Report Number 12

Edition 1

REPORT

Integrated Water Quality Management Plan for the Olifants River System

Monitoring Programme Report

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DEPARTMENT OF WATER AND SANITATION

Water Resource Planning Systems Series

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

Monitoring Programme Report

Study Report No. 12

P WMA 04/B50/00/8916/13

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APPROVAL

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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 have been completed:

- Scenario Analysis Report;
- Reconciliation and Foresight Report;
- Management Options Report;
- Integrated Water Quality Management Plans for each Sub-catchment:
    - IWQMP for the Upper Olifants sub-catchment;
    - IWQMP for the Middle Olifants sub-catchment;
    - IWQMP for the Lower Olifants sub-catchment;
    - IWQMP for the Steelpoort sub-catchment; and
    - IWQMP for the Letaba and Shingwedzi sub-catchments,

The following reports are now underway

- 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).

An important aspect of Integrated Water Resource Management is an integrated and consistent system of monitoring and information management. This is a requirement by the National Water Act (Act 36 of 1998) which requires that the Minister establishes a national monitoring system and an information system. The Act states that "*The purpose of the systems will be to facilitate the continued and co-ordinated monitoring of various aspects of water resources by collecting relevant information and data, through established procedures and mechanisms, from a variety of sources including organs of state, water management institutions and water users*".

This makes it clear that Department of Water and Sanitation (DWS) seeks to co-ordinate and harmonise systems of monitoring and information management of all Water Management Areas (WMA) to ensure such consistency. It also shows that monitoring cannot be dissociated from the information management system into which it feeds.

The objective of the Monitoring Programme Report is therefore to assess the current monitoring requirements at various levels throughout the Water Management Area in respect of variables of concern, location and frequency in relation to users and impacts in the various management units. In addition, a proposed programme for monitoring of the implementation plan is included. The report should assist the Water Resource Management Agency (WMI) to:

- Manage water resources monitoring and information in collaboration with DWS and other relevant organisations;
- Monitor, analyse and evaluate IWRM intentions and actions by collecting, accessing, analysing and sharing a wide range of information for the purposes of monitoring and evaluating IWRM and operational management; and
- Ensure findings are incorporated into a process of review, learning and design of follow-up activities (adaptive management).

The report highlights the need to improve, align and integrate the monitoring network in the Olifants WMA to adequately address the information needs and support IWRM. Co-operation between various organisations needs to take place to allow adequate monitoring to take place in respect of:

- Sampling locations;
- Frequency of monitoring; and
- Parameters measured.

- To maximise the monitoring in the system, the DWS, WMI, Water Service Providers, Water Boards, and other key water users including mines, industries and agriculture should co-ordinate their monitoring programmes to support effective and efficient capacity and resource utilisation;
- In this respect a collaborative effort is needed, that is led by the WMI/ DWS Provincial Office to upload all monitoring data for water users based on IWUL conditions, so that a comprehensive and integrated monitoring programme for these points can be agreed upon between all relevant stakeholders, to limit duplication ensure monitoring is meaningful. A template can be developed and issued to all water users to submit monthly with all relevant data. This will ensure that compliance data is captured timeously and can be used effectively;
- The current "fragmented" programmes can be built upon to ensure that all the monitoring points deliver the same information needs, as required, in a consistent and co-ordinated manner.
- Water quality monitoring must be consistently carried out at all monitoring points according to the agreed upon monitoring programme to enable all strategic points to build up credible data sets. This is specifically needed in those areas where gaps have been identified.
- It may be necessary to enter into co-operative agreements regarding sharing of water quality information (free of charge);
- The water quality variables measured need to be aligned to the WQPLs, Reserve requirements and RQOs, depending on the sites;
- Stream flow monitoring must be included at all the Upper Olifants, Steelpoort and Lower Olifants points just below Phalaborwa before entering the KNP to allow for trend analysis and determination of loads;
- It is also important to install air quality monitoring devices especially in the Upper Olifants sub-catchment to start determining the impact of atmospheric deposition on the water quality. Collaboration should take place between DWS Provincial Office/ WMI so that the data is effectively used and an also supports IWRM efforts.
- The monitoring needs can be phased into immediate, medium term and long term plans to ensure that the information needs are achieved over time.
- The recommendations of the DAM Strategy need to be supported.

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AIP	Alien Invasive Plants
AMD	Acid Mine Drainage
BDS	Blue Drop System
BWPCP	Brugspruit Water Pollution Control Plant
CAIA	Chemical Allied Industry Association
COGTA	Co-operative Governance and Traditional Affairs
CMF	Catchment Management Forum
CSIR	Council for Scientific and Industrial Research
DMR	Department of Mineral Resources
DoA	Department of Agriculture
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
ECMS	Electronic Case Management System
EDC	Endocrine Disrupting Compound
EFR	Ecological Flow Requirements
EWR	Ecological Water Requirements
EWRP	eMalahleni Water Reclamation Plant
eWULAAS	Electronic Water Use Licence Application and Authorisation System
FGM	Focus Group Meeting
GDS	Green Drop System
GIS	Geographical Information System
GLOBALG.A.P.	Global Good Agricultural Practice
GRIP	Groundwater Resource Information Programs
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
NCIMS	National Compliance Information Management System
NIP	National Implementation Plan
NGA	National Groundwater Archive
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
R/O	Regional Office
RQOs	Resource Quality Objectives
RWQOs	Resource Water Quality Objectives
SA	South Africa
SALGA	South African Local Government Association
SANS	South African National Standards
SAWQG	South African Water Quality Guidelines
TDS	Total Dissolved Salts
TOR	Terms of Reference
WARMS	Water Authorisation and Management System
WC/ WDM	Water Conservation/ Water Demand Management
WITS	University of the Witwatersrand
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
WMI	Water Management Institution
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 Elefantes which is controlled by inflows from upstream (South Africa).

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

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

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

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

The following aspects of the study have already been undertaken:

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    - IWQMP for the Letaba and Shingwedzi sub-catchments.

The following reports are now underway

- Monitoring Programmes Report;
- Overarching IWQMP for the Olifants River System; and

- Implementation Plan Report.

1.2 Study Area

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

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

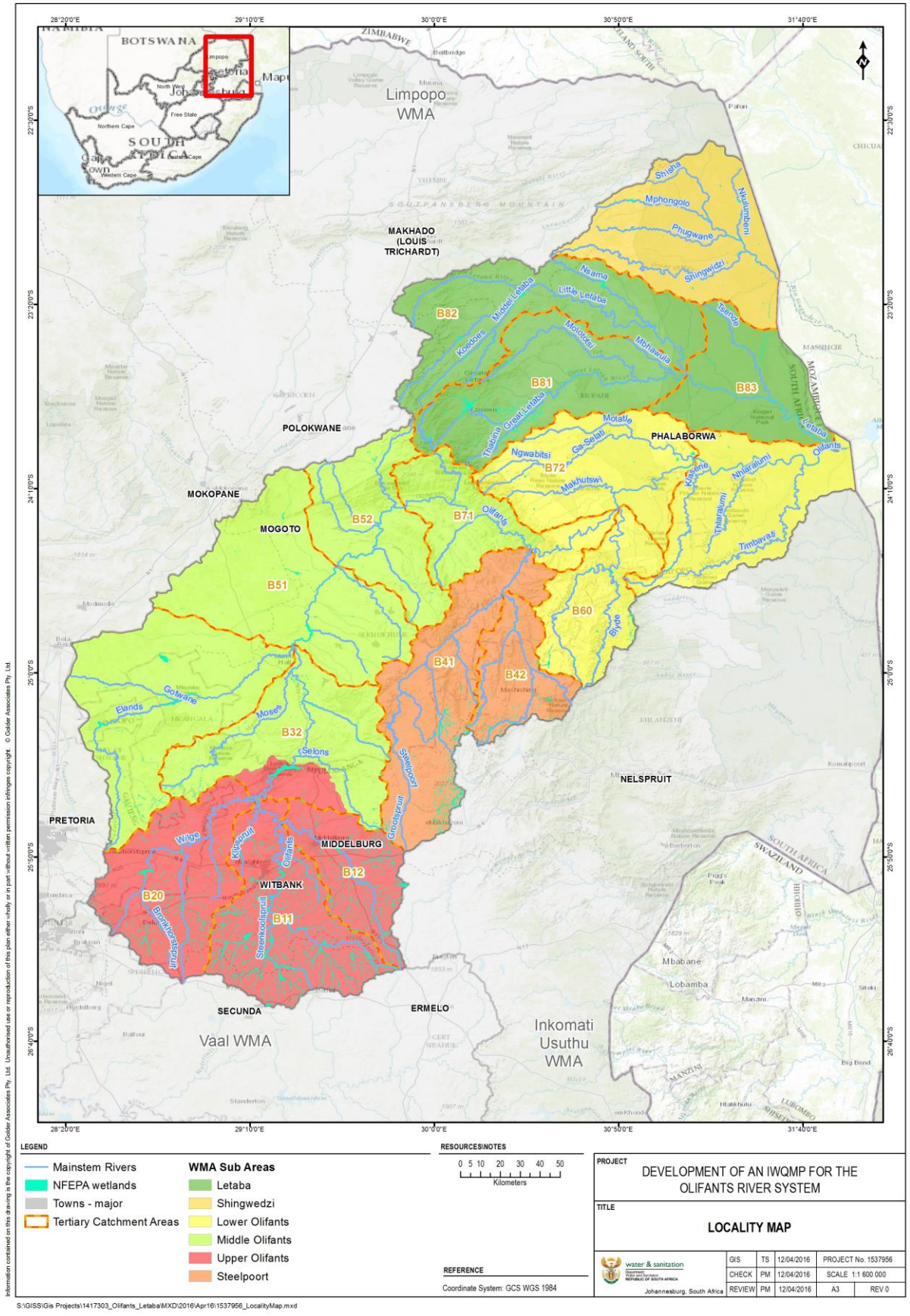

Figure 1: Study Area

1.3 Gaps identified in the Olifants WMA

The following gaps, with regard to water quality monitoring and monitoring programmes, and inadequacies were identified during the course of the project:

- In the various studies undertaken there are differences in:
    - Variables analysed;
    - Time periods and scales of the monitoring;
    - Analytical methods;
    - Laboratories used for the analysis;
    - Differences in data collection; and
    - Poor data storage so that it cannot be beneficially used.
- Lack of integration between the monitoring programmes of the National Programmes and Provincial Offices, and data is not always uploaded to the WMS database;
- There appears to be limited co-ordination between the Resource Quality Information Services and the Departmental Provincial Offices/ WMI regarding the location of monitoring stations, sampling frequency and analyses performed;
- Monitoring programmes are stopped due to contracts expiring;
- There is a lack of integration between various governmental organisations and other organisations undertaking catchment studies with regards to the monitoring programmes and monitoring;
- There appears to be no integration or co-operation between the Department and the Water Boards with regard to monitoring of the Olifants River System;
- Data from the monitoring stations have in many instances proved to be incomplete (information gaps) or insufficient (limited data sets). The data sets were fragmented and in cases their reliability was questionable;
- Monitoring stations are not always suitably located and thus in some instances the most downstream point on the tributaries were too high up in the catchment; meaning that the lower catchment impacts are not accounted for;
- The water quality monitoring variables currently analysed are largely concentrated on chemical and physical constituents: data for metals, microbiological and other emerging chemicals of concern, such as pesticides and contaminants of concern relating specifically to coal fired power stations are lacking;

- Not all monitoring points include flow measurements which limits the accuracy when determining loads and this would have an impact for the implementation of the waste discharge charge system (WDCS);
- No validation processes are in place to verify the data that has been captured (no validation of methods, sampling, analysis, etc.). This therefore sometimes raises questions about the validity of the data that is available on the Department databases;
- Except for one point at the Mamba weir (currently being tested), no continuous monitoring of water quality is practised in the Olifants River System. In impacted catchments the continuous monitoring of key water quality variables such as Electrical Conductivity would be beneficial for use with the flow monitoring stations to accurately assess the loads and compliance against WQPLs and RQOs;
- Groundwater quality data is limited and the monitoring programme will need to be extended.

1.4 Data Acquisition and Management Strategy for Water and Sanitation in South Africa (DWS, 2017)

The Integrated Water Information Systems (IWIS) Sub-Directorate of the Information Programs (IP) Directorate under the Chief Directorate: Water Information Management (WIM) is in the process of finalising a Data Acquisition and Management Strategy for Water and Sanitation in South Africa (DWS, 2017). The objective of the DAM Strategy is to provide strategic guidelines or a framework for managing all water and sanitation related data in order to improve the credibility, availability, accessibility, timeliness, and security of the data.

The proposed methodology followed for the review of water quality data management systems included:

- Assessment of business requirements and Information needs;
- Assessment of data requirements to fulfil the Information needs;
- Assessment of gaps in generating data required to fulfil Information needs;
- Recommendations for improving the effectiveness and efficiency of the water quality data management systems; and
- Propose data architecture for water quality DMS.

In summary the findings from the water quality Data Management System (DMS) review for water quality are:

- The are more than 10 data management systems being used to manage water quality data, including WMS, GIS, BDS, GDS, GRIP, HYDSTRA,

eWULAAS, NGA, Rivers DB, ECMS, NCIMS, WARMS, resulting in data being fragmented and stored in multiple formats.

- Some critical water data are not stored on a DMS but often retained on a personal computer or external hard drive; or in hard copy format,
- The WMS is not fully utilised (or not at all) by Provincial DWS Offices due to perceived lack of user friendliness; and not all the officials from the various DWS Provincial Offices are able to capture water quality data. It has been reported that some water quality data collected in the DWS regions has not been stored into the WMS for years.
- There is no structured DMS for Wetlands data,
- There is missing data that is collected by consultants and external institutions, and
- There is a need to develop data architecture for water quality data.

These findings are not unlike those reported through the course of this project and specifically in the Status Assessment Report (Report number: P WMA 04/B50/00/8916/3).

1.5 Transboundary obligations

Creating working transboundary water governance structures requires development of trust between stakeholders and an effectively functioning governance framework requires that information is easily available and accessible. The South African Development Community (SADC) strategy advocates that member states must communicate on the IWRM approach, co-operation on water management, climate change, variability and water-related disasters (SADC, 2000). There is therefore a process of developing a strategy underway for the Limpopo Basin to assist the basin states with its compliance monitoring. Water quality is one of the aspects under consideration. This strategy should assist in promoting regular information exchange rather than exchange due to incidents.

In addition, the Inco-Maputo Agreement between South Africa and Mozambique that has a specific Annexure on water quality monitoring exists. However, to date there are no clear steps for implementation.

Overall compliance monitoring needs to be improved and prioritised. However, the willingness for co-operation around aspects such as water quality in the Olifants River is a good foundation from which to move forward for both South Africa and Mozambique. The implementation of the Reserve, RQOs and WQPLs on the South African side should be met, which will contribute to the foundation of trust that currently exists and needs to be maintained.

2 OBJECTIVES OF THE MONITORING PROGRAMME REPORT

An important aspect of Integrated Water Resource Management is an integrated and consistent system of monitoring and information management. This is a requirement by the National Water Act (Act 36 of 1998) which requires that the Minister establishes a national monitoring system and an information system. The Act states that "*The purpose of the systems will be to facilitate the continued and co-ordinated monitoring of various aspects of water resources by collecting relevant information and data, through established procedures and mechanisms, from a variety of sources including organs of state, water management institutions and water users*".

This makes it clear that Department of Water and Sanitation (DWS) seeks to co-ordinate and harmonise systems of monitoring and information management of all Water Management Areas (WMA) to ensure such consistency. It also shows that monitoring cannot be dissociated from the information management system into which it feeds.

The objective of the Monitoring Programme Report is therefore to assess the current monitoring requirements at various levels throughout the Water Management Area in respect of variables of concern, location and frequency in relation to users and impacts in the various management units. Proposed monitoring points for ongoing assessment of trends and use in load determination at the WQPL points (outlets of each MU) are presented. The report should assist the Water Resource Management Agency (WMI) to:

- Manage water resources monitoring and information in collaboration with DWS and other relevant organisations;
- Monitor, analyse and evaluate IWRM intentions and actions by collecting, accessing, analysing and sharing a wide range of information for the purposes of monitoring and evaluating IWRM and operational management; and
- Ensure findings are incorporated into a process of review, learning and design of follow-up activities (adaptive management).

3 LEGAL REQUIREMENTS FOR A NATIONAL INFORMATION AND MONITORING SYSTEM

3.1 Legislation

Chapter 14 of the NWA describes the establishment of a number of national systems pertaining to monitoring, assessment and information management. Chapter 3, Part 6 of the NWRS (2004) details monitoring systems (S 3.6.2) and information systems (S 3.6.3).

Section 137 (2) states that the monitoring systems must provide for the collection of appropriate data and information necessary to assess, among other matters:

- The quantity of water in the various water resources;
- The quality of water resources;
- The use of water resources;
- The rehabilitation of water resources;
- Compliance with resource quality objectives;
- The health of aquatic ecosystems; and
- Atmospheric conditions which may influence water resources.

Section 138 of the NWA requires the establishment of mechanisms to co-ordinate monitoring of water resources. It states that:

138. The Minister must, after consultation with relevant -

(a) organs of state;

(b) water management institutions; and

(c) existing and potential users of water, establish mechanisms and procedures to co-ordinate the monitoring of water resources.

Section 140 of the NWA sets out the objectives of national information systems as being:

- To store and provide data and information for the protection, sustainable use and management of water resources;
- To provide information for the development and implementation of the National Water Resource Strategy; and
- To provide information to water management institutions, water users and the public:
    - For research and development;
    - For planning and environment impact assessments;
    - For public safety and disaster management; and
    - On the status of water resources.

Section 68 of the Water Services Act (Act No 108 of 1997)(WSA) provides for the Minister of Water and Sanitation to establish and maintain a national information system to record and provide data on the development, implementation and monitoring of national policy on water services and to provide information to water services institutions, consumers and the public. Section 69 stipulates that the Minister may require any province, water services institution and consumer to furnish information to be included in the national information system. As water services authorities and, in most instances, water services providers and

municipalities collect, store and manage data and information on water services provision either on their own or in conjunction with private service providers.

Provision of Information

Section 141 of the NWA provides for the provision of information from other organisations to the department, where the Minister may require in writing that any person must, within a reasonable given time or on a regular basis, provide the Department with any data, information, documents, samples or materials reasonably required for -

(a) the purposes of any national monitoring network or national information system; or

(b) the management and protection of water resources.

Access to information

Section 142 of the NWA sets out that **i**nformation contained in any national information system established in terms of Chapter 14 of the NWA, must be made available by the Minister, subject to any limitations imposed by law, and the payment of a reasonable charge determined by the Minister.

The strategic objectives set out in NWRS 2 (DWS, 2013) in relation to monitoring and information management are to:

- Develop and implement a national monitoring and information management plan to compile and maintain easily accessible and accurate data to support decision-making, reduce and manage risks and deal with emerging climate change impacts;
- Raise awareness of the importance of investing in the collection and management of high-quality water-related information for supporting water resource management;
- Improve governance of monitoring and information management in the water sector;
- Ensure uninterrupted continuation of existing monitoring programmes;
- Improve and enhance the quality of data and information on all aspects of water;
- Develop a high quality, integrated information management system for the water sector;
- Generate beneficial integrated water information products;
- Improve access to and dissemination of water data and information;
- Ensure that adequate skills and human resource capacity for monitoring and information management is developed; and

- Develop and implement a viable and adequate funding model for monitoring.

3.2 Principles of Information Management

Principles relating to monitoring and information management included in NWRS 2 (DWS, 2013) are:

- The system should be an integrated, easily accessible monitoring and information management system that would support the implementation of sustainable water management;
- Data on water must be collected, managed and protected as a strategic asset;
- The measurement and recording of observations on all aspects of the water value chain are essential for effective water management and inter-institutional collaboration;
- The effective use and exchange of data on water requires alignment with universal standards and world best practice;
- Monitoring and information management in a decentralised, participatory and multi-sectoral environment will require effective governance and co-ordination;
- Water data and information needs to be accessible at all levels of the public, so that all stakeholders can exercise their constitutional rights;
- Adequate skilled human resources are extremely important to ensure consistent quality of hydrological data; and
- Adequate, reliable funding is a prerequisite for the sustained and continued monitoring of water resources, and maintenance of an information management system.

3.3 National Monitoring Programmes

There are a number of national monitoring programmes which have been set up, however, have not necessarily been adequately maintained. These include:

- National Chemical monitoring Programme (NCMP);
- National Eutrophication monitoring Programme (NEMP);
- National Microbiological Monitoring Programme (NMMP);
- National Aquatic Ecosystem Health Monitoring Programme (NAEHMP) including the River Health Programme (RHP);
- National Radioactivity Monitoring Programme (NRMP);
- National Toxicity Monitoring Programme (NTMP); and
- Ecological Reserve Determination and Monitoring.

The frequency of monitoring varies for the different programmes, making some more useful than others in determining situation assessments and trends.

3.4 Network Inventory

In 2014/ 2015 a project was undertaken by the DWS, Chief Directorate: Water Information Management to assess the monitoring network throughout the country (2015). In this respect the Data Catalogue produced by the project was used by the project team to ascertain whether the proposed monitoring sites are part of that network.

In the Olifants WMA, in respect of water quality the following statistics were noted (Table 1)

Table 1: Status of surface water quality stations in the Olifants WMA

WMA	Area (km^2)	MAR(1)		Total number of closed stations / monitored variables	Number of open stations / monitored variables									Coverage of open stations (km^2/ station)(5)
		million m^3/a	mm/a		Chemical	Chemical (Priority Stations)(2)	Radioactivity	Wetland	Eutrophication	Toxicity	Microbial	Estuaries(3)	Total stations(4)	
Olifants	73 669	2 812	38	**11**	70	21	0	0	32	0	14	0	**110**	670

Note: (1) Natural mean annual runoff (WRC, 2008). (2) Priority stations are defined as those located in areas of significant anthropogenic or naturogenic water use where the quality of, or intended use of the water can be adversely affected. (3) These figures differ from the number of stations shown in the Map Book due the fact that all stations are not yet captured in the WMS system. (4) Total number of monitoring stations, which does not necessarily equal the sum of the columns (that includes all monitored variables). (5) Equates to the average area served by a single station.

4 STRATEGIC GOALS AND ACTIONS TOWARDS IMPLEMENTING A MONITORING AND INFORMATION SYSTEM FOR THE OLIFANTS WMA

4.1 Introduction

The collection of accurate data and information on water, and its' correct interpretation, are critical aspects of integrated water resource management, of which integrated water quality management is a large component. An accurate assessment of the catchment and its water uses and impacts cannot be determined if the collection and storage of data and information is not done in a structured manner that allows for extraction of reports that will add value and give guidance to the regulators and the water users. Monitoring is necessary to collect sufficient and accurate data to inform decision-making as well as to reduce and manage risks.

Information based on well-organised monitoring programmes is therefore a prerequisite for accurate assessments and in order to ensure integrated water

resources management the Olifants Water Resources Management Agency (WMI) needs to co-ordinate and maintain an information management system that will:

- Store and provide data and information for the protection, sustainable use and management of water resources;
- Allow the officials within the organisation to have a good understanding of the impacts from the water users based on trends reported and use the data to make decisions;
- Provide information for the development and implementation of the National Water Resource Strategy; and
- Provide information to water management institutions, water users and the public:
    - For research and development;
    - For planning and environment impact assessments;
    - For public safety and disaster management; and
    - On the status of water resources.

For the collection of appropriate data and information it is necessary to assess, amongst others:

- The quantity of water in the various water resources;
- The quality of water resources;
- The use of water resources;
- Seasonal variation (as exceedance during the dry season may cause more severe problems);
- The rehabilitation of water resources;
- Compliance with resource quality objectives;
- The health of aquatic ecosystems;
- Land use activities and the risk posed to a water resource; and
- Atmospheric conditions which may influence water resources.

In many cases these may be included as conditions within a water use authorisation, whether it is an ELU, covered by general authorisation or a water use licence.

4.2 Collaborative monitoring

Establishing how and what monitoring will be undertaken within the Water Resource Management Agency itself, as well as in collaboration with other government departments and other organisations, for local monitoring programmes, must be addressed.

In this respect partners that need to have a role in developing and implementing the monitoring programme for the Olifants WMA in the various sub-catchments' management units include:

- Mpumalanga Provincial Government;
- DWS: Mpumalanga Provincial Office;
- District Municipalities (Health Departments);
- Local municipalities (Water Service Providers);
- Water User Associations/ Irrigation boards;
- Biosphere Reserves;
- Catchment Committees and Forums;
- SanParks;
- Mines and industries; and
- Other organisations that may be undertaking monitoring for specific projects, such as those undertaken by Award (Resilim O project) and the MOSA project;
- Neighbouring WMAs; and
- International Water Committees such as LIMCOM.

4.3 Levels of monitoring

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

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

The DWS Provincial Office/ WMI needs to consider monitoring required at all of these levels within the WMA. There are essentially 5 categories of monitoring described in Table 2 that correspond to the 4 levels.

The fifth category relates to source related on-site (in-house) monitoring and may not be regulated. 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 also include aspects such as:

- Soil amelioration, including aspects such as:
    - Type of soil ameliorant added,
    - Volumes used;
    - Date's used during the year.
- Pesticide use:
    - What type (name); the
    - When spraying or other use will occur; and
    - How much is used.
- Pollution control/ contaminated storm water management dam levels and potential/ actual overflows;
- Issues such as seepage around Tailings Storage Facilities (TSF) and waste dumps;
- Storm water management system aspects in relation to compliance against relevant legislation.

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

Category (Monitoring type)		**Main party responsible**	**Notes**
1	Resource Quality Objectives (surface and groundwater components)	DWS Provincial Office/ WMI	• Mostly Level 1 and 2 monitoring points; • Legislated requirements; • Some of the sites may overlap with those sites where EWR sites are located.
2	Reserve requirements: EWR sites (surface water) and groundwater aspects	DWS Provincial Office/ WMI	• Level 1 and 2 monitoring points; • Legislated requirements; • Some of the sites may overlap with those sites where WQPLs are proposed to be monitored
3	Water Quality Planning Limit sites in each MU	DWS Provincial Office/ WMI (may be some water user collaboration)	• Level 1 and 2 monitoring points; • Proposed sites within the catchment that will give an indication of the upstream impacts in each management unit, and should be used to assist with what load should be removed and to assess progress made
4	Other water resource monitoring sites – often linked to a water user (surface and groundwater)	Water users	• Level 3 and 4 monitoring points; • Catchment sites on the smaller tributaries; • Legislated requirements in respect of water use authorisations;
5	Source related on-site monitoring (surface and groundwater)	Water users	• In-house, not necessarily regulated, however would assist the users to achieve the targets set for the legislated requirements. • This monitoring may also include aspects such as soil amelioration taking place, pesticide use, levels and potential overflow from contaminated dams etc.

4.4 Monitoring points

Table 3 sets out proposed monitoring points already existing for categories 1, 2 and 3, throughout the WMA. It highlights those management units where category 3 monitoring points are missing or not well located, as well as those points that were not included in the National Database as undertaken for the Network Inventory project (DWS, 2015).

It is important to note that many of the rivers in the WMA are non-perennial, so sampling regularly is not possible. In this respect these points should be monitored when water is present.

In all cases an attempt has been made to have a monitoring point as close to the outlet of the MU as possible. MU 9 however, has two monitoring points, B1H5 at Wolwekrans weir, almost central to the MU, however captures the largest portion of the load emanating from the top half of the MU as well as the load from MUs 5 and 7. The load in the "bottom' half of the MU is then captured by Witbank Dam (B1H10).

Monitoring weirs are important in the Upper Olifants sub-catchment, Steelpoort and lower parts of the Lower Olifants. It is noted that for the waste discharge charge system to be implemented further weirs will be required. The reasons for additional weirs (or monitoring points only) are described in Table 4. There are certain management units that do not have surface water monitoring points and where it would be counter-productive to try and implement one as these areas are either located in areas where surface water is most often absent or for example, located in the KNP and impacted only by natural land use activities. These are Timbavati River in MUs 52 and 53; Phugwani River in MU 76, Mphongolo River in MU 77 and the Shingwedzi and tributaries in MU 78 in the KNP.

Table 5 gives reasons for maintaining those monitoring points not included on the National Database.

Samples at the points set out in Table 3 should be taken by the WMI/ DWS Provincial Environmental Officers. Those points described in Table 2 as categories 4 and 5, should be set up in collaboration with all water users in the management unit, so that duplication does not occur, and only monitoring points that will add value are included. This would also save costs. It is very likely that many of the Level 4 and 5 points are already in place, from a DWS monitoring perspective or a water user perspective. This also means that the WMI/ DWS provincial Office needs to have a GIS based system where all points can be added, so that when a new water use is licensed, monitoring points are only added if they will give additional data that will be useful. Existing points for all water use licences need to be added to a GIS based system to assess the current coverage, as duplication may be occurring.

Table 3: Levels 1, 2 and 3 monitoring points

MU	Quaternary catchments	Main River/ tributary	RQO site	EWR site	WQPL Monitoring points (including weirs)	Coordinates	
Upper Olifants							
1	B11D	Trichardspruit			90411 (B1H6)	-26.3558	29.21417
2	B11E	Rietspruit and Blesbokspruit			New point required*	-26.224104	29.119757
3	B11B	Koringspruit			90418 (B1H20)	-25.9397	29.2575
4	B11G	Boesmanskransspruit			New point required*	-25.983385	29.323342
5	B11F	Klippoortjiespruit Tweefonteinspruit			192643#	-26.0519	29.19806
6	B11G	Noupoortspruit			90417 (B1H19)	-25.9397	29.2575
7	B11C/ B11D	Steenkoolspruit Dwars in-die-Weg Spruit			90415 (B1H17)	-26.3056	29.27417
8	B11A/ B11B	Olifants/ Joubertvleispruit/ Viskuile			90416 (B1H18)	-26.2167	29.45917
9	B11F/ B11G	Wolwekrans weir on Olifants	X		90410 (B1H5) and 90412 (B1H10)	-26.00639; -25.89167	29.25389; 29.30417
10	B12A	Klein Olifants			New point required*	-25.971399	29.719293
11	B12B	Rietkuilspruit			188397# and 90425 (B1H27)#	-25.9588	29.77514
12	B12B	Bosmanspruit			90421 (B1H23)#	-25.8828	29.64333
13	B12B	Woestalleenspruit			New point required*	-25.926352	29.623231
14	B12C	Klein Olifants			90413 (B1H12)	-25.8767	29.62944
15	B12C	Klein Olifants (Middelburg Dam)	X		188388#; 90432 (B2R2)	-25.8241; -25.775	29.56439; 29.54583
16	B11K	Brugspruit			185084	-25.7682	29.121
17	B11K	Blesbokspruit			90430 (B1H32) – not well located so needs to move	-25.752231	29.173088
18	B11K	Klipspruit			90408 (B1H4)	-25.6733	29.17111
19	B20G	Grootspruit			New point required*	-25.901520	29.030905
20	B20G	Saalboomspruit/ (Saalklapspruit)			New point required*	-25.909124	29.032692
21	B20G	Saalboomspruit/ Kromdraaispruit			New point required*	-25.735673	28.988955
22	B20E/ B20F	Wilge River		Olifants_ WIL1	90441 (B2H14)	-25.8267	28.88083
23	B20A/ B20B/ B20C	Bronkhorstspruit/ Unnamed tributaries/ Koffiespruit/ Osspruit	X		90443 (however a new point upstream of the Bronkhorstspruit Dam would be better suited)	-25.8869	28.72139

MU	Quaternary catchments	Main River/ tributary	RQO site	EWR site	WQPL Monitoring points (including weirs)	Coordinates	
24	B20D	Honde River/ Bronkhorstspruit			90433 (B2H3)	-25.7989	28.73583
25	B20H; B20J	Grootspruit/ Wilge River	X	Olifants_ EWR4	188223 (B2H16)	-25.5788	29.12747
26	B11H	Spookspruit		SPK-EWR1	90407 (B1H2)	-25.8183	29.33778
27	B12E	Klein Olifants	X	Olifants_ EWR3	New point required*	-25.673001	29.316482
28	B11J	Olfants River	X	Olifants_ EWR1	New point required*	-25.754758	29.317190
29	B11L	Klip/ Olifants	X		New point required*	-25.620317	29.214381
30	B32A	Kranspoortspruit/ Olifants			New monitoring points established upstream of Loskop Dam	-25.471455	29.252746
31	B12D	Vaalbankspruit			188403#	-25.8194	29.4036
Middle Olifants							
32	B32B/ B32C	Olifants d/s Loskop Dam)/ Klipspruit/ Selons	X (Loskop Dam outlet and bottom of B32C)		90455 (B1H17)	-25.41667	29.35833
33	B32E/ B32F	Bloed River			New point required*	-25.140610	29.450128
34	B32D	Olifants River		Olifants_ EWR5	191682#	-25.16167	29.41417
35	B32G/ B32H	Moses River			90448 (B3H7) and 90447 (B3H5)#	-25.2694; -24.990556	29.18472 29.351389
36	B31A/ B31B/ B31C/ B31D/ B31E/ B31F/ B31G/ B31H/ B31J	Elands River		Olifants_ EWR6	90458	-24.9253	29.25917
37	B51E excluding the Zebediela portion running from the R519	Grass Valley River			New point required*	-24.697519	29.422579

MU	Quaternary catchments	Main River/ tributary	RQO site	EWR site	WQPL Monitoring points (including weirs)	Coordinates	
	to the Nkumpi River in B51G						
38	B32J	Olifants			90444 (B3H1)	-25.1617	29.41417
39	B51C/ B51H/ B52A/ B52B/ B52E	Olifants			New point required*	-24.360943	29.761379
40	B51F/ B51G plus the Zebediela portion running from the R519 road in B51E to the Nkumpi River in B51G	Doring/ Nkumpi		Olifants_ EWR7	New point required*	-24.363157	29.354257
41	B52C/ B52D	Chunies			New point required*	-24.284912	29.554275
42	B71E	Motse			New point required*	-24.322762	30.162654
43	B52F/ B52G/ B52J/ B52H/ B71A/ B71C/ B71B	Olifants/ Monametsi			90484 (B5H2)	-24.2675	29.80139
44	B71B/ B71D	Olifants		Olifants_ S10 (EWR8)	New point required*	-24.300692	30.173611
45	B71F	Olifants			New point required*	-24.349356	30.300339
46	B51B/ B51A	Olifants (Flag Boshielo Dam)			90488 (B5R2)	-24.7809	29.4264
Steelpoort							
59	B41A	Grootspruit			New point required*	-25.583682	29.879428
60	B41E	Steelpoort to De Hoop Dam			90467 (B4H3)	-25.0267	29.86017
61	B41C/ B41D	Mapochs River just ustream of confluence with Steelpoort			1000009848[#]	-25.0916	29.86389
62	B41F	Klip			190142	-25.1861	30.02297
63	B42B	Dorps			90472 (B4H10)	-25.0753	30.43889
64	B42F/ B42G	Waterval			90469 (B4H5)	-25.0378	30.21917
65	B41J	Steelpoort		EWR9	1000009856 (L46)[#]	-24.718	30.20074

MU	Quaternary catchments	Main River/ tributary	RQO site	EWR site	WQPL Monitoring points (including weirs)	Coordinates	
					1000009845 (L27)#	-24.659373	30.301860
66	B42D	Spekboom			90470 (B4H9)	-25.0081	30.43889
67	B42H	Spekboom	X		188912 (L74)	-24.6601	30.33681
68	B41K	Steelpoort	X	EWR10	193091 (B4H25)	-24.4835	30.41502
81	B41G	Dwars			90471 (B4H9)	-24.9125	30.10333
Lower Olifants							
47	B60H	Ohrigstadt			1000009803 (L14)	-24.7282	30.57359
48	B60D	Blyde River			90490 (B6H1)	-24.6861	30.815
49	B71J	Olifants		EWR11	90506 (B7H9)	-24.33117	30.74164
50	B60J	Blyde River		EWR12	188281 (B6H17)	-24.31418	30.85620
51	B73A	Klaserie			90502 (B7H4)	-24.5553	31.03222
52	B73E	Timbavati			No monitoring points	-24.547263	31.175270
53	B73F	Timbavati			No monitoring points	-24.455556	31.397770
54	B72C	Makhutswi			90503 (B7H7)	-24.1833	30.81507
55	B72D	Olifants to Phalaborwa barrage	X	EWR13	192539#	-24.06908	31.14528
56	B72H	Ga-Selati			1000009796 (L3)#	-23. 97759	31. 07371
57	B72G	Ga-Selati/ Ngwabitsi			New point required*	-24.057127	30.482941
58	B72J	Molatle			New point required*	-23.910417	30.680457
80	B72K	Ga-Selati	X	EWR14A EWR14B	90518 (B7H19)	-24.038	31.13331
Letaba							
69	B81A; B81B; B81C; B81D; B81E	Groot Letaba	X	Letaba_ EWR2 (B81D) Letaba_ EWR 1 (B81B) Letaba_BR O1 (B81A)	90525 (B8H9) – a new sampling point needed at outlet of MU to incorporate contributions from the Nwanedzi	-23.8803; -23.753828	30.36694; 30.491928
70	B82E; B82F; B82G	Klein Letaba	X		New point required*	-23.312547	30.685658
71	B81G; B81F; B81H; B81J	Groot Letaba			90524 (B8H8)	-23.6581	31.05
72	B82H	Nsama			90581 (at Nsami Dam) – need a		

MU	Quaternary catchments	Main River/ tributary	RQO site	EWR site	WQPL Monitoring points (including weirs)	Coordinates	
					point at the outlet of the MU (non-perennial river)		
73	B82J	Klein Letaba			90536 (B8H28)	-23.6486	31.14722
74	B83A; B83B; B83C; B83D; B83E	Groot Letaba	X	Letaba_ EWR7 (B83D)	90529 (B8H18)	-23.8386	31.64083
79	B82A; B82B; B82C; B82D	Middle Letaba			90547 (at MLD) (B8H54) (canal at Middle Letaba Dam)		
Shingwedzi							
76	B90C	Phugwane			No monitoring points	-	-
77	B90B	Mphongolo			No monitoring points	-	-
78	B90B B90A; B90E; B90D; B90G; B90H	Shingwedzi and tributaries in KNP			No monitoring points	-	-
75	B90F	Shingwidzi		Shingwedzi _SHI1	90582 (B9H2)	-23.21528	31.22

* see Table 4 for reasons for new points; # not included in National Database; # see table 5 for points that are not included in the national Database Inventory (DWS 2015) but that need to be maintained.

Table 4: Reason for new or amendment to existing monitoring point

MU	Quaternary catchments	Main River/ tributary	Reason for new or amended WQPL monitoring point	Coordinates	
Upper Olifants					
2	B11E	Rietspruit and Blesbokspruit	With the implementation of the WDCS[1], specifically in the Upper Olifants in respect of salinity, it will be very important to accurately calculate loads at the outlet of the MU[2]; a weir will be required at these points	-26.224104	29.119757
4	B11G	Boesmanskransspruit		-25.983385	29.323342
10	B12A	Klein Olifants		-25.971399	29.719293
13	B12B	Woestalleenspruit		-25.926352	29.623231
17	B11K	Blesbokspruit	90430 (B1H32) – is situated very high in the MU and only indicates pollution from the urban area (Pine Ridge) so should ideally be moved lower down	-25.752231	29.173088
19	B20G	Grootspruit	Currently no point monitoring the impacts on the Grootspruit from Highveld Steel, and other non-point sources.	-25.901520	29.030905
20	B20G	Saalboomspruit/ (Saalklapspruit)	Currently no point monitoring the impacts from the town of Phola and agricultural impacts which are quite extensive in this MU.	-25.909124	29.032692
21	B20G	Saalboomspruit/ (Saalklapspruit) Kromdraaispruit	The Wilge has been classified as a Class II river, therefore additional protection is needed in this MU. A weir will be required at this point on the Saalboomspruit just above Wilge confluence to assess the loads emanating from this MU; With the implementation of the WDCS[1], specifically in the Upper Olifants in respect of salinity, it will be very important to accurately calculate loads at the outlet of the MU[2];	-25.735673	28.988955
27	B12E	Klein Olifants	With the implementation of the WDCS[1], specifically in the Upper Olifants in respect of salinity, it will be very important to accurately calculate loads at the outlet of the MU[2]; In addition the RQO and Olifants EWR 3 is located in this MU	-25.673001	29.316482
28	B11J	Olfants River	A new monitoring point downstream of Spookspruit confluence is needed, and preferably below Presidentsrus. It does not need to be lower in the MU as the lower impacts are natural;	-25.754758	29.317190
29	B11L	Klip/ Olifants (RQO)	A monitoring point will be required to assess the RQOs in this MU; a water quality point only should be adequate	-25.620317	29.214381
Middle Olifants					
33	B32E/ B32F	Bloed River	New water quality point required as there is currently no data to assess the impacts of the agricultural activities taking place along the river;	-25.140610	29.450128

MU	Quaternary catchments	Main River/ tributary	Reason for new or amended WQPL monitoring point	Coordinates	
37	B51E excluding the Zebediela portion running from the R519 to the Nkumpi River in B51G	Grass Valley River	New water quality point required as there is currently no point to assess the considerable upstream agricultural activities (likely to be non-perennial);	-24.697519	29.422579
39	B51C/ B51H/ B52A/ B52B/ B52E	Olifants	This site is at the Olifantspoort weir, however there appears not be data for this site on the DWS WMS[3]; water quality and flow data need to be implemented at this site;	-24.360943	29.761379
40	B51F/ B51G plus the Zebediela portion running from the R519 road in B51E to the Nkumpi River in B51G	Doring/ Nkumpi	New water quality monitoring point required as there is currently no data to assess the upstream impacts from the large number of villages in this MU.	-24.549727	29.526985
41	B52C/ B52D	Chunies	New water quality monitoring point required as there is currently no data to assess the upstream impacts from the large number of villages in this MU.	-24.335850	29.742086
42	B71E	Motse	There is currently no data relating to the impacts from the extensive villages and mining (Moopetsi) upstream;	-24.322762	30.162654
44	B71B/ B71D	Olifants	This is the Lebalelo weir; it is not included in the list as open sites for the National Monitoring Inventory, water quality and flow data needs to be implemented at this point;	-24.300692	30.173611
45	B71F	Olifants	A monitoring point at the outlet of NU 45 will be quite difficult, however it would be useful to have a point here as it is just upstream of the confluence with the Steelpoort;	-24.349356	30.300339
Steelpoort					
59	B41A	Grootspruit	Weir required to measure flow and water quality at this point as there is currently no data showing the impacts from the Belfast area where coal mining is being extended	-25.576406	29.887239
Lower Olifants					
52	B73E	Timbavati	There are no monitoring points in these MUs as the fall into the KNP[4]	-	-

MU	Quaternary catchments	Main River/ tributary	Reason for new or amended WQPL monitoring point	Coordinates	
53	B73F	Timbavati	with natural upstream impacts;	-	-
57	B72G	Ga-Selati/ Ngwabitsi	New point needed to assess impacts below irrigated areas along the Ga—Selati and Ngwabitsi	-24.057127	30.482941
58	B72J	Molatle	A water quality monitoring point here would allow an assessment of any impacts from the mine at Josephine and Gravelotte; likely to be non-perennial; just upstream of the confluence with the Ga-Selati River	-23.926828	30.891849
Letaba					
69	B81A; B81B; B81C; B81D; B81E	Groot Letaba	A new sampling point needed at outlet of MU to incorporate contributions from the Nwanedzi River;	-23.753828	30.491928
70	B82E; B82F; B82G	Klein Letaba (RQO)	183879 (B8H33) – directly below Giyani WWTW, therefore will need a point lower down at outlet of MU	-23.419656	30.918155
Shingwedzi					
76	B90C	Phugwane	There are no monitoring points in these MUs as the fall into the KNP[4] with natural upstream impacts;	-22.985550	30.942951
77	B90B	Mphongolo		-22.881436	30.798490

Notes: 1). WDCS: Waste discharge charge system; 2). MU: Management Unit

Table 5: Sampling points not included in the National Database Inventory (DWS, 2015) but that need to be maintained

MU	Quaternary catchments	Main River/ tributary	Monitoring point ID	Reason for new or amended WQPL monitoring point	Coordinates	
5	B11F	Klippoortjiespruit Tweefonteinspruit	192643	Need a point here to assess the load from the Klippoortjiespruit, specifically for the WDCS	-26.0519	29.19806
11	B12B	Rietkuilspruit	188397 and 90425 (B1H27)	Considerable data at 188397, however it is very centrally located does not include all contributions. Monitoring point 90425 (B1H27 would be better suited and should be reopened.	-25.9588; -25.963611	29.77514; 29.719722
12	B12B	Bosmanspruit	90421 (B1H23)	Required to determine the load from the Bosmanspruit	-25.8828	29.64333
15	B12C	Klein Olifants (Middelburg Dam)	188388#; 90432 (B2R2)	188388 is just upstream of Middleburg dam;	-25.8241; -25.775	29.56439; 29.54583
31	B12D	Vaalbankspruit	188403#	Needed to assess load from Industry in the Vaalbankspruit	-25.8194	29.4036
34	B32D	Olifants River	191682#	An important point to assess impacts on the Olifants at Groblersdal downstream of the town and the extensive irrigated area	-25.16167	29.41417
35	B32G/ B32H	Moses River	90448 (B3H7) and 90447 (B3H5)#	90448 is upstream of the irrigated area and only includes some of the impacts from the villages; the irrigation is extensive so should needs to be included which monitoring point B3H5 will do as it is located at the outlet of the MU	-25.2694; -24.990556	29.18472 29.351389
42	B71E	Motse	1000009844 (L26)#	This is a valuable point to	-24.40697	30.08049
61	B41C/ B41D	Mapochs River just ustream of confluence with Steelpoort	1000009848 (L31)#	Important for determining the impacts related to the upstream mining	-25.0916	29.86389
65	B41J	Steelpoort	1000009856 (L46)# 1000009845 (L27)#	Both of these points are important to assess the full extent of pollution from the Steelpoort	-24.718 -24.659373	30.20074 30.301860
55	B72D	Olifants to Phalaborwa barrage	192539#	At the Phalaborwa barrage at Lepelle Northern Water	-24.06908	31.14528

MU	Quaternary catchments	Main River/ tributary	Monitoring point ID	Reason for new or amended WQPL monitoring point	Coordinates	
56	B72H	Ga-Selati	1000009796 (L3)#	Needed to monitor impacts on Ga-Selati to MU 80 which is around the Phalaborwa mining complex	-23. 97759	31. 07371

4.5 Variables of concern

The Water Quality Planning Limits report (Report number: P WMA 04/B50/00/8916/4) describes the following variables that should be monitored at each of the points described in Table 3.

- Calcium (dissolved)
- Chloride (dissolved)
- Total Dissolved Solids
- Electrical Conductivity
- Fluoride (dissolved)
- Potassium (dissolved)
- Magnesium (dissolved)
- Sodium (dissolved)
- Ammonium (NH_4-N)
- Nitrate
- Total Phosphorus
- pH
- Ortho-phosphate
- Sulphate (dissolved)
- Total Alkalinity
- Dissolved Organic Carbon
- Dissolved Oxygen
- SAR
- Suspended Solids
- Chlorophyll a
- *Escherichia coli*
- Faecal coliforms
- Aluminium
- Boron
- Chromium (VI)
- Iron
- Manganese

Where these sites are also EWR or RQO sites, then there may be additional variables that need to be monitored, based on the legislated requirements, and may include the following:

- Chloride
- Total Dissolved Solids
- Electrical Conductivity
- Sulphate
- pH
- Phosphate
- Nitrate-Nitrite
- Total IN
- Ammonia
- Chl-*a* phytoplankton
- Alkalinity
- Turbidity
- Dissolved oxygen
- Temperature
- Suspended Solids
- Fluoride
- Aluminium
- Arsenic
- Cadmium (hard)
- Chromium (VI)
- Copper (hard)
- Mercury
- Manganese
- Lead hard
- Selenium
- Zinc
- Chlorine
- Endosulfan
- Atrazine
- Pathogens

4.5.1 Metals

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

- A broader spectrum of metals (and other relevant non-metals and mettalloids) relating to coal-fired power generation, at catchment level as described for the additional WQPLs in Report number: P WMA 04/B50/00/8916/4, as well as to be included in relevant licences, including at least:
    - Antimony
    - Arsenic
    - Barium
    - Beryllium
    - Bromide
    - Cadmium
    - Cobalt
    - Lead
    - Mercury
    - Nickel
    - Selenium
    - Thallium
    - Uranium
    - Vanadium
- It is important these are measured using the ICP-MS method so that the detection limit is fine enough to get an accurate reading;
- The WMI/ DWS Provincial Office needs to enable the consolidation and uploading of existing metals data from mines and industries.

4.5.2 Microbiological Monitoring

The following aspects relating to microbiological contamination need to be implemented by the WMI/ DWS Provincial Office 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.

4.5.3 Emerging contaminants monitoring

The management of emerging contaminants will need to be a collaborative effort between various level of government and other relevant organisations including: DoA, WUA and IBs, Local Government, National and Provincial Departments of Health, National and Provincial Departments of Environmental Affairs. Emerging contaminants and perceptions by stakeholders should not be underestimated. This is particularly with respect to pesticide use in the upper reaches of the Middle Olifants, Lower Olifants and Letaba sub-catchments, as well as contaminants from WWTW, such as hormones and pharmaceutical products that are not routinely monitored. It is proposed that emerging contaminants management be undertaken using best management practices, and linking to research being undertaken:

The following aspects are relevant for pesticide management:

- Pesticide use is regulated by Global Gap certification (GLOBALG.A.P.)[1] that would include aspects such as:
  - concentrations allowed;
  - withholding periods; and
  - spray records keeping (also checked by DAFF).
- Certain pesticides are not permitted for use if fruit is to be exported;
- Fruit is tested for residue for verification for export by PPECB[2];
- Strict rules, for example, cabbage and lettuce where water can get trapped between leaves; would be specifically relevant to microbiologically contaminated water;
- Citrus uses micro sprays and drip irrigation so less chance of run-off;

The following actions are also proposed:

- Spraying is seasonal and varies in different areas of the Olifants WMA. The WMI should be notified of the schedule of spraying or at least when spraying will occur; what is being sprayed when; is it a known EDC/ carcinogen;
- Pesticides are also regulated by South African National Standards (SANS), however after 10 years the licence falls away and generics come into the picture which are not SANS accredited;

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

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

- It would be useful to have a link on the WMI MIS to suppliers who should have data on when certain products are used and in what volumes;
- Based on the above the CMA 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. This may also be in collaboration with the WRC.

The key regulatory measures relevant for the management of the Persistent Organic Pollutants (POPs) life cycle included in the National Implementation Programme (NIP) for the Stockholm Convention on POPs are included in the Implementation Plan.

- Regulations which provide a wide range of controls and measures that include the authorisation of certain listed processes and activities that relate to chemicals management; atmospheric emission licensing; registration of agricultural remedies and chemicals, development of industrial waste management plans for certain identified industries, identification for priority waste streams; import controls and import permit requirements for certain listed products as well as the ability to implement import restrictions on certain identified products and wastes;
- Norms and standards which include remediation standards, air quality and emission standards for listed activities and technical specifications for the management or use of certain products;
- Directives and compliance notices requiring that reasonable measures are taken to prevent and remedy pollution or degradation of the environment;
- Market based management instruments such as the water pricing strategy which includes charges for waste discharges and incentives for introducing new technologies; and
- Public participation requirements in licensing, permitting and environmental authorisation processes.

4.5.4 Category 4 and 5 variables: activity specific

For the category 4 and 5 monitoring points the variables may differ depending on the activities. Major variables for specific activities are included in Table 6.

Table 6: Specific variables of concern related to land use activities in the WMA

Activities	Specific variables of concern	
Coal mining	• pH • Acidity • Alkalinity • Dissolved oxygen • Conductivity • Total Dissolved Solids	• Nitrates (as N) • Orthophosphate (as P) • Iron • Lead • Arsenic • Aluminium

Activities	**Specific variables of concern**	
	• Sodium • Potassium • Sulphate • Free and saline ammonia (as N)	• Manganese • Nickel • Copper
Coal fired power stations	• Antimony • Arsenic • Barium • Beryllium • Bromide • Cadmium • Cobalt	• Lead • Mercury • Nickel • Selenium • Thallium • Uranium • Vanadium
Agricultural areas: Irrigation	• pH • Dissolved oxygen • Nitrates (as N) • Orthophosphate (as P) • Sodium	• Potassium • Chlorides • Pesticides (see discussion in • Aluminium • Iron
Agricultural areas: Intensive animal feedlots	• pH • Dissolved oxygen • Total Dissolved Solids • Free and saline ammonia (as N)	• Nitrates (as N) • Orthophosphate (as P) • Typical (faecal) coli/ E. coli
Industrial areas and mining areas in the Steelpoort and Lower Olifants	• pH • Dissolved oxygen • Conductivity • Total Dissolved Solids • Sodium • Potassium • Sulphate • Aluminium (as Al) • Arsenic (as As) • Boron (as B) • Total chromium (as Cr) • Chromium VI (as Cr) • Copper (as Cu) • Phenolic compounds (as phenol)	• Lead (as Pb) • Soluble ortho-phosphate (as P) • Iron (as Fe) • Manganese (as Mn) • Cyanides (as Cn) • Sulphides (as S) • Fluoride (as F) • Zinc (as Zn) • Cadmium (as Cd) • Mercury (as Hg) • Selenium (as Se)
Urban areas (including downstream WWTW):	• pH • Dissolved oxygen • Typical (faecal) coli/ E. coli • Conductivity • Suspended solids • Sodium	• Potassium • Soap, oil or grease • Free and saline ammonia (as N) • Nitrates (as N) • Orthophosphate (as P)
WWTW final effluent	*All final effluent monitoring should include:* • pH • Dissolved oxygen • Typical (faecal) coli/ E. coli	*Where industrial areas discharge to sewer, the following suite of metals should also be monitored in the final effluent to get a understanding of the pollutants and then the list can be refined if necessary:*

Activities	Specific variables of concern	
	• Temperature • Chemical oxygen demand • Oxygen absorbed • Conductivity • Suspended solids • Sodium content • Soap, oil or grease – especially in areas where abattoirs are located and may be discharging to sewer • Residual chlorine • Free and saline ammonia (as N) • Nitrates (as N) • Orthophosphate (as P)	• Arsenic (as As) • Boron (as B) • Total chromium (as Cr) • Copper (as Cu) • Phenolic compounds (as phenol) • Lead (as Pb) • Soluble ortho phosphate (as P) • Iron (as Fe) • Manganese (as Mn) • Cyanides (as Cn) • Sulphides (as S) • Fluoride (as F) • Zinc (as Zn • Cadmium (as Cd) • Mercury (as Hg) • Selenium (as Se)

4.6 Regional Laboratories

It has been proposed by regional staff at several of the offices that the department should operate its own laboratories, or at least have contracts with the local laboratories. An important aspect is that of laboratory accreditation.

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.

4.7 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.

The readings should then be downloaded or recorded immediately onto the MIS. This could assist as an early warning system (EWS).

5 GROUNDWATER QUALITY MONITORING

Based on the assessment of the groundwater quality data in the Olifants WMA, the current status of the groundwater is impacted specifically by the following constituents:

- Total Hardness – not specifically a health risk up to Class 2 maximum concentration levels, however, warm water systems and certain industrial water uses may be impacted significantly;
- Salinity (TDS due to mainly dissolved Na/Mg-Cl salts) – Health and aesthetic (taste) ;
- Toxic nitrate concentrations due to anthropogenic activities; and
- Toxic fluoride concentrations due to specific rock-aquifer decomposition (or weathering, specifically certain granites and granite-gneisses.

It was however noted in the Status Assessment report (Report number: P WMA 04/B50/00/8916/2) that groundwater quality data is inadequate and the monitoring programme will need to be revitalised. Those groundwater monitoring points recorded as part of the National Database (DWS 2015) are included in Appendix A.

This is particularly important in areas where boreholes are in place for abstraction for domestic use. A hydrocensus will need to be undertaken in all sub-catchments to document all the existing boreholes and data available. This database needs to be maintained and water users need to be able to upload water quality data and water levels onto a central site so that the DWS Provincial Office/ WMI can make proper management decisions in respect of where the hotspots are and in which areas treatment may be necessary.

Where groundwater is used in the domestic sector the SANS 241 standards need to be used for compliance assessment.

6 DATA MANAGEMENT

There is a need to expand the current coverage of water quality data and information because it is inadequate in some areas. This does not mean that the Olifants WMI must do all the monitoring, rather that the Olifants WMI needs to co-ordinate a system to collect and store data related to water resources management.

Data sharing between stakeholders in the water sector is insufficient, resulting in information needs not being satisfied as well as they could be. An effective information management system should be built on the following principles:

Understandable: as information is already in a summarised form, it must be understood by the person receiving the information so that it is correctly interpreted. The person/ group must be able to decode any abbreviations, shorthand notations or any other acronyms contained in the information.

Relevant: information is good only if it is relevant which means that it should be appropriate and meaningful to the decision-maker and the stakeholders who want to access that information;

Complete: it should contain all the facts that are necessary for the decision-maker to satisfactorily solve the problem at hand. Nothing important should be left out. Although information cannot always be complete, every reasonable effort should be made to include it;

Available: information may be useless if it is not readily accessible in the preferred form, when it is needed. Advances in technology have made information more accessible today than ever before.

Reliable: the information should be accurate, consistent with facts and verifiable. Inadequate or incorrect information generally leads to decisions of poor quality, as well as stakeholder concerns and could lead to a breakdown of trust.

Concise: too much information is a burden on management and cannot be processed in time and accurately. Accordingly, information should be to the point but adequate to give a clear picture of what is happening.

Timely: information must be delivered at the right time and the right place to the right person. Premature information can become obsolete or be forgotten by the time it is actually needed. Similarly, important decisions could be delayed because proper and necessary information is not available in time, resulting in missed opportunities. Accordingly the time gap between collection of data and the presentation of the proper information to the decision maker must be reduced as far as possible.

Cost-effective: the cost of gathering data and processing it into information must be weighed against the benefits derived from using such information.

The objective for an effective information management system is to identify:

- What needs to be monitored;
- Where it need to be monitored;
- How often it needs to be monitored; and
- What needs to be reported, how often and to whom?

From this an adequate management information systems needs to be put in place, or an existing system such as the WMS upgraded, to store the data collected and produce management information for decision to be made and for stakeholders to be kept informed.

In this respect 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 actions set out in Integrated Water and Waste Management Plans;
- Allow water users more access to input data, specifically related to their IWUL conditions;
- 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 RECOMMENDATIONS

There is a definite need to improve, align and integrate the monitoring network in the Olifants River System to adequately address the information needs and support IWRM. Co-operation between various organisations needs to take place to allow adequate monitoring to take place in respect of:

- Sampling locations;
- Frequency of monitoring; and
- Parameters measured.
- To maximise the monitoring in the system, the DWS, WMI, Water Service Providers, Water Boards, and other key water users including mines, industries and agriculture should co-ordinate their monitoring programmes to support effective and efficient capacity and resource utilisation;
- In this respect a collaborative effort is needed, that is led by the WMI/ DWS Provincial Office to upload all monitoring data for water users based on IWUL conditions, so that a comprehensive and integrated monitoring programme for these points can be agreed upon between all relevant stakeholders, to limit duplication ensure monitoring is meaningful. A template can be developed and issued to all water users to submit monthly with all relevant data. This will ensure that compliance data is captured timeously and can be used effectively;

- The current "fragmented" programmes can be built upon to ensure that all the monitoring points deliver the same information needs, as required, in a consistent and co-ordinated manner.
- Water quality monitoring must be consistently carried out at all monitoring points according to the agreed upon monitoring programme to enable all strategic points to build up credible data sets. This is specifically needed in those areas where gaps have been identified.
- It may be necessary to enter into co-operative agreements regarding sharing of water quality information (free of charge);
- The water quality variables measured need to be aligned to the WQPLs, Reserve requirements and RQOs, depending on the sites;
- Stream flow monitoring must be included at all the Upper Olifants, Steelpoort and Lower Olifants points just below Phalaborwa before entering the KNP to allow for trend analysis and determination of loads;
- It is also important to install air quality monitoring devices especially in the Upper Olifants sub-catchment to start determining the impact of atmospheric deposition on the water quality. Collaboration should take place between DWS Provincial Office/ WMI so that the data is effectively used and an also support IWRM efforts.
- The monitoring needs can be phased into immediate, medium term and long term plans to ensure that the information needs are achieved over time.
- The recommendations of the DAM Strategy need to be supported.

Development and Implementation of a Data Acquisition and Management (DAM) Strategy for Water and Sanitation in South Africa

The recommendations from the draft *Implementation Plan Report: Review of Data Management Systems (DMS): Water Quality* currently underway are the following:

- **Recommendation 1:** Develop an integrated approach or method to efficiently and effectively manage the ± 10 data management systems used to manage of water quality data.
- **Recommendation 2:** Identify and retrieve data stored in personal computers, hard drives and as hard copies; and transfer into relevant data management systems.
- **Recommendation 3:** Develop a structured data management system for wetlands data.
- **Recommendation 4:** Improve the ease of use of the WMS.
- **Recommendation 5:** Enable access to water quality data collected by external institutions and consultants.

- **Recommendation 6:** Investigate methods for developing data architecture for water quality data.

8 REFERENCES

Department of Water Affairs (2013) *Classification of Significant Water Resources in the Olifants Water Management Area (WMA 4): Management Classes of the Olifants WMA*. Report No: RDM/WMA04/00/CON/CLA/0213

Department of Water and Sanitation (2016) Determination, Review and Implementation of the Reserve in the Olifants/ Letaba System: Ecological Specifications Report. Report No: RDM/WMA02/00/CON/0516

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 Affairs (2014) *Development of a Reconciliation Strategy for the Luvuvhu and Letaba Water Supply System*: Final Reconciliation Strategy. Report No. P WMA 02/B810/00/1412/15

Department of Water Affairs (2015) Review, *Evaluation and Optimisation of the South African Water Resources Monitoring Network*: Network Inventory Volume 1: Main Report.

Department of Water and Sanitation (2017) draft *Implementation Plan Report: Review of Data Management Systems (DMS): Water Quality*

SADC (2000) Revised Protocol on Shared Watercourses in the Southern African Development Community

APPENDIX A:

GROUNDWATER MONITORING POINTS RECORDED AS PART OF THE NATIONAL DATABASE INVENTORY PROJECT

Quaternary	Latitude	Longitude	Station Number	WMS Number	Name / Description	Station Type
B11J	-25.85284	29.24502	ZQMWIT1	89809	2429CD00988 Witbank - Panorama Primary School	Borehole
B20A	-26.13750	28.68889	ZQMDLS1	89977	2628BA00423 Delmas	Borehole
B20J	-25.61306	29.02972	ZQMMAB1	90083	2529CA00036 Kranspoort - Mabelingwe Spa	Spring/ Eye
B20J	-25.61444	29.02861	ZQMMAB2	90084	2529CA00037 Kranspoort - Mabalingwe Spa	Borehole
B31H	-25.07258	28.98527	ZQMTSH2	89772	2528BB00106 Tsamahansi	Borehole
B31J	-24.99041	29.31420	ZQMMHL1	90101	2429CD00178 Marble Hall - Loskop Nursery	Borehole
B32G	-25.35194	29.06694	ZQMBEN1	89878	2529AC00067 Boekenhouthoek/Zithabise ne	Spring/ Eye
B41C	-25.19117	29.93751	ZQMRSL2	89703	2529BB00108 Mapochsgronde Ged Rynfontein	Borehole
B41G	-25.06646	30.10784	ZQMHAZ1	90023	2530AA00425 Hazyview/Numbi Gardens	Borehole
B41J	-24.75680	30.19419	ZQMSKH2	184424	2430CC00092 Schoonoord Leokeng	Borehole
B42B	-25.13424	30.56284	ZQMLYD1	90082	2530BA00024 Sterkspruit 33 Rest Ged 13 - 158384	Borehole
B51A	-24.87263	29.75170	ZQMNEB3	184426	2429DD00273 Phokwane Phatametsane High School	Borehole
B51E	-24.58013	29.05337	ZQMRTN2	89707	2429CA00983 Roedtan (Hardekraal)	Borehole
B51G	-24.22166	29.22146	ZQMPRS1	89683	2429AA00011 Portugal (Pomp NO4 Mogotho Berg)	Borehole
B51H	-24.87139	29.75417	ZQMNEB2	90126	2429DD00328 Uitkyk Nebo Polisie Stasie	Borehole
B52B	-24.75208	30.01396	ZQMSKH1	89729	2430CC00062 Swea (Schoonoord)	Borehole
B60J	-24.34944	30.95028	ZQMHDS1	90026	2430BD00426 Berlin/Hoedspruit Hotel	Borehole
B71F	-24.36513	30.29729	ZQMPNG1	89677	2430AD00496 Streatham (Penge)	Borehole
B72E	-23.98827	30.44702	ZQMTOY2	89765	2330CB00079 Ga-Modjadji (Ga Mokwasele) - H070767	Borehole
B72J	-23.95133	30.61313	ZQMMRS1	90119	2330DC00493 Murchison / Gravelotte - Polisiestasie	Borehole
B73C	-23.93417	31.13944	ZQMPWA1	89694	2331CC00033 Phalaborwa	Borehole
B73F	-24.45987	31.40565	ZQMNKW3	90133	2431AD00113 Kruger National Park/ Orpen Ruskamp	Borehole
B82G	-23.31330	30.70617	ZQMGIY1	90010	2330BC00027 Giyani	Borehole
B83B	-23.51605	31.40816	ZQMNKW9	177410	2331CB00039 Kruger National Park/Mopani	Borehole
B83D	-23.86500	31.58167	ZQMNKW4	90134	Letaba Ruskamp	Borehole
B90A	-22.74169	31.00984	ZQMNKW2	90132	2231CA00071 Kruger National Park/ Punda Hek	Borehole
B90H	-23.11028	31.45750	ZQMSGD1	89722	Shingwedzi	Borehole
	-33.98410	18.14118	ZQMLBW1	90063	3218CC00215 Langeberg-Langebaan Weg - LG1	Borehole

APPENDIX B:

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
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Mr	Leballo	Labane	Lepelle Water
Mr	Lee	Clinton	South 32
Mr	Linstrom	Charles	Exxaro
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Mr	Ramovha	Matshilele	Dept. Mineral Resources
Mr	Ramphisa	Philip	Platreef Mine
Mr	Raphalalani	Israel	Dept. of Water and Sanitation
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Mr	Roman	Henry	DST
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APPENDIX C:

STAKEHOLDERS WHO CONTRIBUTED TO THE PROJECT

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Angelika Möhr	SRK
Anna-Manth	OFF (MCCI)
Ansia de Jager	JWF
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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
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Dr James Meyer	Topigs SA
Eben Ferreira	Keaton Energy Mining Vanggatfontein Colliery Delmas
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Emile Corradie	Bosveld Phosphate
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Imani Munyai	Wescoal Mining
Jakes Louw	Joint Water Forum
James Ndou	Modikwa Platinum Mine
Jan de Klerk	Sasol
Jaques Venter	SANparks
Jerry Penyene	AFASA
Johan van Stryp	Loskop Water Forum
Johanes Mathungene	LEPELLE/ farmer
Johann van Aswegen	DWS, Planning and technical support
Johannes Senyane	Two Rivers Platinum Mine
John Gearg	Wescoal/JKC
Joseph Phasha	DWS, Compliance
Kamo Meso	DWS
Karabo Motene	Glencore Mototolo Platinum Mine
Kerry Beamish	Rand Carbide
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Mashweu Matsiela	Industrial Development Corporation
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Mologadi Mpahlele	Mbuyelo Group (Pty)Ltd (Vlakvarkfontein and Rirhandzu Collieries)
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Raisibe Morudu	Thembisile Hani LM
Ramasenya Meso	DWS
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Reynie Reyneke	EXXARO
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Sabelo Mamba	Small Enterprise Finance Agency
Sakhi Mamashole	FOSKOR
Sakhile Mndaweni	DWS, National Office
Salome Sathekge	Polokwane Municipality
Siboniso Mkhaliphi	DWS
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Steven Friswell	Clover Hill Club Share block
Tanya Botha	Evraz Highveld
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Tshidi Mamotja	Department Environmental Affairs
Vinesh Dilsook	Anglo American Platinum

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