Report Number 11 Edition 1

PLAN

Integrated Water Quality Management Plan for the Olifants River System

Letaba and Shingwedzi Sub-catchments Plan

water & sanitation
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DEPARTMENT OF WATER AND SANITATION

Water Resource Planning Systems Series

Development of an Integrated Water Quality Management Plan for the Olifants River System

Letaba and Shingwedzi Sub-catchments Plan

Study Report No. 11

P WMA 04/B50/00/8916/12

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APPROVAL

Title: Development of an Integrated Water Quality Management Plan for the Olifants River System: **Letaba and Shingwedzi Sub-catchments Plan**

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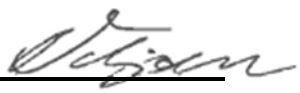

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EXECUTIVE SUMMARY

The Department of Water and Sanitation (DWS) from a planning perspective has identified the need to develop an overarching Integrated Water Quality Management Plan (IWQMP) for the Olifants WMA in order to manage the water resources and needs to take cognisance of, and align to a number of studies and initiatives that have been completed to date, and needs to establish clear goals relating to the quality of the relevant water resource in order to facilitate a balance between protection and use of water resources.

The main objective of the study is to develop management measures to maintain and improve the water quality in the Olifants WMA in a holistic and sustainable manner so as to ensure sustainable provision of water to local and international users. The management measures will be of an overarching nature and will deal with the broader Olifants WMA while taking the strategies and plans developed at the sub-catchment level into account.

The following aspects of the study have already been undertaken:

- Inception Report (Report No: P WMA 04/B50/00/8916/1);
- Water Quality Status Assessment and International Obligations With Respect To Water Quality Report: (Report No: P WMA 04/B50/00/8916/3); and
- Water Quality Planning Limits Report: (Report No: P WMA 04/B50/00/8916/4).

The following components are now underway:

- Scenario Analysis Report;
- Reconciliation and Foresight Report;
- Management Options Report;
- Integrated Water Quality Management Plans for each Sub-catchment:
    - IWQMP for the Upper Olifants sub-catchment;
    - IWQMP for the Middle Olifants sub-catchment;
    - IWQMP for the Lower Olifants sub-catchment;
    - IWQMP for the Steelpoort sub-catchment; and
    - IWQMP for the Letaba and Shingwedzi sub-catchments,
- Monitoring Programmes Report;
- Overarching IWQMP for the Olifants River System; and
- Implementation Plan Report.

The key to the successful management of the water quality in the Olifants River System is the formulation of management measures that will integrate all the relevant aspects that have a

bearing on the water resources. In this respect an assessment of the physical, economic, social, institutional, statutory and ecological aspects in the system was undertaken to understand the current situation and therefore be in a position to assess existing management options and proposed new options that will be able to handle the existing as well as anticipated future challenges (DWS Report number: P WMA 04/B50/00/8916/3).

The objective of this report is to clearly define the various impacts to the water resources in the Letaba and Shingwedzi sub-catchments and propose management options, including an implementation plan, to allow the water users, stakeholders and regulators to implement solutions in a co-ordinated participative manner.

One of the most important aspects of the IWQMP is the development of a monitoring and information plan – this is one of the deliverables that will emanate from this project. This report also describes some of the actions that will be required in respect of monitoring, however further detail will be included in the monitoring plan. An important aspect will be the setting up of a monitoring task team consisting of representatives from each sub-catchment to workshop a collaborative programme for monitoring that should see all users, including communities, participating and contributing to monitoring and data collection.

Another consideration as part of the plan is stakeholder engagement and development of awareness material at various levels. This aspect also needs to consider whether there are any other organisations to partner with - for example national and provincial departments of environmental affairs, health, mineral resources and agriculture. In addition to these strategic partners, other potential partners might include local businesses, environmental organisations, schools and associations. Partnerships can be valuable mechanisms for leveraging resources while enhancing the quality, credibility and success of communication and implementation efforts.

The plan is divided into the strategic management areas for domestic, mining, agriculture, industry and recreation describing the background and context to water quality for each sector and the main management objectives for each sector. The management measures with associated actions are described. An implementation matrix highlights the actions, priority areas, timelines (bring either short, medium or long term) as well as the implementing party and the WMI's role.

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LIST OF ACRONYMS

AIP	Alien Invasive Plants
AMD	Acid Mine Drainage
COGTA	Co-operative Governance and Traditional Affairs
CMF	Catchment Management Forum
CSIR	Scientific and Industrial Research
DMR	Department of Mineral Resources
DoA	Department of Agriculture
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EDC	Endocrine Disrupting Compound
EFR	Ecological Flow Requirements
EWR	Ecological Water Requirements
EWRP	eMalahleni Water Reclamation Plant
FGM	Focus Group Meeting
GDS	Green Drop System
GIS	Geographical Information System
GLOBALG.A.P.	Global Good Agricultural Practice
GWP	Global Water Partnership
IWRM	Integrated Water Resources Management
IWQM	Integrated Water Quality Management
IWQMP	Integrated Water Quality Management Plan
IWUL	Integrated Water Use Licence
IWULA	Integrated Water Use Licence Application
IWWMP	Integrated Water and Waste Management Plan
KNP	Kruger National Park

LNW	Lepelle Northern Water
LOROC	Lower Olifants River Operations Committee
MSS	Municipal Support Strategy
MU	Management Unit
MUTT	Management Unit Task Team
MWCB	Mine Water Co-ordinating Body
MWRP	Mine Water Reclamation Plants
NIP	National Implementation Plan
NMMP	National Microbial Monitoring Programme
NWA	National Water Act
NWRS	National Water Resource Strategy
ORS	Olifants River System
OWRP	Otimum Water Reclamation PLant
PAA	Protected Areas Act
PAC	Project Administrative Committee
PGM	Platinum Group Metals
PMC	Project Management Committee
POP	Persistent Organic Pollutant
PSC	Project Steering Committee
PSP	Professional Service Provider
PPECB	Perishable Products Export Control Board
RDM	Resource Directed Measures
RQOs	Resource Quality Objectives
RWQOs	Resource Water Quality Objectives
SAEON	South African Environmental Observation Network
SALGA	South African Local Government Association
SANS	South African National Standards

SAWQG	South African Water Quality Guidelines
TDS	Total Dissolved Salts
UFS	University of the Free State
WC/ WDM	Water Conservation/ Water Demand Management
WITS	University of the Witwatersrand
WMA	Water Management Area
WMI	Water Management Institution
WMS	Water Management System
WQM	Water Quality Management
WQP	Water Quality Planning
WQPL	Water Quality Planning Limits
WRC	Water Research Commission
WRP	Water Reclamation Plant
WRPM	Water Resource Planning Model
WWTW	Wastewater Treatment Works

1. INTRODUCTION

1.1 Background

The Olifants River System which comprises the Upper, Middle and Lower Olifants River sub-catchments, as well as the Steelpoort, Letaba and Shingwedzi sub-catchments, is a highly utilised and regulated catchment and like many other Water Management Areas (WMA) in South Africa, its water resources are critically stressed in respect of bothy water quantity and quality. This is due to an accelerated rate of development and the scarcity of water resources. There is therefore an urgency to ensure that water resources in the Olifants River System are able to sustain their level of uses and be maintained at their desired states.

The Olifants River flows northwards through Witbank Dam down to Loskop Dam. The confluences of the Klein Olifants, Spookspruit, Klipspruit and Wilge Rivers with the Olifants River are between the Witbank and Loskop dams. From Loskop Dam the Olifants River flows some 80 km to Flag Boshielo Dam. The Moses and Elands Rivers join the Olifants River downstream of Loskop Dam from the west while the Bloed River joins from the east. The Steelpoort River confluences with the Olifants about 50 kilometres before the confluence of the Olifants and Blyde rivers after which it confluences with the Ga-Selati on the border of the Kruger National Park (KNP). The Letaba River joins the Olifants River upstream of the border into Mozambique in the KNP, after which it flows into the Massingir Dam about six (6) kilometres from the border, before it joins the Limpopo River which eventually discharges into the Indian Ocean. The Shingwidzi River flows south east through the KNP becoming the Rio Shingwidzi in Mozambique where it confluences with the Rio Elefantes downstream of the Massingir Dam.

This study focusses on the South African sector of the Olifants River system and does not deal with the Mozambique sector, however the improvement in the South Africa portion of the Olifants River system, will ultimately have a positive impact on the Massingir Dam and the lowest reaches of the Rio Elefantes which is controlled by inflows from upstream (South Africa).

Formal economic activity in the system is highly diverse and is characterised by commercial and subsistence agriculture (both irrigated and rain fed), diverse mining activities, manufacturing, commerce and tourism. Large coal deposits are found in the eMalahleni and Middelburg areas (Upper Olifants) and large platinum group metal (PGM) deposits are found in the Steelpoort, and copper in the Phalaborwa areas. The catchment is home to several large thermal power stations, which provide energy to large portions of the country. Extensive agriculture can be found in the Loskop Dam area, the lower catchment near the confluence of the Blyde and Olifants Rivers as well as in the Steelpoort Valley, the upper Selati catchment and the upper catchments of the Groot Letaba. A large informal economy exists in the Middle Olifants, Middle Letaba and Shingwedzi, with many resource-poor farmers

dependent upon ecosystem services. The WMA has many important tourist destinations, including the Blyde River Canyon and the Kruger National Park. Land use in the Olifants River System is diverse and consists of irrigated and dryland cultivation, improved and unimproved grazing, mining, industry, forestry and urban and rural settlements.

The Department of Water and Sanitation (DWS) from a planning perspective has identified the need to develop an overarching Integrated Water Quality Management Plan (IWQMP) for the Olifants WMA in order to manage the water resources and needs to take cognisance of, and align to a number of studies and initiatives that have been completed to date, and needs to establish clear goals relating to the quality of the relevant water resource in order to facilitate a balance between protection and use of water resources.

The main objective of the study is to develop management measures to maintain and improve the water quality in the Olifants WMA for the different user types in a holistic and sustainable manner to ensure sustainable provision of water to local and international users. The management measures will be of an overarching nature and will deal with the broader Olifants WMA while taking the strategies and plans developed at the sub-catchment level into account.

The following aspects of the study have already been undertaken:

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    - IWQMP for the Letaba and Shingwedzi sub-catchments,
- Monitoring Programmes Report;
- Overarching IWQMP for the Olifants River System; and

- Implementation Plan Report.

1.2 Study Area

The spatial extent of the Olifants River System comprises tertiary drainage regions B11, B12, B20, B31, B32, B41, B42, B52, B52, B60, B71, B72 and B73 in the Olifants River catchment, B81, B82 and B83 in the Letaba catchment and B90 in the Shingwedzi catchment. The study area has been sub-divided into the following sub-catchments (Figure 1):

- Upper Olifants;
- Middle Olifants;
- Steelpoort;
- Lower Olifants; and
- Letaba and Shingwedzi.

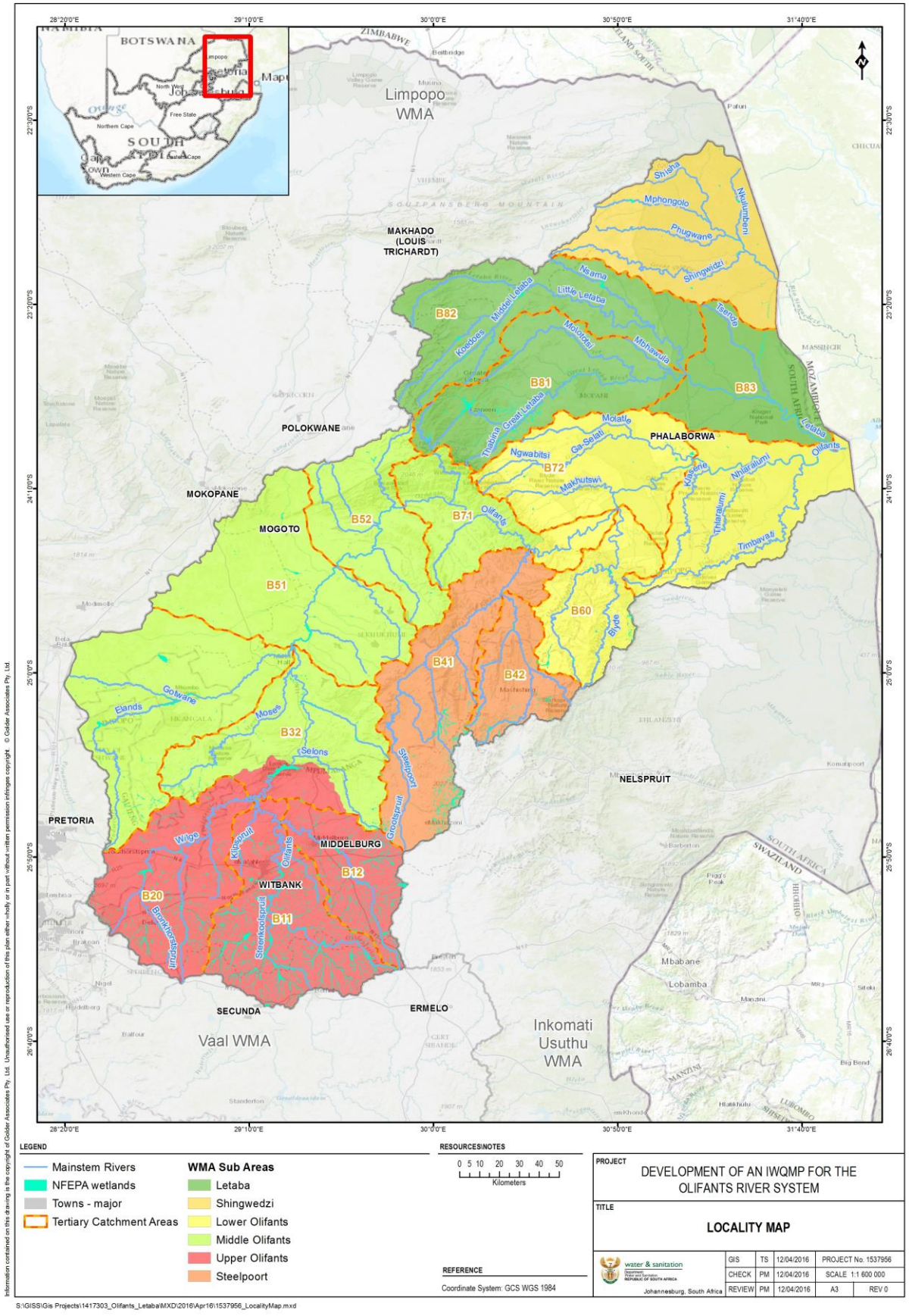

Figure 1: Study Area

1.3 Objective of the Sub-catchment Plans

The objective of this report is to clearly define the various impacts to the water resources in the Letaba and Shingwedzi sub-catchments and propose management options, including an implementation plan, to allow the water users, stakeholders and regulators to implement solutions in a co-ordinated participative manner.

The layout pf the report is shown in Figure 2.

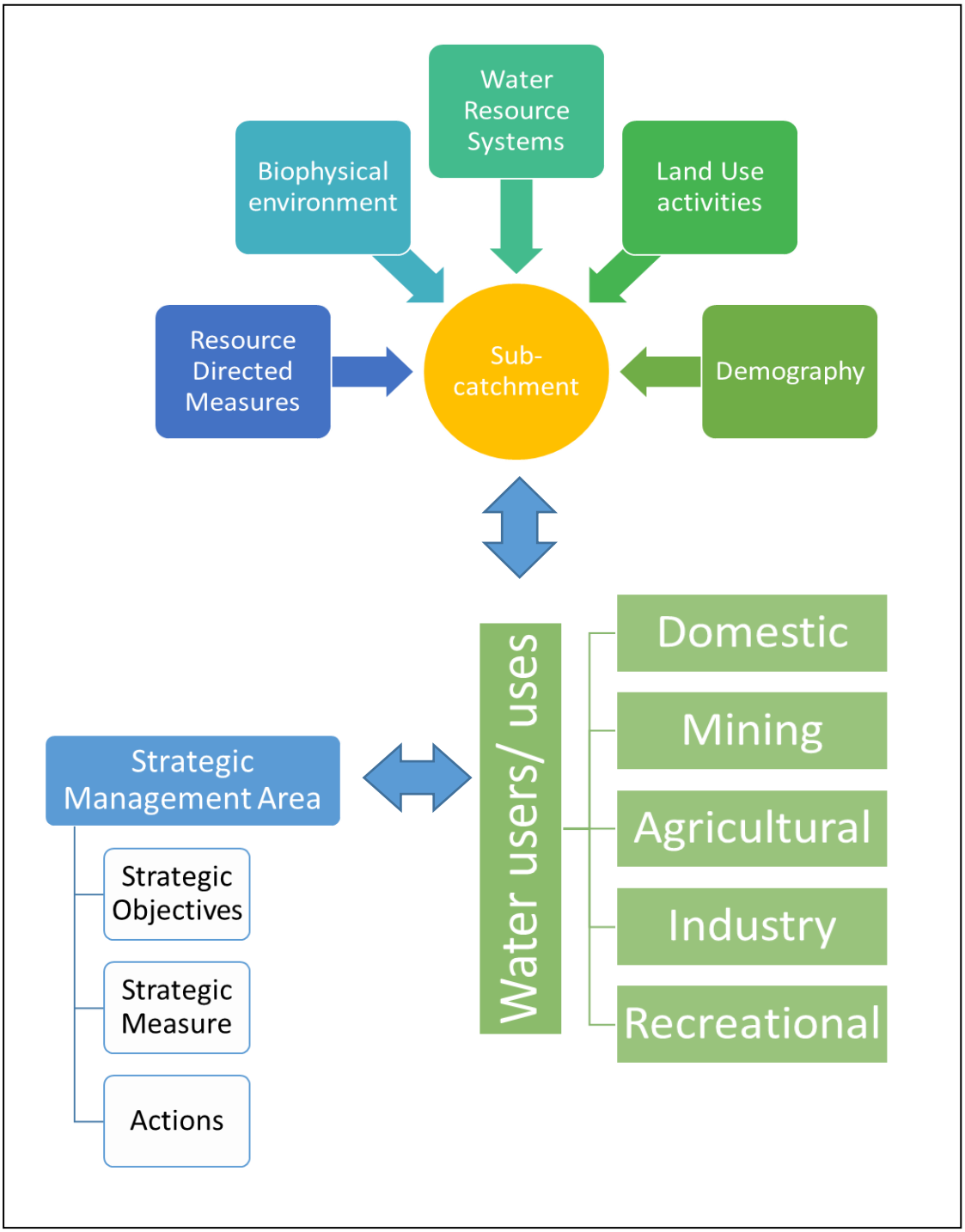

Figure 2: Sub-catchment IWQMP layout

2. SUB-CATCHMENT DESCRIPTION

This chapter gives a brief background to the Letabab and Shingwedzi sub-catchments, setting the scene for which solutions to the impacts are proposed and can be taken forward for implementation by the various relevant regulators, water users and stakeholders

2.1 Biophysical environment

Letaba sub-catchment

The Letaba River catchment is located in the Limpopo Province and covers a total area of 13 400 km². The Letaba River catchment is drained by the Groot Letaba River and its major tributaries the Klein Letaba, Middle Letaba, Letsitele and Molototsi rivers. From the confluence of the Klein and Groot Letaba Rivers, the Letaba River flows through the Kruger National Park until it joins the Olifants River near the border with Mozambique.

The topography of the Letaba varies from a zone of high mountains in the west through low mountains and foothills to the low lying plains in the east. The mountainous zone or Great Escarpment includes the northern portion of the Drakensberg mountain range and the eastern Soutpansberg, which both extend to the western parts of the water management area, and the characteristic wide expanse of the Lowveld to the east of the escarpment. The highest peaks have an elevation of more than 2 000 m above mean sea level (msl). This zone is deeply incised by the major tributaries. The low lying plains cover most of the area and has gentle to flat slopes.

Rainfall mostly occurs during the summer of which peak rainfall months are January and February with mean annual precipitation (MAP) of 612 mm. The annual temperature ranges from 18°C in the mountainous areas to more than 28°C in the northern and eastern parts of the area. The highest temperatures occur in January and the coldest in July.

Shingwedzi sub-catchment

The Shingwidzi River is the northernmost river of the Olifants River WMA, joining it at the lower end of its basin. The Shingwidzi is a seasonal river whose riverbed is dry for prolonged periods. It drains the plain southeast of the Soutpansberg and originates about 40 km to the ESE of Thohoyandou. It flows eastwards across the Lowveld and through the Kruger National Park. The Shingwidzi River catchment (B90) covers a total area of 5 600km². The Shingwidzi River and its major tributaries the Shisha, Mphongolo and Phugwane drain the Shingwidzi River catchment.

Mean annual precipitation (MAP) varies between 700mm and 1500mm in the mountainous zone. The annual rainfall over the remainder of the sub-catchment ranges from 450mm to 800mm. More than 85% of the annual rainfall occurs during

the summer months. Evaporation increases gradually from about 1 500mm/a in the west to 1 900mm/a in the east. About 60% of the evaporation occurs during the six summer months from October to March. Frost is rare.

2.2 Water Resource Systems

Letaba sub-catchment

The gross surface water availability in the Groot Letaba sub-area is estimated at 168 Mm^3/a, which is derived from the yield of the Tzaneen and Ebenezer dams as well as significant run-of-river abstractions. The Tzaneen Dam, if operated in isolation, provides a yield of approximately 60 Mm^3/a. However, when operated in a systems context to supply water to irrigators downstream only when the run-of-river flows are inadequate, the total yield is much greater. Hence the large gross yield of the system.

Mean annual runoff (MAR) is 574 Mm^3. More than 20 major dams have been constructed in the Groot Letaba River catchment. The Tzaneen Dam on the Groot Letaba River and the Middel Letaba Dam are the two largest dams in the Limpopo Province. Other large dams in the catchment include the Ebenezer, Magoebaskloof, Nsami and Modjadji Dams.

Shingwedzi sub-catchment

The main rivers of the Shingwedzi basin are the Mandzoro River, Mphongolo River, Phugwane River, Gole River, Shisha River, Tshamidzi River, Bububu River and the Dzombo River. There are no major dams in these sub-areas because of the limited water resources and the non-availability of suitable sites. Some small dams have, however, been constructed in the Kruger National Park for game watering. Of these, the most notable are the Kanniedood Dam on the Shingwedzi River and the Engelhard Dam on the Letaba River. The Makuleke Dam is in the Mphongolo River. Further downstream the Shingwedzi flows close to the north eastern side of the Massingir Dam's reservoir and joins the Olifants River about 12 km down river from the dam wall.

For many water users, groundwater constitutes the only dependable source of water and its utilisation is of major importance. A large proportion of the rural domestic and stock watering requirements are supplied from groundwater for most of the rural settlements and villages. Groundwater is also used for game watering.

2.3 Resource Directed Measures

Resource Directed Measures (RDM) is a mechanism developed by the Department to give effect to Chapter 3 of the National Water Act (1998; NWA) which focuses on water resources protection. These measures include classification of water resources, determination of the Reserve and Resource Quality Objectives.

The Reserve, Water Resources Classification and setting of Resource Quality Objectives (RQO) for the Olifants Water Management Area have been completed. As

part of the IWQMP development it has been important to ensure alignment with these study outcomes. A summary of each of the outcomes of the processes is described below.

Reserve

The Reserve specifies the quantity, quality, habitat and biotic integrity requirements necessary for the protection of the resource and has priority over other water uses, and will vary according to the class of the resource. The Reserve is a protection measure that forms an integral component of the Catchment Management Strategy (CMS) ultimately developed for each WMA, and informs the various other strategies, control measures and management activities to be developed.

The Reserve for the Letaba and Shingwedzi was updated in 2016 and will gazetted during 2017. There are four Ecological Water Requirement (EWR) sites in the Letaba sub-catchment and one in the Shingwedzi (Table 1).

Table 1: Summary of EWR sites in the Letaba (DWS, 2016)

EWR site	River	Quaternary	Surrounding impacts
Letaba_EWR 1	Groot Letaba	B81B	• Extensive forestry • Developments into the riparian zone • Limited sewerage into river – poor infrastructure • Alien invasive vegetation in the riparian zone • Limited erosion • Upstream informal settlements • Upstream impoundments (Dap Naude, Ebenezer)
Letaba_EWR 2	Lesitele	B81D	• Large scale town developments and informal settlements • Poor infrastructure planning • Wood harvesting • Over grazing and trampling • Removal of riparian vegetation • Cultivation and some commercial farming • Water abstraction • Forestry in the upper catchments • Poor sanitation and sewerage treatment • Alien invasive plants – aquatic and terrestrial
Letaba_BRO1	Broederstroom	B81A	• Extensive forestry • Deposition (upstream forestry) • Invasive plants and fish
Letaba_EWR6	Letaba River (main stem) in the Kruger National Park	B83D	• Very little upstream impacts • No invasive vegetation observed • Limited impacts from flow modifications • Some trampling by mega herbivores – increased erosion during the drought period • Some poor water quality related to anthropogenic impacts from outside the KNP
Shingwedzi_SHI1	B90H-00117	Shingwidzi	• Abstraction outside KNP and for rest camp/staff village • Water quality pollution from outside Kruger National Park • Erosion and siltation – due to trampling

Classification

Classification of significant water resources and the determination of Resource Quality Objectives for the Letaba sub-catchment was promulgated in December 2016 Government Gazette No 40531, 30 December 2016 (GN 1617). Table 2 summarises the classes set. The Letaba upstream of the Tzaneen Dam, southern tributaries of Letaba (from proposed Nwamitwa Dam to Klein Letaba Confluence), and the Letaba Tributaries in the Kruger National Park have all been classified as Class I, meaning that no development may take place in these areas.

The areas in the Letaba from the proposed Nwamitwa Dam to Klein Letaba confluence, Klein Letaba upstream of Middle Letaba Dam, lower Klein Letaba tributaries and the Letaba River (main stem) in the Kruger National Park have been classified as Class II which means that these areas must be protected, and any development must have strict conditions.

The Shingwedzi catchment (B90) has not been classified.

Table 2: Classifaction of the Letaba sub-catchment

Integrated Units of Analysis		**Class**
1	Letaba Upstream of Tzaneen Dam	I
2	Letsitele and Thabina	III
3	Letaba Downstream of Tzaneen to Proposed Nwamitwa Dam	III
4	Letaba from Proposed Nwamitwa Dam to Klein Letaba Confluence	II
5	Southern Tributaries of Letaba in Integrated Units of Analysis 4 (from proposed Nwamitwa Dam to Klein Letaba Confluence)	I
6	Northern Tributaries to Letaba in Integrated Units of Analysis 4 (from proposed Nwamitwa Dam to Klein Letaba Confluence)	III
7	Upper Middle Letaba and Tributaries Upstream of Middle Letaba Dam	III
8	Klein Letaba Upstream of Middle Letaba Dam	II
9	Klein Letaba Downstream of Middle Letaba Dam	III
10	Lower Klein Letaba Tributaries	II
11	Letaba River (main stem) in the Kruger National Park	II
12	Letaba Tributaries in the Kruger National Park	I

Resource Quality Objectives

RQOs have been determined and gazetted (GN 1617, December 2016) for the Letaba catchment. The RQOs (water quality component) set for the Letaba are captured in Table 3.

Table 3: RQOs for Letaba sub-catchment - water quality component

Resource	Parameter	Numerical limit
Letaba River (B81B; B81B)	Nutrients (phosphate)	50th percentile of the data must be less than 0.015 mg/L PO4-P (Aquatic ecosystems: driver)
	Toxics	95th percentile of the data must be within the Target Water Quality Range (TWQR) or A categories for toxics.
Letsitele River (B81D)	Nutrients (phosphate)	50th percentile of the data must be less than 0.025 mg/L PO4 (Agriculture - irrigation: driver).
	Electrical Conductivity (salts)	95th percentile of the data must be less than or equal to 30 mS/m (Aquatic ecosystems: driver).
	Toxics	95th percentile of the data must be within the TWQR or A categories for toxics.
	Faecal coliforms and *E.coli*	Meet the TWQR of 0-130 counts per 100 ml (DWAF, 1996a*2).
Letaba River (B81F; B81C; B81E; B81F; B81F; B81F; B81F)	Nutrients (phosphate)	Immediately applicable: 50th percentile of the data must be less than 0.025 mg/L PO4-P. Post Nwamitwa Dam: 50th percentile of the data must be less than 0.015 mg/L PO4-P (Aquatic ecosystems: driver).
	Electrical Conductivity (salts)	Immediately applicable: 95th percentile of the data must be less than or equal to 55 mS/m.
	pH	5th and 95th percentiles of pH data must be between 6.5 and 8.0 (Aquatic ecosystems: driver).
	Toxics	95th percentile of the data must be within the TWQR or A categories for toxics
Letaba River (B81J; B81J)	Nutrients (phosphate)	50th percentile of the data must be less than 0.025 mg/L PO4-P (Aquatic ecosystems: driver).
	Electrical Conductivity (salts)	95th percentile of the data must be less than or equal to 30 mS/m (Industry Cat 3: driver)
	pH	5th and 95th percentiles of pH data must be between 6.5 and 8.4 (Industry Cat 3: driver).
	Toxics	95th percentile of the data must be within the TWQR or A categories for toxics.
	Turbidity	Not available (Aquatic ecosystems: driver)
B82G up to Giyani	Nutrients (phosphate)	Immediately applicable: 50th percentile of the data must be less than 0.025 mg/L PO4-P. Post Nwamitwa Dam: 50th percentile of the data must be less than 0.075 mg/L PO4-P (Aquatic ecosystems: driver).
	Faecal coliforms and *E. coli*	Meet the TWQR of 0-130 counts per 100 ml (DWAF, 1996a).
	Turbidity	Not available (Aquatic ecosystems: driver)
	Toxics	95th percentile of the data must be within the TWQR or A categories for toxics.
Klein Letaba River (B82G; downstream from Giyani; B82J)	Nutrients (phosphate)	50th percentile of the data must be less than 0.125 mg/L PO4-P (Aquatic ecosystems: driver).
	Electrical Conductivity (salts)	95th percentile of the data must be less than or equal to 55 mS/m (Aquatic ecosystems: driver).
	Faecal coliforms and *E. coli*	Meet the TWQR of 0-130 counts per 100 ml (DWAF, 1996a).
	Turbidity	Not available (Aquatic ecosystems: driver)
	Toxics	95th percentile of the data must be within the TWQR or A categories for toxics.

Resource	Parameter	Numerical limit
Letaba River (B83D; B83A)	Nutrients (phosphate)	50th percentile of the data must be less than 0.025 mg/L PO4-P (Aquatic ecosystems: driver).
	Electrical Conductivity (salts)	95th percentile of the data must be less than or equal to 55 mS/m (Aquatic ecosystems: driver).
	Toxics	95th percentile of the data must be within the TWQR or A categories for toxics
	Turbidity	Not available (Aquatic ecosystems: driver)

2.4 Demographics

Letaba sub-catchment

There are approximately 1.1 million (1 110 335) people residing in the Letaba Sub-Catchment of which the highest densities are in the areas of Tzaneen, Ga Kgapane and Giyani (Figure 61). The vast majority are black (97%) much less being white (2%) (Figure 3). Two main languages are spoken in the area, these are Xitsonga (46%) and Sepedi (35%) and to a lesser degree Tshivenda (12%) (Census 2011).

Although most of the sub-catchments households live within brick or concrete houses (89%) (Figure 4), only 15% have piped water within their homes however 31% have access in their yards and 22% within 200m of their homes (Figure 6). 16% of residents have no access to piped water. The majority of households get their water from the municipality (58%) with a smaller yet substantial proportion using boreholes (19%) (Figure 7). The rest get water through more traditional and natural means.

Only 19% of households have flush toilets therefore households in the sub-catchment predominantly use pit toilets with 58% and 20% of households using ventilated and non-ventilated pit latrines (Figure 5).

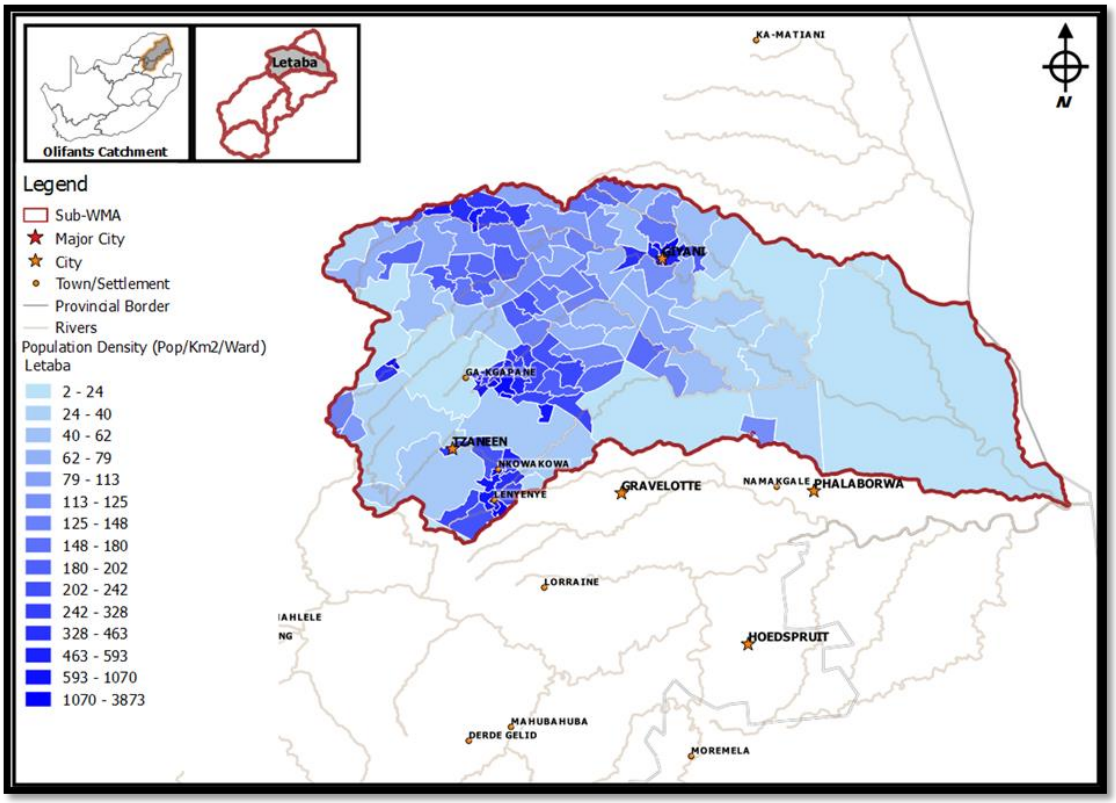

Figure 3: Population density (pop/Ha) by ward in the Letaba Sub-Catchment (Census 2011)

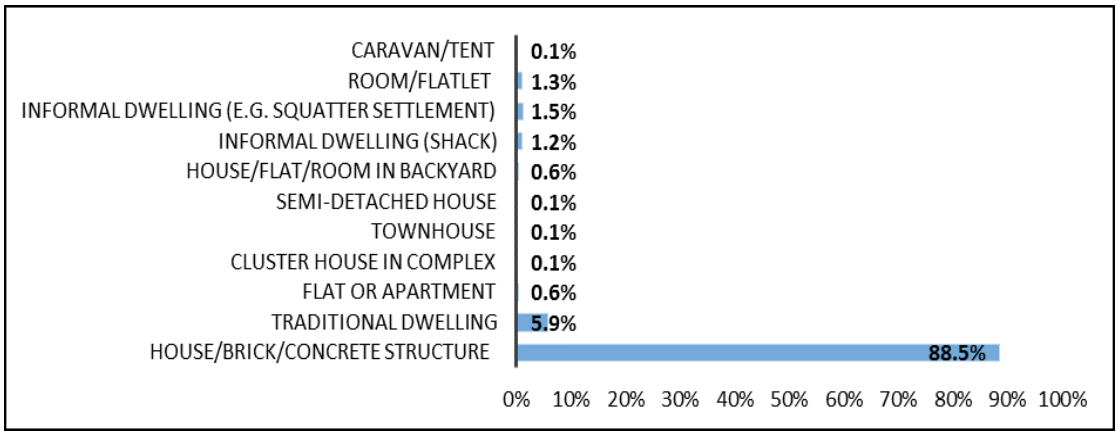

Figure 4: Dwelling demographic of the Letaba Sub-Catchment (Census 2011)

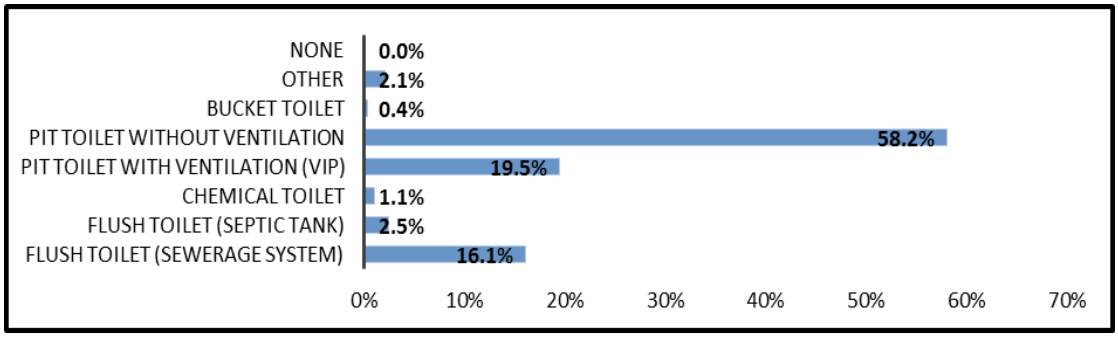

Figure 5: Toilet system demographic in the Letaba Sub-Catchment (Census 2011)

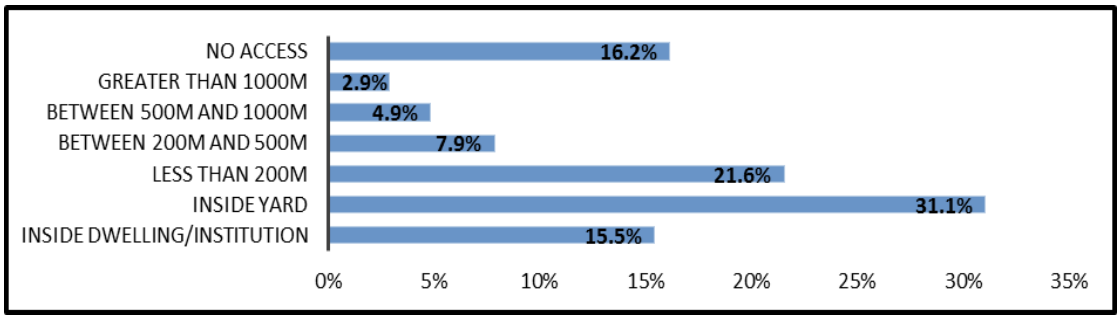

Figure 6: Water access demographic of households in the Letaba Sub-Catchment (Census 2011)

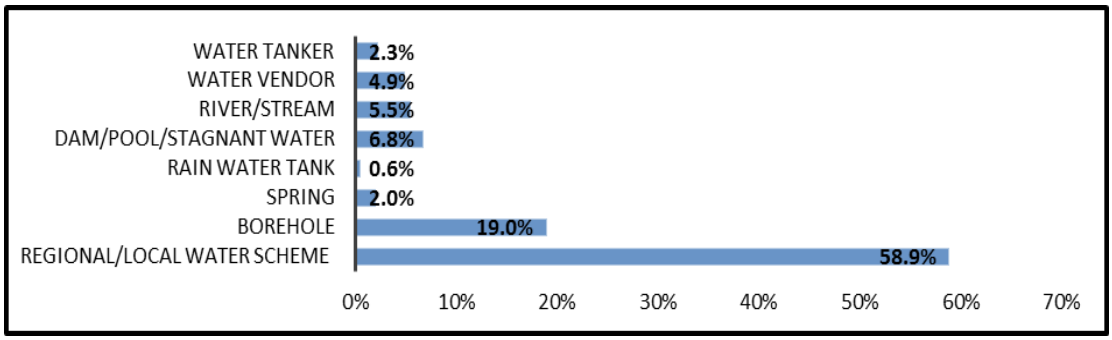

Figure 7: Source of water of households in the Letaba Sub-Catchment (Census 2011)

Shingwedzi sub-catchment

The Shingwedzi sub-catchment has a population of approximately 240 thousand (238 937) people with densities increasing around the rural areas of Ganolanani, Ka-Xikudu and Muthathi (Figure 8). Almost the whole population is black (99.7%) speaking predominantly Xitsonga (90%) and to a lesser degree Tshivenda (9%) (Census 2011).

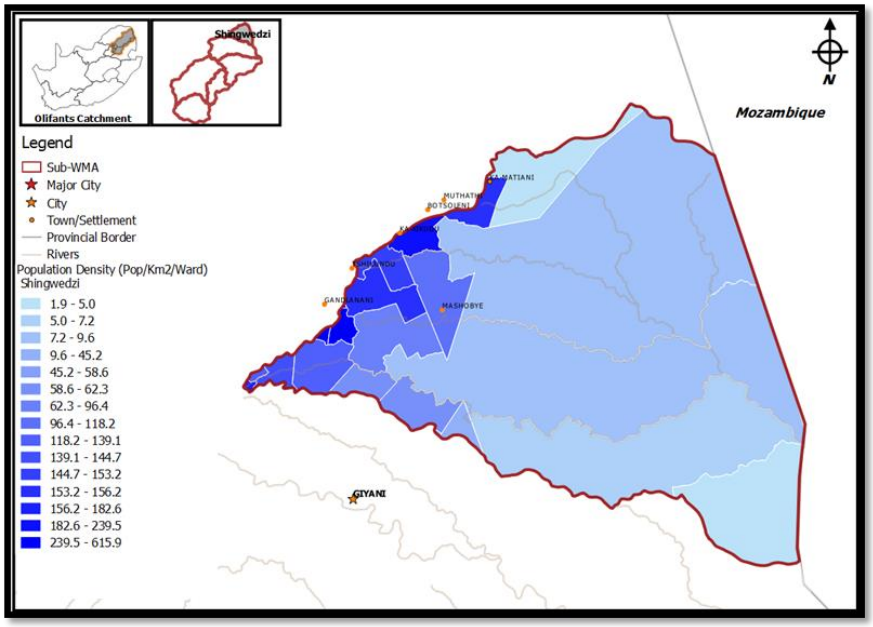

Figure 8: Population demographics of the Shingwedzi sub-catchment (Census 2011)

The characteristics of dwellings in the Shingwedzi sub-catchment are typically that of brick and concrete structures (75%) and traditional structures (23%) (Figure 9). Although this sub-catchment has the highest proportion of formal structures and the lowest proportion of informal dwellings (compared to other sub-catchments in the Olifants), piping infrastructure to these dwellings is minimal with only 9% of dwellings having piped water (Figure 11). Much of the households only have access to piped water in their yards (28%) or within 200m of their homes (32%). 26% have access further than 200m from their homes and 4% have no access to piped water. Most of this water comes from the municipal water scheme (83%) and to some lesser extent boreholes (10%) (Figure 12). As expected with the lack of plumbing within homes, only 9% of dwellings have flush toilet connected to a sewerage system (Figure 10). Most lavatories are pit toilets that are either ventilated (27%) or not (58%).

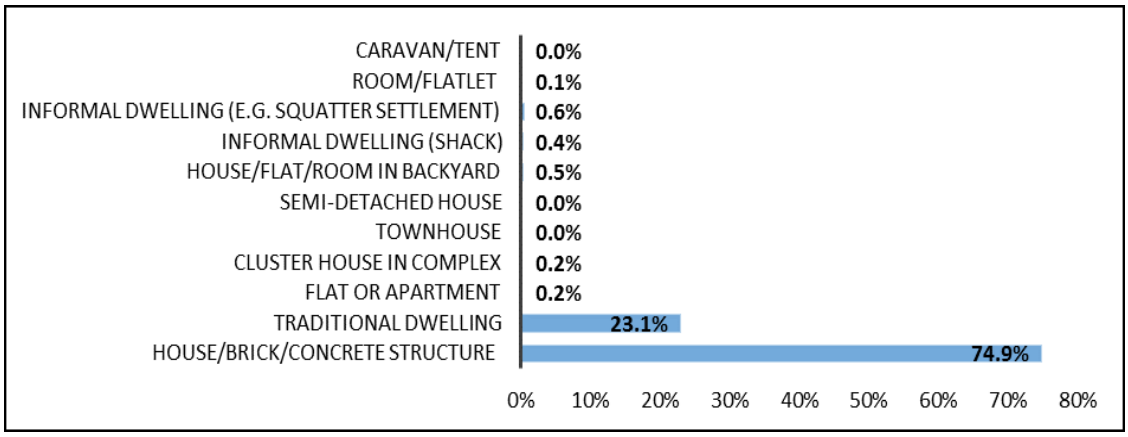

Figure 9: Dwelling demographic of the Shingwedzi sub-catchment (Census 2011)

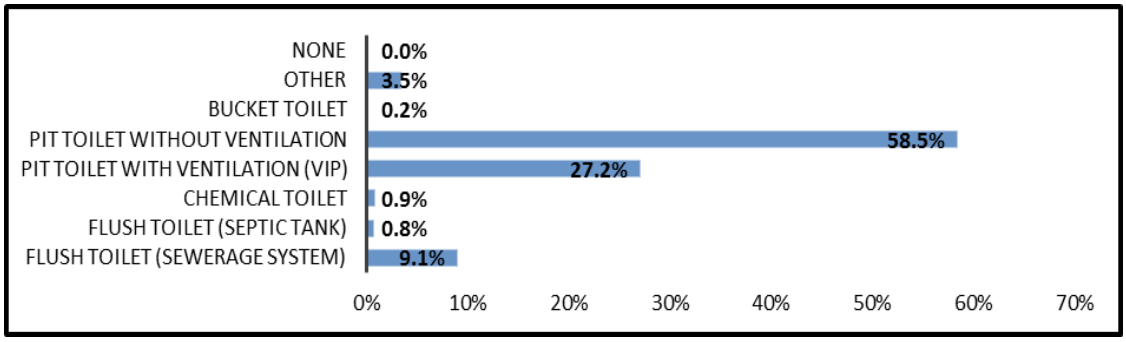

Figure 10: Toilet system demographic in the Shingwedzi sub-catchment (Census 2011)

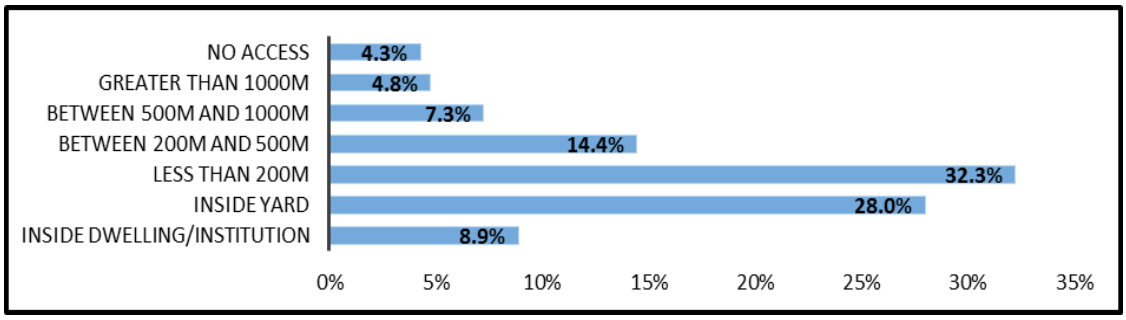

Figure 11: Water access demographic of households in the Shingwedzi sub-catchment (Census 2011)

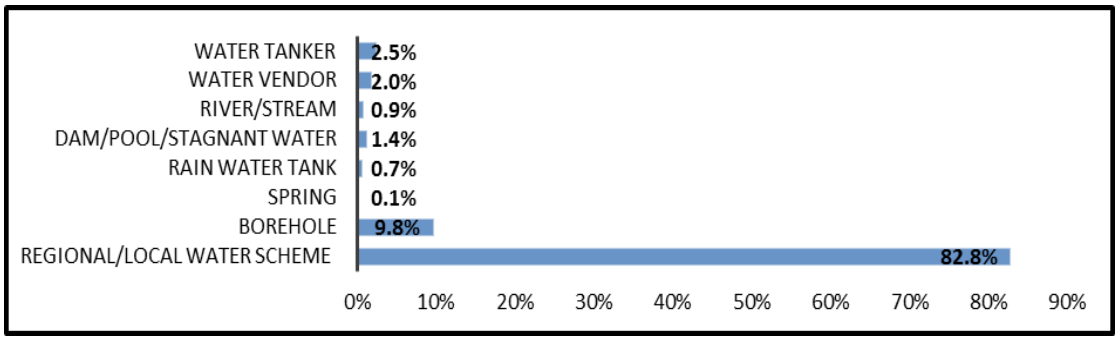

Figure 12: Source of water of households in the Shingwedzi Sub-Catchment (Census 2011)

2.5 Land use activities

Letaba sub-catchment

The economy of the study area is based on forestry, tea, subtropical fruits, summer crops, vegetables and livestock farming. Subsistence farming plays a major role in the economy of the catchment. Ecotourism is regarded as a core industry of the catchment.

The Letaba River catchment is a highly productive agricultural area with mixed farming including cattle ranching, game farming, dry land crop production and irrigated cropping. Agriculture, with the irrigation sector in particular, is the main base of the economy of the region. The total area irrigated measures about 242 km^2. These areas occur mainly along the Groot Letaba River, and its tributaries, the Middle Letaba, Lower Klein Letaba, and the Letsitele Rivers.

Permanent fruit crops (i.e. bananas, citrus and mangoes, 47%) and vegetable and grain cash crops (53%) are cultivated. Some 484 km^2 of pine and blue gum plantations have been established in areas with rainfall of more than 900 mm/a, mainly in the upper reaches of the Groot Letaba River catchment.

Forests have a negative impact on the hydrology through the reduction of runoff by interception and evapotranspiration. Reduction in runoff is estimated at about 52 Mm^3/a, about 25% of the natural runoff in those catchments were afforestation occurs. The impact of forests on rivers during low flows is particularly severe. Since

most of the afforestation was planted and developed long before dams in the catchment were built, it is estimated that the firm yield of the major dams would have been about 10% higher without the afforestation.

Intensive irrigation farming is practised in the upper parts of the Klein Letaba River catchment, upstream and downstream of the Middle Letaba Dam, and particularly along the Groot Letaba and Letsitele Rivers, as well as in the upper Luvuvhu River catchment (Figure 13).

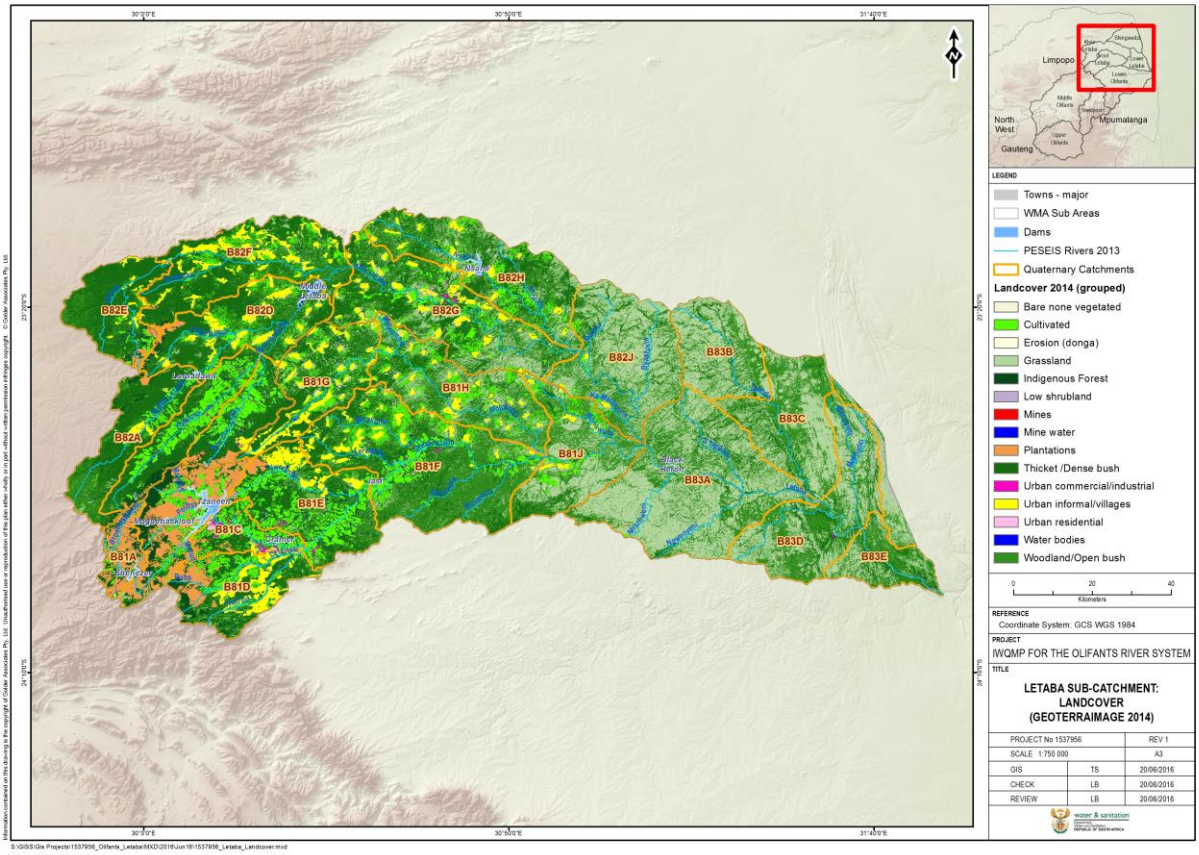

Figure 13: Map illustrating the land use activities in the Letaba sub-catchment

Shingwedzi sub-catchment

The economy of the study area is based on tourism. Subsistence farming plays a minor role in the economy of the catchment. Ecotourism is regarded as a core industry of the catchment. It has been noted that there is the potential for resuscitation of two gold mines in the Malamulele area.

The dominant land use (Figure 14) of the catchment is open bush and grassland. Most of the areas outside the Kruger National Park are dominated by rural settlements, informal farming and very little industrial development. Small scale mining operations, of which the majority are defunct, are dotted through the landscape.

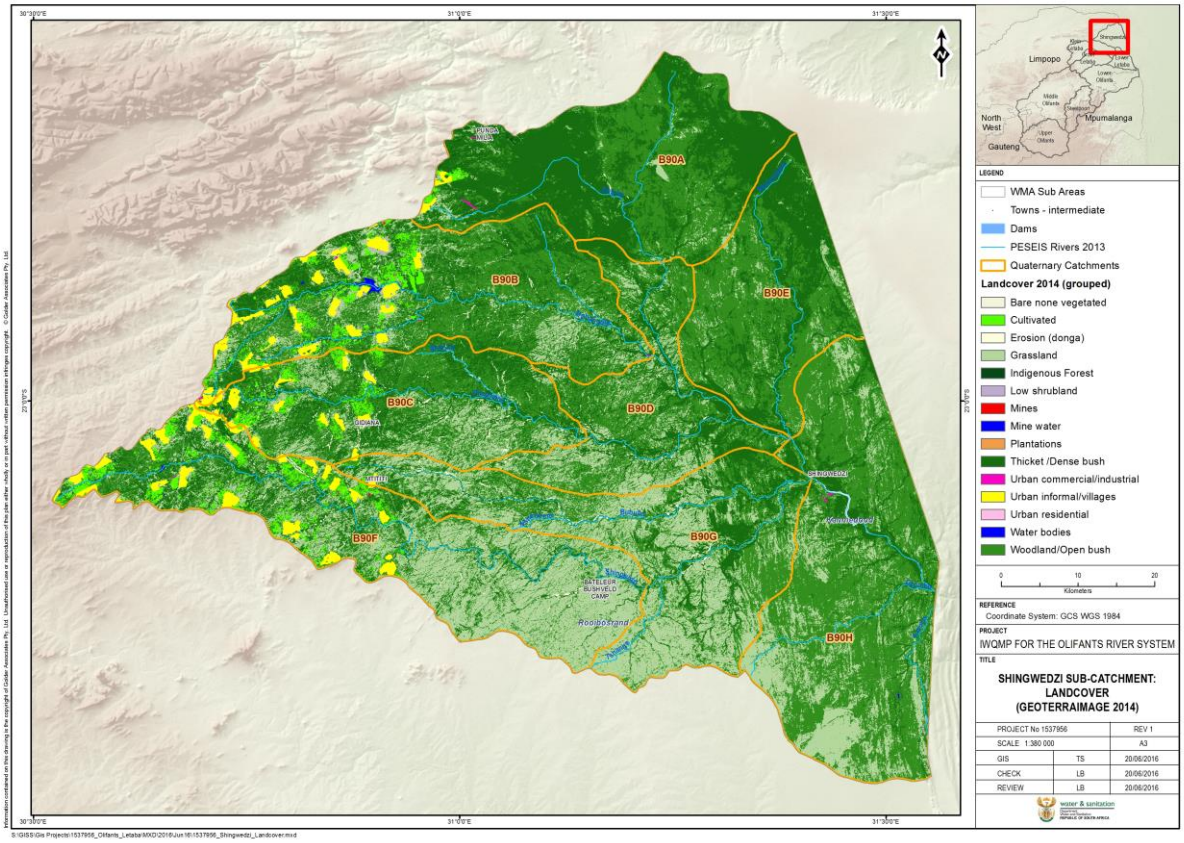

Figure 14: Map illustrating the land use activities in the Shingwedzi sub-catchment

3. FITNESS FOR USE OF WATER IN THE LETABA AND SHINGWEDZI SUB-CATCHMENTS

A fitness for use assessment (compliance) was done against the South Africa Water Quality Guidelines (DWAF, 1996) for the various sectors. As the water users in the catchment are mostly related to domestic, irrigation, aquatic ecosystems and recreation; in most cases the acceptable limit for these uses was used as the limit against which fitness for use was undertaken.

Table 4 and Table 6 show the compliance of 95 percentile data (conservative) versus WQPL. It is important to note that there are cases where the fitness for use of a variable falls within the acceptable range, however the compliance against the WQPL show non-compliance. This means that the WQPL has been set at a stricter value, and it is likely that if the average were to be calculated and compared, it would be in compliance.

Figure 15 and Figure 16 illustrate the compliance of 95% data for total dissolved solids/ electrical conductivity, pH, sulphate, ortho-phosphate, ammonia, chloride and magnesium for the Letaba and Shingwedzi sub-catchments respectively.

Table 4: Compliance of 95 percentile data versus WQPL for the Letaba sub-catchment

		Letaba sub-catchment						
	MU	69	70	71	72	73	74	79
WQ MP/ WEIR ID		90525	183879	90536	No monitoring point	No monitoring point	90529	90539
Calcium (dissolved)	mg/L	15.39	57.6	39.58			56.24	33.37
Chloride (dissolved)	mg/L	29.9	130.5	172.34			145.45	58.62
Total Dissolved Solids	mg/L	165.95		723.48			752.88	430.36
Electrical Conductivity	mS/m	24.97	133.04	97.1			94.34	58.98
Fluoride (dissolved)	mg/L	0.31	0.55	0.54			0.61	0.4
Potassium (dissolved)	mg/L	4.06	14.62	7.15			7.05	4.34
Magnesium (dissolved)	mg/L	8.28	43.3	34.56			6.27	34.06
Sodium (dissolved)	mg/L	17.95	97.5	120.29			56.1	39.61
Ammonia (unionised)	mg/L	0.11	27	0.25			116.21	0.09
Nitrate	mg/L	0.82	22.5	0.63			4.72	0.31
pH	mg/L	8.06	9.24	8.6			8.7	8.72
Ortho-phosphate	mg/L	0.05	8.88	0.07			8.64	0.04
Sulphate (dissolved)	mg/L	13.2	47.6	31.9			0.07	18.28
Total Alkalinity	mg/L	66.33	377.6	235.36			22.07	207.67

Table 5: Compliance of 95 percentile data versus WQPL for the Shingwedzi sub-catchment

		Shingwedzi sub-catchment			
	MU	75	76	77	78
WQ MP/ WEIR ID		90582	No monitoring point	No monitoring point	90583
Calcium (dissolved)	mg/L	46.09			65.01
Chloride (dissolved)	mg/L	204.59			237.34
Total Dissolved Solids	mg/L	1003.58			1076.39
Electrical Conductivity	mS/m	137.6			156.4
Fluoride (dissolved)	mg/L	0.42			0.56
Potassium (dissolved)	mg/L	16.96			20.04
Magnesium (dissolved)	mg/L	9.18			50.53
Sodium (dissolved)	mg/L	51.91			190.41
Ammonia (unionised)	mg/L				0.7
Nitrate	mg/L	0.64			1.23
pH	mg/L	8.7			8.75
Ortho-phosphate	mg/L	8.64			0.16
Sulphate (dissolved)	mg/L	0.19			39.74
Total Alkalinity	mg/L	21.18			432.5

Meets WQPL Non-compliant against the WQPL

The upper portions of the Letaba sub-catchment (MU69) are located within the Kruger to Canyons Biosphere Reserve and several smaller protected areas (Wolkeberg Wilderness Area and the Nature Reserve: Co-operation and

Development), and releases of very good chemical and physical quality water downstream of Tzaneen Dam are noted. However downstream of this area, large urban settlements (and to a much lesser extent irrigation) impact considerably on any available assimilative capacity in respect of nutrients.

Salinity is not a concern in this area and because of the protected areas and the positive impacts on the downstream water quality, should be maintained.

The Shingwedzi sub-catchment has non-perennial rivers, so assimilative capacity is not relevant.

In respect of nutrients, due to the discharge from the WWTW and considerable upstream irrigation, there is no assimilative capacity in any of the rivers. It must be noted that nutrient data assessed does not appear to be very reliable.

Table 6 shows the compliance of the 95% data for TDS against the WQPLs and a compliance map for total dissolved solids/ electrical conductivity, pH, sulphate, ortho-phosphate, ammonia, chloride and magnesium is illustrated in Figure 16.

Table 6: Compliance of present data vs WQPL for TDS and orthophosphate in the Letaba MU

MU	Main River/ tributary	95% TDS	Load (kg/d)	WQPL	Load (kg/d)	Assimilative capacity
69	Groot Letaba	165	9132	180	6636	N
70	Klein Letaba	865	32775	260	9884	N
71	Groot Letaba	586	87226	500	74304	N
72	Nsama	258	10666	260	10783	Y
73	Klein Letaba	447	22717	500	25488	Y
74	Groot Letaba	477	23484	500	14774	N
79	Middle Letaba	329	14837	260	10109	N

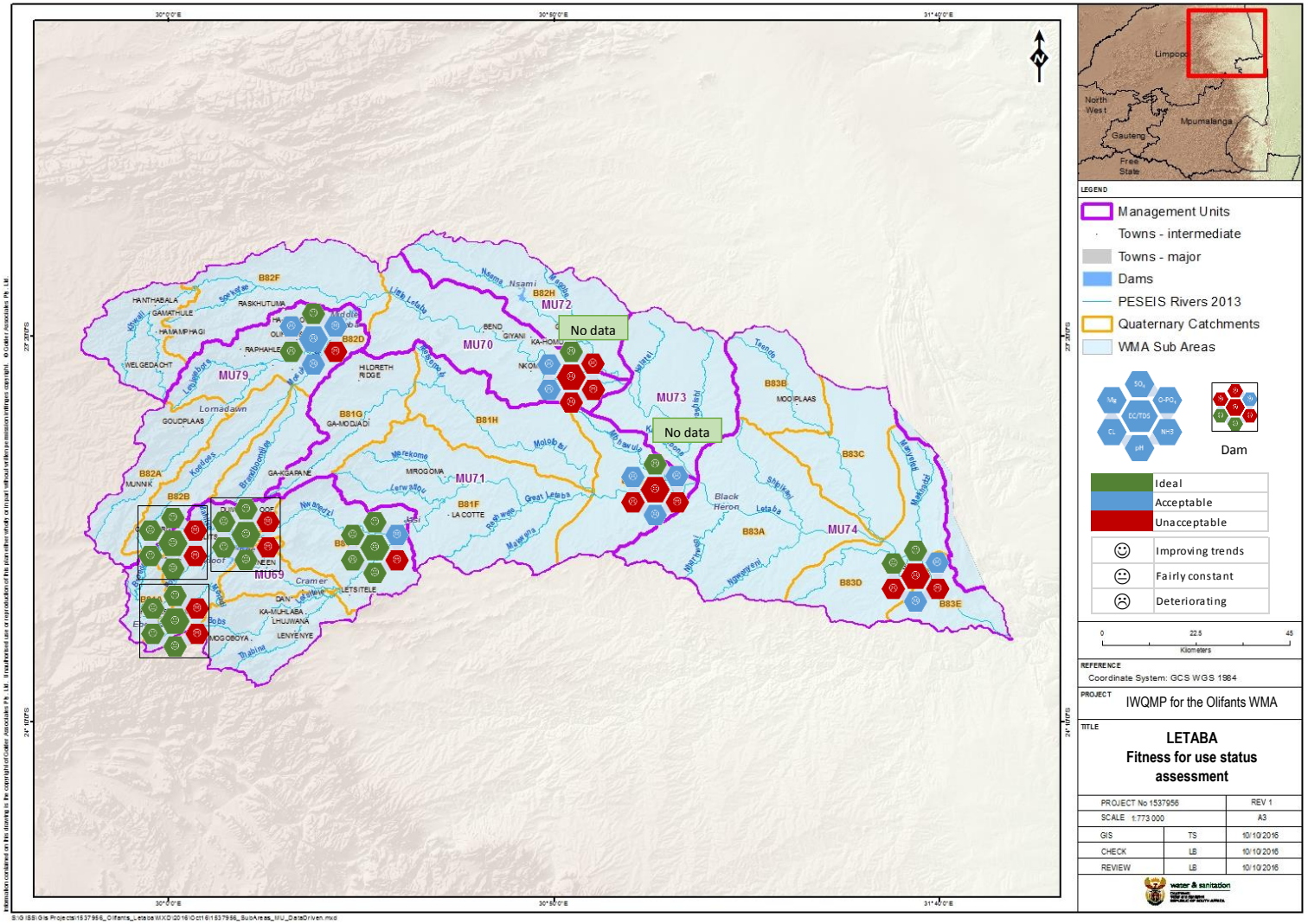

Figure 15: Status assessment (fitness for use) of 95% data

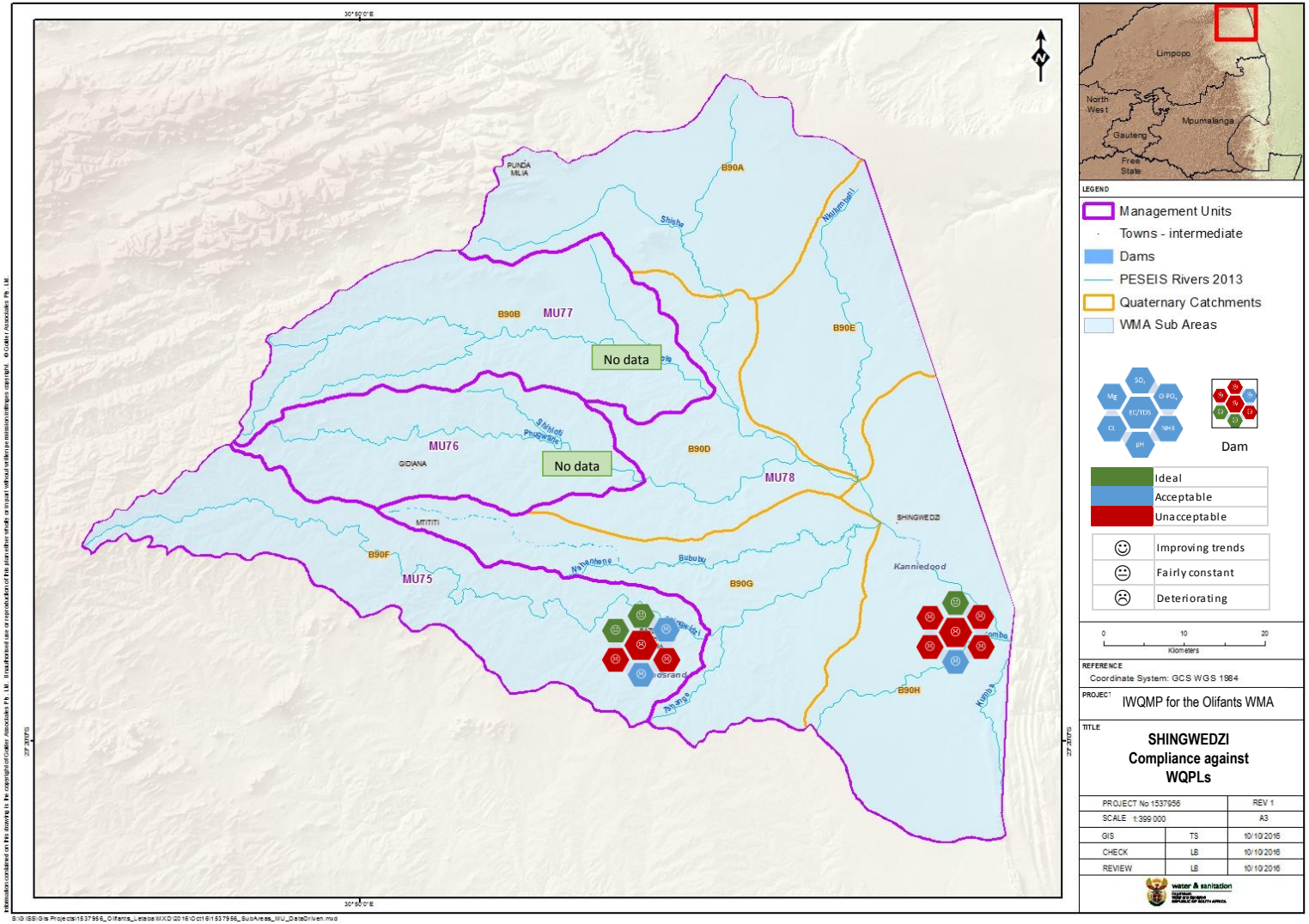

Figure 16: Status assessment (fitness for use) of 95% data for Shingwedzi

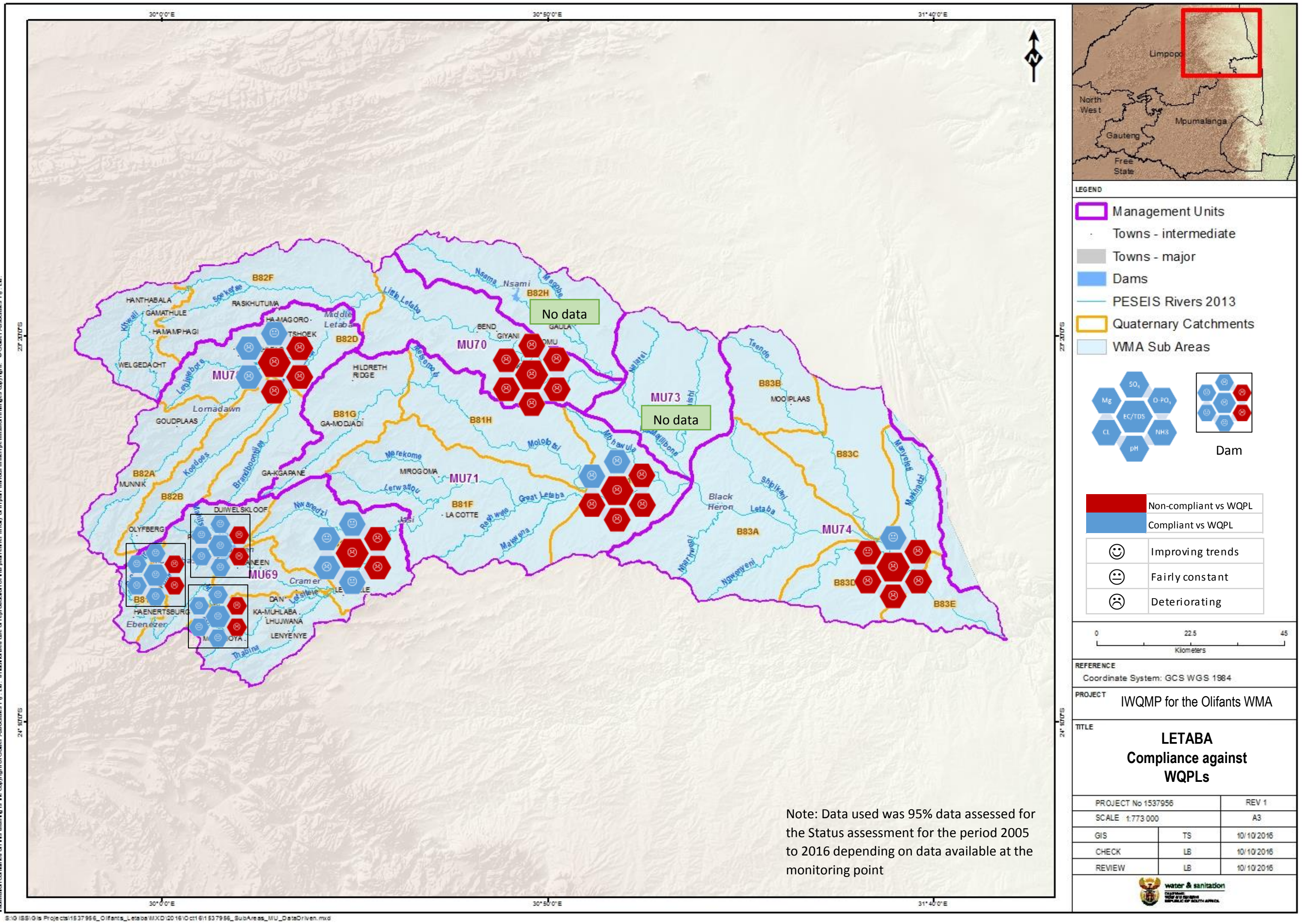

Figure 17: Compliance assessment of 95% data against WQPLs

4. WATER QUALITY PLANNING LIMITS

Water Quality Planning were set for each management unit within the Middle Olifants sub-catchment. Details of the methodology and approach are not repeated in this report, however can be obtained in the report entitled: *Development of an Integrated Water Quality Management Plan for the Olifants River System: Water Quality Planning Limits Report.* Study Report No. 3, Report No: P WMA 04/B50/00/8916/4 (DWS, 2016a).

Figure 18 maps the management units for each of the sub-catchments including the strategic monitoring points used in setting the WQPLs.

Water quality in the upper catchments of the Letaba sub-catchment is very good. The areas around the towns show impacts from urbanisation, especially in MUs 79, 70, 71 and 72. Data in the sub-catchment is limited so will need to be addressed as part of the monitoring plan development. Data for MU 70 has also been considered for MU 72, MU 73 and 79.

Figure 19 maps the management units for each of the sub-catchments including the strategic monitoring points used in setting the WQPLs for the Shingwedzi sub-catchment.

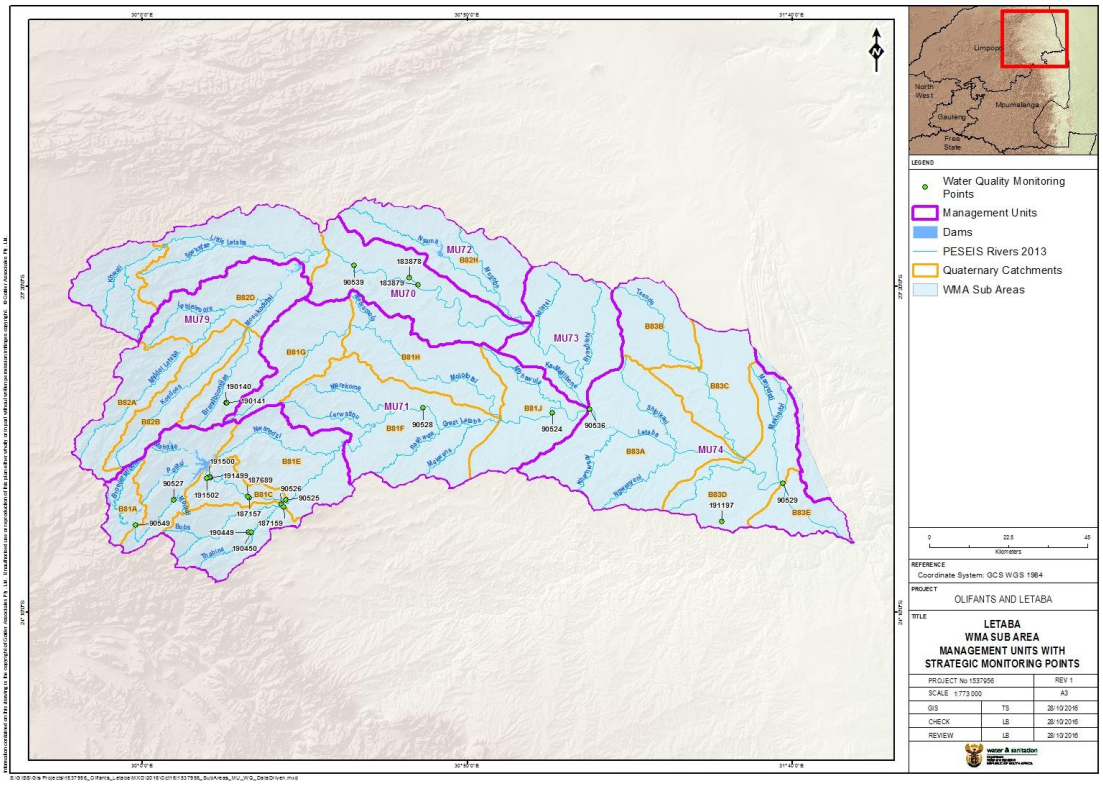

Figure 18: Letaba sub-catchment Management Units showing monitoring points used for the determination of WQPLs

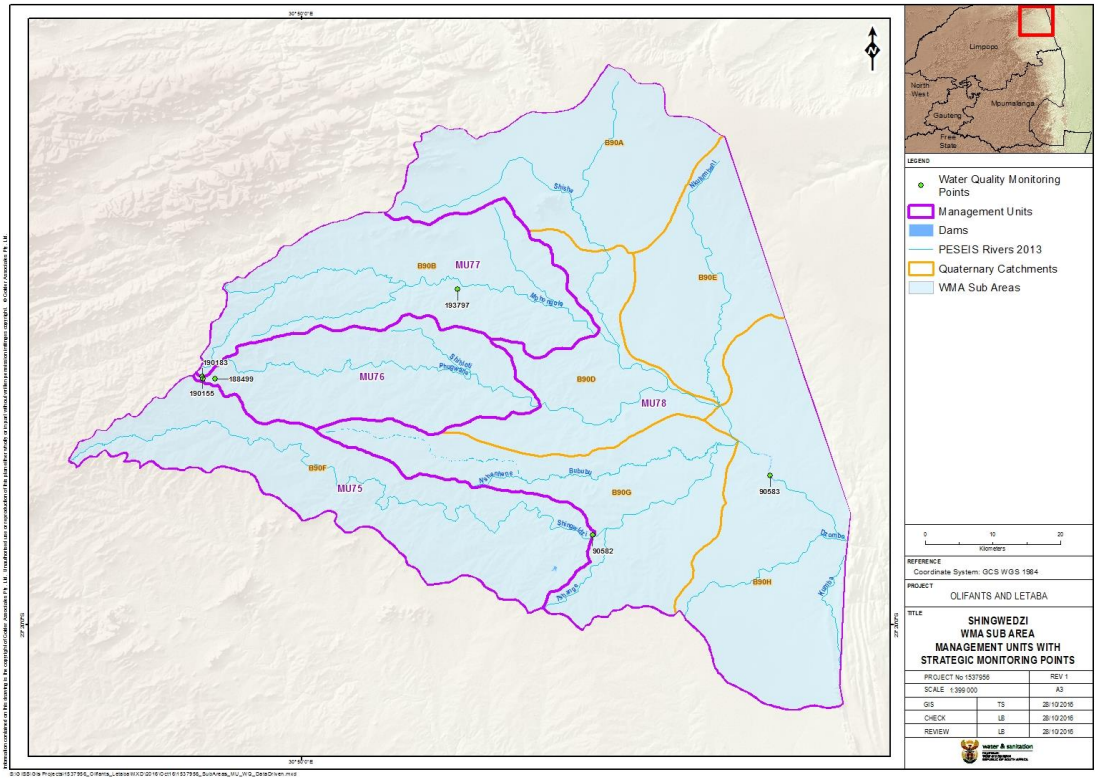

Figure 19: Shingwedzi sub-catchment Management Units showing monitoring points used for the determination of WQPLs

Table 7: WQPLs for catchments in the Letaba sub-catchment

Variable	Units	Management Units in the Letaba sub-catchment								
		69	**70**	**71; 73**	**74**	**79**	**Middle Letaba Dam**	**Magoebaskloof Dam**	**Ebenezer Dam**	**Tzaneen Dam**
Calcium (dissolved)	mg/L	20	50	40	60	35	35	10	10	10
Chloride (dissolved)	mg/L	30	100	180	150	60	60	10	10	20
Total Dissolved Solids	mg/L	120	260	500	300	380	260	60	80	100
Electrical Conductivity	mS/m	20	40	90	50	60	40	10	15	25
Fluoride (dissolved)	mg/L	0.75	0.75	0.75	0.75	0.75	0.75	0.2	0.2	0.2
Potassium (dissolved)	mg/L	10	20	10	10	10	50	5	5	5
Magnesium (dissolved)	mg/L	10	50	35	60	40	30	5	5	5
Sodium (dissolved)	mg/L	20	80	120	115	50	40	10	10	10
Ammonium (NH_4-N)	mg/L	0.05	2	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.3
Total Phosphorus	mg/L	0.25	2.5	0.25	0.25	0.25	0.25	0.25	0.25	0.25
pH		6.5 - 8.4	6.5 - 9.2	6.5 - 8.4	6.5 - 8.4	6.5 - 8.7	6.5 - 8.4	6.5 - 8.4	6.5 - 8.4	6.5 - 8.4
Ortho-phosphate	mg/L	0.02	1	0.02	0.02	0.02	0.005	0.02	0.02	0.2
Sulphate (dissolved)	mg/L	10	30	35	10	20	30	15	15	35
Total Alkalinity	mg/L	70	300	180	120	180	210	40	40	40
Dissolved Organic Carbon	mg/L	5	5	5	5	5	5	5	5	5
Dissolved Oxygen	mg/L	9	9	9	9	9	9	9	9	9
Sodium Absorption Ratio		2	2	2	2	2	2	2	2	2
Suspended Solids	mg/L	25	25	25	25	25	25	25	25	25
Chlorophyll a	µg/L	1	1	1	1	1	1	1	1	1
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130	130	130	130	130
Aluminium	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Boron	mg/L	5	5	5	5	5	5	5	5	5
Chromium (VI)	µg/L	7	7	7	7	7	7	7	7	7
Iron	mg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Manganese	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Table 8: WQPLs for catchments of the Shingwedzi sub-catchment

Variable	Units	Management Units in the Shingwedzi sub-catchment	
		75; 76; 77	**78**
Calcium (dissolved)	mg/L	60	32
Chloride (dissolved)	mg/L	100	30
Total Dissolved Solids	mg/L	280	340
Electrical Conductivity	mS/m	40	45
Fluoride (dissolved)	mg/L	0.70	0.70
Potassium (dissolved)	mg/L	20	20
Magnesium (dissolved)	mg/L	30	30
Sodium (dissolved)	mg/L	50	70
Ammonium (NH_4-N)	mg/L	0.07	0.06
Nitrate	mg/L	0.5	0.2
Total Phosphorus	mg/L	0.25	0.2
pH		6.5 - 8.4	6.5 - 8.4
Ortho-phosphate	mg/L	0.025	0.050
Sulphate (dissolved)	mg/L	30	40
Total Alkalinity	mg/L	150	185
Dissolved Organic Carbon	mg/L	5	5
Dissolved Oxygen	mg/L	9	9
Sodium Absorption Ratio		2	2
Suspended Solids	mg/L	25	25
Chlorophyll a	µg/L	1	1
Escherichia coli	CFU/ 100mL	130	130
Faecal coliforms	CFU/ 100mL	130	130
Aluminium	mg/L	0.01	0.01
Boron	mg/L	5	5
Chromium (VI)	µg/L	7	7
Iron	mg/L	0.1	0.1
Manganese	mg/L	0.02	0.02

5. INTEGRATED WATER QUALITY MANAGEMENT PLAN FOR THE LETBABA AND SHINGWEDZI SUB-CATCHMENTS

This chapter puts forward Strategic management options related to the user sectors and impacts. Reference is made to the Management Options Report, Report number: P WMA 04/B50/00/8916/7 (DWS, 2016b).

5.1 Introduction

The key to the successful management of the water quality in the Olifants River System is the formulation of management measures that will integrate all the relevant aspects that have a bearing on the water resources. In this respect an assessment of the physical, economic, social, institutional, statutory and ecological aspects in the system was undertaken to understand the current situation and therefore be in a position to assess existing management options and proposed new options that will be able to handle the existing as well as anticipated future challenges (DWS Report number: P WMA 04/B50/00/8916/3).

Furthermore it is expected that the growing economy, in the Olifants System, will intensify the pressures on the water quality of the resource and it is therefore necessary to find innovative measures that offer economical and sustainable management solutions. The reconciliation strategies developed for the various systems within the WMA have indicated that extensive augmentation will be needed that may stress the water resources in respect of chemical, physical and microbiological constituents even further.

Scenarios that will have the biggest positive impact in reducing the load in the overall Olifants WMA are described as:

- Reduction of load due to seepages from the mine, industrial and power station waste storage facilities and mining operations in the Upper Olifants sub-catchment, some load from the Steelpoort sub-catchments and the Ga-Selati in the lower Olifants sub-catchments.;
- Reduction of load due to excess mine water on the mining operations threatening to decant or starting to flood the coal reserves in the Upper Olifants sub-catchment;
- Reduction of load from irrigation return flows in the Upper and Middle Olifants;
- Reduction of nutrient load from domestic WWTW that discharge to the water resources, by considering a reduction of the orthophosphate concentration to 1 mgP/l;
- Reduction of nutrient and sediment load from agricultural areas and areas where changing land uses may be occurring;

- Reduction of nutrient and sediment load from run-off from urban/ densely populated areas; and
- Improved reuse of effluent from domestic wastewater treatment works not designed to meet the general discharge limits.

These will be unpacked more specifically for each of the sectors in the sub-sections to follow.

An important aspect to consider when reading this document is that the implementation must be undertaken as a co-ordinated partnership between all regulators, water users and stakeholders.

5.2 Strategic Management Area: Domestic sector

5.2.1 Background and context for water quality

The main towns in the Letaba and Shingwedzi sub-catchments are the towns of Tzaneen and Giyani and the expansive settlements located in the western areas of the sub-catchments, outside of the protected Kruger National Park areas.

The local and district municipalities supplying water and sanitation services to these areas are:

- Mopani District Municipality
  - Greater Tzaneen Local Municipality;
  - Greater Letaba Local Municipality;
  - Greater Giyani Local Municipality;
  - Ba-Phalaborwa Local Municipality;
  - Maruleng Local Municipality; and
  - LIMDMA33 Local Municipality

The main impact sources from the domestic sector are urban run-off, discharge of poorly treated effluent, and groundwater contamination from the large number of pit latrines and unlined oxidation ponds.

Table 9 summarises the source of the potential impacts from contaminated urban run-off.

Table 9: Urban run-off impacts and root causes

Source of impact	Root causes

Surcharging sewers	• Blocked sewers:
	  ○ Poor maintenance by municipality;
	  ▪ Lack of resources (human and budgetary)
	  ✓ Posts not filled
	  ✓ No budgets available due to budgets being moved within the municipality or not budgeted for

	○ Lack of awareness by citizens of what may be disposed ▪ Poor/ no awareness campaigns ✓ Inadequate or no budget ○ Poor/ no by-laws in place/ lack of enforcement for industrial uses such as abattoirs in respect of what may be disposed to sewer
Solid waste	• Inadequate solid waste collection ○ Lack of resources (human and budgetary) ✓ Posts not filled ✓ No budgets available due to budgets being moved within the municipality or not budgeted for ○ Lack of awareness by citizens of impacts of illegal dumping/ littering ▪ Poor/ no awareness campaigns ✓ Inadequate or no budget • Poor/ no by-laws in place/ lack of enforcement
Oils and greases	• Run-off from car wash areas ○ Poor storm water management ○ Grease traps not installed/ maintained ○ By-laws not implemented ▪ Lack of resources (human and budgetary) ✓ Posts not filled ✓ No budgets available due to budgets being moved within the municipality or not budgeted for

There are approximately 21 domestic wastewater treatment works (WWTW) in the Letaba and Shingwedzi sub-catchments, all relatively small, the 2 largest being the Tzaneen WWTW (8ML), Nkowankowa WWTW (4.5ML), Ga-Kgapane WWTW (4ML) and Malamulele WWTW (3ML) contributing more than 80% of the capacity (Table 11). The major concern is around the discharge of non-compliant effluent from the biological filter plants, lack of effluent and flow monitoring and technical skills (process controller (PC) and supervisory skills), as well as not having an understanding of the water use authorisation type.

The large number of oxidation ponds (more than half of the WWTW in the sub-catchment) are also linked to the contamination of groundwater, and considering that groundwater is use for domestic supplies this is an important consideration. Groundwater contamination is also caused by the large number of pit latrines used in the sub-catchment.

Table 10: Sanitation aspects failure

Source of impact	Root causes
Discharge of poorly treated effluent	• Considerable lack of data at all levels • Lack of process controller (PC) and supervisory skills ○ Posts not filled with required skilled personnel;

	▪ No budgets available due to budgets being moved within the municipality or not budgeted for; ✓ Lack of awareness regarding the importance of wastewater treatment; • Inadequate chemical supplies for disinfection o No budgets available due to budgets being moved within the municipality or not budgeted for; ▪ Lack of awareness regarding the importance of wastewater treatment; • Hydraulic load exceeds design capacity o Inadequate/ inappropriate design o Poor operation and maintenance ▪ No budgets available due to budgets being moved within the municipality or not budgeted for ▪ Lack of awareness regarding the importance of wastewater treatment;
Groundwater contamination	• Unlined oxidation ponds • Inadequate groundwater monitoring • Large number of pit latrines • Inadequate groundwater protection zoning

Table 11: Wastewater treatment works in the Letaba and Shingwedzi sub-catchments

WWTW name	WWTW Type (liquid)	WWTW (sludge)	Operational Capacity (Ml)	Highest risk areas			Authoris[n/.] type
				Effluent quality	Skills	Capacity/ no flow measurement devices	
Tzaneen WWTW	Biological filters	Solar drying beds and composting	8	Effluent non-compliance	Inadequate process control skills		Nk
Modjadjiskloof (Duiwelskloof) WWTW	None specified	None specified	Nk	Effluent non-compliance		Inadequate design capacity and flow measurement	Nk
Haenertsburg WWTW							Nk
Letsitele WWTW							Nk
Nkowankowa WWTW	Biological filters	Sludge lagoon/ pond	4.5	Effluent non-compliance	Inadequate process control skills		Nk
Lenyenye WWTW	Aerated ponds/ Oxidation ponds	None specified	1	Effluent non-compliance	Inadequate process control skills		Nk
Ga-Kgapane WWTW	Biological filters	Anaerobic digestion	4	Effluent non-compliance	Inadequate process control skills		Nk
Giyani WWTW	Biological filters and Oxidation ponds	Solar drying beds	2.1	Effluent non-compliance	Inadequate process control skills		Nk
Senwamokgope WWTW	None specified	None specified	Nk	Effluent non-compliance	Inadequate process control skills	Inadequate design capacity and flow measurement	Nk
KNP Mopani WWTW - Oxidation Ponds							Nk
KNP Letaba WWTW - Oxidation Ponds							Nk
KNP - Makhadzi Picnic Spot							Nk
KNP - Shimuweni Oxidation Ponds							Nk
KNP - Tsendze Rest Camp							Nk
Hans Merensky							Nk
Dr CN Phatudi (Shiluvane) Hospital							Nk
Malamulele WWTW	Biological filters	Anaerobic digestion and	3	Effluent compliance		process control	Nk

WWTW name	WWTW Type (liquid)	WWTW (sludge)	Operational Capacity (Ml)	Highest risk areas			Authoris[n/.] type
				Effluent quality	Skills	Capacity/ no flow measurement devices	
		Solar drying beds					
Hlanganani Ponds WWTW							Nk
KNP Punda Maria WWTW							Nk
KNP Shingwedzi WWTW - Oxidation Ponds							Nk
KNP - Sirheni Bush Camp Oxidation Ponds							Nk

*Nk = not known

5.2.2 Management objectives

The management objectives for the domestic sector are:

- Reduction of nutrient and sediment load from run-off from urban/ densely populated areas;
- Reduction of nutrient load from domestic WWTW that discharge to the water resources which also links to reduction of microbiological contamination;
- Improved reuse of effluent from domestic wastewater treatment works not designed to meet the general discharge limits; and
- To get a better understanding of the contamination of groundwater from unlined oxidation pond systems and other on-site sanitation facilities and implement groundwater protection zoning, specifically in those areas where sanitation facilities have contaminated the groundwater, and groundwater is used for domestic use.

5.2.3 Management Measures

Table 12 sets out the proposed management measures and specific actions to support the management objectives for the domestic sector.

Table 12: Management Measures for the Domestic Sector

Strategic Measure D-1: Prevent/ limit surcharging sewers
1. Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate inspections and maintenance of sewers is undertaken; 2. Develop and enforce by-laws for industrial users such as abattoirs, in respect of what may be disposed to sewer, to prevent blockages; o *PRIORITY AREAS: Giyani, Tzaneen, Lebowakgomo, Letsitele, Malumulele and Nkowankowa* 3. Develop awareness programmes to ensure that the public are aware of the impacts that can be caused when incorrectly disposing of solid waste into sanitation systems;
Strategic Measure D-2: Prevent or limit erosion and sedimentation from villages and larger settlements
1. Consider innovative ways to collect and treat storm water emanating as run-off from semi-urban areas where subsistence farming is common; including for example: o Rainwater harvesting; o Landscaping that will allow water for gardening and subsistence agriculture to be better collected and stored including for example, ▪ Domestic landscaping around each house; ▪ Stone contour bunds;

- Water collection pits (lined with clay);
- Mulching to ensure that water is kept within reach of crop roots and prevents evapo-transpiration of water by creating a micro-climate;

- Retention ponds to store water from surface runoff during rainfall events and can then be used later;

Strategic Measure D-3: Ensure adequate solid waste collection

1. Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate solid waste collection is undertaken;
    - *PRIORITY AREAS: for all areas*
2. Develop and enforce by-laws for littering and illegal dumping;
3. Develop awareness programmes to ensure that the public are aware of the impacts/ nuisances that can be caused when littering or dumping solid waste illegally;

Strategic Measure D-4: Reduce contaminated run-off from industrial areas

1. Make financial provision and appoint adequate personnel to undertake inspections in industrial areas;
2. Develop and enforce by-laws for industries (including car wash areas) including:
    i. oil/ grease traps;
    ii. adequate storm water management systems that may incorporate retention/ effluent ponds to contain dirty water;
        - *PRIORITY AREAS: Giyani, Tzaneen, Lebowakgomo, Malumelele, Nkowankowa and all other areas where small industries are being established.*
3. Develop awareness programmes to ensure that the public are aware of the impacts that can be caused when incorrectly disposing wastewater from car wash areas;

Strategic Measure D-5: Ensure compliant effluent from WWTW

1. Make financial provision and appoint adequately skilled and unskilled personnel at the WWTW – based on DWS process controller regulations. This may require that district and local municipalities consider co-operative partnerships to regionalise a skills base. This should work well in the Letaba and Shingwedzi sub-catchments as the WWTW are small and should require limited but effective operation and maintenance.
2. Undertake a prioritisation exercise to assess which WWTWs are in the poorest condition and what infrastructure requirements are needed so that these can be budgeted for and relevant funding organisations approached once a plan has been set up;
    - *PRIORITY AREAS: Giyani, Tzaneen, Lebowakgomo, Malumelele, Nkowankowa WWTW in respect of discharging back to the water resource; and all oxidation pond systems should be assessed*

3. Assess whether the effluent is of a quality that could allow it to be used for irrigation;
    - *All oxidation pond systems*
4. Assess lawful water use and implement directives as necessary for water use authorisation application;
5. Review existing IWULs and request amendment applications as necessary;
6. Push for the promulgation of the Green Drop system as a regulation;
7. Collaborate with COGTA and SALGA to implement the WWTW aspects of the Municipal Management Strategy;
8. Undertake awareness campaigns:
    - At all levels and specifically amongst the managers in local government, about the importance of compliance to the Green Drop requirements;
    - Amongst the officials working at the WWTW itself about the importance of their job (build pride and passion for undertaking the job);
    - Within local communities being served by the WWTW, about the importance of reporting sewer leaks, poor O &M and why it is important to prevent vandalism.

Strategic Measure D-6: Develop a groundwater protection plan

1. Strategic actions from the National Groundwater Strategy (WRC Report number) need to be considered and the WMI must be involved in the Key Deliverables roll-out which over a 3 year period includes:

    YEAR 1

    - The national groundwater champion designated and developed
    - Stakeholder communication initiated with a website in this regard (linked to the Community of Practice - below)
    - The National Stakeholder Core Group established and functional
    - A Groundwater Governance Strategic Action Plan, indicating critical deliverables and respective stakeholder responsibilities, developed
    - A Groundwater Governance Community of Practice established as a long-term process for achieving a stakeholder-driven NGS roll-out initiated (potentially through a WRC programme)
    - A ‘groundwater awareness-raising through stakeholders’ strategy developed, including the media
    - Groundwater sector organisation in response to the participation requirements (Groundwater Division; Groundwater academic institutions) underway
    - Plans for groundwater source protection by municipalities in place (with WRC support)
    - A prototype groundwater management plan developed for one CMA (possibly as

a WRC consultancy)

- A strategy for a new, more detailed, phase of groundwater resource assessment in place

YEARS 1 - 3

- A Groundwater Code of Practice (widely understood national policy) developed cooperatively
- A groundwater management plan for each CMA developed (per example – above) as basis for overall roll-out to local level
- Introduction of groundwater sustainable utilisation into various sector development plans as the basis for the rollout of further sector actions.
- Promotion of relevant available guidelines ongoing and commissioning of critical new ones underway
- Groundwater use verification completed country-wide
- A country-wide groundwater pollution assessment undertaken
- A suite of groundwater regulations developed and publication initiated
- The first local shared aquifer management institutions in place in all nine CMAs
- The new phase of regional / local groundwater resource assessment underway
- A National Groundwater Information System in place, adapted and expanded with participation of stakeholders
- A groundwater capacity building strategy developed and implementation underway
- A groundwater education & training programme, initiated jointly by the groundwater academic and technical institutions, for stakeholders at all governance levels
- Indicators of 'groundwater sustainable utilisation and good governance', linked to the Water & Sanitation Strategic Development Goals (SDG), developed
- District / Local Municipalities have started to appoint/contract hydrogeologists to manage water supplies from groundwater and shared aquifers.

2. Undertake a hydrocensus of the boreholes in the area to enable mapping of:
    - Aquifers that are already badly contaminated (hot spots); and
    - Aquifers where water is abstracted and used for domestic use.

This task will need to be undertaken in collaboration with all relevant role players, including DWS, Local Government and private citizens who have boreholes. This will allow the relevant communities and district/ local municipalities to understand the specific treatment requirements for the type of water usage.

Strategic Measure D-7: Data collection

1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including:
    - Water quality and quantity data;
    - Data related to other conditions in the IWUL that may ultimately impact on water quality, and that need to be reported on;
    - Incidents reporting by the public.

5.3 Strategic Management Area: Agricultural sector

5.4.1 Background and context for water quality

The upper areas of the sub-catchment, specifically management units 69, 70 and 71 are driven by intensive irrigation agriculture (Tzaneen and Giyani areas) and tourism (Kruger National Park). The rest of the sub-catchment has considerable subsistence agriculture as well as game farms which are also associated with the tourism sector.

The main concerns related to this sector are:

- Pesticide use
    - Links to endocrine disruption in livestock and humans
- Fertiliser use
    - Nutrient enrichment from over fertilisation

Intensive animal feedlots/ abattoirs are included under the Industrial sector.

The management of emerging contaminants (linked in one instance to pesticide use) will need to be a collaborative effort between various level of government and other relevant organisations including: DoA, WUA and IBs, Local Government, National and Provincial Departments of Health, National and Provincial Departments of Environmental Affairs. Emerging contaminants and perceptions by stakeholders should not be underestimated. This is particularly with respect to pesticide use in the upper reaches of the Groot and Klein Letaba River around the Tzaneen and Giyani areas. It is proposed that emerging contaminants management be undertaken using best management practices, and linking to research being undertaken:

The following aspects are relevant for pesticide management:

- Pesticide use is regulated by Global Gap certification (GLOBALG.A.P.)[1] that would include aspects such as:

[1] GLOBALG.A.P. today is the **world's leading farm assurance program**, translating consumer requirements into Good Agricultural Practice in a rapidly growing list of 0ver 100 countries; available for 3 scopes of production: Crops, Livestock, Aquaculture and consisting of a total of 16 standards.

- concentrations allowed;
- withholding periods; and
- spray records keeping (also checked by DAFF).

- Certain pesticides are not permitted for use if fruit is to be exported;
- Fruit is tested for residue for verification for export by PPECB[2];
- Strict rules, for example, cabbage and lettuce where water can get trapped between leaves; would be specifically relevant to microbiologically contaminated water;
- Citrus uses micro sprays and drip irrigation so there is less chance of run-off.

5.4.2 Management objectives

The management objectives for the agricultural sector in the Letaba and Shingwedzi sub-catchments include:

- Reduction of nutrient and sediment load from agricultural areas and areas where changing land uses may be occurring;
- Research into the fate of pesticides that may be linked to endocrine disruption in humans and livestock.

5.4.3 Management Measures

Table 13 sets out the proposed management measures with supporting actions to support the management objectives for the agricultural sector.

Table 13: Management Measures for the Agricultural Sector

Strategic Measure A-1: Reduce nutrient load from cultivated areas
• Develop Best Management Practices (BMP) for fertiliser application to ensure that over-fertilisation does not take place; • Implement best management practice around buffer strips to allow some natural infiltration during rainfall events.
Strategic Measure A-2: Implement a pesticide monitoring programme
1. Develop and communicate a schedule of spraying: spraying is seasonal; varies in different areas of the Olifants. The CMS should be notified of the schedule of spraying or at least when spraying will occur; what is being sprayed when? Is it a known EDC/ carcinogen etc? 2. Meet with the South Africa National Standards Boards to discuss the concerns around generic pesticide use: Pesticides are also regulated by South African National Standards (SANS), however after 10 years the licence falls away and generics come into the picture which are not SANS accredited; cheaper but use does lead to poorer yields.

[2] South Africa's official export certification agency for the perishable produce industry

3. Based on the above the CMA should develop a monitoring programme at very specific sites and at specific times throughout the year to get a better understanding of water pollution from pesticide use. This may also be in collaboration with the WRC or other relevant research institutions such as the local universities.

The key regulatory measures relevant for the management of the Persistent Organic Pesticides (POPs) life cycle included in the National Implementation Plans (NIP) for the Stockholm Convention on POPs need to be included.

4. Develop and implement regulations which will provide a wide range of controls and measures that include the authorisation of certain listed processes and activities that relate to chemicals management; atmospheric emission licensing; registration of agricultural remedies and chemicals, development of industrial waste management plans for certain identified industries, identification for priority waste streams; import controls and import permit requirements for certain listed products as well as the ability to implement import restrictions on certain identified products and wastes;
5. Develop norms and standards which include remediation standards, air quality and emission standards for listed activities and technical specifications for the management or use of certain products;
6. Issue directives and compliance notices requiring that reasonable measures are taken to prevent and remedy pollution or degradation of the environment;
7. Develop market based management instruments such as the water pricing strategy that should include charges for waste discharges and incentives for introducing new technologies; and
8. Undertaken annual awareness campaigns regarding the requirements in licensing, permitting and environmental authorisation processes.

Strategic Measure A-4: Data collection

1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including:
    - Water quality and quantity data;
    - Internal audits;
    - Data related to other conditions in the IWUL or data collected by the agricultural sector that may ultimately impact on water quality, and that needs to be reported on.

5.5 Strategic Management Area: Industrial sector

5.5.1 Background and context for water quality

The main industrial activities in the Letaba and Shingwedzi sub-catchments include smaller industrial areas around the Giyani, Tzaneen, Lebowakgomo, Letsitele, Malumulele and Nkowankowa areas. There are a few isolated mines that are

inactive, however may be resuscitated. These are included in this section related to industries.

The impacts from the main industrial activities are related to metals and oils and greases contamination from storm water run-off, nutrient enrichment and microbiological contamination from livestock feedlots as well as discharge of poor quality industrial effluent to sewer thereby causing blockages and poor functioning of the wastewater treatment works. The likely sources include:

- Contaminated run-off from industrial areas:
    - Poorly managed storm water systems where clean and dirty water is not separated and dirty water is not contained;
- Intensive animal feedlots
    - Management of manure stockpiles
        - Seepage to groundwater and surface water resources if site is not lined and storm water management is not in place;
    - Overflow from retention/ effluent ponds due to:
        - poor management, such as siltation/ sludge build-up;
        - inadequate design;
    - Seepage of irrigated effluent;
    - Disposal of dead animals.
- Discharge of effluent to sewer from abattoirs causing severe problems at the WWTW because of fat build-up due to :
    - Inadequate/ poor maintenance of fat and grease traps;
    - Inadequate design.

5.5.2 Management objectives

The main management objectives for the industrial sector are:

- The reduction of load due to run-off from industrial areas, including intensive animal feedlots;
- Improved quality of industrial effluents discharged to sewer.

5.5.3 Management Measures

Table 14 sets out the proposed management measures to support the management objectives for the industrial sector.

Table 14: Management Measures for the Industrial Sector (and small mining areas)

Strategic Measure I-1: Reduce load (salinity, metals and oils and greases) from run-off from industrial areas *(links to D-1.1 and D-1.2)*

1. Collaborate with the various industries and relevant small mines within a management unit to assess the storm water management in these areas and prioritise where biggest improvements can be made;

   PRIORITY AREAS: Giyani, Tzaneen, Lebowakgomo, Letsitele, Malumulele and Nkowankowa

2. Assess lawful water use and implement directives as necessary for water use authorisation application;
3. Develop by-laws for storm water management in industrial areas (links to D-1.1 and D-1.2);
4. Review existing IWULs and request amendment applications as necessary;
5. Implement compliance enforcement.

- **Strategic Measure I-2: Reduce nutrient load and microbiological contamination from intensive animal feedlots and abattoirs**

1. Develop Best Management Practices for regulations around intensive animal feedlots including:
   - Storm water management and ponds design;
   - Storage facilities/ areas for manure;
   - Monitoring requirements for rivers and groundwater;
   - Protection around boreholes.

Strategic Measure I-3: Data collection

1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including:
   - Water quality and quantity data;
   - Internal audits;
   - Data related to other conditions in the IWUL that may ultimately impact on water quality, or data that is collected by users and will assist the water quality information.

5.6 Strategic Management Area: Recreational sector

5.6.1 Background and context for water quality

The main recreational areas in the Letaba and Shingwedzi sub-catchments are the dams in the upper Letaba catchment (Tzaneen Dam, Ebenezer Dam, Magoebaskloof Dam, Middle Letaba Dam) where boating and fishing and full-contact recreational activities take place.

Areas of concern in the recreational sector include:

- General public litter;

- Cross contamination from boats moving from one dam to another
- Fuel/ oils contamination from boats
- Contamination from package waste water treatment plants/ septic tank systems on the banks of rivers and dams
    - Lack of operation and maintenance by private individuals or lodge owners;
    - Inadequate designs for the number of people accommodated

5.6.2 Management objectives

The management objectives for the recreational sector are:

- Reduction of contaminants from recreational activities such as boating and lodge sanitation facilities.

5.6.3 Management Measures

Table 15 sets out the proposed management Measures to support the management objectives for the recreational sector.

Table 15: Management Measures for the Recreational Sector

Strategic Measure R-1: Develop Best Management Practices for recreational areas
1. Develop Best Management Practices around: o Cross contamination from boats moving from one dam to another o Fuel/ oils contamination from boats
Strategic Measure R-2: Reduce nutrient and microbiological contamination from riverside accommodation and facilities in dam areas
1. Inspect to ensure relevant authorisations are in place for package waste water treatment plants/ septic tank systems on the banks of rivers and dams; 2. Enforce directives against non-compliance; 3. Confirm adequate operation and maintenance by private individuals or lodge owners; 4. Confirm designs for the number of people accommodated.
Strategic Measure R-3: Data collection
1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including: o Water quality and quantity data; o Internal/ external audits; o Data related to other conditions in the authorisation that may ultimately impact on water quality, or data that is collected by users and will assist the water quality information.

6. MONITORING AND INFORMATION

One of the most important aspects of the IWQMP is the development of a monitoring and information plan – this is one of the deliverables that will emanate from this project. The situation assessment has identified the following gaps in respect of monitoring and information:

- Not all parameters are measured, for example metals, microbiology and emerging contaminants are lacking, and nutrients, specifically ortho-phosphate and nitrates are not adequately monitored;
- Certain MUs do not have a dedicated monitoring point;
- Additional weirs may be required as described;
- Compliance monitoring in the local government sector is totally inadequate;
- Laboratory contracts are not adequately budgeted and maintained; and
- There is no electronic system that can be used for water users to load compliance data or any data that would be relevant to integrated water resources management.

These need to be considered at various levels described in the sections to follow.

6.1 Collaborative monitoring

The 4 levels of monitoring considered as part of the Status Assessment (Report number: P WMA 04/B50/00/8916/3) were:

- *Level 1:* water quality and/ or quantity monitoring points on the main stem Olifants River;
- *Level 2:* water quality and/ or quantity monitoring points on the main tributaries (often at a downstream point of the tributary);
- *Level 3:* water quality and/ or quantity monitoring points on minor tributaries (often up and downstream of specific activities);
- *Level 4:* water quality and/ or quantity monitoring points at point sources.

The DWS/ WMI needs to consider all the monitoring required at the various levels within the WMA. There are essentially 5 categories of monitoring described in Table 16 that should take place in the sub-catchment. Table 17 sets out those monitoring points already existing at the first 3 levels, and also specifies where additional monitoring points need to be considered.

It is important to note that the monitoring at category 5 should not necessarily be restricted to an in-stream water quality measurement, but should include aspects such as:

- Soil amelioration taking place i.e type of soil ameliorant added, volumes used by farmers; dates used during the year;
- Pesticide use: what type, when spraying or other use will occur; how much is used; The most common pesticides used (based on kilogrammes used) in the Limpopo and Mpumalanga Provinces are (WRC, 2015):
    - Glyphosate
    - Petroleum-oil
    - Mancozeb
    - Atrazine
    - Copper-oxychloride
    - Acetochlor
    - Terbuthylazine
    - Metolachlor
- Pollution control/ contaminated storm water management dam levels and potential/ actual overflows at feedlots;

All of these would also be aspects that if monitored, reported and acted upon would be an early warning system to a potential impact in the resource itself.

Table 16: Water quality monitoring categories, responsible parties and links to monitoring point levels

Category (Monitoring type)		**Main party responsible**	**Notes**
1	Resource Quality Objectives (surface and groundwater components)	DWS Provincial Office/ WMI	• Mostly Level 1 and 2 monitoring points; • Legislated requirements; • Some of the sites may overlap with those sites where EWR sites are located.
2	Reserve requirements: EWR sites (surface water) and groundwater aspects	DWS Provincial Office/ WMI	• Level 1 and 2 monitoring points; • Legislated requirements; • Some of the sites may overlap with those sites where WQPLs are proposed to be monitored
3	Water Quality Planning Limit sites in each MU	DWS Provincial Office/ WMI (may be some water user collaboration)	• Level 1 and 2 monitoring points; • Proposed sites within the catchment that will give an indication of the upstream impacts in each management

Category (Monitoring type)		Main party responsible	Notes
			unit, and should be used to assist with what load should be removed and to assess progress made
4	Other water resource monitoring sites – often linked to a water user (surface and groundwater)	Water users	• Level 3 and 4 monitoring points; • Catchment sites on the smaller tributaries; • Legislated requirements in respect of water use authorisations;
5	Source related on-site monitoring (surface and groundwater)	Water users	• In-house, not necessarily regulated, however would assist the users to achieve the targets set for the legislated requirements. • This monitoring may also include aspects such as soil amelioration taking place, pesticide use, levels and potential overflow from contaminated dams etc.

Table 17: Current monitoring sites in the Letaba and Shingwedzi sub-catchments

MU	Quaternary catchments	Main River/ tributary	EWR	RQO	WQPL Monitoring points
LETABA					
69	B81A; B81B; B81C; B81D; B81E	Groot Letaba	Letaba_EWR2 (B81D) Letaba_EWR 1 (B81B) Letaba_BRO1 (B81A)	X	90525 (B8H9) – an new sampling point needed at outlet of MU to incorporate contributions from the Nwanedzi
70	B82E; B82F; B82G	Klein Letaba		X	183879 (B8H33) – directly below Giyani WWTW, therefore will need a point lower down at outlet of MU
71	B81G; B81F; B81H; B81J	Groot Letaba			90524 (B8H8)
72	B82H	Nsama			90581 (at Nsami Dam) – need a point at the outlet of the MU (non-perennial river)
73	B82J	Klein Letaba			90536 (B8H28)
74	B83A; B83B; B83C; B83D; B83E	Groot Letaba	Letaba_EWR7 (B83D)	X	90529 (B8H18)

MU	Quaternary catchments	Main River/ tributary	EWR	RQO	WQPL Monitoring points
79	B82A; B82B; B82C; B82D	Middle Letaba			90547 (at MLD) (B8H54) (canal at Middle Letaba Dam)
SHINGWEDZI					
76	B90C	Phugwane			No monitoring points
77	B90B	Mphongolo			No monitoring points
78	B90B B90A; B90E; B90D; B90G; B90H	Shingwedzi and tributaries in KNP			193797
75	B90F	Shingwidzi	Shingwedzi_SHI1		188499 (B9H2 B9H3

Groundwater monitoring is an aspect that has been neglected and this will need to be considered in greater detail in the monitoring report. Groundwater monitoring should be expanded across the WMA but with preference in those areas that have been highlighted as having high stress indices and where groundwater is used for domestic purposes.

A monitoring task team consisting of representatives from each sub-catchment needs to be set up to workshop a collaborative programme for monitoring that should see all users, including communities, participating and contributing to monitoring. Overall this should result in cost savings at all levels.

Collaboration with DWS Resource Quality Information Services (RQIS) and Chief Directorate: Water Information Management will need to take place in this respect as the project entitled: *Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network,* has put forward the following that needs to be incorporated into this plan:

- *Training of technicians and samplers:* The maintenance and, particularly in the case of water quality, the actual monitoring/sampling is largely dependent on the capabilities of the field technicians and samplers. DWS should provide continuous practical training of field technicians and samplers to ensure consistency and accurate monitoring.

- *Expansion of quality management systems*: The Hydstra system provides tools to support quality control for surface and hydro-meteorological data. However, the need exists for the existing knowledge of auditing and error detection offered by experienced DWS specialists to be applied in quality management systems for use by all technicians and data managers. Furthermore a range of (automated) tests and associated training in interpretation of these test need to be developed to support data auditing.

6.1.1 Monitoring for metals

There is a lack of data relating to metals. A programme considering the following aspects needs to be implemented:

- Include a broader spectrum of metals at catchment level, in the Letaba and Shingwedzi sub-catchments this only needs to be included around the areas of Giyani, Tzaneen, Lebowakgomo, Letsitele, Malumulele and Nkowankowa where there may be impacts from industries and where there may be domestic use from rivers;
- The DWS/ WMI needs to enable the consolidation and upload of existing metals data from industries.

6.1.2 Microbiological Monitoring

The following aspects relating to microbiological contamination need to be implemented by the DWS/ WMI and local government structures, and are linked closely to nutrient management:

- Compliance enforcement of the microbiological standards at all WWTW;
- Routine microbiological monitoring at points downstream of WWTWs, villages and towns. It may even be an option to consider the use of microbiological kits to at least get an indication of the extent of the microbiological pollution taking place;
- Hotspot identification and communication via a GIS based information management system;
- A groundwater monitoring programme needs to be implemented to assess the impacts on groundwater around specific oxidation ponds as well as where sanitation systems, such as pit latrines, are still used, to ascertain:
    - The extent of microbiological contamination; and
    - The need for treatment of water from boreholes where water is used by communities for domestic purposes.

6.1.3 Emerging contaminants monitoring

The WMI should consider a monitoring programme at very specific sites and at specific times throughout the year to get a better understanding of water pollution from pesticide use as well as emerging contaminants, such as hormones and other pharmaceutical by-products from WWTW. This may also be in collaboration with the WRC and National Research Foundation (NRF), as well as other academic institutions such as academic institutions (SAEON, Universities, CSIR). This will allow for more detailed or novel analysis of the data that may be covered by the routine analysis. This will also allow the plan to become adaptive to bring in new technologies and analytical approaches into an important programme.

6.1.4 Regional Laboratories

It has been proposed by regional staff at several of the offices that the department should operate its own laboratories, or at least have contracts with the local laboratories. This may also help with supplying and calibration of field instrumentation. Collaboration with DWS Resource Quality Information Services (RQIS) and Chief Directorate: Water Information Management will need to take place in this respect as the project entitled: *Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network,* has put forward the following that needs to be incorporated into this plan so that the WMI ensures that it is taken forward:

- Two possible options for laboratory analysis would be considered involving either the upscaling or decentralisation of the current DWS laboratory facilities or the full outsourcing of all analyses to external laboratories.

6.1.5 Field equipment

Taking field measurements can also add valuable data. In this respect each official should be issued with field equipment that will allow them to take a measurement at any stage when in the field. The type of equipment required could include an instrument that could measure:

- Total Dissolved Solids/ Electrical Conductivity;
- pH; and
- Dissolved Oxygen.

All officials should always ensure that they have sampling equipment, such as bottles and filters when going into the field.

Microbiology kits may also be an aspect that should be considered.

6.1.6 Management Information System

A GIS based management information system needs to be developed (or the existing WMS upgraded, if feasible) to:

- Link to field instruments so that data collected is uploaded automatically;
- Link to management Measures set out in IWWMPs;
- Allow water users more access to input data, specifically related to their IWUL;
- Allow DWS and the WMI to draw data and reports from the system without having to ask the water users for a hard copy report;
- Allow water users a comparison/ snap shot of other users in the catchment;
- Ensure hotspots/ and incidents are flagged; and

- Act as an early warning system.
- Link to an app that would allow other stakeholders to upload incidents (including the location and a photograph). This will also allow a more rapid response time.

7. STAKEHOLDER ENGAGEMENT

When developing the stakeholder engagement plan that should also include the awareness campaigns, some basic questions to ask are:

- Who do you want to reach;
- What information do you want to distribute or communicate; and
- What are the most effective mechanisms to reach your stakeholders?

Developing a communication and implementation plan will help to ensure that all the important elements have been covered before starting out. The plan itself provides a blueprint for action and does not have to be lengthy or complex. The plan will be most effective when a variety of people are involved in its development. These should include:

- A communications specialist or someone who has experience in developing and implementing a communications plan;
- Technical experts in the subject matter (both scientists and policy experts, if necessary);
- Someone who represents the stakeholders (i.e. the people or groups you want to reach); and
- Key individuals who will be involved in implementing the plan.

In developing the plan, consider whether there are any other organisations to partner with - for example national and provincial departments of environmental affairs, health, mineral resources and agriculture. In addition to these strategic partners, other potential partners might include local businesses, environmental organisations, schools and associations. Partnerships can be valuable mechanisms for leveraging resources while enhancing the quality, credibility and success of communication and implementation efforts.

Developing a communication and implementation plan is a creative and iterative process that will involve a number of interrelated steps that can be revisited and refined until an integrated, comprehensive and achievable plan is realised.

8. IMPLEMENTATION MATRIX

The implementation framework to follow summarise the strategic objectives, measures and associated actions for each of the Strategic Management Areas: Domestic, Industrial, Agricultural and Recreational. The following are used for the proposed timelines:

- Short term: 0 – 3 years;
- Medium term: 3 – 5 years;
- Long term: 5 – 10 years

The timeframes do not mean that an activity should be completed, rather, that an activity should have been initiated, and the timeframes at least give the Implementing Party an opportunity to plan and budget for the activity.

Table 18: Implementation matrix for the Letaba and Shingwedzi Sub-catchments

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
Strategic Management Area: Domestic sector					
Strategic objectives: • Reduction of nutrient and sediment load from run-off from urban/ densely populated areas; • Reduction of nutrient load from domestic WWTW that discharge to the water resources which also links to reduction of microbiological contamination; • Improved reuse of effluent from domestic wastewater treatment works not designed to meet the general discharge limits; and • To get a better understanding of the contamination of groundwater from unlined oxidation pond systems and other on-site sanitation facilities and implement groundwater protection zoning, specifically in those areas where sanitation facilities have contaminated the groundwater, and groundwater is used for domestic use.					
Strategic Measure D-1: Prevent/ limit surcharging sewers					
D-1.1	Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate inspections and maintenance of sewers is undertaken;	Giyani, Tzaneen, Lebowakgomo, Letsitele, Malumulele	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-1.2	Develop and enforce by-laws for industrial users such as abattoirs, in respect of what may be disposed to sewer, to prevent blockages;		Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-1.3	Develop awareness programmes to ensure that the public are aware of the impacts that can be caused when incorrectly disposing of solid waste into sanitation systems;	All areas	Short to medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
Strategic Measure D-2: Prevent or limit erosion and sedimentation from villages and larger settlements					
D-2.1	Consider innovative ways to collect and treat storm water emanating as run-off from semi-urban areas where	All areas	Short to medium term	District/ Local Municipality in collaboration with	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	subsistence farming is common			SALGA and COGTA and relevant research institutions	
Strategic Measure D-3: Ensure adequate solid waste collection					
D-3.1	Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate solid waste collection is undertaken;	All areas	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-3.2	Develop and enforce by-laws for littering and illegal dumping;	All areas	Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-3.3	Develop awareness programmes to ensure that the public are aware of the impacts/ nuisances that can be caused when littering or dumping solid waste illegally;	All areas	Short to medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
Strategic Measure D-4: Reduce contaminated run-off from industrial areas					
D-4.1	Make financial provision and appoint adequate personnel to undertake inspections in industrial areas;	Giyani, Tzaneen, Lebowakgomo, Letsitele, Malumulele	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-4.2	Develop and enforce by-laws for industries (including car wash areas) including oil/ grease traps; adequate storm water management systems that may incorporate retention/ effluent ponds to contain dirty water;		Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-4.3	Develop awareness programmes to	All areas	Short to medium	District/ Local	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	ensure that the public are aware of the impacts that can be caused when incorrectly disposing wastewater from car wash areas;		term	Municipality in collaboration with SALGA and COGTA	
Strategic Measure D-5: Ensure compliant effluent from WWTW					
D-5.1	Make financial provision and appoint adequately skilled and unskilled personnel at the WWTW – based on DWS process controller regulations. This may require that district and local municipalities consider co-operative partnerships to regionalise a skills base;	Priority WWTW: ○ *Giyani,* ○ *Tzaneen,* ○ *Lebowakgomo,* ○ *Letsitele,* ○ *Malumulele*	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-5.2	Undertake a prioritisation exercise to assess which WWTWs are in the poorest condition and what infrastructure requirements are needed so that these can be budgeted for and relevant funding organisations approached once a plan has been set up;		Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-5.3	Assess whether the effluent is of a quality that could allow it to be used for irrigation	All oxidation pond systems should be assessed	Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-5.4	Assess lawful water use and implement directives as necessary for water use authorisation application;	All areas	Short term	WMI	Lead
D-5.5	Review existing IWULs and request amendment applications as necessary;	All WWTW	Short to medium term	WMI	Lead
D-5.6	Push for the promulgation of the Green	-	Short term	WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	Drop system as a regulation;				
D-5.7	Collaborate with COGTA and SALGA to implement the WWTW aspects of the Municipal Management Strategy;	All areas	Short to medium term	WMI	Lead
D-5.8	Undertake awareness campaigns	All areas	Short to medium term	WMI	Lead
Strategic Measure D-6: Develop a groundwater protection plan					
D-6.1	Consider strategic actions from the National Groundwater Strategy (WRC Project No. K8/1117/1)) and the WMI must be involved in the Key Deliverables roll-out over a 3 year period.	-	Short term	WMI	Lead
D-6.2	Undertake a hydrocensus of the boreholes in the area to enable mapping of aquifers that are already badly contaminated (hot spots); and aquifers where water is abstracted and used for domestic use.	All areas	Short term	WMI in collaboration with all relevant role players, including DWS, Local Government and private citizens who have boreholes	Lead
Strategic Measure D-7: Data collection					
D-7.1	Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system	Links to all sectors and must not be done in isolation for each sector, however may consider slightly different aspects for each sector	Short term	WMI in collaboration with relevant DWS directorates	Lead
Strategic Management Area: Agricultural sector					

Strategic Objectives: • Reduction of nutrient and sediment load from agricultural areas and areas where changing land uses may be occurring; • Research into the fate of pesticides that may be linked to endocrine disruption in humans and livestock; and • Research around the metals from agricultural lime					
Strategic Measure A-1: Reduce nutrient load from cultivated areas					
A-1.1	Develop Best Management Practices (BMP) for fertiliser application to ensure that over-fertilisation does not take place	All areas	Short to medium term	DoA	Support
A-1.2	Implement best management practice around buffer strips to allow some natural infiltration during rainfall events	All areas	Short to medium term	DoA	Support
Strategic Measure A-2: Implement a pesticide monitoring programme					
A-2.1	Develop and communicate a schedule of spraying as spraying is seasonal and varies in different areas of the Olifants WMA; The CMS should be notified of the schedule of spraying or at least when spraying will occur; what is being sprayed when?	Tzaneen, Giyani areas	Short to medium term	Water User Associations/ Irrigation Boards	Support
A-2.2	Meet with the South Africa National Standards Boards to discuss the concerns around generic pesticide use	-	Short term	Water User Associations/ Irrigation Boards/ DoA/ Agri SA	Support
A-2.3	Develop a monitoring programme at very specific sites and at specific times throughout the year to get a better understanding of water pollution from pesticide use.	Tzaneen, Giyani areas	Medium term	WMI in collaboration with research institutions	Lead/ support
A-2.4	Develop and implement regulations	-	Medium to long	DEA in collaboration	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	which will provide a wide range of controls and measures that include the authorisation of certain listed processes and activities that relate to chemicals management; atmospheric emission licensing; registration of agricultural remedies and chemicals, development of industrial waste management plans for certain identified industries, identification for priority waste streams; import controls and import permit requirements for certain listed products as well as the ability to implement import restrictions on certain identified products and wastes		term	with various other national and provincial departments such as Water and Sanitation and Health	
A-2.5	Develop norms and standards which include remediation standards, air quality and emission standards for listed activities and technical specifications for the management or use of certain products	-	Medium to long term	DEA in collaboration with various other national and provincial departments such as Water and Sanitation and Health	Support
A-2.6	Issue directives and compliance notices requiring that reasonable measures are taken to prevent and remedy pollution or degradation of the environment	All areas	Short term	WMI	Lead
A-2.7	Develop market based management instruments such as the water pricing strategy that should include charges for waste discharges and incentives for	-	Medium to long term	DWS in collaboration with various other national and provincial departments	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	introducing new technologies				
A-2.8	Undertake annual awareness campaigns regarding the requirements in licensing, permitting and environmental authorisation processes	All areas	Short term	WMI	Lead
Strategic Measure A-3: Implement an agricultural lime research project					
A-3.1	Implement a research programme with relevant suppliers to investigate the metals release from agricultural lime.	-	Medium term	DoA, Research Institutions (including universities)	Support
Strategic Measure A-4: Data collection					
A-4.1	Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system	Links to all sectors and must not be done in isolation for each sector, however may consider slightly different aspects for each sector	Short term	WMI in collaboration with relevant DWS directorates	Lead
Strategic Management Area: Industrial sector (and small mining areas)					
Strategic objectives: • The reduction of load due to run-off from industrial (and small mining areas) areas, including intensive animal feedlots; • Improved quality of industrial effluents discharged to sewer.					
Strategic Measure I-1: Reduce load (salinity, metals and oils and greases) from industrial waste sites					
I-1.1	Collaborate with the various industries and mines within a management unit to assess the storm water management in these areas and prioritise where biggest improvements can be made	Giyani, Tzaneen, Lebowakgomo, Letsitele, Malumulele	Short to medium term	Mines/ Industries	Support
I-1.2	Assess lawful water use and implement directives as necessary for water use	All industries	Short term	WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	authorisation application;				
I-1.3	Develop by-laws for storm water management in industrial areas (links to D-1.1 and D-1.2)		Short to medium term	Local Government	Lead
I-1.4	Implement compliance enforcement		Short to medium term	WMI	Lead
Strategic Measure I-2: Reduce nutrient load and microbiological contamination from intensive animal feedlots and abattoirs					
I-2.1	Develop Best Management Practices for regulations around intensive animal feedlots	-	Short to medium term	DoA	Support
Strategic Measure I-3: Data collection					
I-3.1	Develop a system/ use an existing system that will allow water users to submit compliance data and other relevant data electronically to a central data system	Links to all sectors and must not be done in isolation for each sector, however may consider slightly different aspects for each sector	Short to medium term	WMI in collaboration with relevant DWS directorates	Lead
Strategic Management Area: Recreational sector					
Strategic objectives: • Reduction of contaminants from recreational activities such as boating and lodge sanitation facilities					
Strategic Measure R-1: Develop Best Management Practices for recreational areas					
R-1.1	Develop Best Management Practices around cross contamination from boats moving from one dam to another and fuel/ oils contamination from boats	Tzaneen Dam, Ebenezer Dam,	Short term	DEA/ DWS	Support
Strategic Measure R-2: Reduce nutrient and microbiological contamination from riverside accommodation and facilities in dam areas					
R-2.1	Inspect to ensure relevant authorisations are in place for package waste water treatment plants/ septic tank systems on	Tzaneen Dam, Ebenezer Dam, Magoebaskloof Dam and any areas along the rivers (such as	Short to medium term	WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	the banks of rivers and dams;	Game Farms) where septic tank systems may be in place • R-2.1 to 2.4 should be undertaken simultaneously			
R-2.2	Enforce directives against non-compliance;		Short to medium term	WMI	Lead
R-2.3	Confirm adequate operation and maintenance by private individuals or lodge owners;		Short to medium term	WMI	Lead
R-2.4	Confirm designs for the number of people accommodated.		Short to medium term	WMI	Lead
Strategic Measure R-3: Data collection					
R-3.1	Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system	Links to all sectors and must not be done in isolation for each sector, however may consider slightly different aspects for each sector	Short to medium term	WMI in collaboration with relevant DWS directorates	Lead

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APPENDIX A:

PROJECT STEERING COMMITTEE MEMBERS

Title	Surname	First Name	Organisation
Mr	Atwaru	Yakeen	Department of Water and Sanitation
Mr	Bierman	Bertus	Joint Water Forum/ Lebalelo WUA
Dr	Burgess	Jo	Water Research Commission
Dr	Cogho	Vic	Glencore
Mr	Dabrowski	James	Private Consultant
Mr	De Witt	Pieter	Dept. of Agriculture, Forestry and Fisheries
Dr	Driver	Mandy	SANBI
Ms	Fakude	Barbara	DWS
Mr	Gouws	Marthinus NJ	Depart. Of Agriculture, Rural Development and Land Administration
Mr	Govender	Bashan	Dept. of Water and Sanitation
Mr	Govender	Nandha	Strategic Water Partnership Network
Mr	Grobler	Geert	Dept. of Water and Sanitation
Dr	Gyedu-Ababio	Thomas	IUCMA
Mr	Harris	James	Olifants River Forum
Mr	Hugo	Retief	AWARD
Mr	Jezewski	Witek	Dept. of Water and Sanitation
Mr	Keet	Marius	Dept. of Water and Sanitation: Gauteng
Mrs	Kobe	Lucy	Dept. of Water and Sanitation
Mr	Kruger	Dirko	Agri-SA
Ms	Kubashni	Mari	Shanduka Coal
Mr	Le Roux	Roelf	Magalies Water
Mr	Leballo	Labane	Lepelle Water
Mr	Lee	Clinton	South 32
Mr	Linstrom	Charles	Exxaro
Mr	Liphadzi	Stanley	Water Research Commission
Mr	Llanley	Simpson	DST
Mr	Mabada	Hangwani	Dept. of Water and Sanitation: Limpopo
Mr	Mabalane	Reginald	Chamber of Mines
Mr	Mabogo	Rudzani	Dept. of Mineral Resources
Mrs	Mabuda	Mpho	Dept. of Water and Sanitation
Mr	Mabuda	Livhuwani	Dept. of Water and Sanitation
Mr	Macevele	Stanford	Dept. of Water and Sanitation: Mpumalanga
Mr	Machete	Norman	Limpopo Provincial Administration
Mr	Madubane	Max	Dept. of Mineral Resources
Mr	Maduka	Mashudu	Dept. of Mineral Resources
Mr	Malinga	Neo	Dept. of Water and Sanitation
Mr	Mannya	KCM	Dept. of Agriculture, Forestry and Fisheries
Mr	Masenya	Reuben	Dept. of Mineral Resources
Ms	Maswuma	Z	Dept. of Water and Sanitation
Mr	Mathebe	Rodney	Dept. of Water and Sanitation
Ms	Mathekga	Jacqueline	Dept. of Mineral Resources
Ms	Mathey	Shirley	Dept. of Mineral Resources
Ms	Matlala	Lebogang	Dept. of Water and Sanitation
Mr	Matodzi	Bethuel	Dept. of Mineral Resources
Mr	Mboweni	Manias Bukuta	Department of Agriculture, Rural Development and Land Administration
Mr	Meintjies	Louis	National Water Forum TAU SA
Mr	Mntambo	Fanyana	Dept. of Water and Sanitation: Mpumalanga
Mr	Modipane	B J	House of Traditional Leadership

	Modjadji	N	Lepelle Water
Dr	Molwantwa	Jennifer	IUCMA
Mr	Mongwe	Victor	Dept. of Economic Development, Environment and Tourism
Mr	Moraka	William	SALGA – National
Mr	Morokane	Molefe	Dept. of Mineral Resources
Mr	Mortimer	M	Dept. of Agriculture, Fisheries and Forestry
Mr	Mosefowa	Kganetsi W	Dept. of Water and Sanitation
Ms	Mosoa	Moleboheng	Dept. of Water and Sanitation
Mr	Mphaka	Matlhodi	SANBI
Mr	Mthembu	Dumisani	Dept. of Environmental Affairs
Ms	Mudau	S	Chamber of Mines
Ms	Muhlbauer	Ritva	Anglo
Ms	Muir	Anet	Dept. of Water and Sanitation
Mr	Mulaudzi	M	Dept. of Water and Sanitation
Mr	Musekene	Lucky	Dept. of Water and Sanitation
Dr	Mwaka	Beason	Dept. of Water and Sanitation
Mr	Nditwani	Tendani	Dept. of Water and Sanitation
Ms	Nefale	Avhashoni	Dept. of Water and Sanitation
Mr	Nethononda	B	Dept. of Environmental Affairs
Mr	Nethwadzi	Phumudzo	Dept. Mineral Resources
Mr	Nico	Dooge	Glencore
Mr	Nokeri	Norman	Lepelle Water
Mr	Oberholzer	Michael	Dept. of Mineral Resources
Ms	Olivier	Dorothy	Dept. of Mineral Resources
Mr	Opperman	Nic	Agri-SA
Mr	Parrott	Brenton JS	Delmas WUA: Representing irrigators in the Upper Olifants Area
Mr	Phalandwa	Musa	Eskom
Mr	Po	Jan	Dept. of Agriculture, Fisheries and Forestry
Mr	Potgieter	Jan	National Dept. of Agriculture
Ms	Ralekoa	Wendy	DWS
Mr	Ramatsekia	Rudzani	Dept. Mineral Resources
Ms	Rammalo	Albertina	MDW
Mr	Ramovha	Matshilele	Dept. Mineral Resources
Mr	Ramphisa	Philip	Platreef Mine
Mr	Raphalalani	Israel	Dept. of Water and Sanitation
Mr	Riddel	Eddie	SANPARKS – KNP
Mr	Roman	Henry	DST
Mr	Rossouw	Ossie	Lebalelo WUA
Mr	Schmahl	Carel	Lepelle Water
Mr	Selepe	Marcus	IUCMA
Mrs	Shai	Caroline	Dept. of Water and Sanitation
Dr	Sharon	Pollard	Award
Ms	Shaw	Vicki	Mine Water Coordinating Body (MWCB)
Ms	Sigwaza	Thoko	Dept. of Water and Sanitation
Ms	Sinthumule	Ethel	Dept. of Mineral Resources
Ms	Sithole	Nelisiwe	Mpumalanga Provincial Department of Agriculture
Ms	Skosana	M	Dept. of Water and Sanitation
Mr	Stephinah	Mudau	Chamber of Mines
Mr	Surendra	Anesh	Eskom
Mr	Surmon	Mark	Palabora Mining Company
Mr	Tloubatla	L	Dept. of Water and Sanitation

Mr	Tshivhandekano	Aubrey	Dept. of Mineral Resources
Mr	Tshukudu	Rabeng	Mpumalanga Provincial Government
Ms	Ugwu	Phindile	DMR
Mr	Van Aswegen	Johann	Dept. of Water and Sanitation
Mr	Van Den Berg	Ockie	Dept. of Water and Sanitation
Mr	Van der Merwe	Alwyn	Eskom
Mr	Van Niekerk	Peter	Dept. of Water and Sanitation
Mr	Van Rooyen	Marius	Mpumalanga Provincial Department of Agriculture
Mr	Van Stryp	Johan	Loskop Irrigation Board: representing irrigators in the Middle Olifants Area
Mr	Van Vuuren	Jurie	Lower Blyde WUA: representing irrigators in the Lower Olifants Area
Mr	Venter	Jacques	SANPARKS – KNP
Mr	Viljoen	Pieter	Dept. of Water and Sanitation
Ms	Willard	Candice	DST
Ms	Zokufa	T	Dept. of Water and Sanitation

APPENDIX B:

STAKEHOLDERS WHO CONTRIBUTED TO THE SUB-CATCHMENT WORKSHOPS

Name	**Organisation**
Adivhaho Rambuda	DWS, Bronkhorstpruit
Adolph Maredi	DWS
Alistair Collier	Olifants Joint Water Forum
Alta van Dyk	Lonmin Akanani
André Venter	Letaba Water User Association
Aneshia Sohan	Sasol
Angelika Möhr	SRK
Anna-Manth	OFF (MCCI)
Ansia de Jager	JWF
Avhafuni Ratombo	DWS, Bronkhorstspruit
Avril Owens	SRK
Ayanda Mtatwa	DWS: MWM
Betty Marhaneleh	LDARD: Mopani
Betty Nguni	DWS
Bongani Mtzweni	Samancor
Brenda Lundie	Sasol Satellite Operations
Cara	Kungwini Wise
Carina Koelman	DARDLEA
Caroline Shai	DWS, Compliance
Cecilia Mkhatshwa	City of Tshwane
Celiwe Ntuli	DWS
Charles Linström	Exxaro
Charlotte Khoza	Lepelle Northern Water
Christo Louw	DWS
Craig Zinn	Mpumamanzi Group
Danny Talhami	Clover Hill Club Share block
David Paila	Glencore Lion
Dayton Tangwi	DWS
Decia Matumba	SALGA
Derrick Netshitungulu	Nkwe Platinum
Dr James Meyer	Topigs SA
Eben Ferreira	Keaton Energy Mining Vanggatfontein Colliery Delmas
Eddie Ridell	KNP
Edwin Mamega	DAFF
Elmien Webb	Glencore
Emile Corradie	Bosveld Phosphate
Faith Mugivhi	ASA Metals/ Dilokong Chrome Mine
Farah Adams	Golder Associates Africa
Gavin Tennant	Agri-Letaba
Geert Grobler	DWS

Gloria Moloto	DWS, Bronkhorstspruit
Gloria Sambo	Agriculture
Heather Booysen	Samancor
Hugo Retief	AWARD
Imani Munyai	Wescoal Mining
Jakes Louw	Joint Water Forum
James Ndou	Modikwa Platinum Mine
Jan de Klerk	Sasol
Jaques Venter	SANparks
Jerry Penyene	AFASA
Johan van Stryp	Loskop Water Forum
Johanes Mathungene	LEPELLE/ farmer
Johann van Aswegen	DWS, Planning and technical support
Johannes Senyane	Two Rivers Platinum Mine
John Gearg	Wescoal/JKC
Joseph Phasha	DWS, Compliance
Kamo Meso	DWS
Karabo Motene	Glencore Mototolo Platinum Mine
Kerry Beamish	Rand Carbide
Kgaowelo Moshokwa	Anglo American Coal- Goedehoop Colliery
L.D Mutshaine	DWS: MWM
Leah Muoetha	Lepelle Northern Water
Lebo Mosoa	DWS
Lebohang Sebola	Lepelle Northern Water
Lee Boyd	Golder Associates Africa
Lee-Ann Ryan-Beeming	Glencore Eastern Chrome Mines
Lerato Maesela	LEDET
Linda Desmet	Palabora Mining Company
Love Shabane	DAFF
Lucas Masango	Private
Lulu Moya	Greater Giyani Municipality
M.S Makuwa	LEDET
Mahlakoane Foletji	DAFF: LUSM
Marcia Mofokeng	DWS: Letaba CMF
Marie Helm	DA Councillor, Mopani District Municipality
Martha Mokonyane	Mbuyelo Group (Pty)Ltd (Vlakvarkfontein and Rirhandzu Collieries)
Mashweu Matsiela	Industrial Development Corporation
Mathabo Kgosana	DWS, Planning and technical support
Michelle Proenca	GS Schoonbee Estates
Mologadi Mpahlele	Mbuyelo Group (Pty)Ltd (Vlakvarkfontein and Rirhandzu Collieries)
Moses Sithole	SBBC
Movwape Ntchabeleng	DAFF
Mpho Makgatha	Steve Tshwete Local Municipality

Musa Lubambo	DWS, Bronkhorstspruit
Ndwamato Ramabulama	DAFF
Nico Dooge	Glencore
Nnzumbeni Tshikalange	DWS
Nomathemba Mazwi	Resource Protection and Waste
Nonceba Noqayi	DWS, Mbombela
Nonki Lodi	AFASA
P.K Dzambuken	DWS: Tzaneen
Palo Kgasago	DAFF
Percy Ratombo	DWS
Phillemon Mphahlele	Municipal Health Services
Phuti Mabotha	LEDET
Pieter Pretorius	Loskop Irrigation Board
Pieter Viljoen	DWS
Portia Munyai	DWS
Pumale Nkuna	DWS:Mpumda
Raisibe Morudu	Thembisile Hani LM
Ramasenya Meso	DWS
Reginah Kganyago	DWS
Resenga Shibambo	DWS, Enforcement
Reynie Reyneke	EXXARO
Robert Davel	Mpumalanga Agriculture (provincial affiliate Agri SA)
Sabelo Mamba	Small Enterprise Finance Agency
Sakhi Mamashole	FOSKOR
Sakhile Mndaweni	DWS, National Office
Salome Sathekge	Polokwane Municipality
Siboniso Mkhaliphi	DWS
Simon Moewg	NEPRO
Solomon Tshikovhele	DWS: HO
Stanford Macevele	DWS: MP
Stephan Kitching	Wescoal Processing
Steven Friswell	Clover Hill Club Share block
Tanya Botha	Evraz Highveld
Tendani Nditwani	DWS: NWRP
Thabiso Mpahlele	Lepelle Northern Water
Thia Oberholzer	Evraz Highveld
Thomas Napo	LDARD
Timothy Marobane	Steelpoort Business Bridge Chamber
Tintswalo Ndleve	DEA (NRM)
Tony Bowers	Mpumamanzi Group cc
Tshepo Magongwoto	LEDET
Tshidi Mamotja	Department Environmental Affairs
Vinesh Dilsook	Anglo American Platinum

Wilna Wepener	Lonmin Akanani
Zama Ramokgadi	Tubatse Chrome
Zonke Miya	Mpumamanzi Group cc