Report Number 10 Edition 1

PLAN

Integrated Water Quality Management Plan for the Olifants River System

Steelpoort Sub-catchment Plan

water & sanitation
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Water Resource Planning Systems Series

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

Steelpoort Sub-catchment Plan

Study Report No. 10

P WMA 04/B50/00/8916/11

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APPROVAL

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

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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 Steelpoort 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 Steelpoort 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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LIST OF ACRONYMS

AIP	Alien Invasive Plants
AMD	Acid Mine Drainage
COGTA	Co-operative Governance and Traditional Affairs
CMF	Catchment Management Forum
CSIR	Scientific and Industrial Research
DMR	Department of Mineral Resources
DoA	Department of Agriculture
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EDC	Endocrine Disrupting Compound
EFR	Ecological Flow Requirements
EWR	Ecological Water Requirements
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
PGM	Platinum Group Metals
PMC	Project Management Committee
POP	Persistent Organic Pollutant
PSC	Project Steering Committee
PSP	Professional Service Provider
PPECB	Perishable Products Export Control Board
RDM	Resource Directed Measures
RQOs	Resource Quality Objectives
RWQOs	Resource Water Quality Objectives
SAEON	South African Environmental Observation Network
SALGA	South African Local Government Association
SANS	South African National Standards
SAWQG	South African Water Quality Guidelines

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

1. INTRODUCTION

1.1 Background

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

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

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

Formal economic activity in the system is highly diverse and is characterised by commercial and subsistence agriculture (both irrigated and rain fed), diverse mining activities, manufacturing, commerce and tourism. Large coal deposits are found in the eMalahleni and Middelburg areas (Steelpoort) 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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- 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):

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

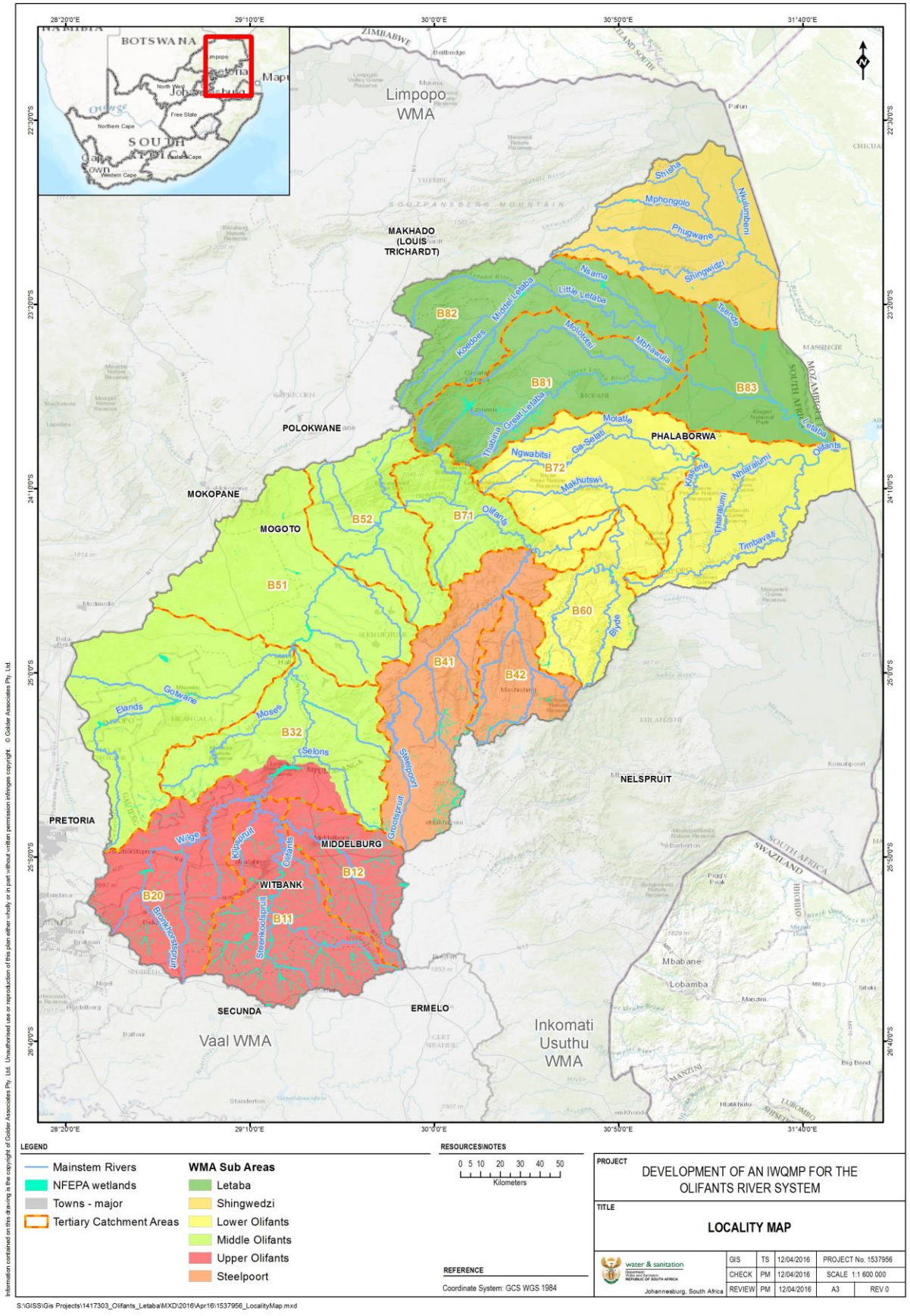


Figure 1: Study Area

1.3 Objective of the Sub-catchment Plan

The objective of this report is to clearly define the various impacts to the water resources in the Steelpoort 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.

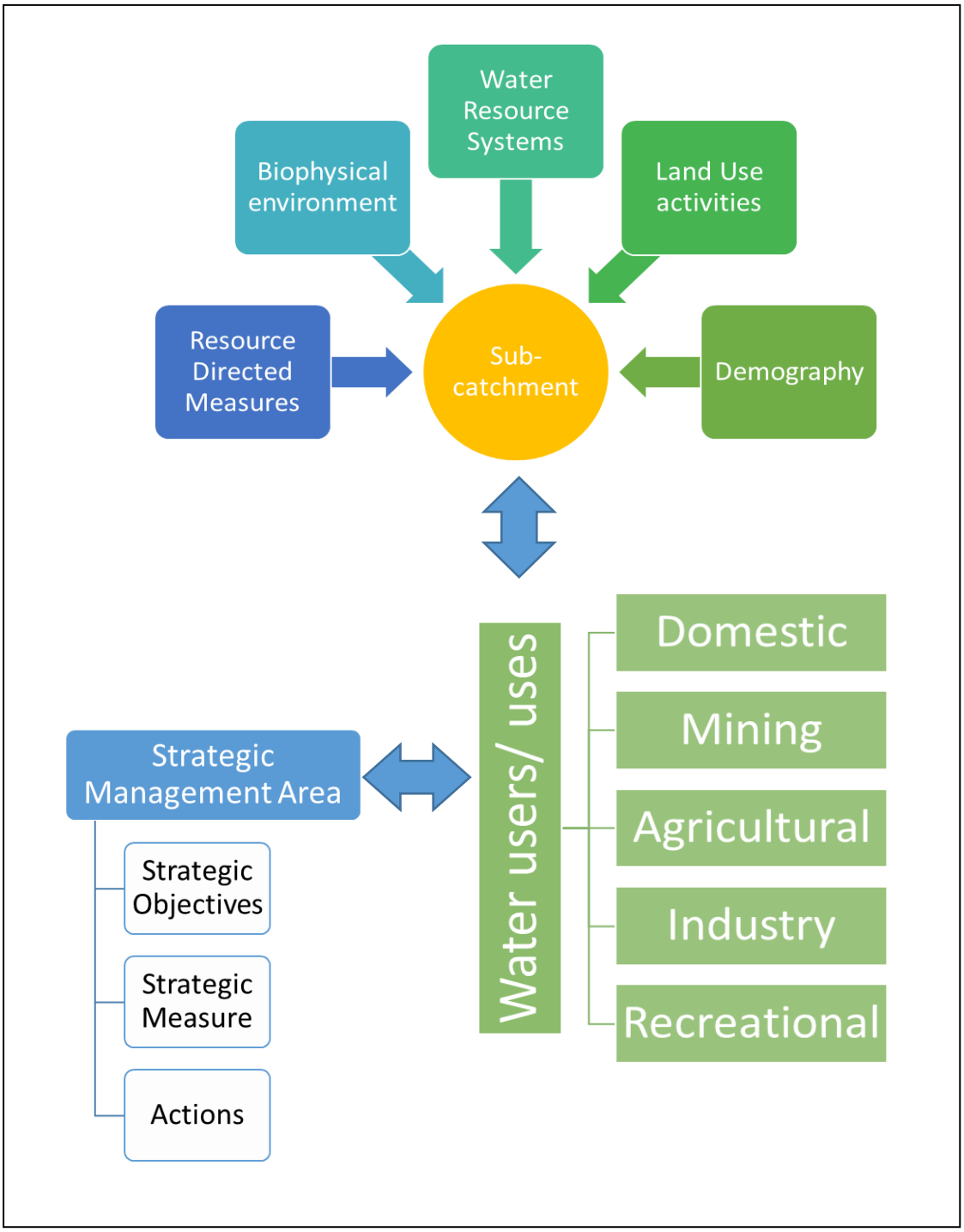


Figure 2: Sub-catchment IWQMP layout

2. SUB-CATCHMENT DESCRIPTION

This chapter gives a brief background to the Steelpoort 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 Bio-physical environment

The Steelpoort sub-catchment (7 136 km^2) corresponds to the catchment of the Steelpoort River and its tributaries, the Dwars and Spekboom Rivers. Other rivers include the Klip, Klein Dwars, Tonteldoosloop, Witpoort and Waterval Rivers. The catchment starts from the Grootspruit River in the south; up to its confluence in the north with the Olifants River main stem and includes the towns of Belfast in the south, Steelpoort in the north and Roossenekal.

Rainfall occurs predominantly in the summer months (October – March), with January generally experiencing the heaviest rain. The mean annual rainfall for the area range between 600-1000 mm. Thunderstorms, with the associated low infiltration of the soil and erosion in mountainous areas, are common.

Average daytime summer temperatures vary between 19°C and 22°C while the winter averages are between 13°C and 19°C. Early morning frost occurs in low-lying areas. High evaporation occurs in the warm areas and evaporation rates are about 80 percent higher during summer than in winter.

2.2 Water Resource Systems

The main river in the sub-catchment is the Steelpoort River and its tributaries, the Dwars and Spekboom. Other rivers include the Klip, Klein Dwars, Tonteldoosloop, Witpoort and Waterval Rivers. The catchment starts from the Grootspruit River in the south; up to its confluence in the north with the Olifants River main stem and includes the towns of Belfast in the south, Steelpoort in the north and Roosseneka

The catchment has a MAR of 396 Mm^3. There are three major dams in the catchment with a combined capacity of 17 Mm^3 and a firm yield of 18.7 Mm^3/a. The combined capacity of small and minor dams in the catchment is 20.4 Mm^3.

There are seven controlled irrigation schemes in the catchment, with a combined scheduled irrigation area of 8 621 ha. Infrastructure other than main dams include 118.08 km canal systems and 5.9 km pipelines.

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.

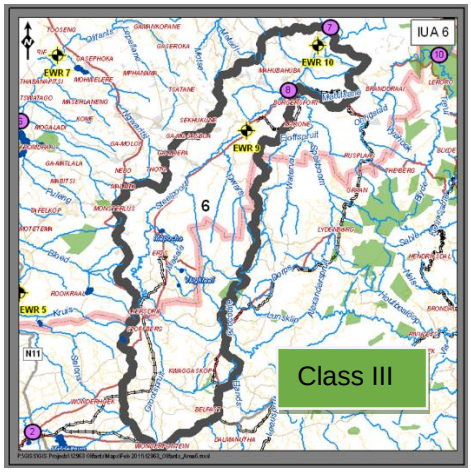
The Reserve for the Olifants WMA has been determined (DWS, 2016) and will be gazetted later in 2017. Three are two EWR sites in the Steelpoort.

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

EWR site	River	Quaternary	Notes
EWR 9	Steelpoort	B41J	• Downstream of the confluence of the Steelpoort and Dwars River • Downstream of De Hoop Dam
EWR 10	Steelpoort	B41K	• Downstream Steelpoort before it joins Olifants

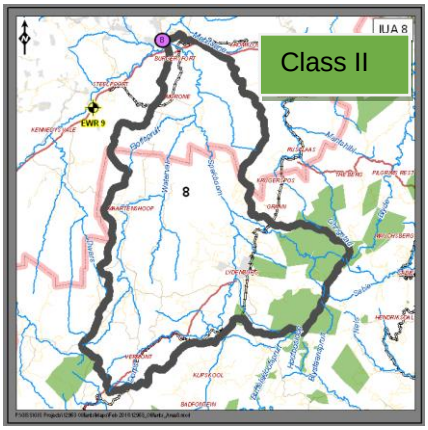
Classification

The Steelpoort sub-catchment was divided into Integrated Units of Analysis (IUA) 6 (Groot, Steelpoort and Dwars Rivers), IUA 8 (Spekboom, Dorps and Waterval), classed as a Class III and Class II respectively.



The ecological condition of the Steelpoort, Klip and Dwars Rivers can be described as follows:

The present state of the Steelpoort has been modified from the natural (D category) due to impacts from agriculture and settlements. The Klip and Dwars are still in a good present state. However, the impacts from mining on the Dwars resulted in a moderately modified state (B/C category). The main stem Steelpoort is of moderate ecological importance. However, the Klip and Dwars have a high importance and sensitivity (Velorenvallei nature reserve, the transition from mountain to bushveld and unique geology). Three EWR sites are present in the IUA, namely two on Steelpoort (below De Hoop Dam and just before confluence with the Olifants) and one on the Dwars just before the confluence with the Steelpoort.



The present state of the Spekboom, Dorps and Waterval rivers range from almost natural (Waterval source) to degraded (Dorps). The ecological importance of the Spekboom and Waterval is high and moderate for the Dorps. A number of protected areas have been identified in the upper reaches of this IUA. The impacts are mainly from urbanisation and some agriculture in the catchment. No EWR site is situated in this IUA.

Figure 3: Classification and brief ecological description of the IUAs for the Steelpoort 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 Steelpoort are captured in Table 2. The monitoring points are located at the outlet of quaternary catchments: B41K and B42K.

Table 2: RQOs for Steelpoort - water quality component

Variable	Units	Bound	Steelpoort confluence with Olifants B41K	Spekboom B42H
Chloride (Cl)	mg/l	Upper		
Total Dissolved Solids	mg/l	Upper		
Electrical Conductivity	mS/m	Upper		
Sulphate	mg/l	Upper		
pH	units	Upper		
Phosphate	mg/l P	Upper	0.125	
Nitrate-Nitrite	mg/l N	Upper		
Total Inorganic Nitrogen	mg/l	Upper		
Ammonia	mg/l N	Upper		
Chl-*a* phytoplankton	µg/l	Upper		
Alkalinity	mg/l ($CaCO_3$)	Upper		
Turbidity	NTU	Upper		
Dissolved oxygen	mg/l	Upper		
Temperature		Upper		
Suspended Solids	mg/l	Upper		

Variable	Units	Bound	Steelpoort confluence with Olifants B41K	Spekboom B42H
Fluoride	mg/l	Upper	2	3
Aluminium	mg/l	Upper	0.63	0.15
Arsenic	mg/l	Upper	0.058	0.13
Cadmium (hard)	µg/l	Upper	1.6	5
Chromium (VI)	µg/l	Upper	68	200
Copper (hard)	µg/l	Upper	4.9	8
Mercury	µg/l	Upper	0.53	1.7
Manganese	mg/l	Upper	0.68	1.3
Lead hard	µg/l	Upper	5.8	13
Selenium	mg/l	Upper	0.013	0.03
Zinc	µg/l	Upper	14.4	36
Chlorine	ug/l	Upper	1.8 free Cl	5 free Cl
Endosulfan	ug/l	Upper	0.08	0.2
Atrazine	ug/l	Upper	48.8	100
Pathogens	*E. coli* Counts per 100ml	Upper		

2.4 Demography

The Steelpoort Sub-Catchment has a population of approximately 345 thousand people (345 220). The population is most dense in the areas of Lydenburg, Kokwaneng and Derde Gelid (Figure 4). This population is predominantly black (94%) followed by a much smaller proportion of white residents (5%). Sepedi is the chief language spoken by 70% of the population with other languages being Afrikaans (5%), IsiNdebele (6%), IsiZulu (5%), and SiSwati (7%) (Census 2011).

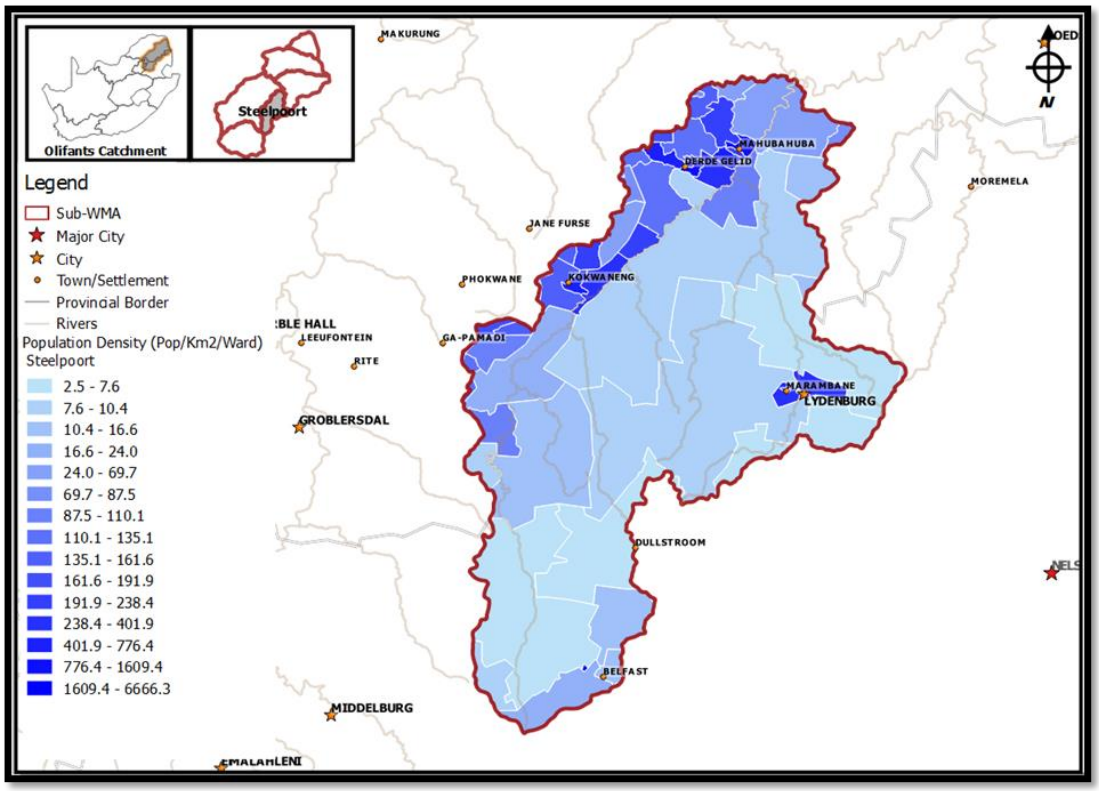


Figure 4: Population density (pop/Ha) by ward in the Steelpoort sub-catchment (Census 2011)

Similarly to the Middle-Olifants, the Steelpoort has a comparatively smaller proportion (14%) of households living in informal dwellings (shack) and a larger proportion of households (76%) living in brick and concrete structures (Figure 5). Most households have access to piped water with approximately 66% of access being evenly spread through homes, yards and within 200 m of homes. A relatively large 21% of households have no access to piped water. The source of water in the sub-catchment is predominantly from municipal water schemes and boreholes (71%), but 15% do get their water directly from natural sources (i.e. Rivers and springs) (Figure 7). The most commonly used toilets are pit latrines with (6%) and without (57%) ventilation. 30% of households have access to flushing toilets that are connected to the sewer system (Figure 6).

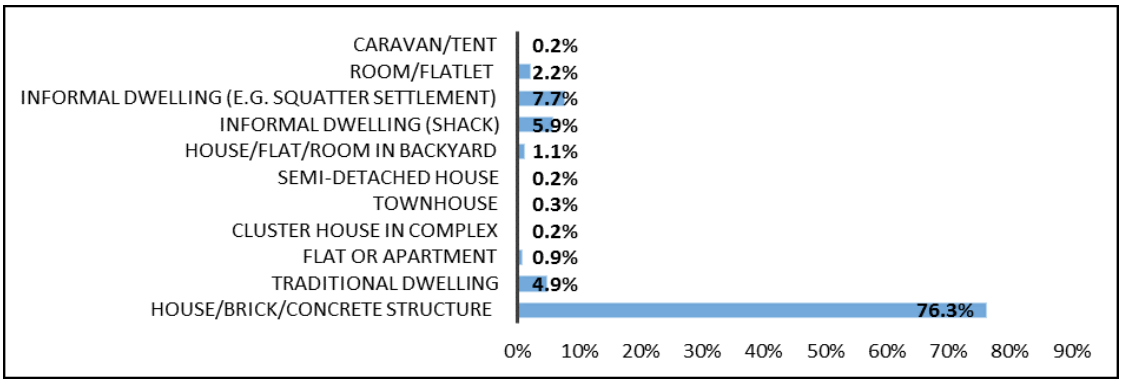


Figure 5: Dwelling demographic of the Steelpoort Sub-Catchment (Census 2011)

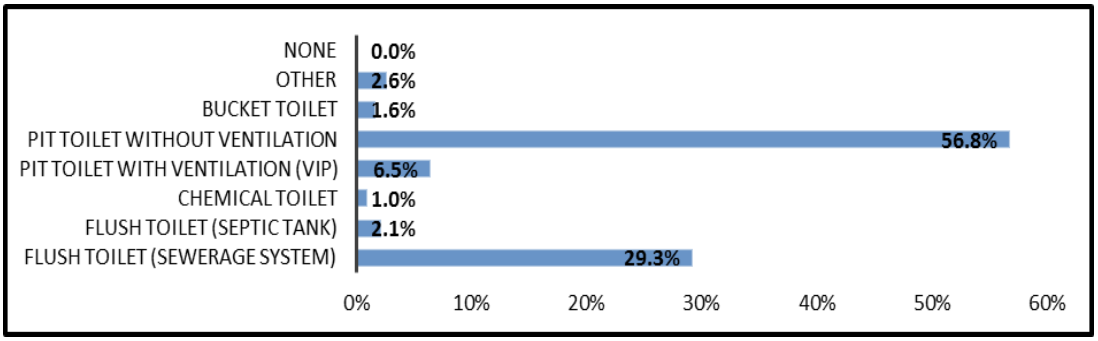


Figure 6: Toilet system demographic in the Steelpoort Sub-Catchment (Census 2011)

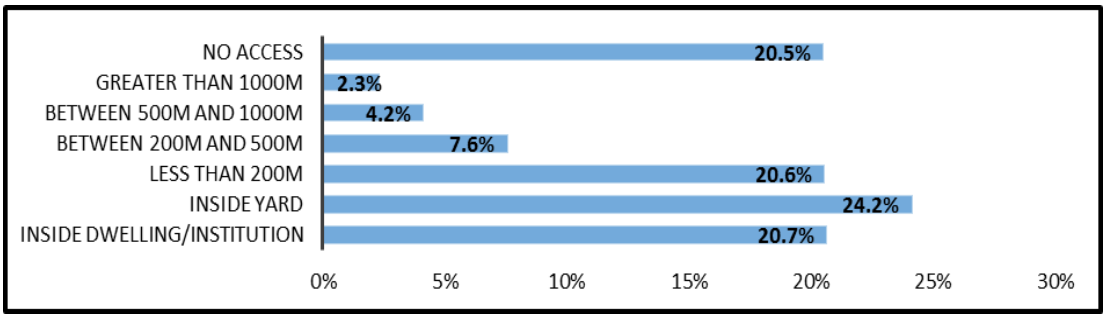


Figure 7: Water access demographic of households in the Steelpoort Sub-Catchment (Census 2011)

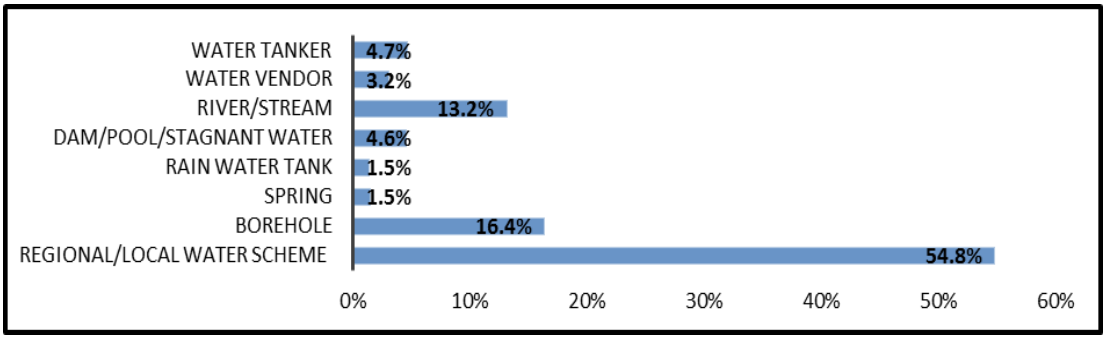


Figure 8: Source of water of households in the Steelpoort Sub-Catchment (Census 2011)

2.5 Land use activities

The Steelpoort sub-catchment is dominated by grassland, woodland and cultivated areas (

Figure **9**). The land-use cover is as follows:

- Irrigation crops: 94 km^2;
- Dryland crops: 605 km^2;
- Afforestation: 75 km^2; and
- Livestock and game: 20 500 units, mainly sheep.

There are three major platinum mining operators present in the catchment (Amplats, Impala Platinum and Aquarius). Samancor operates the Eastern Chrome Mine (ECM) situated close to Steelpoort, Xstrata Alloys operate both the Thornecliffe and Helena Chrome Mines near Steelpoort and Evraz Highveld Steel operates the Mapochs Mine near Roossenekal.

Samancor also operates the Tubatse Ferrochrome Plant (TFC) and Xstrata Alloys' Lion Ferrochrome Operation is located near Steelpoort.

Other mining products include granite and coal. The existing mines use mainly public and borehole water and a small amount of excess water pumped from the workings.

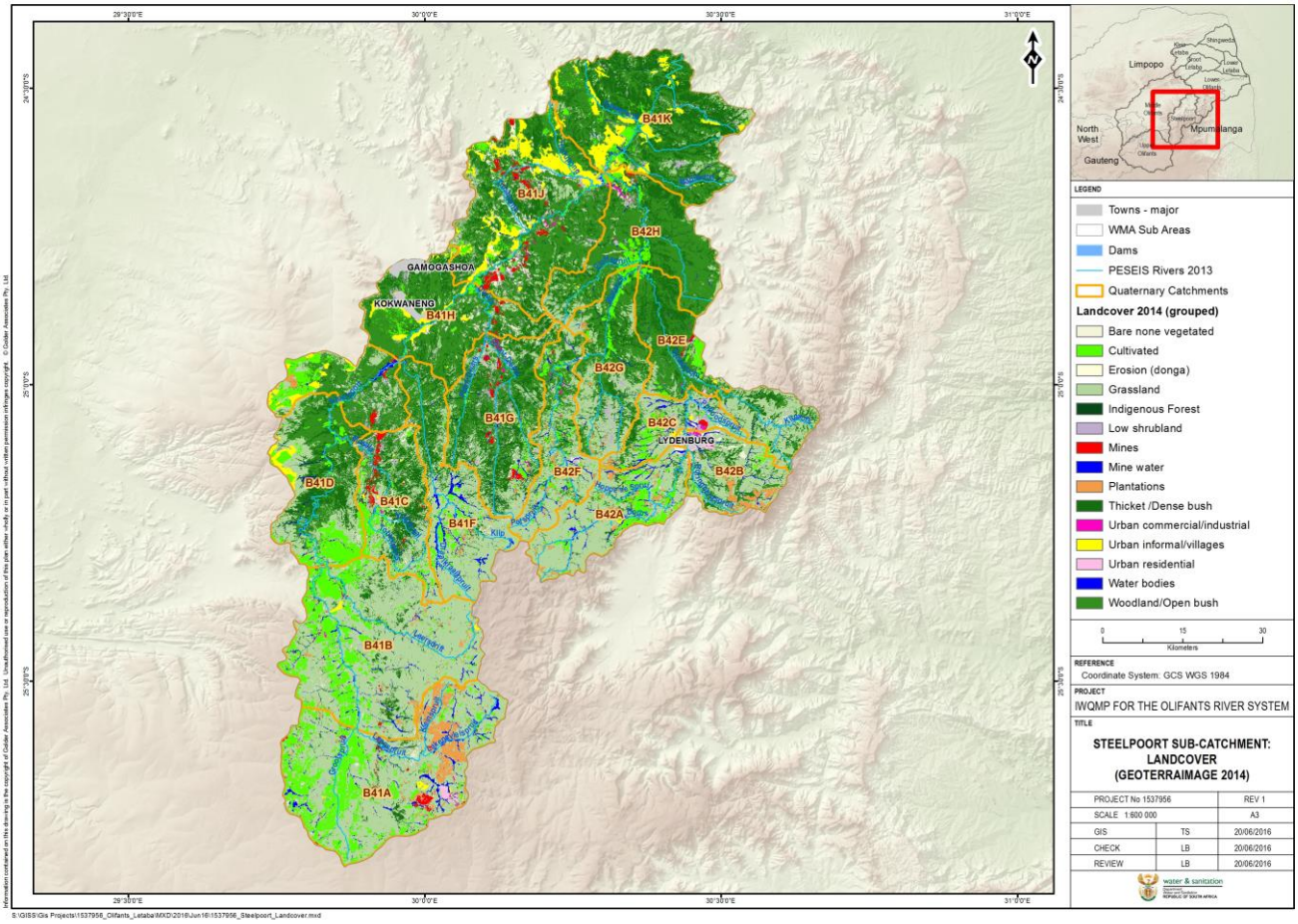


Figure 9: Map illustrating the land use activities in the Steelpoort sub-catchment

3. FITNESS FOR USE OF WATER IN THE STEELPOORT 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 has been used as the limit against which compliance was undertaken.

There are a number of areas that have been designated Protected Areas under PAA, specifically in the areas of the of the upper Steelpoort sub-catchment, including the Dorps River. This area supplies good quality water to the Olifants and development in respect of mines and industries in the Steelpoort should be managed to maintain the current chemical and physical water quality.

Table 3 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.

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

Table 4 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 3: Compliance of 95 percentile data against WQPL

Management Units	Steelpoort										
	59	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**81**
Calcium (dissolved)	11.6	33.1	70.3	28.4	31.8	16.9	119	13.9		35.14	43.4
Chloride (dissolved)	23.97	15.63	7.65	14.2	5.7	6.57	101.6	7		43.13	10.5
Total Dissolved Solids	145.68	305.33	306.3	280.15	113.36	239.18	457.37	156		458.15	504.6
Electrical Conductivity	22.68	96.19	45.56		19.29	29.55	81.67	20.69	43.54	63.68	60.6
Fluoride (dissolved)	0.48	0.42	0.15	0.45	0.2	0.37	0.19	0.32		0.4	0.31
Potassium (dissolved)	3.69	2.84	1.63	2.76	0.98	3.31	1.98	1.6		3.45	2.23
Magnesium (dissolved)	9.64	18.73	55.3	16.38	45	22.03	182	11.94		36.36	44.65
Sodium (dissolved)	15.71	19.54	13.21	17.36	5.97	8.69	86.9	8.4		36.12	24.92
Ammonia (unionised)	0.2	0.08	1.83	0.11	0.41	0.1	3.42	0.09		0.09	0.13
Nitrate	0.09	0.53	6.74	0.62	0.63	0.22	3.17	0.14	1.51	2.97	7.78
pH	8.13	8.45	8.29	8.44	8.28	8.46	8.5	8.26		8.77	8.62
Ortho-phosphate	0.04	0.04	2.16	0.04	0.1	0.03	2.36	0.03	0.12	0.02	0.05
Sulphate (dissolved)	14.42	18.55	31.51	15.89	9	10.35	84	9.29		42.51	17.87
Total Alkalinity	60.59	170.05	169.96	155.84	85.1	138.09	273.6	94.21		229.75	307.05

Non-compliant against the WQPL

Meets WQPL

Table 4: Assimilative capacity and loads for TDS against WQPLs

MU	Main River/ tributary	TDS (mg/L) 95%	Load (kg/d)	WQPL	Load (kg/d)	Assimilative capacity
59	Grootspruit	146	17053	260	30551	Y
60	Steelpoort	258	29241	260	29428	Y
61	Masala	444	18401	260	10783	N
62	Klip	92	4565	260	13029	Y
63	Dorps	139	13723	120	11820	N
64	Waterval	149	11787	160	12718	Y
65	Steelpoort	457	8394	400	7258	N
66	Spekboom	156	2299	160	2350	Y
67	Spekboom	nd	nd	160	3456	Y
68	Steelpoort	981	40433	290	12027	N
81	Dwars	505	35198	400	27994	N

*nd: no data available for that MU

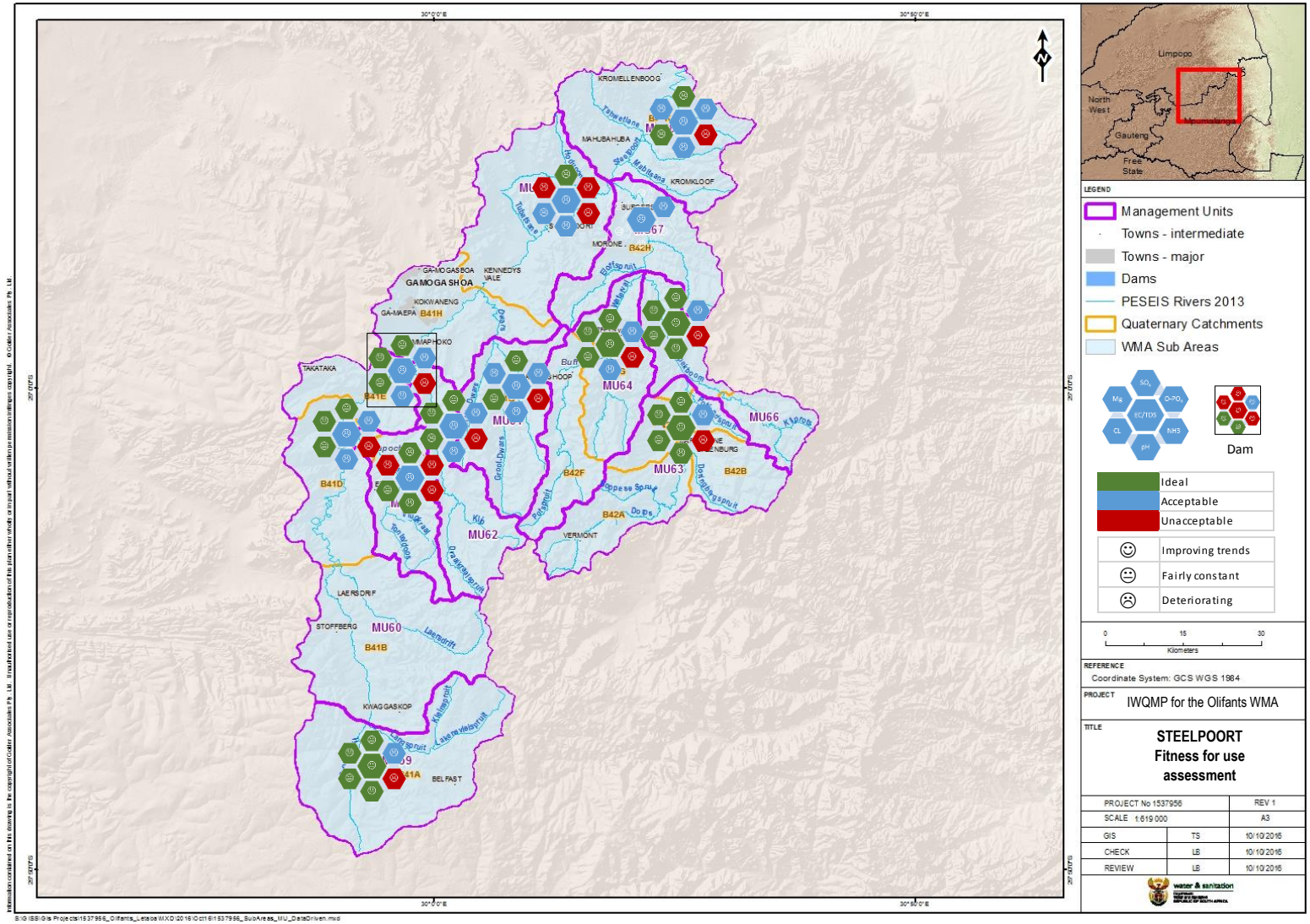


Figure 10: Status assessment of 95% data

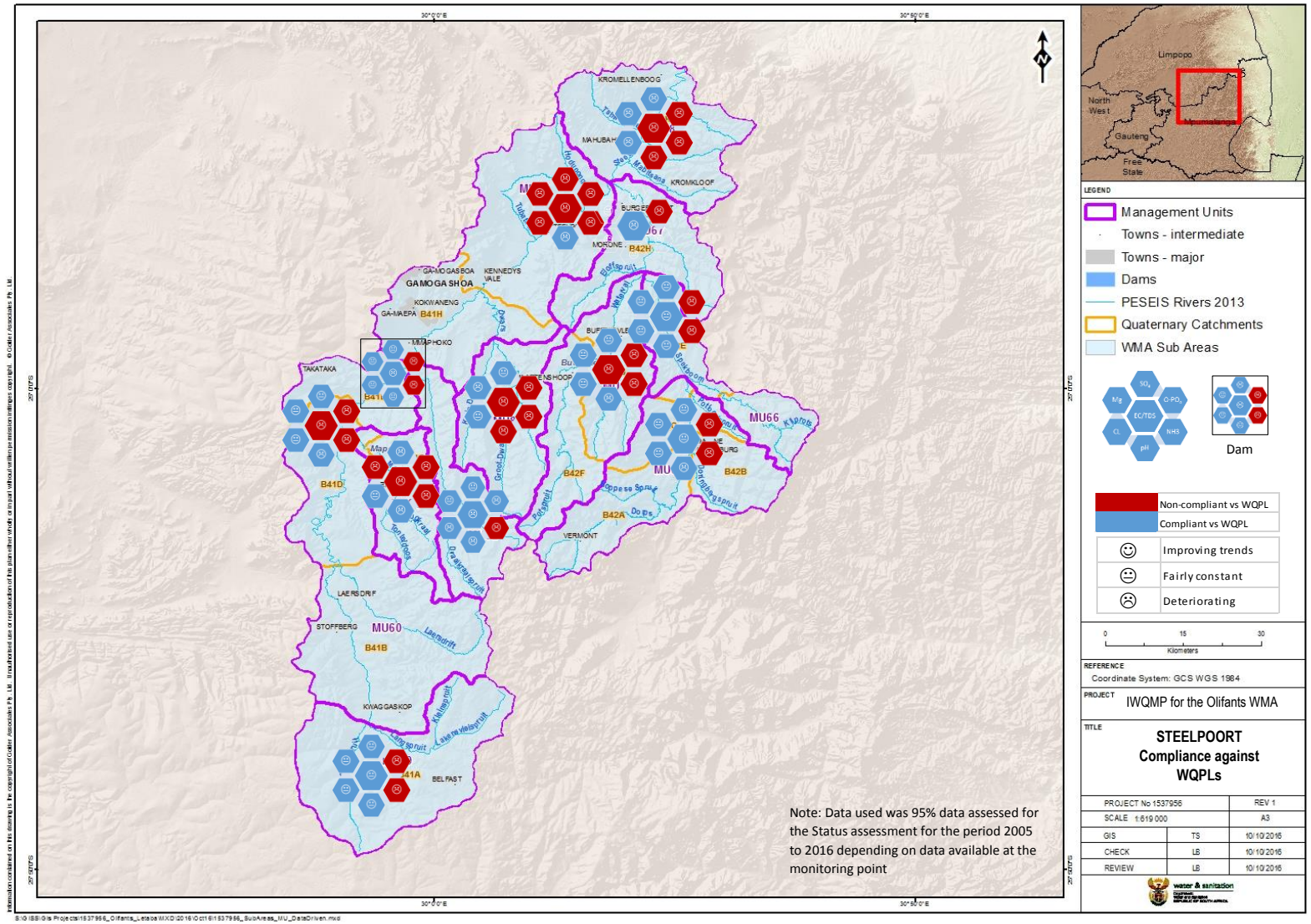


Figure 11: Compliance of 95% data against the WQPLs

4. WATER QUALITY PLANNING LIMITS

Water Quality Planning were set for each management unit within the Steelpoort 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 Steelpoort sub-catchment including the strategic monitoring points used in setting the WQPLs. Table 5 and Table 6 set out the proposed WQPLs for the management units delineated for the Steelpoort sub-catchment:

- upstream of De Hoop Dam (MU 59, 60, 61 and 62 including De Hoop Dam); and
- downstream of De Hoop Dam (MU 63, 64, 66, 67, 81, 65 and 68).

The water quality in this sub-catchment is on the whole fairly good except for MU 81 (Dwars River) which shows impacts from the upstream mines. Elevated TDS is also noted in the Steelpoort just upstream of the confluence with the Olifants River.

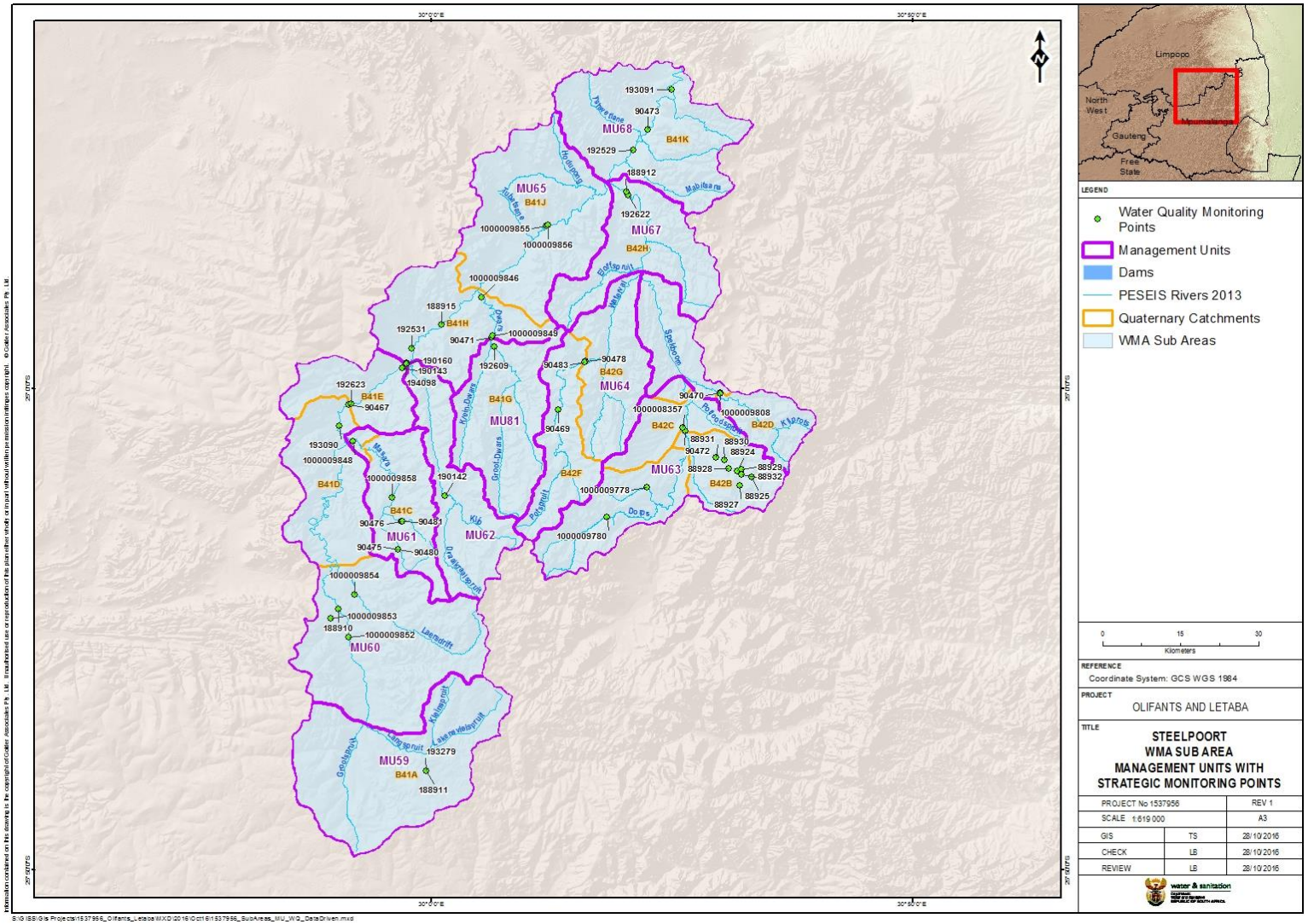


Figure 12: Steelpoort sub-catchment Management Units showing monitoring points used for the determination of WQPLs

Table 5: WQPLs for catchments upstream of De Hoop Dam catchments of the Steelpoort sub-catchment

Variable	Units	Management Units in Steelpoort sub-catchment upstream of De Hoop Dam					De Hoop Dam
		59	60	61	62	81	
Calcium (dissolved)	mg/L	15	15	15	32	45	32
Chloride (dissolved)	mg/L	25	25	25	20	20	20
Total Dissolved Solids	mg/L	260	260	260	260	400	280
Electrical Conductivity	mS/m	30	30	50	45	60	45
Fluoride (dissolved)	mg/L	0.75	0.75	0.75	0.75	0.75	0.75
Potassium (dissolved)	mg/L	50	10	10	10	10	10
Magnesium (dissolved)	mg/L	30	30	50	20	50	20
Sodium (dissolved)	mg/L	70	20	20	25	30	25
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	0.5	0.5	0.5	0.5	0.5	0.5
Total Phosphorus	mg/L	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
Ortho-phosphate	mg/L	0.01	0.01	0.01	0.005	0.025	0.005
Sulphate (dissolved)	mg/L	20	20	40	30	20	30
Total Alkalinity	mg/L	70	120	170	150	300	150
Dissolved Organic Carbon	mg/L	5	5	5	5	5	5
Dissolved Oxygen	mg/L	9	9	9	9	9	9
Sodium Absorption Ratio		2	2	2	2	2	2
Suspended Solids	mg/L	25	25	25	25	25	25
Chlorophyll a	µg/L	1	1	1	1	1	1
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130	130
Aluminium	mg/L	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
Chromium (VI)	µg/L	7	7	7	7	7	7
Iron	mg/L	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

Table 6: WQPLs for catchments downstream of De Hoop Dam catchments of the Steelpoort sub-catchment

Variable	Units	Management Units in Steelpoort sub-catchment downstream of De Hoop Dam				
		63	**64**	**66**	**67**	**68**
Calcium (dissolved)	mg/L	32	20	20	20	40
Chloride (dissolved)	mg/L	20	10	10	10	50
Total Dissolved Solids	mg/L	120	160	160	160	290
Electrical Conductivity	mS/m	45	40	30	40	45
Fluoride (dissolved)	mg/L	0.75	0.75	0.75	0.75	0.75
Potassium (dissolved)	mg/L	10	10	10	10	10
Magnesium (dissolved)	mg/L	45	30	15	15	40
Sodium (dissolved)	mg/L	10	10	10	10	40
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	0.5	0.5	0.5	0.5	1.5
Total Phosphorus	mg/L	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 - 8.7
Ortho-phosphate	mg/L	0.005	0.02	0.02	0.02	0.02
Sulphate (dissolved)	mg/L	20	30	10	10	50
Total Alkalinity	mg/L	120	140	100	100	200
Dissolved Organic Carbon	mg/L	5	5	5	5	5
Dissolved Oxygen	mg/L	9	9	9	9	9
Sodium Absorption Ratio		2	2	2	2	2
Suspended Solids	mg/L	25	25	25	25	25
Chlorophyll a	µg/L	1	1	1	1	1
Escherichia coli	CFU/ 100mL	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130
Aluminium	mg/L	0.01	0.01	0.01	0.01	0.01
Boron	mg/L	0.5	0.5	0.5	0.5	0.5
Chromium (VI)	µg/L	7	7	7	7	7
Iron	mg/L	0.1	0.1	0.1	0.1	0.1
Manganese	mg/L	0.02	0.02	0.02	0.02	0.02

5. INTEGRATED WATER QUALITY MANAGEMENT PLAN FOR THE STEELPOORT 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 Steelpoort 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 Steelpoort 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 to water quality

The main towns using water in the Steelpoort sub-catchment are the towns of Burgfersfort, Lydeburg and Belfast and surrounding settlement areas. The local and district municipalities supplying water and sanitation services to these areas are:

- Greater Sekhuhune District Municipality:
    - Elias Motsoaledi Local Municipality;
    - Makhuduthamaga Local Municipality;
    - Greater Tubatse Local Municipality; and
    - Fetakgomo Local Municipality.

The main impact sources from the domestic sector are urban run-off and discharge of poorly treated effluent.

Table 7 summarises the source of the potential impacts from contaminated urban run-off.

Table 7: 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

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

There are approximately 13 domestic wastewater treatment works (WWTW) in the Steelpoort, with the largest being in Lydenburg (8Ml) and Belfast (3.5 Ml)(Table 9). The major concerns are around the discharge of non-compliant effluent, lack of technical skills and inadequate flow monitoring.

The oxidation pond systems are also linked to the contamination of groundwater, and considering that groundwater is used 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 8: Sanitation aspects failure

Source of impact	Root causes
Discharge of poorly treated effluent	• Lack of process controller (PC) and supervisory skills ○ Posts not filled with required skilled personnel; ▪ No budgets available due to budgets being moved within the municipality or not budgeted for; ✓ Lack of awareness regarding the importance of wastewater treatment; • Inadequate chemical supplies for disinfection ○ 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 ○ Inadequate/ inappropriate design ○ 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 • Increased private boreholes drawing down water levels and contamination plumes

Table 9: Wastewater treatment works in the Steelpoort 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	
Tubatse	Anaerobic ponds/ Facultative ponds	Solar drying beds	1	Effluent monitoring	Technical skills	Flow monitoring	License
Mokgorwane 1							License
Mokgorwane 2							Nk
Doornbosch							Nk
Ga-Mapodile	Anaerobic ponds/ Facultative ponds	None specified	0.2	Effluent monitoring	Technical skills	Flow monitoring	Nk
Mohlakwana							License
Belfast	Activated sludge and Maturation ponds	Anaerobic sludge and Solar drying beds	3.5	Effluent quality compliance	PC, supervisory and maintenance skills	Flow monitoring	Nk
Burgersfort WWTW	Activated sludge	Solar drying beds and Thermo-chemical treatment	1.5	Effluent compliance	Technical skills	Flow monitoring	License
Roossenekal WWTW	Biological filters	Solar drying beds	0.4	Effluent monitoring	Technical skills	Flow monitoring	License
Coromandel (farm)							Nk

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

Table 10: 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: Burgersfort, Lydenburg* 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: Burgersfort, Lydenburg, Tubatse, Belfast*
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 Steelpoort sub-catchment 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: Burgersfort, Belfast, Lydenburg*
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:
    1. At all levels and specifically amongst the managers in local government, about the importance of compliance to the Green Drop requirements;
    2. Amongst the officials working at the WWTW itself about the importance of their job (build pride and passion for undertaking the job);
    3. Within local communities being served by the WWTW, about the importance of reporting sewer leaks, poor O &M and why it is important to prevent vandalism.

Strategic Measure D-6: Develop a groundwater protection plan

1. Strategic actions from the National Groundwater Strategy (WRC Report number K8/1117/1) need to be considered and the WMI must be involved in the Key Deliverables roll-out which over a 3 year period includes:

    YEAR 1

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

    YEARS 1 - 3

    - A Groundwater Code of Practice (widely understood national policy) developed

cooperatively

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

2. Undertake a hydrocensus of the boreholes in the area to enable mapping of:
   - Aquifers that are already badly contaminated (hot spots) – this would be from both domestic and mining activities; 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, as well as industries and mines in the area. 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: Mining Sector

5.3.1 Background and context to water quality

Mining in the area is dominated by chrome and platinum. The mines use municipal water as well as treated mine water.

Mining activities are impacting significantly on the water quality of the water resource system which is changing the characteristics of some of the water resources to such an extent that its ecological infrastructure value has been lost. Complete or partial loss of wetlands, and impacts on water quality due to mining activities has, and continues, to impact on the water resource system of the WMA.

Unlike the salinization impacts in the Upper Olifants the concerns around the Steelpoort mines are more related to metals contamination due to:

- Seepage from tailings facilities; and
- Seepage from waste rock dumps.

5.3.2 Management objectives

The management objectives for the mining sector are the reduction of load due to seepages from mine tailings facilities and waste rock dumps.

5.3.3 Management Measures

Table 11 sets out the proposed management measures and associated actions to support the management objectives for the mining sector.

Table 11: Management Measures for the Mining Sector

Strategic Measure M-1: Reduce load from seepages
1. Assess the sources of the loads emanating from the management units contributing to the total load to get an understanding of where the biggest load is located;
2. Consider and undertake further investigations into passive treatment systems including man-made wetlands in those areas where seepage is a concern; This would require collaboration and agreements between research institutes, DMR, Chamber of Mines, DWS and the WMI, to allow research to progress without the need for laborious regulatory processes in the short term. This option should involve research institutes such as the Council for Scientific and Industrial Research (CSIR), Water Research Commission (WRC) and Universities, such as the University of the Witwatersrand (WITS) and University of the Free State (UFS) that have a long standing association with the mining sector.
3. Assess lawful water use and implement directives as necessary for water use authorisation application;
4. A project in collaboration with mines and industries to assess the current water management in terms of the Best Practise Guidelines and Regulation 704 to be used

to develop a set of agreed measures, commitments and implementation schedules for each management unit. These should be linked to the existing IWWMPs and IWULs for each of the water users in the catchment. This would allow for exchange of ideas, consolidation of various options and will prevent duplication, specifically in areas such as water quality monitoring, so could have some cost savings.

In order to achieve this it would be necessary to establish a Management Unit Task Team (MUTT) with representatives from all of the water users within the Management Unit.

5. Ensure that all Integrated Water and Waste Management Plans (IWWMP) and associated components are upgraded and action plans set specific Measures, timelines and responsible divisions on the mine, specifically including the operationalisation of water and salt balances: water and salt balances all need to be at the same level of confidence and accuracy and reflect different operating conditions and seasonal variations.
6. Review existing IWULs and request amendment applications as necessary;
7. Implement compliance enforcement.
8. Undertake relevant data collection and implement the waste discharge charge system

Strategic Measure M-2: Data collection

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

5.4 Strategic Management Area: Agricultural sector

5.4.1 Background and context to water quality

Agriculture in the Steelpoort includes dryland crops and subsistence agriculture, limited irrigation and livestock. The main concerns related to this sector are:

- Fertiliser use
    - Nutrient enrichment from over fertilisation

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

5.4.2 Management objectives

The management objectives for the agricultural sector in the Steelpoort include:

- Reduction of nutrient and sediment load from agricultural areas and areas where changing land uses may be occurring.

5.4.3 Management Measures

Table 12 sets out the proposed management measures with supporting actions to support the management objectives for the agricultural sector.

Table 12: 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-4: Data collection
2. 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 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 to water quality

The impacts from the main industrial activities in the Steelpoort are related to metals and potentially oils and greases contamination from the extensive industry in the Tubatse area; and nutrient enrichment and microbiological contamination from livestock feedlots. 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;
- Seepage from waste facilities
    - Historically not lined;
    - No seepage/ leachate collection systems in place.
- Intensive animal feedlots
    - Inadequate 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
  - poor management, such as siltation/ sludge build-up;
  - inadequately designed;
- Seepage of irrigated effluent;
- Disposal of dead animals.

- Discharge of effluent to sewer from abattoirs causing severe problems at the WWTW because of fat build-up due to:
  - Inadequate/ poor maintenance of fat and grease traps;
  - Inadequate design.

5.5.2 Management objectives

The main management objectives for the industrial sector are:

- The reduction of load due to seepages from the industrial and power station waste storage.

5.5.3 Management Measures

Table 13 sets out the proposed management measures to support the management objectives for the industrial sector.

Table 13: Management Measures for the Industrial Sector

Strategic Measure I-1: Reduce load (metals and oils and greases) from run-off from industrial areas *(links to D-1.1 and D-1.2)*
1. Collaborate with the various industries within a management unit to assess the storm water management in these areas and prioritise where biggest improvements can be made; *PRIORITY AREAS: Burgersfort, Tubatse* 2. Assess lawful water use and implement directives as necessary for water use authorisation application; 3. Develop and implement by-laws for storm water management in industrial areas (links to D-1.1 and D-1.2); 4. Review existing IWULs and request amendment applications as necessary; 5. Implement compliance enforcement.
• **Strategic Measure I-2: Reduce nutrient load and microbiological contamination from intensive animal feedlots and abattoirs**
1. Develop Best Management Practices for regulations around intensive animal feedlots including: o Storm water management and ponds design; o Storage facilities/ areas for manure;

- Monitoring requirements for rivers and groundwater;
- Protection around boreholes.

Strategic Measure I-3: Data collection

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

5.6 Strategic Management Area: Recreational sector

5.6.1 Background and context to water quality

There are no major recreational dams in the Steelpoort. The De Hoop Dam is located in the De Hoop nature Reserve and no boating or recreational facilities have been established. In this are therefore the biggest area of concern would be contamination from package waste water treatment plants/ septic tank systems on the banks of rivers and small dams, often associated with Game Farms and lodges. The failures of these would be due to lack of operation and maintenance by private individuals or lodge owners; and installation of inadequate designs for the number of people accommodated.

5.6.2 Management objectives

The management objectives for the recreational sector in the Steelpoort is the reduction of contaminants from recreational activities such as recreational sanitation facilities located close to rivers or dams.

5.6.3 Management Measures

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

Table 14: Management Measures for the Recreational Sector

Strategic Measure R-1: 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-2: 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;
- Certain MUs do not have a dedicated monitoring point;
- Additional weirs will be required as described in Strategic Measure M-5 in Table 11;
- 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.

The DWS/ WMI needs to consider all the monitoring required at the various levels within the WMA. There are essentially 5 categories of monitoring described in Table 15 that should take place in the sub-catchment. Table 16 sets out those monitoring points already existing at the first 3 levels, and also specifies where additional monitoring points need to be considered.

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

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

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

Table 15: Water quality monitoring 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 16: Current monitoring points

MU	Quaternary catchments	Main River/ tributary	WQPL point (weir)	EWR	RQO
59	B41A	Grootspruit	New point needed		
60	B41E	Steelpoort to De Hoop Dam	192623 (B4H24)		
61	B41C	Masala (confluences with the Grootspruit)	1000009848 (B4H14)		
62	B41F	Klip	190142		
63	B42B	Dorps	90472 (B4H10)		
64	B42F/ B42G	Waterval	90469 (B4H5) – need a point a bit lower in the MU		

MU	Quaternary catchments	Main River/ tributary	WQPL point (weir)	EWR	RQO
65	B41J	Steelpoort	1000009856	EWR9	
66	B42D	Spekboom	90470 (B4H9)		
67	B42H	Spekboom	188912 (L74)		X
68	B41K	Steelpoort	193091 (B4H25)	EWR10	X
81	B41G	Dwars	90471 (B4H9)		

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;
- 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 and field equipment

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

following that needs to be incorporated into this plan so that the WMI ensures that it is taken forward:

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

6.1.5 Field equipment

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

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

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

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

6.1.6 Management Information System

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

- Link to field instruments so that data collected is uploaded automatically;
- Link to management Measures set out in IWWMPs;
- Allow water users more access to input data, specifically related to their IWUL;
- Allow DWS and the WMI to draw data and reports from the system without having to ask the water users for a hard copy report;
- Allow water users a comparison/ snap shot of other users in the catchment;
- Ensure hotspots/ and incidents are flagged; and
- Act as an early warning system.
- Link to an app that would allow other stakeholders to upload incidents (including the location and a photograph). This will also allow a more rapid response time.

7. STAKEHOLDER ENGAGEMENT

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

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

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

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

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

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

8. IMPLEMENTATION MATRIX

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

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

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

Table 17: Implementation matrix for the Steelpoort 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;	Burgersfort, Lydenburg	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	All areas	Short to medium term	District/ Local Municipality in	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	from semi-urban areas where subsistence farming is common			collaboration with 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;	Burgersfort, Tubatse, Lydenburg, Belfast	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		Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	to contain dirty water;				
D-4.3	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;	All areas	Short to medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
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: ○ Lydenburg; ○ Burgersfort; ○ Belfast	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

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
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 Drop system as a regulation;	-	Short term	WMI	Lead
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 WRC Report number K8/1117/1) and the WMI must be involved in the Key Deliverables roll-out over a 3 year period.	-	Short term	WMI	Lead
D-6.2	Undertake a hydrocensus of the boreholes in the area to enable mapping of aquifers that are already badly contaminated (hot spots); and aquifers where water is abstracted and used for domestic use.	All areas where borehole water is used for domestic use	Short term	WMI in collaboration with all relevant role players, including DWS, Local Government and private citizens who have boreholes; industries and mines	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	Short term	WMI in collaboration with relevant DWS directorates	Lead

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
		different aspects for each sector			
Strategic Management Area: Mining sector					
Strategic objectives: • Reduction of load due to seepages					
Strategic Measure M-1: Reduce load from seepages					
M-1.1	Assess the sources of the loads emanating from the management units contributing to the total load to get an understanding of where the biggest load is located	Burgersfort, Tubatse areas	Short to medium term	Mines and Industries	Support
M-1.2	Consider and undertake further investigations into passive treatment systems including man-made wetlands in those areas where seepage is a concern	Burgersfort, Tubatse areas	Short to medium term	Mines and Industries	Support
M-1.3	Assess lawful water use and implement directives as necessary for water use authorisation application	All areas	Short to medium term	WMI	Lead
M-1.4	Undertake a project in collaboration with mines and industries to assess the current water management in terms of the Best Practise Guidelines and Regulation 704 to be used to develop a set of agreed measures, commitments and implementation schedules for each management unit; including the	All areas	Medium term	WMI/ DWS/ mines. industries and power stations	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	establishment of a Management Unit Task Team (MUTT) with representatives from all of the water users within the Management Unit.				
M-1.5	Ensure that all Integrated Water and Waste Management Plans (IWWMP) and associated components are upgraded and action plans set specific measures, timelines and responsible divisions on the mine, specifically including the operationalisation of water and salt balances, in accordance with DWS IWWMP requirements	All mines and industries. • *Should be undertaken when doing actions M-1.3, M-1.4 and M-1.6 and not in isolation*	Short to medium term	Mines/ Industries/ Power Stations in collaboration with WMI	Lead, collaborate and support
M-1.6	Review existing IWULs and request amendment applications as necessary	All areas	Short term	WMI	Lead
M-1.7	Implement compliance enforcement	All areas	Short term	WMI	Lead
M-1.8	Undertake relevant data collection and implement the waste discharge charge system	All areas	Medium to long term	DWS/ WMI	Lead
Strategic Measure M-2: Data collection					
M-2.1	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: Data collection					
A-2.1	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 (metals and oils and greases) from run-off from industrial areas *(links to D-1.1 and D-1.2)*					
I-1.1	Collaborate with the various industries within a management unit to assess the	Burgersfort; Tubatse	Short to medium term	Mines/ Industries/ Power Stations	Support

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	storm water management in these areas and prioritise where biggest improvements can be made				
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 lodge sanitation facilities along rivers and dams					
Strategic Measure R-1: Reduce nutrient and microbiological contamination from riverside accommodation and facilities in dam areas					
R-1.1	Inspect to ensure relevant authorisations are in place for package waste water treatment plants/ septic tank systems on	Loskop Dam area, Rhenosterkop Dam	Short to medium term	WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	WMI's Role
	the banks of rivers and dams;	area, R-2.1 to 2.4 should be undertaken simultaneously			
R-1.2	Enforce directives against non-compliance;		Short to medium term	WMI	Lead
R-1.3	Confirm adequate operation and maintenance by private individuals or lodge owners;		Short to medium term	WMI	Lead
R-1.4	Confirm designs for the number of people accommodated.		Short to medium term	WMI	Lead
Strategic Measure R-2: Data collection					
R-2.1	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

9. REFERENCES

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Department of Water and Sanitation (2016a): *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

Department of Water and Sanitation (2016b): *Development of an Integrated Water Quality Management Plan for the Olifants River System: Management Options Report.* Study Report No. 6, Report No: P WMA 04/B50/00/8916/7

Department of Water and Sanitation (2015) *Olifants River Water Supply System Reconciliation Strategy.* Report No. P WMA 04/B50/00/8715

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 A:

STAKEHOLDERS WHO ATTENDED AND CONTRIBUTED TO THE SUB-CATCHMENT WORKSHOPS

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

Heather Booysen	Samancor
Hugo Retief	AWARD
Imani Munyai	Wescoal Mining
Jakes Louw	Joint Water Forum
James Ndou	Modikwa Platinum Mine
Jan de Klerk	Sasol
Jaques Venter	SANparks
Jerry Penyene	AFASA
Johan van Stryp	Loskop Water Forum
Johanes Mathungene	LEPELLE/ farmer
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