Report Number 8

Edition 1

PLAN

Integrated Water Quality Management Plan for the Olifants River System

Middle Olifants Sub-catchment Plan

Edition 1

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

Middle Olifants Sub-catchment Plan

Study Report No. 8

P WMA 04/B50/00/8916/9

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Tel: (012) 336 7500/ +27 12 336 7500
Fax: (012) 336 6731/ +27 12 336 6731

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APPROVAL

Title: Development of an Integrated Water Quality Management Plan for the Olifants River System: **Middle Olifants Sub-catchment Plan**

Authors:	Lee Boyd, Farah Adams, Tracy Reddy, Derek Weston; Reviewer: Trevor Coleman
Reviewers:	Project Management Committee
Lead PSP:	Golder Associates Africa
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Approved for Golder Associates Africa by:

Lee Boyd
Project Manager

Trevor Coleman
Project Leader

Approved for the Department of Water and Sanitation by:

Moleboheng W. Mosoa
Project Manager:

Pieter Viljoen
Project Leader

Dr Beason Mwaka
Director: Water Resources Planning Systems

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Project Administration Committee (PAC)

Pieter Viljoen (Chair)	WRPS: WQP	DWS Project Leader
MW (Lebo) Mosoa	WRPS: WQP (North)	DWS Project Manager
Geert Grobler	WRPS: WQP	DWS
Trevor Coleman	Golder Associates Africa	Project Leader
Lee Boyd	Golder Associates Africa	Project Manager
Priya Moodley	Golder Associates Africa	Project co-ordinator
Antoinette Pietersen	Golder Associates Africa	Stakeholder Engagement Specialist
Farah Adams	Golder Associates Africa	Project administration and stakeholder engagement
Project Management Committee (PMC)		
Pieter Viljoen (Chair)	WRPS: WQP	DWS Project Leader
MW (Lebo) Mosoa	WRPS: WQP (North)	DWS Project Manager
Geert Grobler	WRPS: WQP	DWS
Trevor Coleman	Golder Associates Africa	Project Leader
Lee Boyd	Golder Associates Africa	Project Manager
Antoinette Pietersen	Golder Associates Africa	Stakeholder Engagement Specialist
Sakhile Mndaweni	WRPS: IHP	DWS
Celiwe Ntuli	WRPS: SO	DWS
Rodrick (Rod) Schwab	WRPS: EES	DWS
Tendani Nditwani	NWP: North	DWS
Witek Jezewski	NWP: North	DWS
Ockie Van Den Berg	OA: North	DWS
Smangele Mgquba	Climate change	DWS
Stanford Macevele	Mpumalanga (Bronkhorstspruit)	DWS
Marcia Malapane	Mpumalanga (Lydenburg)	DWS
Maditsietsi Moloto	Mpumalanga (Bronkhorstspruit)	DWS
Johann Van Aswegen	BHT-Province	DWS
Wendy Ralekoa	DWS	DWS
Barbara Weston	WE (Reserve)	DWS
Gladys Makhado	WE (Reserve- Project manager)	DWS
Boitumelo Sejamoholo	WE (RQO)	DWS
Solomon Makate	WSR: Green Drop	DWS
Willy Mosefowa	Resource Protection and Waste	DWS
Felicia Nemathaga	Resource Protection and Waste	DWS
Bashan Govender	PMU: Mine	DWS
Senzo Nyathikazi	PMU: Mine	DWS
Muthraparsad Namisha	CM (industry)	DWS
Sibusiso Mkhaliphi	CM (Agriculture)	DWS
Phillemon R Shibambo	Compliance and Enforcement	DWS
Innocent Mashatja	Compliance and Enforcement	DWS
Gerhard Cilliers	Resource Quality Services	DWS
Sebastian Jooste	Resource Quality Services	DWS
Kobus Pretorius	National Infrastructure Branch	DWS
Martha Komape	Limpopo Province	DWS

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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 Middle Olifants sub-catchment 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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AIP	Alien Invasive Plants
AMD	Acid Mine Drainage
BWPCP	Brugspruit Water Pollution Control Plant
CAIA	Chemical Allied Industry Association
COGTA	Co-operative Governance and Traditional Affairs
CMF	Catchment Management Forum
CSIR	Council for 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	Optimum Water Reclamation Plant
PAA	Protected Areas Act
PAC	Project Administrative Committee
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 originates at Trichardt, east of Johannesburg, and flows through to the Kruger National Park. The Letaba River, drained by the Groot Letaba River with its major tributaries being the Klein Letaba, Middle Letaba, Letsitele and Molototsi rivers, joins the Olifants River upstream of the border into Mozambique. Thereafter the Olifants joins the Limpopo River before discharging into the Indian Ocean. The Shingwidzi River flows through the Kruger National Park becoming the Rio Shingwidzi in Mozambique.

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 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.

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.

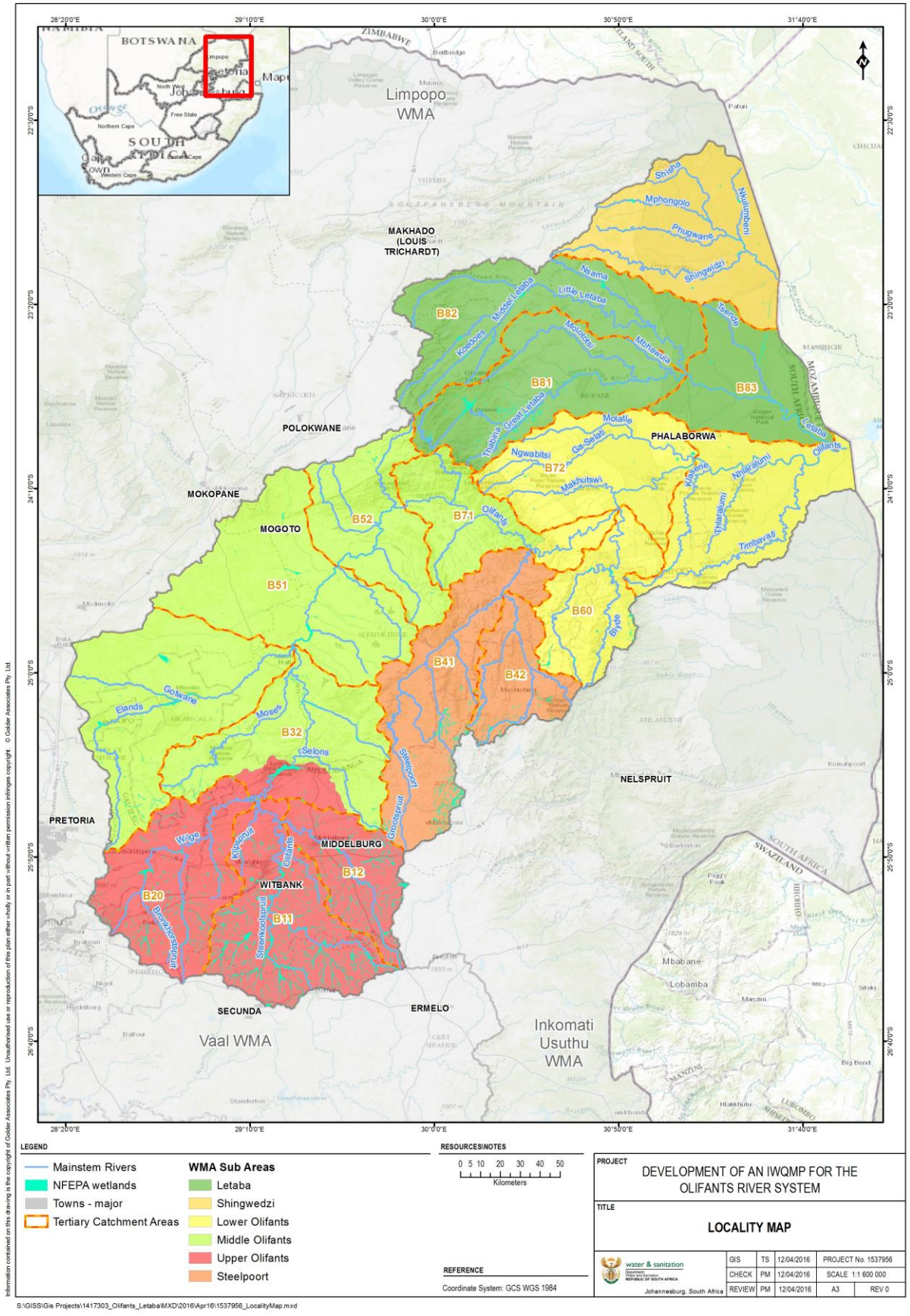


Figure 1: Study Area

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 Middle Olifants sub-catchment 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.

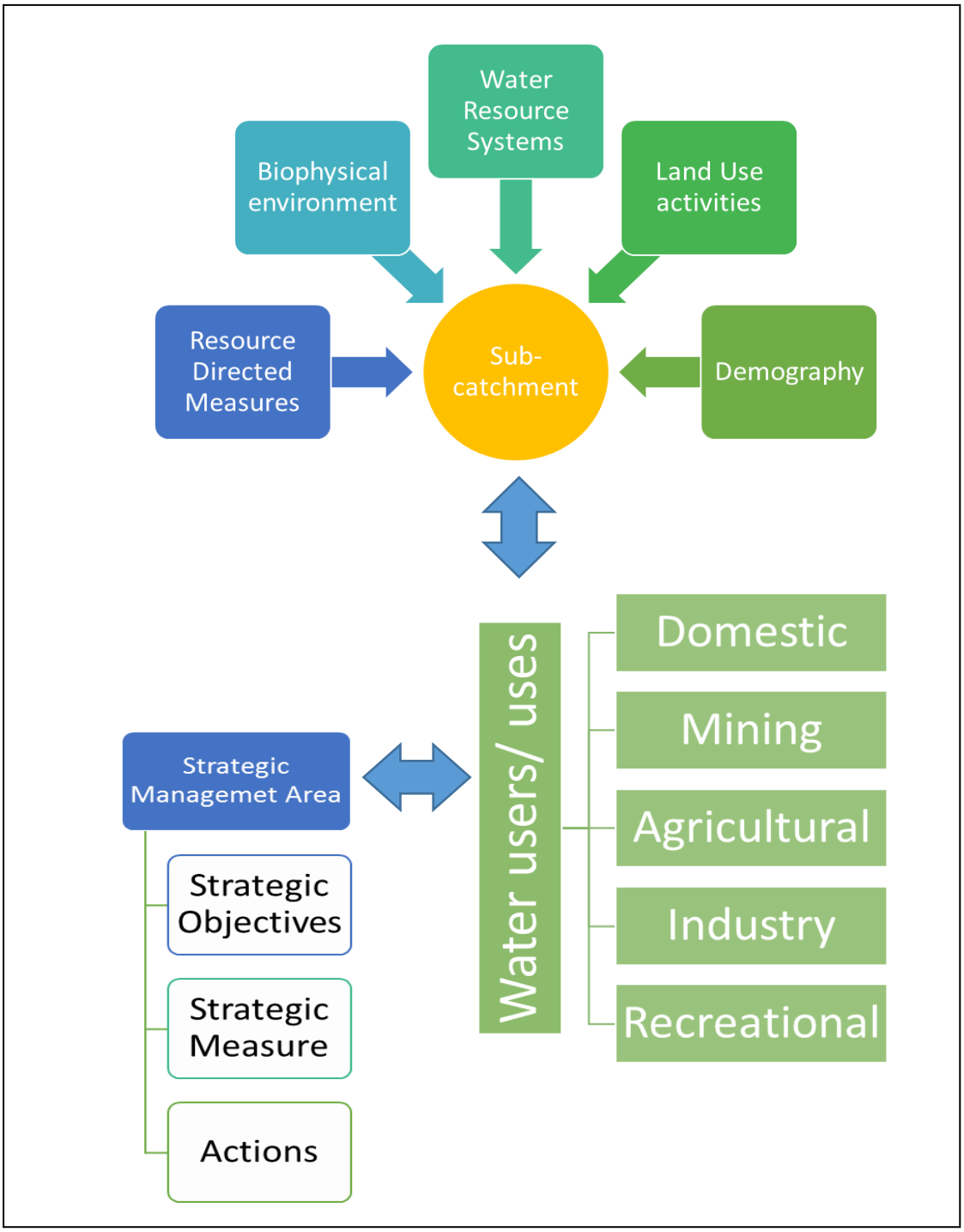


Figure 2: Sub-catchment IWQMP layout

2. SUB-CATCHMENT DESCRIPTION

This chapter gives a brief background to the Middle Olifants sub-catchment, 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

The Middle Olifants sub-catchment covers an area of 22 791 km2, the largest area in the WMA. There are no metropolitan areas situated in the area however it includes the larger towns of Cullinan, Kwamhlanga, Marble Hall, Groblersdal and Roedtan and the Local Municipalities of Polokwane, Lepelle-Nkumpi, Fetakgomo and Makhuduthamaga.

Several rural townships are also located in the area including Lebowakgomo, Burgersfort, Lydenburg and Belfast and numerous settlements that fall within the municipal boundaries.

The Middle Olifants River flows through the Middleveld region which is also known as the Springbok Flats and ends in the mountainous region of the Drakensberg. Rainfall on the Springbok Flats does not make a significant contribution to the surface water resources of the Olifants River.

The region between Loskop Dam and the Tuduma River downstream of Flag Boshielo Dam falls within 'The Bushveld Complex' and is dominated overwhelmingly by the Rashoop Granophyre Suite and Lebowa Granite Suite subdivisions of the Bushveld Complex (Cawthorn et al., 2006). There are also elements of the Pretoria Group (Martini et al., 2001). The most prominent rock types in the region are: mudrock, quarzitic sandstone, ironstone, quartzite and feldspar. The Bushveld Complex is economically important as according to Cawthorn et al. (2006) the Bushveld Complex contains some of the largest deposits of major mineral deposits: the platinum group elements, chromium, vanadium, fluorite andelusite with base and precious metals including tin, copper, silver and gold as well as dimension stone (gabbro, norite and granite) (Cawthorn et al., 2006).

The Middle Olifants falls within the Savannah Biome which usually has an herbaceous layer dominated by grass with a discontinuous or open tree layer.

Rainfall is strongly seasonal and falls mainly in summer. The mean annual temperature ranges between 14°C in the southwest to more than 22°C in the north. Maximum temperatures are usually experienced in January and minimum temperatures occur on average in July. It is a summer rainfall area (October to March) with peak rainfall in January and February, generally as thunderstorms. The mean annual precipitation (MAP) ranges between 500 and 800 mm. Evaporation generally exceeds precipitation and can be as high as 2 000 mm on the Springbokvlakte.

2.2 Water Resource Systems

The Flag Boshielo Dam, the Bloed, Klipspruit and Grass Valley Rivers are located in this catchment. Several protected areas occur within the catchment and include Mbusa, Moutse, Kwaggavoetpad and Schuinsdraai Nature Reserves.

The MAR for the Middel Olifants catchment is 481 Mm^3/a. Major tributaries are the Selons River, Moses River, Bloed River and the Elands River, confluencing with the Olifants River upstream of the Flag Boshielo Dam. Downstream of the dam there are a number of small tributaries that enter the Olifants River.

The major dams in the catchment include the Rust de Winter Dam, Rhenosterkop Dam, Rooikraal Dam (in Bloed River) and the Flag Boshielo Dam. Many smaller farm dams are also found in the area. The major dams have a combined capacity of 143 Mm^3 and a firm yield of 69.5 Mm^3/a. The combined capacity of small and minor dams in the catchment is 3.4 Mm^3.

The Middle Olifants sub-catchment comprises 5 main catchment areas listed in Table 1.

Table 1: Middle Olifants sub-catchment areas

Sub-Catchment	Sub-catchment areas with main river	Quaternary catchments	Gross area (km^2)
Middle Olifants	Olifants River	B32 A - J	4 293 km^2
	Elands/ Moses Rivers	B31 A - H	6 148 km^2
	Olifants River	B51 A- H	6 170 km^2
	Olifants River	B52 A - H	3 558 km^2
	Olifants River	B71 A - F	2 622 km^2

Large dams in the Middle Olifants sub-catchment are listed in Table 2. In addition to the yield of the major dams listed there are a large number of farm dams in the Olifants River catchment that contribute to the yield of the system (DWS, 2011).

Table 2: Large dams in the Middle Olifants sub-catchment (DWS, 2011)

Name	Full supply capacity (million m^3)	Historic firm yield (million m^3)	1:50 Year Yield (million m^3)
Flag Boshielo	1 788	53.0	56.0
De Hoop	347.4	65.0	66.0*
Buffelskloof	5.4	14.7	14.7
Der Bruchen	9.0	8.3	8.3
Belfast	5.5	5.7	5.7
Lydenburg	1.1	2.5	2.5

***** *After meeting the EWR water requirements. The yield of De Hoop Dam reduces from 99 million m3/a to 66 million m3/a as a result of the EWR requirements*

	Full supply capacity of minor dams	**Yield of farm dams and run-of river**
Small dams	60	71

The Flag Boshielo Dam supplies downstream users which include the platinum and chrome mines, agriculture, domestic use and the transfer of water from the Olifants WMA to Polokwane in the Limpopo WMA. Effluent is transferred from Polokwane to mines near Mogalakwena. This volume represents an additional source that remains in the Middle Olifants which has been included as a transfer in since this volume would otherwise have flowed out of the area.

The water entering the Middle Olifants through the Loskop Dam includes a large contribution from return flows from the municipal wastewater treatment works (WWTW) serving eMalahaleni and Steve Tshwete Local Municipal areas and excess mine water from mines in the Upper Olifants sub-catchment, the quality of which is not always acceptable.

2.3 Resource Directed Measures (RDM)

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.

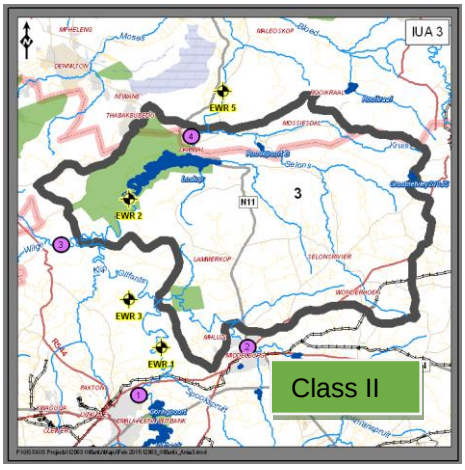
The Reserve for the Olifants WMA has been determined (DWS, 2016) and will be gazetted later in 2017. There are four Ecological Water Requirement (EWR) sites in the Middle Olifants sub-catchment (Table 3): EWR 2, 5, 6, 7 and 8.

Table 3: Summary of EWR sites in the Middle Olifants (DWS, 2016)

EWR site	River	Quaternary	Notes
Olifants_EWR5	Olifants	B32D	• Downstream from the confluence of the Selons River
Olifants_EWR6	Elands	B31G	• Downstream of the Rhenosterkop Dam and Mkombo Nature Reserve
Olifants_EWR7	Olifants	B51G	• Downstream Flag Boshielo Dam • Settlements
Olifants_S10 (EWR8)	Olifants	B71D	• Downstream of the Flag Boshielo Dam below the confluence with the Mohlapitse River • settlements • High silt

Classification

The Middle Olifants sub-catchment was divided into Integrated Units of Analysis (IUA) and include a portion of IUA 3 (Selons River area including Loskop Dam), IUA 4 (Elands River catchment area), IUA 5 (Middle Olifants up to Flag Boshielo Dam), IUA 7 (Middle Olifants below Flag Boshielo Dam to upstream of Steelpoort River).



The ecological state of Lower Klein Olifants, Selons, and Loskop Dam water resources have been degraded (C to B category), mainly due to the upstream impacts from the Olifants and Klein Olifants. However, the presence of unproclaimed wilderness areas and nature reserves provides habitats for the various biota in the system that gives it a high ecological importance.

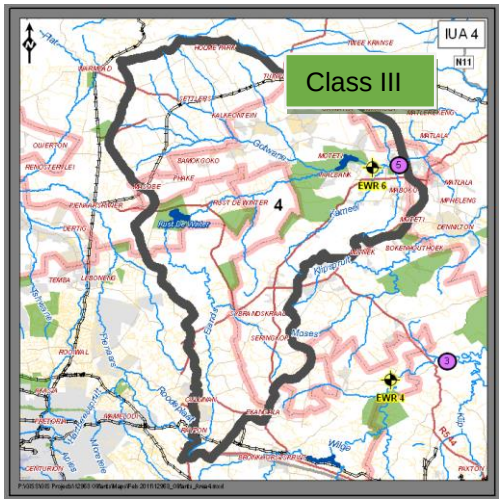
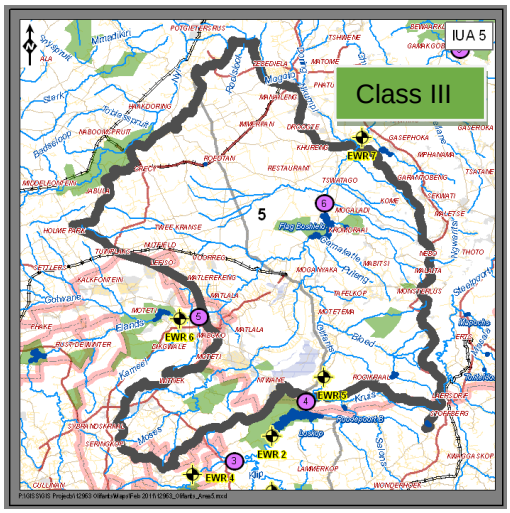
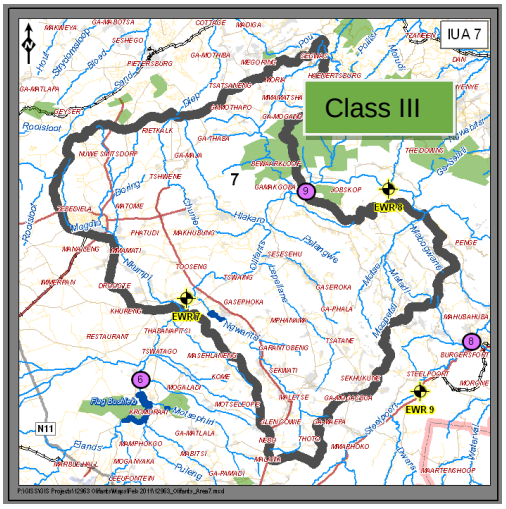
	The Elands River is mainly rural in the upper reaches with impacts from agriculture, dams and settlements in the lower reaches of the catchment. The upper reaches are still in a very good ecological state (B category), but degraded along the river to a D category below the dams. Moderate important system as it provides good habitats for the biota present. Some conservation areas are present in this IUA. An EWR site (EWR 6) on the Elands is situated below Mkhombo Dam.
	The Olifants River below Loskop Dam, Lower Elands and the Moses River are ecologically mainly in a C category as the upstream impacts (mainly water quality related) are somewhat mitigated by Loskop Dam. The ecological importance is moderate with a few conservation areas present. The EWR site is situated below Loskop Dam on the Olifants.
	The ecological importance of the main stem Olifants and smaller tributary systems is this IUA is low to moderate, especially for some of the tributaries. The present state of the main stem is in an E category that is mainly due to agricultural impacts. One EWR site below Flag Boshielo Dam is situated in this IUA.

Figure 3: Classification and brief ecological description of the IUAs for the Middle Olifants sub-catchment (DWS, 2013)

Resource Quality Objectives

RQOs have been determined and gazetted (GN 39943, April 2016) for the Olifants WMA. The RQOs (water quality component) set for the Middle Olifants are captured in

Table **4**. The monitoring points are located at the outlet of quaternary catchment: B32C and outlet of Loskop Dam.

Table 4: RQOs for Middle Olifants - water quality component

Variable	Units	Bound	Olifants B32C Bottom of quat, outlet)	Loskop Dam outlet
Chloride (Cl)	mg/l	Upper		
Total Dissolved Solids	mg/l	Upper		
Electrical Conductivity	mS/m	Upper	111	85
Sulphate	mg/l	Upper	500	200
pH	units	Upper		
Phosphate	mg/l P	Upper		0.025
Nitrate-Nitrite	mg/l N	Upper		4
Total Inorganic Nitrogen	mg/l			1
Ammonia	mg/l N	Upper		
Chl-*a* phytoplankton	µg/l	Upper		20
Alkalinity	mg/l ($CaCO_3$)	Upper	60	
Turbidity	NTU	Upper		
Dissolved oxygen	mg/l	Upper	4	
Temperature		Upper	≤abs (dev from ambient) 4.0	
Suspended Solids	mg/l	Upper		
Fluoride	mg/l	Upper	3	2.5
Aluminium	mg/l	Upper	0.15	0.105
Arsenic	mg/l	Upper	0.13	0.095
Cadmium (hard)	µg/l	Upper	5	3
Chromium (VI)	µg/l	Upper	200	121
Copper (hard)	µg/l	Upper	8	6
Mercury	µg/l	Upper	1.7	0.97
Manganese	mg/l	Upper	1.3	0.99
Lead hard	µg/l	Upper	13	9.5
Selenium	mg/l	Upper	0.03	0.022
Zinc	µg/l	Upper	36	25.2
Chlorine	ug/l	Upper	5.0 free Cl	3.1 free Cl
Endosulfan	ug/l	Upper	0.2	
Atrazine	ug/l	Upper	100	

Variable	Units	Bound	Olifants B32C Bottom of quat, outlet)	Loskop Dam outlet
Pathogens	counts/ 100ml *E. coli*	Upper		

2.4 Demography

The Middle-Olifants Sub-catchment has the largest population of all sub-catchments in the Olifants with approximately 1.7 Million people (1 771 163). The population densities increase around the towns and settlements of Kwaggafontein, Jane Furse, Vlaklaagte and Siyabuswa (

Figure 4). 98% of the residing population are black and Sepedi is spoken by 63% of the population with IsiNdebele being spoken by 18% (Census 2011).

The economy is characterised by some intensive irrigation agriculture (specifically around Marble Hall and Groblersdal), commercial dryland agriculture (in the Springbok Flats region), some subsistence agriculture and limited platinum mining as well as light manufacturing and tourism. Pasture is the most common crop type, followed by maize. High value crops include citrus and grapes.

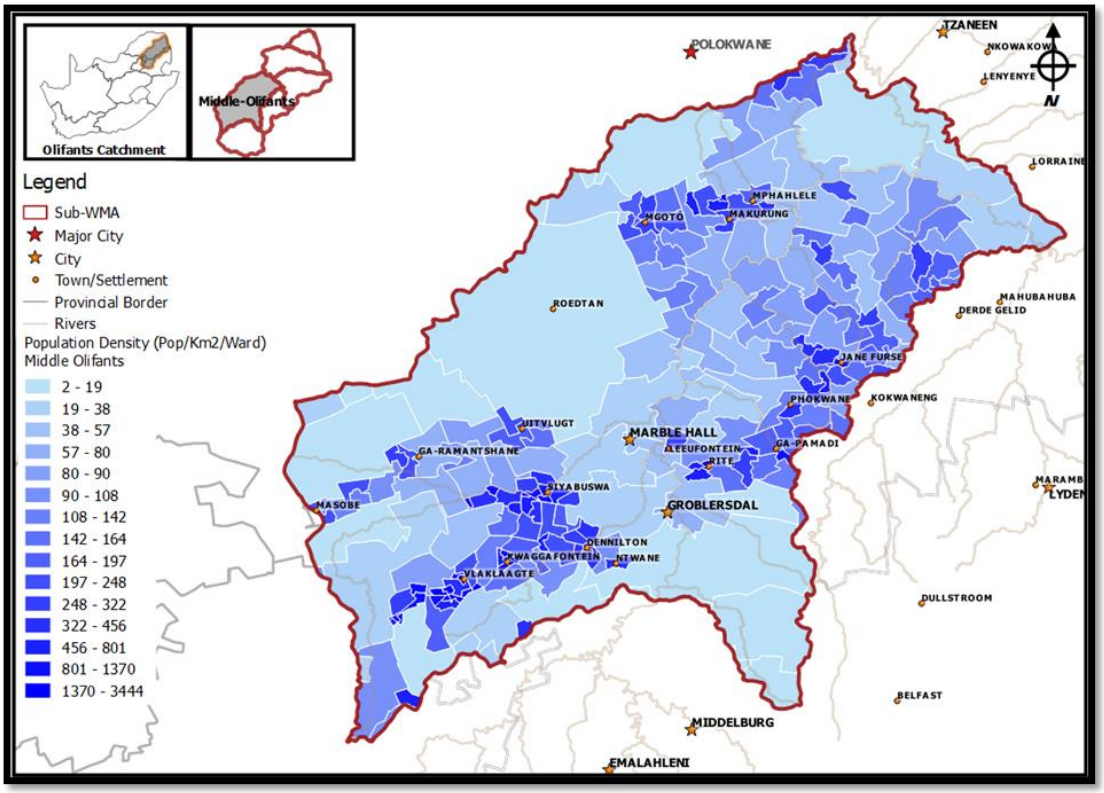


Figure 4: Population density (pop/Ha) by ward in the Middle Olifants sub-catchment (Census 2011)

The majority of households reside within brick and concrete structures (87%) (Figure 5), most of which have access to piped water (within their homes, in their yards or within 200 m) (Figure 7). A relatively large proportion (18%) has no access to piped water whatsoever. 83% of households use pit latrines as toilets (Figure 6). The source of water used comes mostly from regional and local water schemes (65%) and boreholes (14%) while 7% of households get their water from natural sources such as rivers and streams (Figure 8).

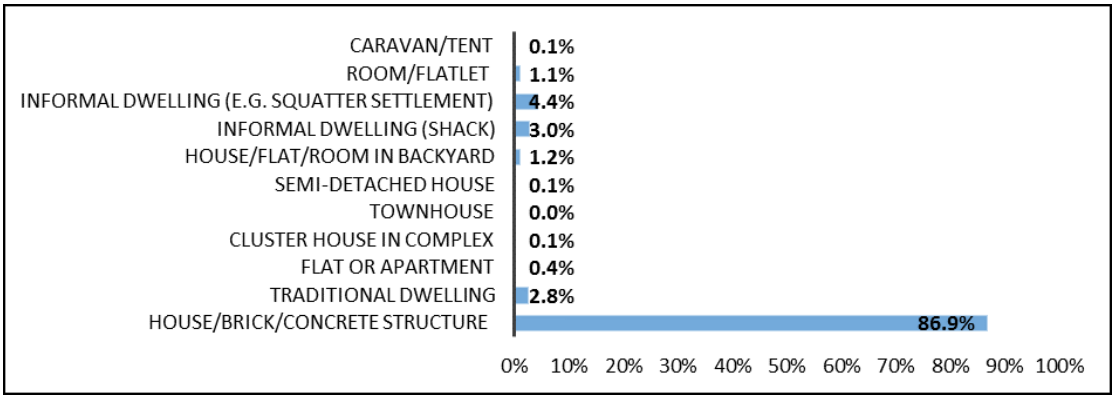


Figure 5: Dwelling demographic of the Middle Olifants sub-catchment (Census 2011)

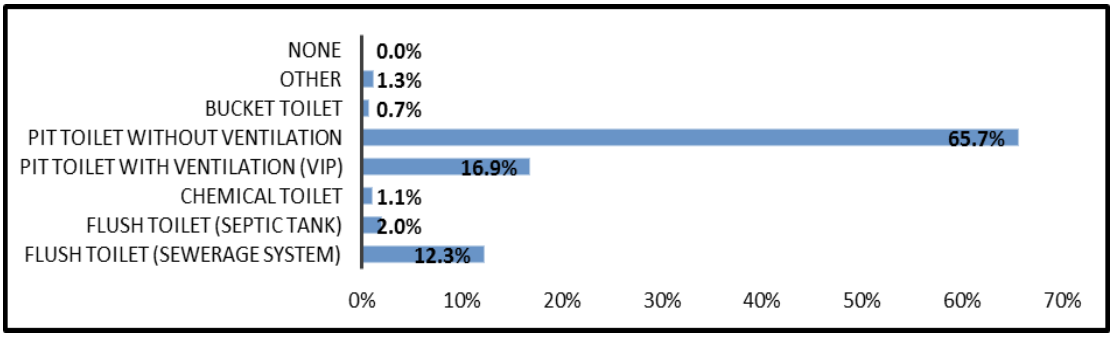


Figure 6: Toilet system demographic in the Middle Olifants sub-catchment (Census 2011)

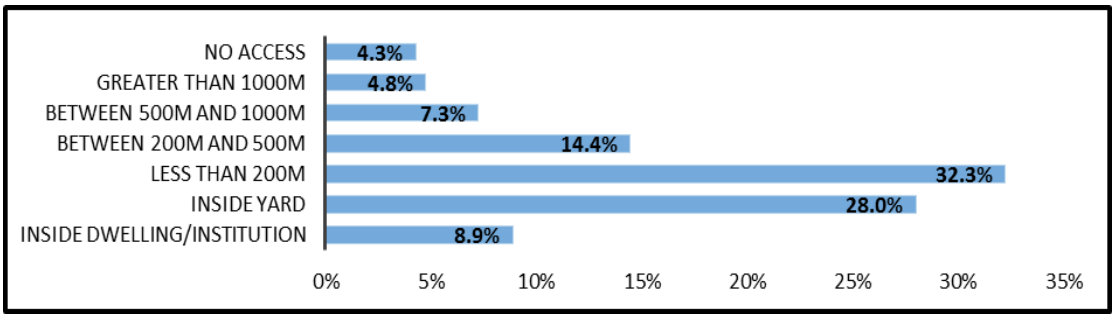


Figure 7: Water access demographic of households in the Middle-Olifants Sub-Catchment (Census 2011)

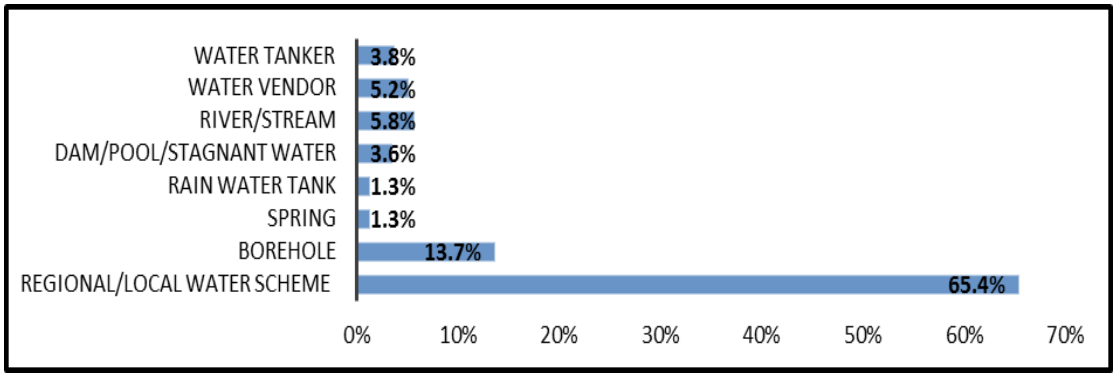


Figure 8: Source of water of households in the Middle-Olifants Sub-Catchment (Census 2011)

2.5 Land use activities

Land use in the Middle Olifants is characterised by scattered rural settlements located in the Elands River catchment and extensive agriculture practised in the irrigation schemes drawing water from the Loskop Dam and the Olifants River (

Figure **9**). The major towns in the lower part are Groblersdal, Marble Hall and the urban settlements located in the Western Highveld area of the Elands River catchment.

The irrigation sector is by far the largest water user in the Olifants River catchment, and particularly the Middle Olifants sub-catchment with an estimated requirement of 486 million m^3/a (adjusted to 98% assurance of supply), comprising 48% of the water requirements within the Olifants catchment.

Dryland crops (maize and wheat) are cultivated on approximately 1 500 km^2. Severe land degradation is experienced in the Middle Olifants sub-area. The main agricultural activities are maize and wheat.

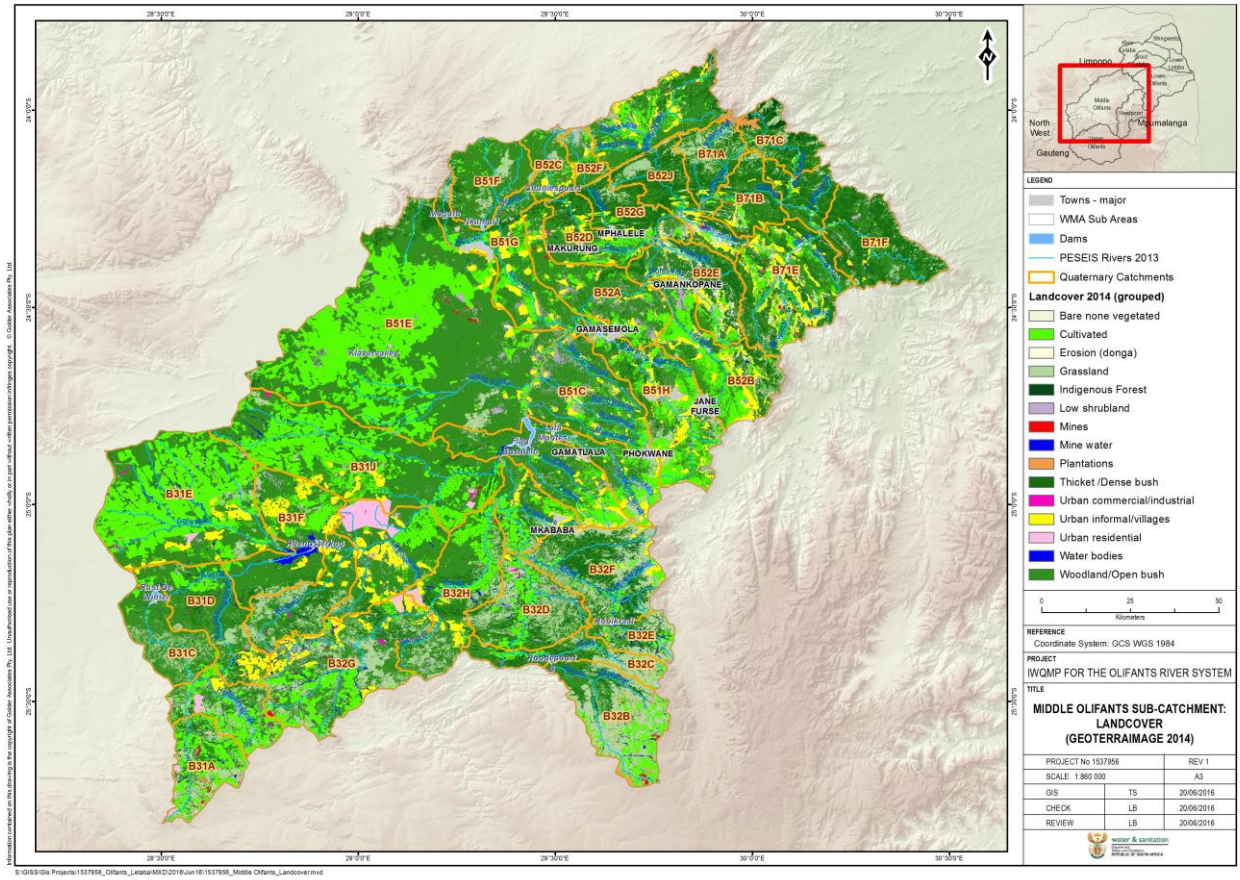


Figure 9: Map illustrating the land use activities in the Middle Olifants sub-catchment

3. FITNESS FOR USE OF WATER IN THE MIDDLE OLIFANTS SUB-CATCHMENT

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 compliance was undertaken. Figure 10 shows the compliance of 95% data for total dissolved solids/ electrical conductivity, pH, sulphate, ortho-phosphate, ammonia, chloride and magnesium.

In the Middle Olifants, the pH is for the most part in the acceptable range of 6.5 to 8.4, with non-compliances being on the upper limits.

There are concerns around several of the management units that are considerably higher in salts than allowed for in the RQOs. These include the two management units (MU 34 and 38) immediately downstream of Loskop Dam as well as MU 36 (Elands River) where it appears that there are considerable impacts from irrigated lands and limited mining in the Marble Hall area. Downstream of this area in the rest of the Middle Olifants sub-catchment there is very limited data and additional monitoring points may be required.

Therefore while the salinity decreases dramatically, there are still some increasing trends that need to be halted, coming from Loskop Dam as well as the Moses and Elands tributaries. In addition, an important consideration is that the downstream irrigators need to comply with strict chemical, physical and microbiological water quality for export requirements. Higher salinity would also imply that subsistence farmers irrigating from the river would have poorer yields. The impact of using any remaining assimilative capacity could therefore have serious economic implications for the area. The Flag Boshielo Dam is bounded by the Schuinsdraai Nature Reserve declared in March 1993 and designated as such under the PAA. The TDS and chloride at this point are elevated above the proposed WQPL.

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 5 shows the compliance of 95 percentile data 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 is red. 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.

Table 5: Compliance of 95 percentile data against WQPL

Management Unit		Middle Olifants														
		32	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**
Calcium (dissolved)	mg/L	36.64	nd	53.99	13.6	108.93	nd	51.76	82.75	nd	nd	90.1	90.1	41.65	nd	nd
Chloride (dissolved)	mg/L	18.86		41.92	25.82	276.12		67.97	86.1			70.4	70.4	61.8		
Total Dissolved Solids	mg/L	328.91		618.76	207.93	1179.49		837	774.45			785.37	785.37	481		
Electrical Conductivity	mS/m	50.1		82.42	30.95	249.4		112.05	92.32			95.76	95.76	74.12		
Fluoride (dissolved)	mg/L	0.46		1.83	1.4	1.87		1.36	4.93			0.2	0.2	0.54		
Potassium (dissolved)	mg/L	5.92		4.41	6.74	11.82		7.05	3.84			2.36	2.36	4.47		
Magnesium (dissolved)	mg/L	21.04		40.15	5.89	112.91		39.71	84.5			405	405	40.39		
Sodium (dissolved)	mg/L	29.59		66.32	34.4	224.62		147.92	203.5			58.64	58.64	54.25		
Ammonia (unionised)	mg/L	0.3		0.12	0.08	0.14		0.12	1.05			2.81	2.81	2.79		
Nitrate	mg/L	0.54		1.94	0.4	1.58		1.04	0.61			2.44	2.44			
pH	mg/L	8.2		8.17	8.26	8.61		8.53	8.59			8.8	8.8	8.36		
Ortho-phosphate	mg/L	0.04		0.69	0.05	0.09		0.06	1			1.01	1.01	0.33		
Sulphate (dissolved)	mg/L	146.42		146.15	17.16	294.88		129.3	129.3			20.26	20.26	82.06		
Total Alkalinity	mg/L	72.29		227.56	93.76	295.29		384.5	384			521.1	521.1	177.32		

Non-compliant against the WQPL

Meets WQPL

Table 6 shows the compliance of the 95% data 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 11.

Table 6: Compliance of present data vs WQPL for TDS in the Middle Olifants MUs

MU	Main river/ tributary	TDS (mg/L) 95%	Load (kg/d)	WQPL	Load (kg/d)	Assimilative capacity
32	Olifants d/s Loskop Dam)/ Klipspruit/ Selons	167	16523	260	25609	Y
33	Bloed River	nd	nd	180	7465	nd
34	Olifants River	619	16290	260	6739	N
35	Moses River	117	11353	240	16174	Y
36	Elands River	738	152494	500	18144	N
37	Grass Valley River	nd	nd	355	2760	nd
38	Olifants	427	4144	500	4752	N
39	Olifants	1188	54987	355	4601	N
40	Doring/ Nkumpi	nd	nd	355	3987	nd
41	Chunies River	nd	nd	355	3067	nd
42	Motse	820	23977	355	10428	N
43	Olifants/ Monametsi	1410	158927	260	2920	N
44	Olifants	491	80630	260	2471	N
45	Olifants	nd	0	260	25609	

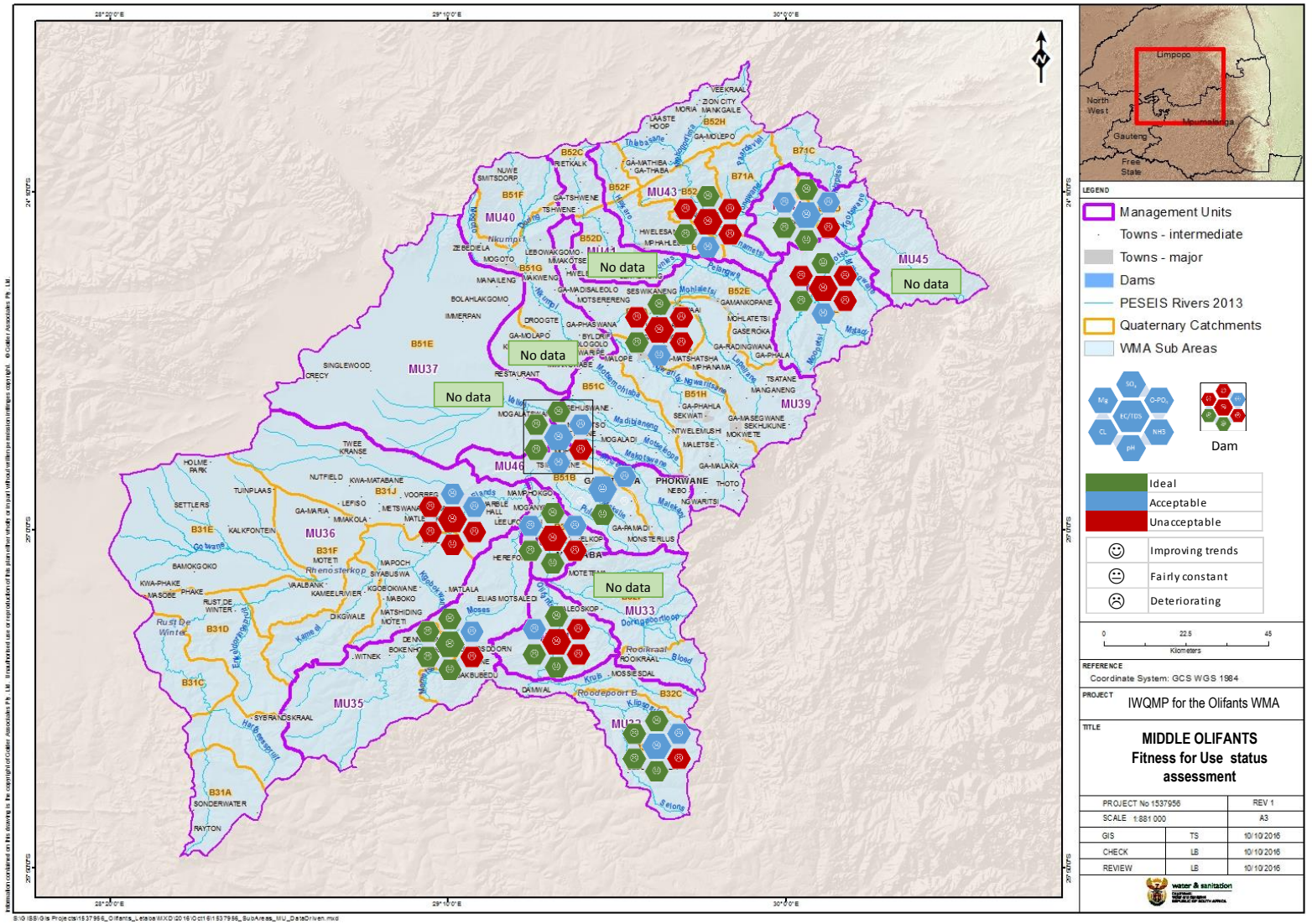


Figure 10: Status assessment of 95% data

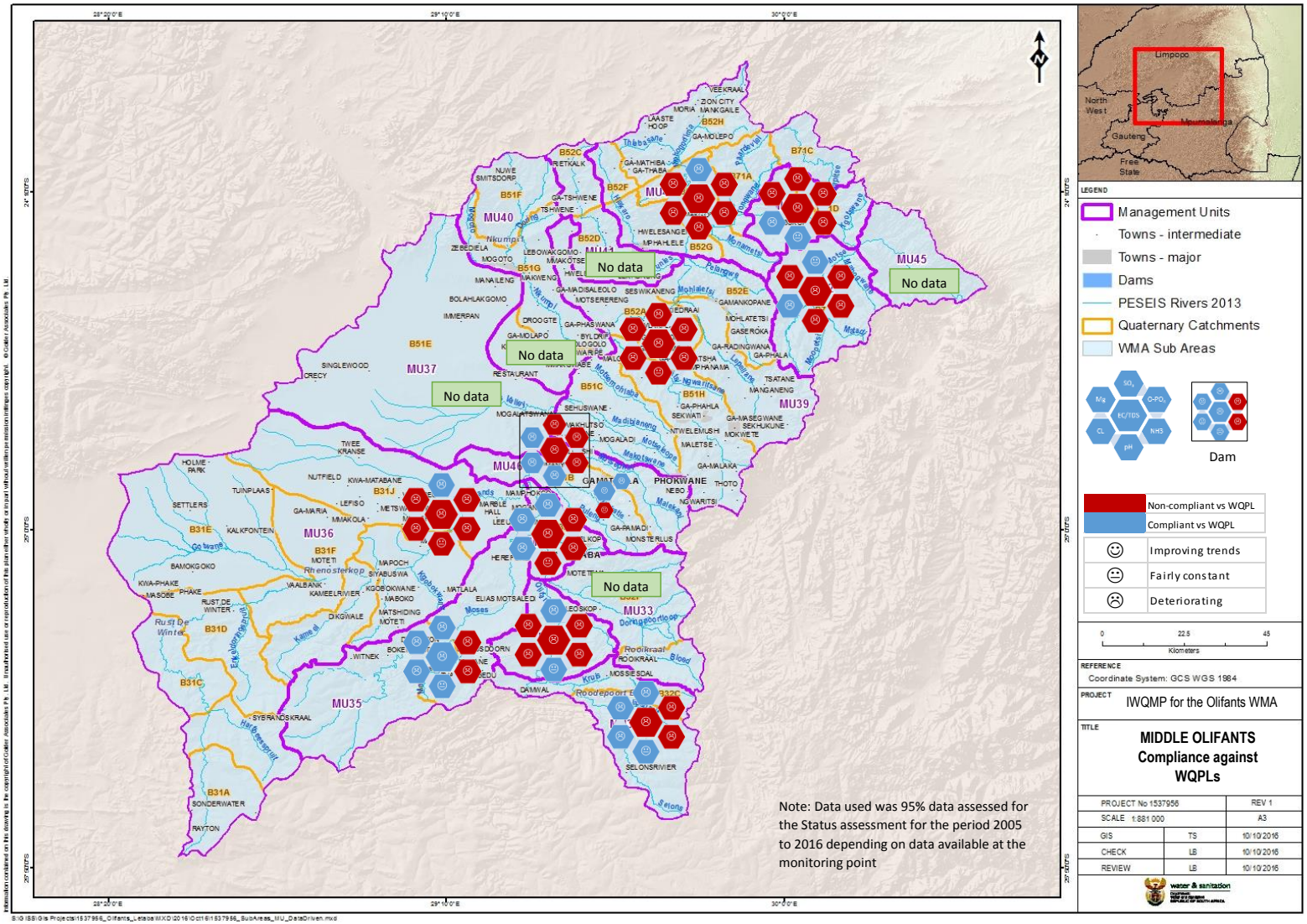


Figure 11: Compliance of 95% data against WQPLs

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 12 maps the management units for the Middle Olifants sub-catchment including the strategic monitoring points used in setting the WQPLs. Those management units specifically linked to the main stem Olifants River are shown in the purple colour.

There are concerns around several of the management units that are high in salts. These include the two management units (MU 34 and 38) immediately downstream of Loskop Dam as well as MU 36 (Elands River) where it appears that there are considerable impacts from irrigated lands and limited mining in the Marble Hall area.

Downstream of Flag Boshielo Dam the water quality is mostly acceptable for irrigation and domestic use, except for TDS which is on the high side. The management units downstream of Flag Boshielo Dam are lacking in data. Monitoring point 192537 on the Olifants has been used to propose WQPLs for these management units, all of which have similar water uses. Notes for MUs where no monitoring data were available:

- MU33: considered data from MU34;
- MU37: considered data from MU46;
- MU40: considered data from MU39 and MU41; and
- MUs 42, 44 and 45: considered data based on monitoring point B71 192537.

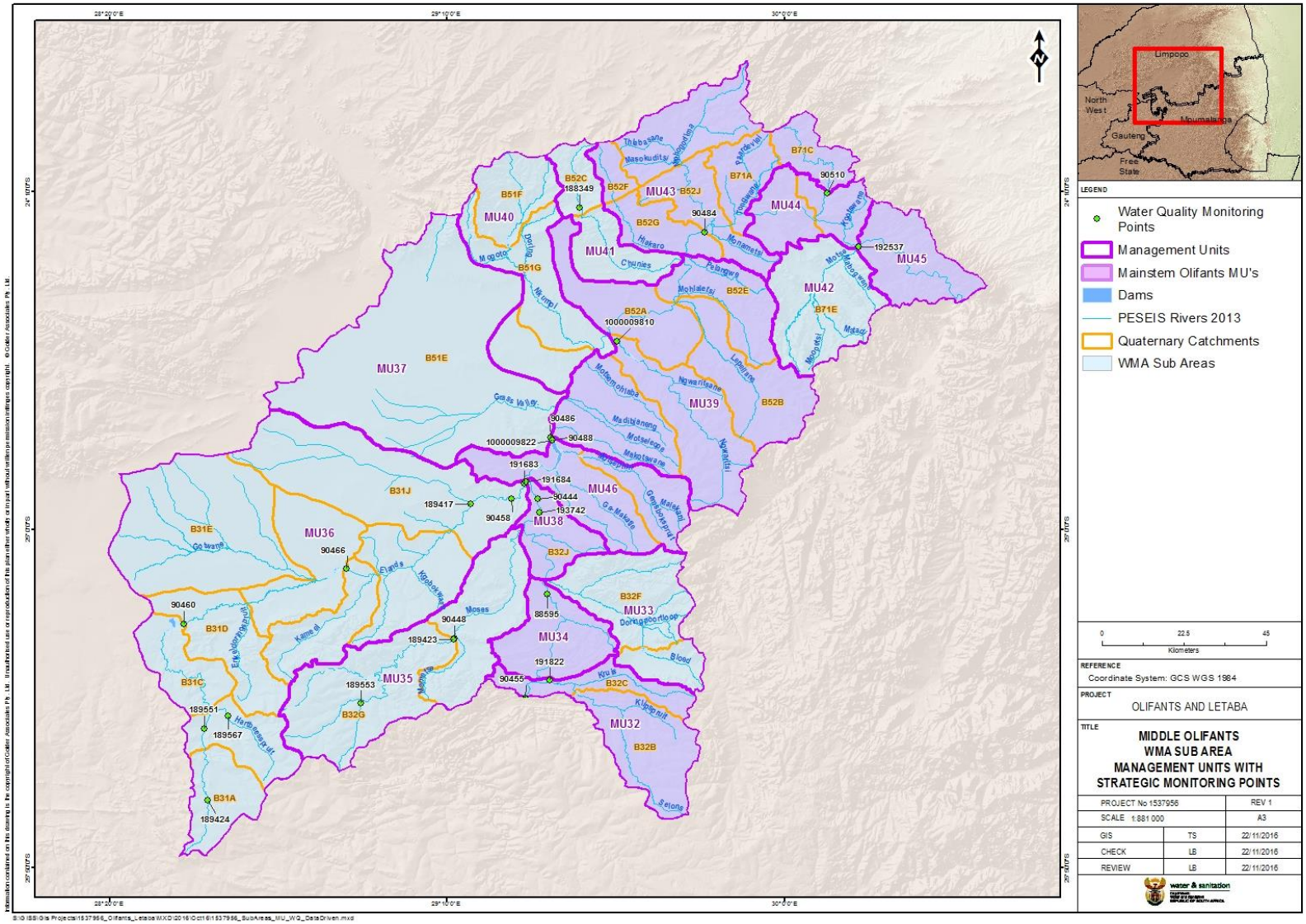


Figure 12: Middle Olifants sub-catchment Management Units showing monitoring points used for the determination of WQPLs

Table 7: WQPLs for catchments in the Flag Boshielo Dam catchments of the Middle Olifants sub-catchments

Variable	Units	Management Units in the Middle Olifants to Flag Boshielo Dam									
		32	**33**	**34**	**35**	**36**	**38**	**46**	**Rhenoster kop Dam**	**Rust de Winter Dam**	**Flag Boshielo Dam**
Calcium (dissolved)	mg/L	20	25	40	24	80	50	32	20	20	40
Chloride (dissolved)	mg/L	20	7	20	30	100	70	70	25	25	50
Total Dissolved Solids	mg/L	260	180	260	240	500	500	450	180	180	430
Electrical Conductivity	mS/m	40	25	40	40	90	75	70	30	30	70
Fluoride (dissolved)	mg/L	0.75	0.7	0.75	1	1	0.75	0.75	0.75	0.75	0.75
Potassium (dissolved)	mg/L	10	2	10	50	20	10	50	10	10	10
Magnesium (dissolved)	mg/L	25	15	25	30	30	40	30	10	10	30
Sodium (dissolved)	mg/L	30	5	30	70	70	70	70	25	25	90
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	0.5	0.5	0.5	0.1	0.5	0.5	0.5	0.5	0.5	0.5
Total Phosphorus	mg/L	0.25	0.1	0.25	0.25	0.25	0.25	0.25	0.1	0.1	0.25
pH		6.5-8.4	6.5-8.4	6.5-8.4	6.5 - 8.4	6.5 - 8.4	6.5-8.4	6.5 - 8.4	6.5-8.4	6.5-8.4	6.5-8.4
Ortho-phosphate	mg/L	0.01	0.02	0.01	0.025	0.05	0.02	0.005	0.025	0.025	0.01
Sulphate (dissolved)	mg/L	150	25	150	30	300	150	180	200	200	100
Total Alkalinity	mg/L	90	90	90	120	150	120	120	80	120	120
Dissolved Organic Carbon	mg/L	10	5	10	5	5	10	5	10	10	10
Dissolved Oxygen	mg/L	9	9	9	9	9	9	9	9	9	9
Sodium Absorption Ratio		2	2	2	2	2	2	2	1.5	1.5	2
Suspended Solids	mg/L	5	25	5	25	25	5	25	25	25	5
Chlorophyll a	µg/L	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130	130	130	130	130	130
Aluminium	mg/L	0.15	0.1	0.15	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Boron	mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Variable	Units	Management Units in the Middle Olifants to Flag Boshielo Dam									
		32	**33**	**34**	**35**	**36**	**38**	**46**	**Rhenoster kop Dam**	**Rust de Winter Dam**	**Flag Boshielo Dam**
Chromium (VI)	µg/L	7	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	0.1
Manganese	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Table 8: WQPLs for catchments downstream of the Flag Boshielo Dam catchments of the Middle Olifants sub-catchments

Variable	Units		Management Units in the Middle Olifants downstream Flag Boshielo Dam						
		37	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Calcium (dissolved)	mg/L	32	32	32	32	32	32	32	35
Chloride (dissolved)	mg/L	85	85	85	85	85	20	65	65
Total Dissolved Solids	mg/L	355	355	355	355	355	260	260	450
Electrical Conductivity	mS/m	55	55	55	55	55	40	40	75
Fluoride (dissolved)	mg/L	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Potassium (dissolved)	mg/L	50	50	50	50	50	10	10	10
Magnesium (dissolved)	mg/L	30	30	30	30	30	35	40	40
Sodium (dissolved)	mg/L	70	70	70	70	70	20	30	30
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	3	3	3	3	3	0.5	0.5	0.5
Total Phosphorus	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
pH		6.5 - 8.4	6.5 - 8.4	6.5 - 8.4	6.5 - 8.4	6.5 - 8.4	6.5 - 8.4	6.5 - 8.4	6.5 - 8.4
Ortho-phosphate	mg/L	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Sulphate (dissolved)	mg/L	30	90	30	30	30	60	60	60
Total Alkalinity	mg/L	120	120	120	120	120	120	120	120
Dissolved Organic Carbon	mg/L	5	5	5	5	5	5	5	5
Dissolved Oxygen	mg/L	9	9	9	9	9	9	9	9

Variable	Units		Management Units in the Middle Olifants downstream Flag Boshielo Dam						
		37	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Sodium Absorption Ratio		2	2	2	2	2	2	2	2
Suspended Solids	mg/L	25	25	25	25	25	25	25	25
Chlorophyll a	µg/L	0.001	1	0.001	0.001	0.001	1	1	1
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	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
Boron	mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chromium (VI)	µg/L	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
Manganese	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

5. INTEGRATED WATER QUALITY MANAGEMENT PLAN FOR THE MIDDLE OLIFANTS SUB-CATCHMENT

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 Middle Olifants sub-catchment are the towns of Groblersdal, Marble Hall and the urban settlements located in the Western Highveld area of the Elands River catchment.

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

- Nkangala District Municipality:
  - Thembisile Local Municipality: and
  - Dr JS Moroka Local Municipality
- Metsweding District Municipality:
  - Nokeng tsa Taemane Local Municipality; and
  - Kungwini Local Municipality.
- Waterberg District Municipality:
  - Modimolle Local Municipality;
  - Mookgopong Local Municipality; and
  - Bela-Bela Local Municipality.
- Greater Sekhuhune District Municipality:
  - Greater Marble Hall Local Municipality;
  - Elias Motsoaledi Local Municipality;
  - Makhuduthamaga Local Municipality;
  - Greater Tubatse Local Municipality; and
  - Fetakgomo Local Municipality
- Capricorn District Municipality
  - Polokwane Local Municipality;
  - Lepelle Nkumpi Local Municipality; and
  - Mogalakwena Local Municipality (very small portions).

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 used.

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: o 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 o Lack of awareness by citizens of what may be disposed ▪ Poor/ no awareness campaigns ✓ Inadequate or no budget o 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 o Lack of resources (human and budgetary) ✓ Posts not filled ✓ No budgets available due to budgets being moved within the municipality or not budgeted for o 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 o Poor storm water management o Grease traps not installed/ maintained o 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 22 domestic wastewater treatment works (WWTW) in the Middle Olifants, all relatively small, the 2 largest being the Groblersdal and Marble Hall WTWW contributing more than 50% of the effluent discharged (Table 11). The major concern is around the discharge of non-compliant effluent, lack of effluent and flow monitoring and technical skills (process controller (PC) and supervisory skills).

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	• Lack of process controller (PC) and supervisory skills o 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 • Inadequate groundwater protection zoning • Large number of pit latrines

Table 11: Wastewater treatment works in the Middle Olifants sub-catchment

WWTW name	WWTW Type (liquid)	WWTW (sludge)	Operational Capacity (Ml)	Highest risk areas			Authoris[n/.] type
				Effluent quality	Skills	Capacity/ no flow measurement devices	
Lepelle-Nkumpi	Lebowakgomo Oxidation Ponds 1 WWTW	Aerated ponds/ Oxidation ponds	1.9	Poor effluent compliance	Technical skills	Flow monitoring	License
Lepelle-Nkumpi	Lebowakgomo Industrial WWTW	Activated sludge	3	Poor effluent compliance	-	Hydraulic and organic overload	Undetermined
Lepelle-Nkumpi	Lebowakgomo RWWTW (Middelkop)	-	-	-	-	-	License
Fetakgmomo/ Greater Tubatse	Penge WWTW	Anaerobic/ Facultative ponds	0.5	Poor effluent monitoring	Technical skills	Flow monitoring	License
Elias Motsoaledi	Groblersdal WWTW	Activated sludge and BNR	5	Poor effluent monitoring	Technical skills	Flow monitoring	License
Ephraim Mogale	Marble Hall WWTW	Aerated/ Oxidation ponds	5.6	Poor effluent compliance	Technical skills	Flow monitoring	License
Ephraim Mogale	Elandskraal WWTW	Anaerobic/ Facultative ponds	0.5	Poor effluent monitoring	Technical skills	Flow monitoring	License
Makhuduthamaga	Jane Furse LCH WWTW	-	-	-	-	-	License
Makhuduthamaga	Jane Furse Hospital WWTW	-	-	-	-	-	License
Makhuduthamaga	Jane Furse Oxidation Ponds WWTW	Anaerobic ponds/ Facultative ponds	1	Poor effluent monitoring	Technical skills	Flow monitoring	License
Lepelle-Nkumpi	Lebowakgomo	Anaerobic/	1	Poor effluent monitoring	Technical skills	Flow monitoring	Permit

WWTW name	WWTW Type (liquid)	WWTW (sludge)	Operational Capacity (Ml)	Highest risk areas			Authoris[n/.] type
				Effluent quality	Skills	Capacity/ no flow measurement devices	
	Oxidation Ponds 2	Facultative ponds					
Fetakgmomo/ Greater Tubatse	Atok Mine Residents WWTW	-	-	-	-	-	Undetermined
Fetakgmomo/ Greater Tubatse	Sekhukhune College WWTW	-	-	-	-	-	Undetermined
Ephraim Mogale	Tompi Seleka Ponds WWTW	-	-	-	-	-	Undetermined
Mookgophong	Thusang (Roedtan)	Anaerobic/ Facultative ponds	No Information	Poor effluent compliance	Technical skills	Flow measurement	Undetermined
Ephraim Mogale	Manapsane	-	-	-	-	-	License
Makhuduthamaga	Phatametsane	-	-	-	-	-	Undetermined
Elias Motsoaledi	Dennilton	Aerated/ Oxidation ponds	1	Poor effluent monitoring	Technical skills	Flow monitoring	Undetermined
Makhuduthamaga	Glen Cowie	-	-	-	-	-	License
Makhuduthamaga	Nebo	Anaerobic/ Facultative ponds	2	Poor effluent monitoring	Technical skills	Flow monitoring	Undetermined
Makhuduthamaga	Jerusalem	-	-	-	-	-	Undetermined
Fetakgmomo/ Greater Tubatse	Mecklenburg-B	Anaerobic/ Facultative ponds	0.3	Poor effluent monitoring	Technical skills	Flow monitoring	Undetermined
Elias Motsoaledi	Motetema-A	Anaerobic/ Facultative ponds	0.4	Poor effluent monitoring	Technical skills	Flow monitoring	Undetermined

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: For Action 1 and 2: Groblersdal; Marble Hall; Dennilton and all other areas where waterborne sanitation systems are in place*
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: Groblersdal; Marble Hall; Dennilton 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 Middle Olifants 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: Groblersdal 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 need to be considered and the WMI must be involved in the Key Deliverables roll-out which over a 3 year period includes:

    YEAR

    - 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 sub-catchment (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 economy of the Middle Olifants is driven by agriculture with the area having a rural characteristic. The upper areas of the sub-catchment, specifically management units 35 and 36 are driven by intensive irrigation agriculture (specifically around Marble Hall and Groblersdal). The rest of the sub-catchment has considerable subsistence agriculture associated with the extensive villages and a large number of smallholdings upon which a variety of economic activities take place (agriculture, grazing, light manufacturing, associated commercial activities and some tourism). There is also commercial dryland agriculture (in the Springbok Flats region).

The main concerns related to this sector are:

- Agricultural lime use
    - Metals contamination (aluminium and iron)
- 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 Middle Olifants. 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 Middle Olifants 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.

In addition, specific research around the use of agricultural lime and its' impacts should be undertaken.

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
1. Develop Best Management Practices (BMP) for fertiliser application to ensure that over-fertilisation does not take place;
2. 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; Loskop area is all year round. 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

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

yields.

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.

The key regulatory measures relevant for the management of the POPs life cycle included in the NIP for the Stockholm Convention on POPs need to be included in the Implementation Plan.

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-3: Implement an agricultural lime research project

1. Implement a research programme with relevant suppliers to investigate the metals release from agricultural lime.

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 Middle Olifants sub-catchment include smaller industrial areas around the Dennilton, Marble Hall and Groblersdal areas.

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.
- Discharge of effluent to sewer from other industries, such as electroplaters and paint industries, causing severe toxic shock of the biological aspects of the WWTW.

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

Strategic Measure I-1: Reduce load (salinity, metals and oils and greases) from run-off from industrial areas
1. Collaborate with the various industries within a management unit to assess the storm water management in these areas and prioritise where biggest improvements can be made; o *PRIORITY AREAS: Dennilton, Marble Hall and Groblersdal areas.* 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 D1.2); 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: o Storm water management and ponds design; o Storage facilities/ areas for manure; o Monitoring requirements for rivers and groundwater; o 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: o Water quality and quantity data; o Internal audits; o 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 Middle Olifants sub-catchment is the Loskop 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:

- Water quality and quantity data;
- Internal/ external audits;
- 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;
- It is noted that there are deposits of uranium and thorium in the Middle Olifants sub-catchment and some of these have been mined. Research needs to be undertaken to assess whether there is radioactive product contamination in the streams and rivers located near known mining operations;
- Further specific agrochemicals should also be included based on the recent research undertaken by Dr J Dabrowsky (WRC, 2015). The most common pesticides used (based on kilogrammes used) in the Limpopo and Mpumalanga Provinces are:
    - Glyphosate
    - Petroleum-oil
    - Mancozeb
    - Atrazine
    - Copper-oxychloride
    - Acetochlor
    - Terbuthylazine
    - Metolachlor
- Certain MUs do not have a dedicated monitoring point;
- Additional weirs may be required, however will depend on the implementation of the Waste Discharge Charge System;
- 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.

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

6.1 Collaborative monitoring

The DWS/ WMI needs to consider all the monitoring required at the various levels within the WMA.

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.

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 category 5 monitoring 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 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 water quality monitoring sites

MU	Quaternary catchments	Main River/ tributary	EWR	RQO	WQPL Monitoring points (including weirs)
32	B32B/ B32C	Olifants d/s Loskop Dam)/ Klipspruit/ Selons		X (Loskop Dam outlet and bottom of B32C)	90455
33	B32E/ B32F	Bloed River			New point required
34	B32D	Olifants River	Olifants_EWR5		88595
35	B32G/ B32H	Moses River			90448
36	B31A/ B31B/ B31C/ B31D/ B31E/ B31F/ B31G/ B31H/ B31J	Elands River	Olifants_EWR6		90458
37	B51E excluding the Zebediela portion running from the R519 to the Nkumpi River in B51G	Grass Valley River			New point required
38	B32J	Olifants			88595
39	B51C/ B51H/ B52A/ B52B/ B52E	Olifants			New point required
40	B51F/ B51G plus the Zebediela portion running from the R519 road in B51E to the Nkumpi River in B51G	Doring/ Nkumpi	Olifants_EWR7		New point required
41	B52C/ B52D	Chunies River			New point required
42	B71E	Motse			192537 – no recent data, point needs to be reopened
43	B52F/ B52G/ B52J/ B52H/ B71A/ B71C/ B71B	Olifants/ Monametsi			90484 – no recent data, point needs to be reopened
44	B71B/ B71D	Olifants	Olifants_S10 (EWR8)		New point required
45	B71F	Olifants			New point required
46	B51B/ B51A	Olifants (Flag Boshielo Dam)			90488

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; and

- The DWS/ WMI needs to enable the consolidation and upload of existing metals data from mines and 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 (Table 18) summarises 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 Middle Olifants Sub-catchment

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;	Groblersdal; Marble Hall; Dennilton and all other areas where waterborne sanitation systems are in place	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;	Groblersdal; Marble Hall; Dennilton	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: ○ Groblersdal; ○ All oxidation pond systems should be assessed	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 Report number) and the WMI must be involved in the Key Deliverables roll-out which over a 3 year period includes:	-	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: spraying is seasonal; varies in different areas of the Olifants; Loskop area is all year round. The CMS should be notified of the schedule of spraying or at least when spraying will occur; what is being sprayed when?	Upper Middle Olifants: Elands, Moses and Olifants just downstream of Loskop Dam	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, focussing on those contaminants identified in the Limpopo and Mpumalanga Provinces are (WRC,	Upper Middle Olifants: Elands, Moses and Olifants just downstream of Loskop Dam	Medium term	WMI in collaboration with research institutions	Lead/ support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	2015): ○ Glyphosate; Petroleum-oil; Mancozeb; Atrazine; Copper-oxychloride; Acetochlor; Terbuthylazine and Metolachlor				
A-2.4	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	-	Medium to long term	DEA in collaboration with various other national and provincial departments such as Water and Sanitation and Health	Support
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	All areas	Short term	WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	taken to prevent and remedy pollution or degradation of the environment				
A-2.7	Develop market based management instruments such as the water pricing strategy that should include charges for waste discharges and incentives for introducing new technologies	-	Medium to long term	DWS in collaboration with various other national and provincial departments	Support
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					
Strategic objectives: • The reduction of load due to run-off from industrial 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					

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
I-1.1	Collaborate with the various industries within a management unit to assess the storm water management in these areas and prioritise where biggest improvements can be made	Dennilton, Marble Hall and Groblersdal areas	Short to medium term	Mines/ Industries/ Power Stations	Support
I-1.2	Assess lawful water use and implement directives as necessary for water use authorisation application;	All industries	Short term	WMI	Lead
I-1.3	Develop by-laws for storm water management in industrial areas (links to D-1.1 and D1.2)		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	Loskop Dam	Short term	DEA/ DWS	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	fuel/ oils contamination from boats				
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 the banks of rivers and dams;	Loskop Dam area, Rhenosterkop Dam area, R-2.1 to 2.4 should be undertaken simultaneously	Short to medium term	WMI	Lead
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:

SUB- CATCHMENT STAKEHOLDERS WHO HAVE CONTRIBUTED TO THE PLAN

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
Johannes Mathungene	LEPELLE/ farmer
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