existing supply infrastructure) the settlement (water supply footprint) polygon was assigned a unique identifier. This identifier could later be linked back to the costing table used by the engineers.



Map 9 - Example of data captured from engineers drawings

Shape *	MATERIAL	PIPE_TYPE	SCHEME_ID
Polyline	uPVC	Reticulation	C3-1
Polyline	uPVC	Reticulation	C3-1
Polyline	uPVC	Reticulation	C3-1
Polyline	uPVC	Reticulation	C3-1
Polyline	uPVC	Reticulation	C3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	B3-1
Polyline	uPVC	Reticulation	C3-1
Polyline	uPVC	Reticulation	C3-1
Polyline	uPVC	Reticulation	C2-1
Polyline	uPVC	Reticulation	C2-1
Polyline	uPVC	Reticulation	D3-1
Polyline	uPVC	Reticulation	D3-1
Polyline	uPVC	Reticulation	D3-1
Polyline	uPVC	Reticulation	D3-1
Polyline	uPVC	Reticulation	D3-1
Polyline	uPVC	Reticulation	E2-1
Polyline	uPVC	Reticulation	E3-3
Polyline	uPVC	Reticulation	E3-1
Polyline	uPVC	Reticulation	F3-1
Polyline	uPVC	Reticulation	F3-1
Polyline	uPVC	Reticulation	F3-1
Polyline	uPVC	Reticulation	F3-4
Polyline	uPVC	Reticulation	G2-1
Polyline	uPVC	Reticulation	G2-1
Polyline	uPVC	Reticulation	G2-1

Table 43 - Example of concept design pipeline attributes

NODE_TYPE	SCHEME_ID	
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	H12-28	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	C12-1	Zululand
Borehole	D12-1	Zululand
Standpipe	C12-1	Zululand
Standpipe	D11-1	Zululand
Standpipe	I12-7	Zululand
Standpipe	I12-7	Zululand
Standpipe	H5-1	Zululand
Standpipe	H5-1	Zululand
Standpipe	H10-3	Zululand
Standpipe	H10-3	Zululand
Standpipe	H10-3	Zululand
Standpipe	H10-3	Zululand
Standpipe	C12-1	Zululand
Borehole	D11-3	Zululand
Standpipe	C12-1	Zululand

Table 44 - Example of concept design attributes

8.5 Cost Estimates for Proposed Infrastructure

The rates provided by Umgeni Water are shown on the tables below:

Reservoir

0.25	ML	R 1 381 197
0.5	ML	R 2 243 761
0.75	ML	R 2 980 166
1	ML	R 3 645 000
1.25	ML	R 4 261 226
1.5	ML	R 4 841 294
1.75	ML	R 5 392 922
2	ML	R 5 921 320
2.25	ML	R 6 430 212
2.5	ML	R 6 922 382
2.75	ML	R 7 399 978
3	ML	R 7 864 705
3.25	ML	R 8 317 942
3.5	ML	R 8 760 828
3.75	ML	R 9 194 316
4	ML	R 9 619 213
4.25	ML	R 10 036 211
4.5	ML	R 10 445 910
4.75	ML	R 10 848 834
5	ML	R 11 245 442
5.25	ML	R 11 636 143
5.5	ML	R 12 021 299
5.75	ML	R 12 401 237
6	ML	R 12 776 250
6.25	ML	R 13 146 603
6.5	ML	R 13 512 537
6.75	ML	R 13 874 271
7	ML	R 14 232 007
7.25	ML	R 14 585 930
7.5	ML	R 14 936 210
7.75	ML	R 15 283 004
8	ML	R 15 626 457
8.25	ML	R 15 966 705
8.5	ML	R 16 303 873
8.75	ML	R 16 638 079
9	ML	R 16 969 431
9.25	ML	R 17 298 034
9.5	ML	R 17 623 983
9.75	ML	R 17 947 368
10	ML	R 18 268 275
10.25	ML	R 18 586 783

Pump Station (Civil, Mech and Elec)

0.25	MW	R 11 000 000
0.5	MW	R 18 000 000
0.75	MW	R 25 000 000
1	MW	R 33 000 000
1.25	MW	R 44 000 000
1.5	MW	R 55 000 000
1.75	MW	R 66 000 000
2	MW	R 77 000 000

Pump Station Expansion (Mech and Elec)

0.25	MW	R 3 750 000
0.5	MW	R 7 500 000
0.75	MW	R 11 250 000
1	MW	R 15 000 000
1.25	MW	R 18 750 000
1.5	MW	R 22 500 000
1.75	MW	R 26 250 000
2	MW	R 30 000 000

Water Works

0-50	ML/d	R 4 000 000
50-100	ML/d	R 2 500 000
100-1000	ML/d	R 2 000 000

Water Works Augmentation

0-50	ML/d	R 1 800 000
50-200	ML/d	R 1 500 000

Pipes Steel (mm Ø)

150	mm	R 550
200	mm	R 600
300	mm	R 700
350	mm	R 800
400	mm	R 900
450	mm	R 1 300
500	mm	R 1 650
600	mm	R 1 980
700	mm	R 2 500
800	mm	R 3 200
850	mm	R 3 350
1000	mm	R 3 971

10.5	ML	R 18 902 970
10.75	ML	R 19 216 906
11	ML	R 19 528 659
11.25	ML	R 19 838 293
11.5	ML	R 20 145 870
11.75	ML	R 20 451 447
12	ML	R 20 755 080
12.25	ML	R 20 056 820
12.5	ML	R 21 356 719
12.75	ML	R 21 654 824
13	ML	R 21 951 180
13.25	ML	R 22 245 832
13.5	ML	R 22 538 820
13.75	ML	R 22 830 185
14	ML	R 23 119 964
14.25	ML	R 23 408 196
14.5	ML	R 23 694 914
14.75	ML	R 23 980 153
15	ML	R 24 263 945
15.25	ML	R 24 546 322
15.5	ML	R 24 827 313
15.75	ML	R 25 106 948
16	ML	R 25 385 254
16.25	ML	R 25 662 259
16.5	ML	R 25 937 989
16.75	ML	R 26 212 467
17	ML	R 26 485 720
17.25	ML	R 26 757 769
17.5	ML	R 27 028 638
17.75	ML	R 27 298 349
18	ML	R 27 566 923
18.25	ML	R 27 834 379
18.5	ML	R 28 100 739
18.75	ML	R 28 366 021
19	ML	R 28 630 244
19.25	ML	R 28 893 426
19.5	ML	R 29 155 585
19.75	ML	R 29 416 737
20	ML	R 29 676 900
20.25	ML	R 29 936 088
20.5	ML	R 30 194 319
20.75	ML	R 30 451 606
21	ML	R 30 707 965
21.25	ML	R 30 963 410
21.5	ML	R 31 217 955

1100	mm	R 4 075
1200	mm	R 4 500
1300	mm	R 6 065
1400	mm	R 6 900
1600	mm	R 8 500
1800	mm	R 9 563

Pipes Plastic (mm Ø)

75	mm	R 100
100	mm	R 140
200	mm	R 250
300	mm	R 350

Fittings and Auxiliaries

Pipes Installation (mm Ø)

150	mm	R 858
200	mm	R 936
300	mm	R 1 091
350	mm	R 1 247
400	mm	R 1 403
450	mm	R 2 027
500	mm	R 2 573
600	mm	R 3 087
700	mm	R 3 898
800	mm	R 4 990
850	mm	R 5 224
1000	mm	R 6 192
1100	mm	R 6 354
1200	mm	R 7 017
1300	mm	R 9 457
1400	mm	R 10 759
1600	mm	R 13 254
1800	mm	R 14 910

21.75	ML	R 31 471 614
22	ML	R 31 724 399
22.25	ML	R 31 976 325
22.5	ML	R 32 227 402
22.75	ML	R 32 477 644
23	ML	R 32 727 062
23.25	ML	R 32 975 668
23.5	ML	R 33 223 474
23.75	ML	R 33 470 489
24	ML	R 33 716 726
24.25	ML	R 33 962 195
24.5	ML	R 34 206 906
24.75	ML	R 34 450 869
25	ML	R 34 694 093
25.25	ML	R 34 936 589
25.5	ML	R 35 178 366
25.75	ML	R 35 419 432
26	ML	R 35 659 798
26.25	ML	R 35 899 471
26.5	ML	R 36 138 460
26.75	ML	R 36 376 774
27	ML	R 36 614 421
27.25	ML	R 36 851 408
27.5	ML	R 37 087 744
27.75	ML	R 37 323 436
28	ML	R 37 558 493
28.25	ML	R 37 792 920
28.5	ML	R 38 026 726
28.75	ML	R 38 259 917
29	ML	R 38 492 501
29.25	ML	R 38 724 484
29.5	ML	R 38 955 873
29.75	ML	R 39 186 675
30	ML	R 39 416 895

8.5.1 Proposed Short Term Supply Schemes

The tables below show the cost estimate for short term schemes which tie into the existing reticulation.

Scheme Name	Cost
C7-1	R 60 857 009

C7 – Refers to the drawing number (i.e. drawings on the attached CD)
1 – Refers to the scheme number on the associated drawing
Each scheme number has an associated cost which is also captured on the GIS database.

The cost estimates are based on providing a UAP service only. The upgrading of existing works or rehabilitation of existing water infrastructure have not been included in the cost estimates. The estimates exclude all operational and maintenance costs.

The cost estimates cover the price of undertaking the construction of the water scheme as well as professional fees for the following: geotechnical engineering fees, environmental fees and engineering fees.

In some cases the GIS picked up single scattered houses which are shown to be un-serviced within a polygon which is serviced. It is assumed that these houses came about after the construction of the water supply in that area. For the purpose of the conceptual design and cost estimates, it was proposed that these houses be supplied with standpipes by connecting into the existing water reticulation infrastructure.

8.5.1.1 Uphongolo Local Municipality

Scheme Name	Cost
Link to existing	
C7-1	R 60 857 009
D13-2	R 55 218 658
G9-9	R 94 842 504
B6-1	R 3 749 340
B6-2	R 1 822 062
B7-1	R 1 129 051
B7-2	R 2 643 954
B7-3	R 2 785 701
B7-4	R 1 127 622
B7-5	R 11 649 434
B7-6	R 9 322 963
B7-8	R 21 971 931
B7-9	R 13 346 743
B8-1	R 14 970 316
B8-2	R 715 246
B8-3	R 852 705
B8-4	R 715 246

B8-5	R 993 023
B8-6	R 715 246
B8-7	R 577 788
B9-1	R 783 976
B9-2	R 783 976
B9-3	R 577 788
B9-4	R 577 788
B9-5	R 854 135
B10-1	R 4 430 914
B11-1	R 4 840 430
B12-1	R 7 874 523
B12-2	R 16 124 890
B13-1	R 6 773 426
C6-1	R 13 105 093
C7-2	R 16 442 694
C8-1	R 993 023
C9-1	R 1 814 914
C10-2	R 5 532 011
C12-1	R 35 563 716
D6-1	R 23 148 138
D6-2	R 1 819 203
D6-3	R 2 240 156
D8-1	R 14 058 724
D10-2	R 5 115 347
D11-1	R 4 983 607
D12-1	R 1 539 997
E6-1	R 15 028 081
E6-3	R 2 923 159
E6-4	R 3 192 358
E6-5	R 14 760 312
E6-5 a	R 4 585 527
E6-5 b	R 3 609 022
E6-6	R 1 405 398
E6-7	R 4 986 466
E6-8	R 2 506 495
E6-9	R 2 510 784
E6-10	R 3 198 076
F9-2	R 2 503 636
G9-2	R 3 903 953
G10-2 b	R 7 324 689
G10-3	R 15 595 070
Total	**R 558 018 037**

8.5.1.2 Edumbe Local Municipality

Scheme Name	Cost
Link to existing	
B1-2	R 7 475 014
B2-1	R 33 924 221
B3-1	R 32 513 898
B4-1	R 19 024 384
C1-1	R 715 246
C2-1	R 38 712 395
C3-1	R 17 910 421
C3-2	R 5 393 123
C4-1	R 509 059
C4-2	R 1 130 481
C5-1	R 1 127 622
C5-2	R 509 059
C5-3	R 2 366 178
C5-4	R 1 129 051
E4-4	R 7 741 353
Total	**R 170 181 504**

8.5.1.3 Abaqulusi Local Municipality

Scheme Name	Cost
Link to existing	
F3-2	R 53 650 253
G6-1	R 122 178 094
E7-1	R 33 470 389
E7-6	R 7 871 664
E7-7	R 1 127 622
E8-3	R 1 817 773
F3-1	R 2 506 495
F3-5	R 1 129 051
F4-1	R 41 039 181
F5-1	R 11 309 555
F5-8	R 1 130 481
F5-11	R 3 885 369
F6-1	R 53 576 493
F7-5	R 28 520 454
F8-1	R 28 530 461
G3-1	R 38 984 452
G3-2	R 7 460 718
G4-1	R 21 079 113
G4-3	R 12 837 323
G5-3	R 6 226 451
G5-4	R 7 465 007
G6-3	R 25 260 049

G7-1	R 30 583 761
G7-2	R 1 816 344
G8-1	R 5 115 347
G8-2	R 10 897 180
H2-1	R 3 883 939
H2-2	R 1 403 968
H2-3	R 1 402 539
H6-1	R 3 190 928
H6-6	R 13 915 548
H6-7	R 852 705
H7-1	R 1 130 481
H7-2	R 2 779 983
H7-3	R 11 452 732
H8-1	R 25 104 007
H8-2	R 3 878 221
H8-3	R 4 019 968
H8-4	R 2 228 719
H8-5	R 3 885 369
H8-7	R 1 952 373
I2-1	R 9 253 396
I2-2	R 10 365 930
I2-3	R 1 130 481
I3-1	R 2 502 207
I3-2	R 1 816 344
I3-3	R 6 906 596
J2-2	R 1 130 481
J3-1	R 716 676
J3-2	R 1 127 622
J3-3	R 852 705
J3-4	R 1 541 427
J3-5	R 4 429 484
J4-2	R 990 163
J4-3	R 715 246
J4-4	R 5 254 235
Total	**R 689 283 553**

8.5.1.4 Nongoma Local Municipality

Scheme Name	Cost
Link to existing	

H13-1	R 69 997 636
J9-16	R 90 451 724
E12-1	R 3 604 733
F10-1	R 8 846 739
F11-1	R 9 811 808
F11-3	R 3 196 647
F11-4	R 2 507 925
F11-5	R 3 886 798
F11-6	R 5 262 812
F11-7	R 1 539 997
F11-8	R 2 092 690
F11-10	R 1 131 911
F11-12	R 577 788
F12-1	R 12 971 923
F12-2	R 10 358 782
G10-3	R 27 331 933
G10-5	R 27 722 865
G11-1	R 31 846 619
G11-3	R 1 817 773
G11-6	R 13 120 818
G11-8	R 3 540 293
G12-1	R 715 246
G12-2	R 6 379 635
G12-3	R 2 984 741
G12-10	R 2 506 495
G12-12	R 4 230 444
H9-1	R 16 976 802
H9-2	R 1 819 203
H9-3	R 13 541 770
H9-4	R 5 672 329
H9-5	R 36 187 997
H9-6	R 37 114 357
H9-7	R 8 769 433
H10-1	R 37 339 129
H10-2	R 4 717 267
H10-3	R 20 294 390
H10-4	R 13 117 959
H10-5	R 4 576 950
H10-6	R 1 266 510
H10-7	R 3 335 535
H10-8	R 4 022 827
H10-9	R 5 746 776
H10-10	R 8 296 905
H10-11	R 16 842 203
H11-1	R 10 636 558
H11-6	R 1 403 968

H11-7	R 5 539 159
H11-8	R 4 102 993
H11-12	R 8 294 046
H11-15	R 17 384 889
H11-16	R 5 948 675
H11-17	R 1 129 051
H12-1	R 14 008 579
H12-12	R 7 187 231
H12-13	R 4 986 466
H12-23	R 11 119 093
I8-1	R 34 665 947
I9-1	R 13 249 699
I9-2	R 1 265 080
I9-3	R 22 548 159
I10-1	R 22 381 999
I10-2	R 8 852 458
I10-3	R 12 845 901
I10-4	R 5 815 505
I10-5	R 5 539 159
I10-6	R 4 024 257
I10-7	R 1 266 510
I10-8	R 3 885 369
I10-9	R 4 299 173
I11-1	R 70 562 510
I11-2	R 5 257 094
I12-2	R 42 860 451
I12-3	R 3 192 358
I12-4	R 5 809 787
I12-5	R 8 842 451
J9-1	R 4 436 632
J9-3	R 783 976
J9-4	R 1 265 080
J9-5	R 852 705
J9-6	R 6 501 368
J9-7	R 2 367 607
J9-8	R 4 502 502
J9-9	R 2 233 008
J9-11	R 7 745 642
J9-12	R 20 008 036
J9-15	R 1 403 968
J9-25	R 3 054 899
J9-26	R 12 293 208
J9-28	R 2 507 925
J10-3	R 68 095 405
J10-4 a	R 1 266 510
J10-4b	R 7 467 866

J11-1	R 16 680 442
J11-2	R 852 705
J11-3	R 10 911 475
J11-4	R 1 129 051
J11-5	R 33 636 438
J11-6	R 9 677 208
J11-8	R 1 127 622
J11-9	R 2 230 149
K9-2	R 1 267 939
K10-1	R 1 266 510
K10-2	R 1 542 856
K10-3	R 1 403 968
K10-4	R 990 163
K10-5 a	R 1 816 344
K10-5 b	R 2 507 925
K10-6	R 450 336
K10-7	R 7 466 436
K10-8	R 1 958 091
K10-9	R 1 816 344
K10-10	R 1 266 510
K10-22	R 1 127 622
K10-23	R 1 406 827
K10-24	R 18 202 492
K11-9	R 9 803 230
K11-10	R 6 634 538
Total	**R 1 240 939 254**

8.5.1.5 Ulundi Local Municipality

Scheme Name	Cost
Link to existing	
I8-1	R 131 339 005
L5-1	R 105 821 652
I5-2	R 6 353 903
I7-1	R 14 214 767
I8-2	R 11 608 775
I8-4	R 1 196 351
I8-5	R 5 539 159
I8-6	R 14 904 919
I8-7	R 28 895 551
I8-8	R 46 186 616
J7-1	R 48 169 757
J7-3	R 40 887 317
J8-1	R 3 610 452
J8-2	R 2 920 300

J8-4	R 7 467 866
J8-7	R 577 788
J8-8	R 577 788
J8-9	R 1 816 344
J8-10	R 577 788
J9-28	R 5 398 841
K6-4	R 7 731 346
K7-1	R 1 127 622
K7-2	R 1 814 914
K7-3	R 9 937 830
K7-4	R 37 091 484
K7-5	R 2 227 290
K7-6	R 852 705
K7-7	R 2 709 824
K7-8	R 7 457 859
K7-12	R 7 599 606
K9-3	R 1 129 051
K9-4	R 19 876 296
K9-6	R 1 819 203
K9-7	R 3 611 881
K9-8	R 4 849 007
K9-9	R 852 705
K9-10	R 1 408 257
K9-11	R 6 084 704
K9-12	R 2 367 607
K9-15	R 2 923 159
K9-16	R 12 689 858
K9-17	R 5 265 671
K9-24	R 1 265 080
K9-25	R 990 163
L4-1	R 22 519 568
L6-1	R 44 000 257
L7-1	R 7 812 942
L7-2	R 577 788
L7-3	R 990 163
L7-4	R 3 066 336
L7-5	R 2 230 149
L7-6	R 1 265 080
L7-7	R 1 887 932
L7-8	R 15 602 218
L7-9	R 1 955 232
L8-1	R 7 265 967
L9-1	R 20 774 065
L10-1	R 46 440 089
L10-3	R 3 126 488
L10-4	R 4 025 686

L10-5	R 10 771 158
L10-6	R 13 255 417
M6-2	R 4 223 296
M7-1	R 1 545 716
M7-2	R 6 491 361
M8-1	R 5 116 776
M8-2	R 1 541 427
M8-3	R 852 705
M9-1	R 29 431 089
M9-2	R 17 044 102
M9-3	R 5 131 072
M9-7	R 23 185 306
M9-8	R 3 892 516
M9-12	R 20 340 246
M10-1	R 1 266 510
M10-2	R 1 266 510
M10-3	R 1 335 239
N6-2	R 5 954 393
N6-4	R 2 095 549
N7-1	R 5 469 000
Total	**R 965 497 411**

Summary of short term supply

Municipality	Total Cost
Edumbe	R 170 181 504
Uphongolo	R 558 018 037
Abaqulusi	R 689 283 553
Nongoma	R 1 240 939 254
Ulundi	R 965 497 411
Total	**R 3 623 919 758**

8.5.2 Proposed Long Term Supply Schemes

The costing of the proposed infrastructure was based on information/rates provided by Umgeni Water.

8.5.2.1 Edumbe Local Municipality

Scheme Name	Cost	Total
Small Package Plant		**R 107 057 651**
B1-1	R 107 057 651	
Existing Borehole Electronically Operated		**R 109 522 885**
D2-2	R 1 817 773	
D2-3	R 1 680 315	
D2-4	R 1 129 051	
D2-5	R 1 541 427	
D4-1	R 13 518 897	
D5-1	R 2 371 896	
D5-2	R 8 789 447	
D5-3	R 5 069 491	
D5-4	R 13 392 875	
E5-1	R 28 390 144	
E5-3	R 25 522 100	
E5-4	R 6 299 469	
New Borehole Electronically operated		**R 106 224 113**
B1-3	R 3 357 294	
D2-1	R 3 630 781	
D3-1	R 3 907 128	
D3-2	R 4 043 157	
D3-3	R 3 768 240	
D4-2	R 8 314 376	
E2-1	R 4 320 933	
E3-1	R 7 485 337	
E3-2	R 7 074 391	
E3-3	R 3 216 976	
E3-4	R 3 216 976	
E3-5	R 3 216 976	
E3-6	R 3 769 669	
E3-7	R 9 270 867	
E4-1	R 3 493 323	
E4-2	R 3 769 669	
E4-3	R 3 079 518	
E4-5	R 3 630 781	
E4-6	R 16 172 382	
E5-2	R 7 485 337	
Total		**R 322 804 649**

Cost per capita = R 77 923

8.5.2.2 Uphongolo Local Municipality

Scheme Name	Cost	Total
Existing Boreholes Electronically Operated		**R 21 228 981**
D9-3	R 1 131 911	
D9-4	R 1 266 510	
D10-1	R 2 506 495	
E9-1	R 2 091 261	
E9-2	R 3 886 798	
E10-1	R 1 816 344	
E11-7	R 3 893 946	
E11-8	R 2 101 268	
E11-9	R 1 129 051	
E11-10	R 1 405 398	
Existing Borehole Electronically Operated with Storage		**R 5 561 778**
E11-6	R 5 561 778	
New Borehole Mechanically operated		**R 70 575 120**
C9-2	R 2 940 630	
C10-1	R 2 940 630	
C11-1	R 2 940 630	
D11-2	R 2 940 630	
D11-3	R 2 940 630	
D13-1	R 2 940 630	
E10-2	R 2 940 630	
E10-3	R 2 940 630	
E10-4	R 2 940 630	
E10-5	R 2 940 630	
E11-3	R 2 940 630	
E11-4	R 2 940 630	
E12-4	R 2 940 630	
F9-1	R 2 940 630	
F10-2	R 2 940 630	
F10-4	R 2 940 630	
F10-5	R 2 940 630	
F11-1	R 2 940 630	
G9-3	R 2 940 630	
G9-5	R 2 940 630	
G9-6	R 2 940 630	
G9-7	R 2 940 630	
G9-8	R 2 940 630	
G9-10	R 2 940 630	
New Borehole Electronically operated		**R 77 425 000**
C11-2	R 3 493 323	

D7-1	R 3 630 781	
D7-2	R 3 354 435	
D9-1	R 4 044 586	
D9-2	R 4 043 157	
E6-2	R 4 318 074	
E10-6	R 4 595 850	
E11-1 a	R 3 354 435	
E11-1 b	R 5 698 377	
E11-1 c	R 3 632 211	
E11-1 d	R 3 493 323	
E11-2	R 5 005 366	
E11-5	R 5 008 225	
E12-2	R 4 595 850	
F10-3	R 3 354 435	
F10-6	R 9 141 986	
G10-2 a	R 6 660 586	
Total		**R 174 790 879**

Cost per capita = R 23 289

8.5.2.3 Abaqulusi Local Municipality

Scheme Name	Cost	Total
Existing Boreholes Electronically Operated		**R 63 251 314**
E7-2	R 8 232 465	
E7-3	R 3 059 188	
E7-4	R 5 542 018	
E8-1	R 4 160 285	
E8-4	R 3 881 080	
E8-6	R 1 544 286	
E8-7	R 1 541 427	
E8-8	R 854 135	
E8-10	R 5 123 924	
F3-7	R 3 193 788	
F5-7	R 1 822 062	
F6-2	R 3 199 506	
F7-7	R 3 056 329	
F8-4	R 443 189	
G5-2	R 2 507 925	
G6-5	R 1 816 344	
G7-3	R 10 905 757	
H8-6	R 2 367 607	

Existing Borehole Electronically Operated with Storage		**R 17 711 455**
E7-5	R 7 542 670	
J4-1	R 10 168 785	
New Borehole Mechanically operated		**R 55 871 970**
E8-2	R 2 940 630	
F2-2	R 2 940 630	
F3-4	R 2 940 630	
F3-6	R 2 940 630	
F3-8	R 2 940 630	
F3-9	R 2 940 630	
F4-2	R 2 940 630	
F4-4	R 2 940 630	
F7-3	R 2 940 630	
F7-4	R 2 940 630	
F7-6	R 2 940 630	
F8-2	R 2 940 630	
F8-3	R 2 940 630	
G4-2	R 2 940 630	
G4-4	R 2 940 630	
H2-4	R 2 940 630	
H5-8	R 2 940 630	
H6-2	R 2 940 630	
I4-2	R 2 940 630	
New Borehole Electronically operated		**R 129 031 594**
E8-5	R 3 354 435	
E8-9	R 3 630 781	
F2-1	R 3 905 698	
F3-3	R 8 448 975	
F4-3	R 3 491 893	
F6-3	R 5 695 518	
F6-4	R 3 630 781	
F7-1	R 11 620 527	
F7-2	R 6 384 239	
H3-1	R 4 043 157	
H3-2	R 3 630 781	
H3-3	R 3 630 781	
H4-1	R 3 630 781	
H4-2	R 3 630 781	
H4-3	R 3 630 781	
H4-4	R 3 630 781	
H5-1	R 5 831 546	
H5-2	R 6 381 380	
H5-3	R 7 349 308	
H5-4	R 7 346 449	

H5-7	R 3 355 865	
H5-9	R 11 196 715	
H5-10	R 3 630 781	
I4-1	R 4 318 074	
J2-1	R 3 630 781	
New Borehole Electronically Operated with Storage		**R 8 449 846**
J2-3	R 8 449 846	
TOTAL		**R 274 316 179**

Cost per capita = R 36 548

8.5.2.4 Nongoma Local Municipality

Scheme Name	Cost	Total
Existing boreholes electronically Operated		**R 184 211 522**
E12-3	R 3 202 365	
F11-2	R 3 199 506	
F11-9	R 2 367 607	
G12-4	R 1 610 156	
G12-5	R 1 678 885	
G12-6	R 1 542 856	
G12-7	R 2 367 607	
G12-8	R 2 643 954	
G13-1	R 646 517	
G13-2	R 990 163	
G13-3	R 1 680 315	
H11-2	R 1 817 773	
H11-5	R 1 816 344	
H11-11	R 852 705	
H11-13	R 4 435 202	
H11-14	R 6 017 404	
H12-2	R 1 541 427	
H12-4	R 1 542 856	
H12-5	R 3 192 358	
H12-6	R 1 266 510	
H12-7	R 715 246	
H12-8	R 1 129 051	
H12-9	R 1 955 232	
H12-10	R 2 094 120	
H12-11	R 15 318 724	
H12-14	R 1 405 398	
H12-15	R 3 057 759	

H12-16	R 1 541 427	
H12-17	R 2 918 871	
H12-18	R 6 359 621	
H12-24	R 2 920 300	
H12-25	R 2 918 871	
H12-26	R 3 332 676	
H12-27	R 852 705	
H13-2	R 1 405 398	
H13-3	R 4 297 744	
H13-4	R 2 921 730	
H13-5	R 2 505 066	
I12-1	R 2 369 037	
I12-7	R 3 883 939	
J9-18	R 5 675 188	
J9-20	R 577 788	
J9-23	R 1 266 510	
J9-24	R 3 471 564	
J11-7	R 1 129 051	
J11-10	R 2 641 095	
J11-11	R 715 246	
J11-12	R 715 246	
J11-14	R 3 054 899	
J11-15	R 1 541 427	
J11-16	R 991 593	
J11-17	R 852 705	
J11-18	R 646 517	
J11-19	R 646 517	
J11-20	R 852 705	
J11-21	R 1 405 398	
J11-24	R 990 163	
J11-25	R 1 677 456	
K10-11	R 1 680 315	
K10-12	R 1 403 968	
K10-13	R 1 816 344	
K10-14	R 1 403 968	
K10-15	R 1 129 051	
K10-16	R 5 259 953	
K10-18	R 990 163	
K10-19	R 852 705	
K10-20	R 646 517	
K10-21	R 2 092 690	
K10-25	R 13 113 670	
K10-26	R 2 369 037	
K10-27	R 1 541 427	
K11-1	R 3 467 275	
K11-2	R 1 953 802	

K11-3	R 1 817 773	
K11-4	R 852 705	
K11-5	R 715 246	
K11-6	R 715 246	
K11-7	R 1 955 232	
K11-8	R 1 267 939	
Existing Borehole electronically operated with storage		**R 39 421 532**
G12-9	R 14 701 128	
G12-11	R 6 832 152	
K11-13	R 17 888 252	
New Borehole electronically operated		**R 1 816 344**
H12-28	R 1 816 344	
Total		**R 225 449 397**

Cost per capita = R 10 094

8.5.2.5 Ulundi Local Municipality

Scheme Name	Cost	Total
Existing boreholes electronically Operated		**R 32 729 836**
I5-1	R 2 367 607	
I6-4	R 3 053 470	
J7-2	R 1 129 051	
K5-3	R 8 145 151	
K5-4	R 1 678 885	
K6-1	R 4 432 343	
K9-1	R 1 541 427	
K9-2	R 1 263 651	
K9-18	R 1 403 968	
K9-19	R 2 230 149	
K9-20	R 715 246	
K9-21	R 1 267 939	
K9-23	R 1 680 315	
L9-2	R 1 820 632	
Existing Borehole electronically operated with storage		**R 73 648 431**
N6-1	R 18 785 674	
N6-3	R 54 862 757	
New Borehole electronically operated		**R 78 508 696**
I6-1	R 7 758 824	

I6-2	R 4 594 420	
I6-3	R 5 971 864	
I6-5	R 6 107 893	
J5-1	R 3 630 781	
J5-2	R 5 008 225	
J6-1	R 5 834 406	
J6-2	R 9 760 549	
J6-3	R 3 905 698	
J6-4	R 5 212 983	
K5-1	R 3 079 518	
K5-2	R 3 079 518	
K6-2	R 3 769 669	
K6-3	R 10 794 347	
Total		**R 184 886 964**

Cost per capita = R 9 251

Summary of long term supply

Municipality	Total Cost
Edumbe	R 322 804 649
Uphongolo	R 174 790 879
Abaqulusi	R 274 316 179
Nongoma	R 225 449 397
Ulundi	R 184 886 964
Total	**R 1 182 248 068**

8.6 Phasing of scheme options

The phasing includes proposed plans to address the water backlogs. Various potential funding such as MIG, PIG etc. may be applied for to undertake these projects. The phasing is based on both the short and long term proposals.

An average cost for each scheme type was compared with the cost estimate for an individual scheme. If the scheme was less than or equal to the average it was assumed that the project could be untaken over a year. If the cost ratio was higher than the average cost, the ratio was used to determine the duration of the project. However, this is flexible depending on the nature and type of project.

An example of the above explanation is demonstrated as follows for the scheme type link to existing for the Edumbe Local Municipality.

Scheme Name	Cost
Link to existing	
B1-2	R 7 475 014
B2-1	R 33 924 221
B3-1	R 32 513 898
B4-1	R 19 024 384
C1-1	R 715 246
C2-1	R 38 712 395
C3-1	R 17 910 421
C3-2	R 5 393 123
C4-1	R 509 059
C4-2	R 1 130 481
C5-1	R 1 127 622
C5-2	R 509 059
C5-3	R 2 366 178
C5-4	R 1 129 051
E4-4	R 7 741 353
Total	**R 170 181 504**

The total number of schemes is 15.

The total cost of the 15 schemes is R 170 181 504.

The average cost per scheme is R 170 181 504 / 15 = R 11 345 433.

To phase scheme B1-2 which costs R 7 475 014, is R 7 475 014 / R 11 345 433 = 0.7, hence scheme B1-2 is phased to be undertaken in one year.

To phase scheme C2-1 which costs R 38 712 395, is R 38 712 395 / R 11 345 433 = 3.4, hence scheme C2-1 is phased over four years.

The phasing of the schemes is indicated in Table 45.

Implementation Year	LM	Total Cost
2015/16	eDumbe	R 263 230 967
	Uphongolo	R 506 563 737
	Abaqulusi	R 656 160 519
	Nongoma	R 816 980 579
	Ulundi	R 627 688 337
		R 2 870 624 139

Implementation Year	LM	Total Cost
2016/17	eDumbe	R 54 520 048
	Uphongolo	R 129 436 504
	Abaqulusi	R 45 040 700
	Nongoma	R 194 871 439
	Ulundi	R 193 448 726
		R 617 317 418

Implementation Year	LM	Total Cost
2017/18	eDumbe	R 175 235 139
	Uphongolo	R 38 096 821
	Abaqulusi	R 148 904 489
	Nongoma	R 99 278 443
	Ulundi	R 66 471 791
		R 527 986 683

Implementation Year	LM	Total Cost
2018/19	Uphongolo	R 58 711 854
	Abaqulusi	R 113 494 022
	Nongoma	R 355 258 190
	Ulundi	R 262 775 519
		R 790 239 585

Table 45 - Phasing of Schemes

9. DEVELOP AN UPDATED GEO DATABASE INCLUDING META DATA OF ALL RELEVANT INFORMATION

All the GIS infrastructure data, both existing and proposed, together with the water supply footprints have been incorporated into a structured geodatabase. All fields requested in the terms of reference, whether populated or not, have been included in the attribute tables of each dataset.

Metadata for each dataset was captured (for the entire dataset), and within the attribute table, metadata fields applicable to specific fields have also been included. These include metadata on the source of the population statistics, the water source data, and the connection type data.

A "completeness" field was also included in the feature class for the water supply footprints. This field gives a snapshot view of the percentage completeness of all the fields in the dataset for each area.

Other data included in the geodatabase are administrative boundaries (wards, local municipalities, district municipalities) together with locality features such as place names and neighbouring countries. Both urban and cadastral data from the Surveyor General's Office has been included. Social facilities including health facilities and schools have been provided, both to assist with water planning needs, as well as to provide information about the area in which the user is working.

All household information has been added to the geodatabase – Eskom household points as well as the DRDLR settlement boundaries. Topography in the form of 20m contours from the 1:50 000 topographic map series were used in the planning process, and can be found in the geodatabase. Rivers and road network data have also been included.

Along with all the base data, infrastructure specific to the District Municipality has been imported. The Water Services Development Plan (WSDP) for 2013, as well as the draft 2014 WSDP data received from the municipality has been incorporated into the geodatabase.

Along with the data received from outside sources, the geodatabase also contains the data which has been captured during this project. The water supply footprints, proposed water pipelines and proposed water features (boreholes, standpipes etc.) have been added to the geodatabase.
A detailed list of all the datasets, along with their metadata can be found in Annexure 1. An outline of the GIS methodology can be found in Annexure 2.

DVD's containing all spatial information, files of all working maps, as well as the map series showing the planned service infrastructure, have been provided in conjunction with this report. A series of A0 maps have also been prepared and exported to pdf these can be viewed in Annexure 3. One map shows the entire District Municipality, with others showing each of the local municipalities within the district.

10. CONCLUSION AND RECOMMENDATIONS

10.1 Total cost of proposed schemes in the Zululand District Municipality

The following table gives an indication in the form of a summary of the proposed conceptual scheme types and the associated costs which need to be undertaken to alleviate the current water backlog of 44473 households in the Zululand District Municipality.

Zululand DM	
Scheme Type	**Total**
Link to existing scheme	R 3 623 919 758
Package Plants	R 107 057 651
Existing boreholes electronically operated	R 410 944 538
Boreholes electronically operated with storage	R 136 343 195
New boreholes mechanically operated	R 126 447 090
New boreholes electronically operated	R 393 005 747
TOTAL	**R 4 797 717 979**

10.2 Total cost of phases of schemes in the Zululand District Municipality

An average cost for each scheme type was compared with the cost estimate for an individual scheme. If the scheme was less than or equal to the average it was assumed that the project could be untaken over a year. If the cost ratio was higher than the average cost, the ratio was used to determine the duration of the project. However, this is flexible depending on the nature and type of project. A detailed description of the phasing can be viewed in section 8.6 of the report.

The proposed conceptual design schemes may be phased according to the tables below.

Implementation Year	LM	Total Cost
2015/16	eDumbe	R 263 230 967
	Uphongolo	R 506 563 737
	Abaqulusi	R 656 160 519
	Nongoma	R 816 980 579
	Ulundi	R 627 688 337
		R 2 870 624 139

Implementation Year	LM	Total Cost
2016/17	eDumbe	R 54 520 048
	Uphongolo	R 129 436 504
	Abaqulusi	R 45 040 700
	Nongoma	R 194 871 439
	Ulundi	R 193 448 726
		R 617 317 418

Implementation Year	LM	Total Cost
2017/18	eDumbe	R 175 235 139
	Uphongolo	R 38 096 821
	Abaqulusi	R 148 904 489
	Nongoma	R 99 278 443
	Ulundi	R 66 471 791
		R 527 986 683

Implementation Year	LM	Total Cost
2018/19	Uphongolo	R 58 711 854
	Abaqulusi	R 113 494 022
	Nongoma	R 355 258 190
	Ulundi	R 262 775 519
		R 790 239 585

10.3 Proposed Future Work

It is recommended that the concept designs covered in this report be advanced to preliminary designs.

It is recommended that the link to existing schemes for the various local municipalities be undertaken first due to the existing water treatment and bulk infrastructure. The table below is a summary of the cost of the link to existing schemes that can be undertaken.

Link to existing schemes	
Local Municipality	**Total**
Edumbe	R 170 181 504
Uphongolo	R 558 018 037
Abaqulusi	R 689 283 553
Nongoma	R 1 240 939 254
Ulundi	R 965 497 411
Total	**R 3 453 738 255**

11. ANNEXURES

Annexure 1 - Database Design and attribute table

GEODATABASE STRUCTURE/DATA DICTIONARY			
FEATURE DATASET	**FEATURE CLASSES**	**DESCRIPTION**	**SOURCE**
Administration	District Municipalities	District Municipality boundaries from 2011	Demarcation Board
	Local Municipalities	Local Municipality boundaries from 2011	Demarcation Board
	Neighbouring Countries	Borders of neighbouring countries	SA Atlas
	Ocean	Dataset created to show ocean next to KZN coast	MHP GeoSpace
	Place Names	Main place names within KZN	SA Atlas
	RSA Provinces	Provincial boundaries	Demarcation Board
	Subplace Names	Subplace names from centroids of poylgon data	Statistics SA
	Wards	Ward boundaries from 2011	Demarcation Board
Cadastral	Erf	Urban cadastral data	Surveyor General's Office, PMB
	Farm portions	Farm portion cadastral data	Surveyor General's Office, PMB
DWA	Boreholes	Point dataset showing existing boreholes	Department of Water Affairs
	Reservoirs	Point dataset showing existing reservoirs	Department of Water Affairs
	Scheme Areas	Polygons showing existing water scheme areas	Department of Water Affairs
	WTW	Point dataset showing existing water treatment works	Department of Water Affairs
	Surface Water Abstraction Works	Point dataset showing existing surface water abstraction works	Department of Water Affairs
	Water Pump Stations	Point dataset showing existing water pump stations	Department of Water Affairs
Facilities	Education	Point dataset showing location of all schools	KZN Department of Education
	Health	Point dataset showing location of all health facilities	KZN Department of Health
Settlements	Households	2011 household points	Eskom

Topography	Contours 20m	Contours at 20m intervals	National Geospatial Information
Transport	DOT 2014	All roads (major and minor) from 2014	Department of Transport
UAP_Nodes	Nodes	Digitised water nodes (boreholes, standpipes etc) captured off hard copy maps	MM PDNA/MHP GeoSpace
UAP_Pipelines	Pipelines	Digitised water pipelines captured off hard copy maps	MM PDNA/MHP GeoSpace
UAP_Zululand	Zululand water supply footprints	Digitised water supply footprints around settlements in the Zululand District Municipality, incorporating the settlement boundaries received from the district.	Zululand District Municipality/ MHP GeoSpace
Zululand_Services	Boreholes	Existing boreholes within Zululand District Municipality	Zululand District Municipality
	Bulk components	Bulk components within Zululand District Municipality (WSDP 2013)	Zululand District Municipality
	Bulk pipes	Bulk pipelines within Zululand District Municipality (WSDP 2013)	Zululand District Municipality
	Planned components	Planned components within Zululand District Municipality (WSDP 2013)	Zululand District Municipality
	Planned pipes	Planned pipelines within Zululand District Municipality (WSDP 2013)	Zululand District Municipality
	Pongola sewer nodes	Sewer nodes (manholes etc) in the Pongola area	Zululand District Municipality
	Pongola sewer pipes	Sewer pipelines in the Pongola area	Zululand District Municipality
	Scheme boundaries	Water scheme areas within Zululand District Municipality	Zululand District Municipality
	Scheme components	Scheme components within Zululand District Municipality (WSDP 2013)	Zululand District Municipality
	Scheme pipes	Scheme pipelines within Zululand District Municipality (WSDP 2013)	Zululand District Municipality
	Sewer lines	Sewer pipelines within Zululand District Municipality	Zululand District Municipality
	Sewer nodes	Sewer nodes (manholes etc) within Zululand District Municipality	Zululand District Municipality
	VIP	VIP point data within Zululand District Municipality	Zululand District Municipality
	Water tanker routes	Water tanker supply routes within Zululand District Municipality (WSDP 2013)	Zululand District Municipality

	WSDP 2014 components	Scheme components within Zululand District Municipality (WSDP 2014 - draft)	Zulmap
	WSDP 2014 pipelines	Scheme pipelines within Zululand District Municipality (WSDP 2014 - draft)	Zulmap
	WTW	Existing water treatment works within Zululand District Municipality	Zululand District Municipality
	WWTW	Existing waste water treatment works within Zululand District Municipality	Zululand District Municipality

WATER SUPPLY FOOTPRINTS ATTRIBUTES

Field Name	Alias	Description	Units/Values/Field Type
DM	District Municipality	Name of the municipality in which the area falls	Text
Area_m2	Area in square metres	GIS calculated	Number
Name	Name	Name of area if known	Text
Short_SS	Short term supply status	Is there an existing supply?	Y/N lookup table
Interim_SS	Interim supply status	Is there an interim supply?	Y/N lookup table
Bulk_SS	Bulk supply status	Is there a bulk supply?	Y/N lookup table
ST_Supply	Sustainable supply	Is the supply sustainable?	Y/N lookup table
Sust_2016	Sustainable to 2016	Is existing supply sustainable to 2016?	Y/N lookup table
Not_2016	Not sustainable to 2016	If N, What needs to be done to ensure sustainable supply to 2016?	Text
ExistPlans	Existing plans	Are there existing plans to ensure sustainably beyond 2016?	Y/N lookup table
Horizon30	30 year horizon plans	If Y, are these plans for 30 year horizon?	Y/N lookup table
Plans30yr	Detail of plans	If Y, what are these plans.	Text
Sust2046	Sustainable to 2046	If N, What needs to be done to ensure sustainable supply to 2046?	Text
Schm_E	Existing scheme name	Name of any existing supply scheme	Text
Schm_F	Future scheme name	Name of any future proposed scheme	Text

Sou_E	Existing source	Existing water source from lookup table	Lookup table (eg borehole, reservoir)
Sou_F	Future source	Future water source from lookup table	Lookup table (eg borehole, reservoir)
WatNam_E	Existing source name	Name of existing source	Text
WatNam_F	Future source name	Name of future source	Text
Proj_Typ	Project type	Type of project from lookup table	Lookup table (eg MWIG, BIG)
SuppDate	Scheme supply date	Date of proposed intervention	Text
Treat	Treatment type	Existing treatment type from lookup table	Lookup table (eg WTW, sand filter)
WT_Nam	WTW name	Name of water treatment works	Text
Conn	Connection	Type of water connection from lookup table	Lookup table (eg yard, house, community standpipe)
Design_E	Existing design demand	Demand for which this scheme has been designed	Number (million m^3 p.a.)
LowDemandForecast	Demand Low	Low demand forecast	Number (million m^3 p.a.)
HighDemandForecast	Demand High	High demand forecast	Number (million m^3 p.a.)
ProbableDemand	Probable demand	Probable demand forecast	Number (million m^3 p.a.)
Supp_E	Existing supply	Current water supply capacity	Number (million m^3 p.a.)
CurrentWaterRequirements	Water requirements	Current water requirements	Number (million m^3 p.a.)
FutureWaterRequirements	Future water requirements	Future water requirements	Number (million m^3 p.a.)
Proj_ID	Project ID	ID of project if known	Text
HH_Low	Households low	Lowest estimate of households served	Number
HH_High	Households high	Highest estimate of households served	Number
Pop_Low	Population low	Lowest estimate of number of people	Number
Pop_High	Population high	Highest estimate of number of people	Number
Capturer	Capturer	Person who captured the area from lookup table	Lookup table (eg MHP GeoSpace, Mlungisi Dimba MM PDNA)

Sanitation	Type of sanitation scheme	Type of sanitation scheme from lookup table	Lookup table (eg septic tank, VIP)
Comments	Comments	General comments	Text
Assumptions	Assumptions	Assumptions made about existing infrastructure	Lookup table (eg Existing water scheme has enough capacity to be extended)
Assumptions_Other	Other Assumptions	Any other assumptions made about the area	Text
PopStats_Source	Population Statistics Source	The data source for the population statistics	Lookup table (eg Census 2011, Eskom 2011)
Source_Metadata	Metadata on water source	Information on whether the population data has been edited or verified	Lookup table (eg. Spatial calculation, Verified)
Connection_Metadata	Metadata on connection type	Information on whether the population data has been edited or verified	Lookup table (eg. Spatial calculation, Verified)
Completeness	Completeness of data	A percentage showing the number of fields populated per rectod	Number
SettlementType	Settlement Type	Settlement type (rural, urban etc) where available	Text
SanitationLOS	Sanitation Level of Service	The current sanitation level of service where data is available	Text

WATER PIPELINE ATTRIBUTES

Field Name	Alias	Description
Pipeline_Type	Pipeline type	Type of pipeline from lookup table
Project_Type	Project type	Project type from lookup table
Supply_Type	Supply type	Supply type from lookup table
Water_Source	Water source	Water source from lookup table
Capturer	Capturer	Data capturer from lookup table
Comments	Comments	General comments

WATER NODE ATTRIBUTES

Field Name	Alias	Description
Node_Type	Type of facility	Type of facility from lookup table
Capturer	Data capturer	Data capturer from lookup table
Comments	Comments	General comments

LOOK UP TABLES	
DOMAIN NAME AND CODES	**DESCRIPTION**
Capturer	**Name of data capturer**
0	Not updated
1	Juan Wood (MM PDNA)
2	Petrus Buthelezi (MM PDNA)
3	Mlungisi Dimba (MM PDNA)
4	MHP GeoSpace
5	District Municipality
6	MM PDNA Data Capturers
7	MM PDNA Team 2
Connection	**Water connection type**
0	Unknown
1	Yard connection
2	House connection
3	Community standpipe
4	Jojo tank
5	Reservoir
Metadata	**Metadata**
Calculated	Calculated
Verified	Verified
Captured	Captured by MHP GeoSpace
Quality Assured	QA by MHP GeoSpace

Annexure 2 – GIS Methodology

GIS METHODOLOGY

WATER SUPPLY FOOTPRINTS

- Settlement data (DWA settlements; Department of Rural Development and Land Reform settlements; Eskom household points) overlaid on aerial photography
- Polygons digitized around settlement clusters with outlying households being incorporated where possible
- Polygons captured over whole district, including areas with existing supply
- Fields added to attribute table as per Umgeni Water requirements
- Web mapping application developed so polygons could be edited, updated, created by users outside of the office environment

POPULATION STATISTICS

- Census 2011 data extracted using the SuperCross application from StatsSA
- Household counts calculated for each polygon using a spatial join between the demand polygons and the Eskom 2011 household points
- Population growth rate calculated by extrapolating the growth rate for each ward from 2001 to 2014 using census data from 2001 and 2011
- Growth rate applied to the household count to obtain figures for the highest possible household number in 2014
- Total population was divided by the number of households per sub-place to get the average household size per house per sub-place
- Household size data linked to demand areas (spatial join) and summarized to get the number of people in each demand area
- Growth rate (as calculated previously) applied to these numbers to reach a best possible approximated population figure for 2014 per demand area
- Water demand forecasts (high and low) calculated by using these population figures multiplied by the estimated water consumption appropriate to each settlement type as advised by the engineers in accordance with the Department of water Affairs standard.

CURRENT WATER INFORMATION

- All available water data from the municipalities – boreholes, reservoirs, springs, pipelines, water treatment works etc – added to ArcGIS project along with the demand area polygons
- Demand areas selected according to data falling within their boundaries (select by location tool) and attribute table updated accordingly
- Where no data was available from the municipality, the spatial information from Umgeni Water and the Department of Water Affairs was used in this query
- Additional data was received towards the end of the project for Amajuba, Ugu and uThukela District Municipalities requiring the spatial queries to be rerun and the attribute tables updated accordingly

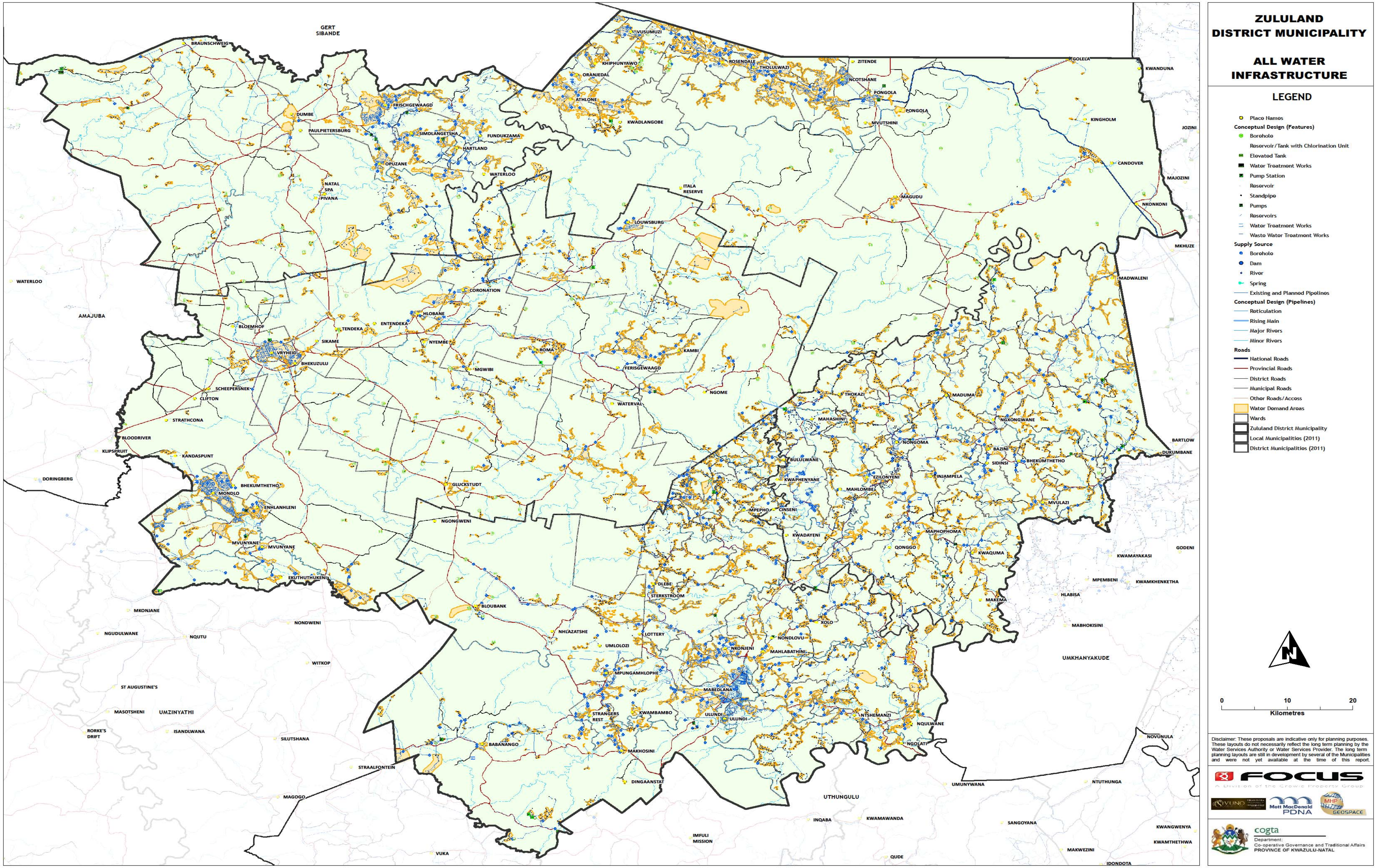
CONCEPT DESIGNS AND COSTING

- All water infrastructure data and the water demand areas plotted on A1 maps at 1:20 000 scale
- Engineers produced concept designs hand drawn onto these maps
- Hard copy maps then scanned and georeferenced
- Concept designs digitized off the georeferenced scans
- Geodatabase with feature datasets for lines and points with available attribute information; domains used to reduce data capture time and possibility of errors
- Digitized data checked at map edges to ensure continuity of data
- All concept data (digitized) for each district merged to one dataset in the geodatabase
- Proposed water schemes given a unique ID by the engineers
- These ID captured into the GIS to link to the costing table from the engineers

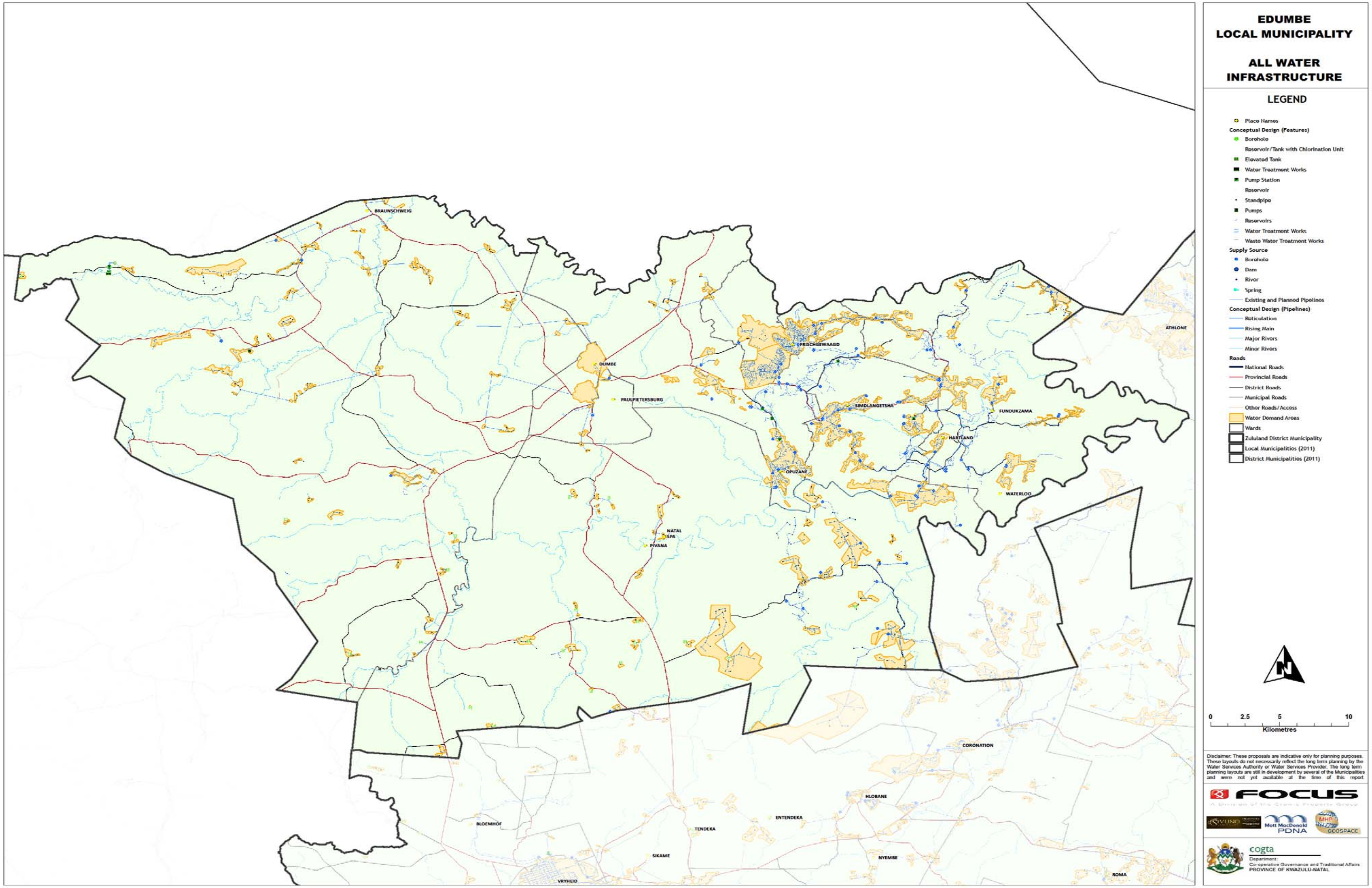
METADATA

- Three geodatabases have been prepared:
    1. Base Data:
        - Roads, rivers, place names, administrative boundaries etc
        - Settlement data – Eskom household points
        - Cadastral data – urban and rural
        - Social facilities – health, education
        - Topography – 20m contours
    2. Infrastructure:
        - Existing pipelines, reservoirs, boreholes etc
    3. UAP:
        - Pipelines, standpipes, boreholes etc
        - Water supply footprints
- Metadata created for each dataset using ArcCatalog
- Data stored in WGS 1984

Annexure 3 – Planned Infrastructure Maps



ZULULAND DISTRICT MUNICIPALITY
ALL WATER INFRASTRUCTURE
LEGEND
Place Names
Conceptual Design (Features)
Borehole
Reservoir/Tank with Chlorination Unit
Elevated Tank
Water Treatment Works
Pump Station
Reservoir
Standpipe
Pumps
Reservoirs
Water Treatment Works
Waste Water Treatment Works
Supply Source
Borehole
Dam
River
Spring
Existing and Planned Pipelines
Conceptual Design (Pipelines)
Reticulation
Rising Main
Major Rivers
Minor Rivers
Roads
National Roads
Provincial Roads
District Roads
Municipal Roads
Other Roads/Access
Water Demand Areas
Wards
Zululand District Municipality
Local Municipalities (2011)
District Municipalities (2011)
0 10 20
Kilometres
Disclaimer: These proposals are indicative only for planning purposes. These layouts do not necessarily reflect the long term planning by the Water Services Authority or Water Services Provider. The long term planning layouts are still in development by several of the Municipalities and were not yet available at the time of this report.
FOCUS
Mott MacDonald PDNA
MHP GEOSPACE
cogta
Department: Co-operative Governance and Traditional Affairs
PROVINCE OF KWAZULU-NATAL


EDUMBE
LOCAL MUNICIPALITY
ALL WATER
INFRASTRUCTURE
LEGEND
Place Names
Conceptual Design (Features)
Borehole
Reservoir/Tank with Chlorination Unit
Elevated Tank
Water Treatment Works
Pump Station
Reservoir
Standpipe
Pumps
Reservoirs
Water Treatment Works
Waste Water Treatment Works
Supply Source
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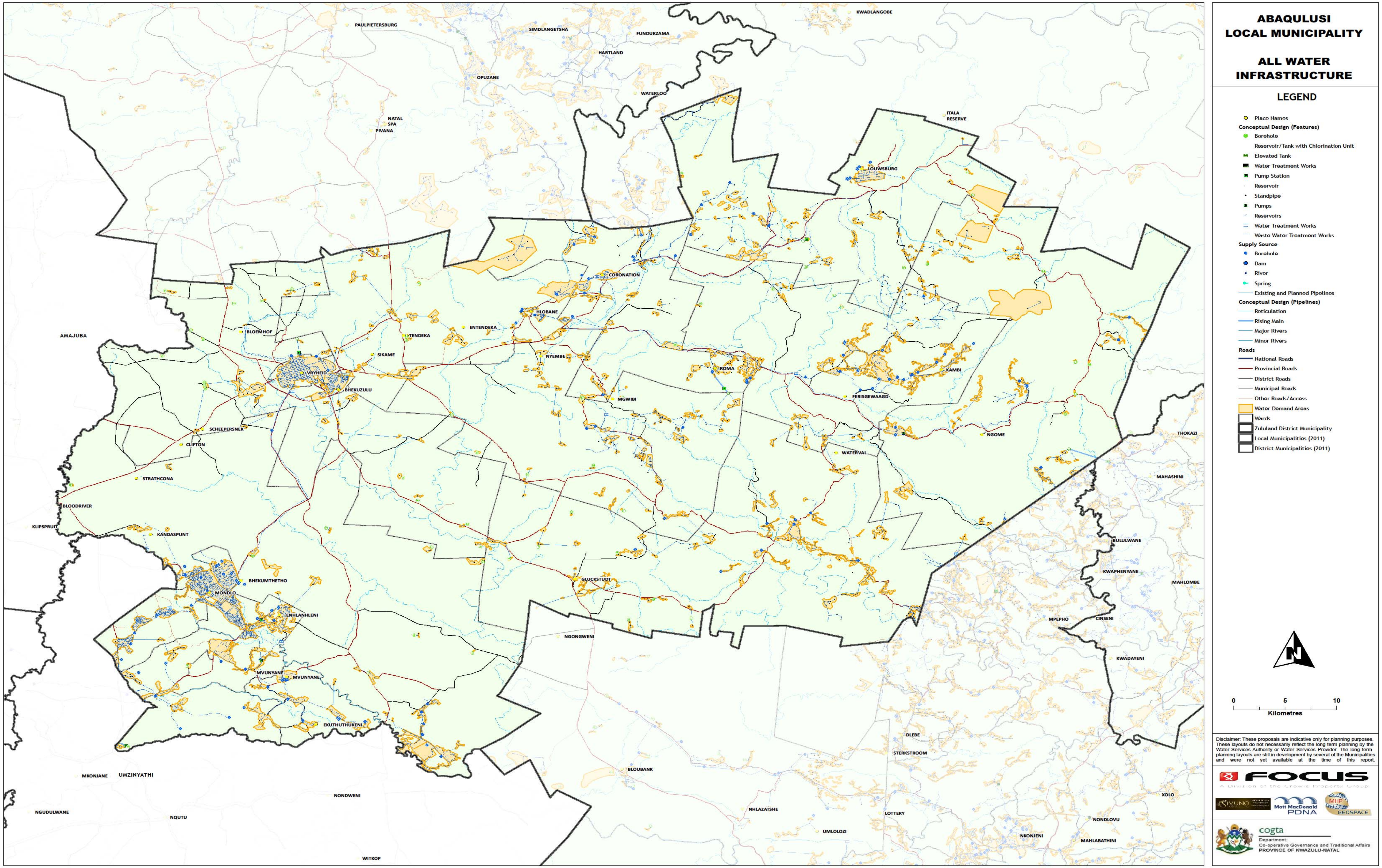
River
Spring
Existing and Planned Pipelines
Conceptual Design (Pipelines)
Reticulation
Rising Main
Major Rivers
Minor Rivers
Roads
National Roads
Provincial Roads
District Roads
Municipal Roads
Other Roads/Access
Water Demand Areas
Wards
Zululand District Municipality
Local Municipalities (2011)
District Municipalities (2011)
0
2.5
5
10
Kilometres
Disclaimer: These proposals are indicative only for planning purposes. These layouts do not necessarily reflect the long term planning by the Water Services Authority or Water Services Provider. The long term planning layouts are still in development by several of the Municipalities and were not yet available at the time of this report.
FOCUS
Mott MacDonald
PDNA
GEOSPACE
cogta
PROVINCE OF KWAZULU-NATAL
BRAUNSCHWEIG
FRISCHGEWAAGD
DUMBE
PAULPIETERSBURG
SIMDLANGETSHA
FUNDUKZAMA
HARTLAND
OPUZANE
WATERLOO
ATHLONE
NATAL SPA
PIVANA
CORONATION
HLOBANE
ENTENDEKA
BLOEMHOF
TENDEKA
SIKAME
NYEMBE
ROMA
VRYHEID



ABAQULUSI
LOCAL MUNICIPALITY
ALL WATER
INFRASTRUCTURE
LEGEND
Place Names
Conceptual Design (Features)
Borehole
Reservoir/Tank with Chlorination Unit
Elevated Tank
Water Treatment Works
Pump Station
Reservoir
Standpipe
Pumps
Reservoirs
Water Treatment Works
Waste Water Treatment Works
Supply Source
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Existing and Planned Pipelines
Conceptual Design (Pipelines)
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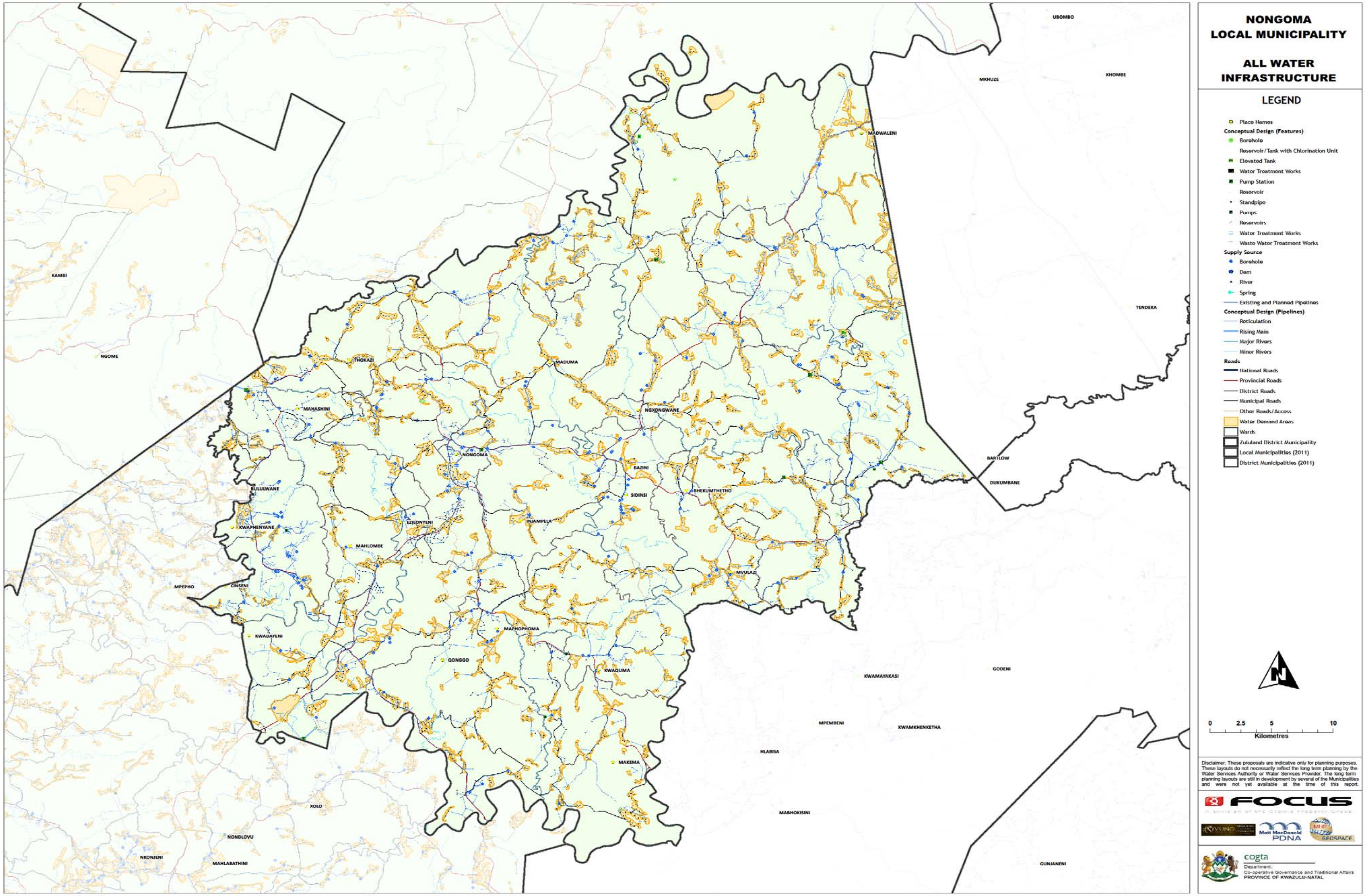
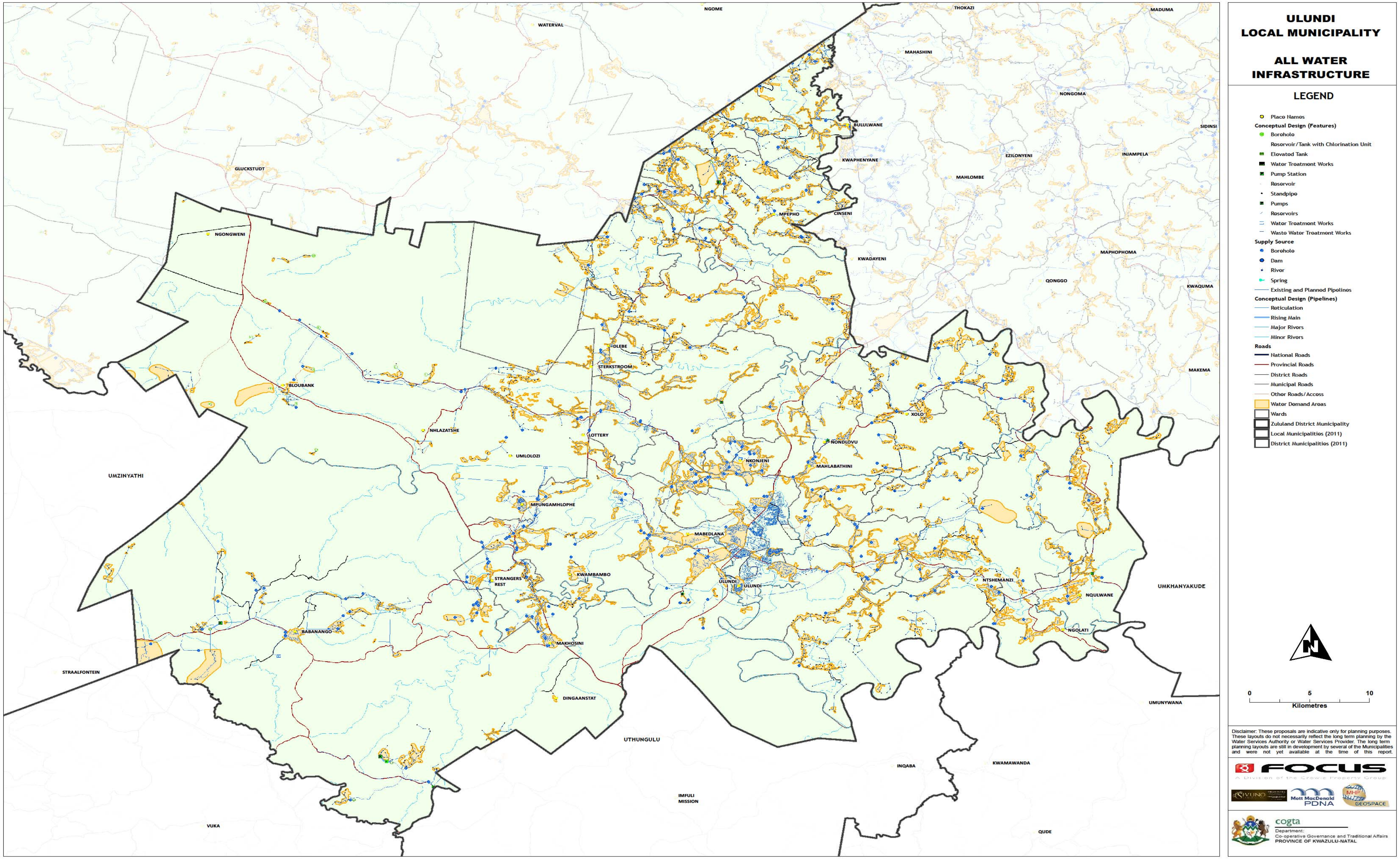
Rising Main
Major Rivers
Minor Rivers
Roads
National Roads
Provincial Roads
District Roads
Municipal Roads
Other Roads/Access
Water Demand Areas
Wards
Zululand District Municipality
Local Municipalities (2011)
District Municipalities (2011)
0
5
10
Kilometres
Disclaimer: These proposals are indicative only for planning purposes. These layouts do not necessarily reflect the long term planning by the Water Services Authority or Water Services Provider. The long term planning layouts are still in development by several of the Municipalities and were not yet available at the time of this report.
cogta
Department:
Co-operative Governance and Traditional Affairs
PROVINCE OF KWAZULU-NATAL
PAULPIETERSBURG
SIMDLANGETSHA
FUNDUKZAMA
KWADLANGOBE
HARTLAND
OPUZANE
WATERLOO
NATAL SPA
PIVANA
ITALA RESERVE
LOUWSBURG
CORONATION
HLOBANE
ENTENDEKA
TENDEKA
BLOEMHOF
AMAJUBA
SIKAME
NYEMBE
VRYHEID
BHEKUZULU
ROMA
KAMBI
MGWIBI
FERISGEWAAGD
NGOME
SCHEEPERSNEK
CLIFTON
WATERVAL
THOKAZI
STRATHCONA
MAHASHINI
BLOODRIVER
KLIPSPRUIT
KANDASPUNT
BULULWANE
KWAPHENYANE
BHEKUMTHETHO
GLUCKSTUDT
MAHLOMBE
MONDLO
ENHLANHLENI
MPEPHO
CINSENI
NGONGWENI
KWADAYENI
MVUNYANE
EKUTHUTHUKENI
DLEBE
STERKSTROOM
BLOUBANK
MKONJANE
UMZINYATHI
NONDWENI
XOLO
NGUDULWANE
NQUTU
NHLAZATSHE
LOTTERY
NONDLOVU
UMLOLOZI
NKONJENI
MAHLABATHINI
WITKOP


NONGOMA
LOCAL MUNICIPALITY
ALL WATER
INFRASTRUCTURE
LEGEND
Place Names
Conceptual Design (Features)
Borehole
Reservoir/Tank with Chlorination Unit
Elevated Tank
Water Treatment Works
Pump Station
Reservoir
Standpipe
Pumps
Reservoirs
Water Treatment Works
Waste Water Treatment Works
Supply Source
Borehole
Dam
River
Spring
Existing and Planned Pipelines
Conceptual Design (Pipelines)
Reticulation
Rising Main
Major Rivers
Minor Rivers
Roads
National Roads
Provincial Roads
District Roads
Municipal Roads
Other Roads/Access
Water Demand Areas
Wards
Zululand District Municipality
Local Municipalities (2011)
District Municipalities (2011)
0 2.5 5 10
Kilometres
Disclaimer: These proposals are indicative only for planning purposes. These layouts do not necessarily reflect the long term planning by the Water Services Authority or Water Services Provider. The long term planning layouts are still in development by several of the Municipalities and were not yet available at the time of this report.
UBOMBO
KHOMBE
MKHUZE
MADWALENI
KAMBI
TENDEKA
NGOME
THOKAZI
MADUMA
MAHASHINI
NGXONGWANE
NONGOMA
BAZINI
BARTLOW
DUKUMBANE
BULULWANE
BHEKUMTHETHO
SIDINSI
KWAPHENYANE
EZILONYENI
INJAMPELA
MAHLOMBE
MVULAZI
MPEPHO
CINSENI
MAPHOPHOMA
KWADAYENI
QONGGO
GODENI
KWAMAYAKASI
KWAQUMA
MPEMBENI
KWAMKHENKETHA
HLABISA
MAKEMA
XOLO
MABHOKISINI
NONDLOVU
NKONJENI
MAHLABATHINI
GUNJANENI


ULUNDI
LOCAL MUNICIPALITY
ALL WATER
INFRASTRUCTURE
LEGEND
Place Names
Conceptual Design (Features)
Borehole
Reservoir/Tank with Chlorination Unit
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0 5 10
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FOCUS
Mott MacDonald PDNA
MHP GEOSPACE
cogta
Department:
Co-operative Governance and Traditional Affairs
PROVINCE OF KWAZULU-NATAL
NGOME
THOKAZI
MADUMA
WATERVAL
MAHASHINI
NONGOMA
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NKONJENI
MAHLABATHINI
UMZINYATHI
MPUNGAMHLOPHE
MABEDLANA
KWAMBAMBO
STRANGERS REST
ULUNDI
NTSHEMANZI
UMKHANYAKUDE
NQULWANE
BABANANGO
MAKHOSINI
NGOLATI
STRAALFONTEIN
DINGAANSTAT
UMUNYWANA
UTHUNGULU
INQABA
KWAMAWANDA
IMFULI MISSION
VUKA
QUDE

12. ACKNOWLEDGEMENT AND DISCLAIMER

This report was prepared by the consortium consisting of Focus, Mott Macdonald PDNA, MHP GeoSpace and Sivuno Consulting with the technical support from Zululand District Municipality under the direction and review from COGTA and Umgeni Water.

The information and data obtained in this report was obtained from Zululand District Municipality Infrastructure Development Plans (IDP's), Water Services Development Plans (WSDP) and mainly engagements with Zululand District Municipality staff.

Neither the consortium nor any of its employees assume any liability or responsibility for any third party use of any information discussed in this report.

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