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Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Report Number: P WMA 04/B50/00/8310/13

DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM

WP10197

Preliminary Screening of Reconciliation Options

In association with:
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PROJECT NAME	**:**	**DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM (WP 10197)**
REPORT TITLE	**:**	Preliminary Screening of Reconciliation Options
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LIST OF REPORTS

Title	Report Number
Inception Report	P WMA 04/B50/00/8310/1
Summary Report	P WMA 04/B50/00/8310/2
Extent of Invasive Alien Plants and Removal Options	P WMA 04/B50/00/8310/3
Future Water Reuse Possibilities	P WMA 04/B50/00/8310/4
Possible Water Conservation and Demand Management Measures	P WMA 04/B50/00/8310/5
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Preliminary Screening and Schemes to be investigated	P WMA 04/B50/00/8310/8
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Preliminary Reconciliation Strategy	P WMA 04/B50/00/8310/13
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Main Report with Executive Summaries of Reconciliation Strategies	P WMA 04/B50/00/8310/15
Yield Assessment of De Hoop and Flag Boshielo Dam	P WMA 04/B50/00/8310/16

List of Abbreviations & Acronyms

CMA	Catchment Management Agency
DWA	Department of Water Affairs
EWR	Ecological Water Requirements (Ecological Component of the Reserve)
GIS	Geographical information System
IB	Irrigation Board
IDP	Integrated Development Plan
IAP	Invasive Alien Plants
IWRM	Integrated Water Resources Management
KNP	Kruger National Park
m^3/a	Cubic metre per annum
MAR	Mean Annual Runoff
NWA	National Water Act (Act 36 of 1998)
NWRS	National Water Resource Strategy
OWAAS	Olifants Water Availability Assessment Study
RO	Regional Office
RWQO	Resource Water Quality Objectives
SMT	Study Management Team Committee
SSC	Study Steering Committee
ToR	Terms of Reference
TLU	Transvaal Landbou Unie
URV	Unit Reference Value
WAAS	Water Availability Assessment Study
WCDM	Water Conservation /Demand Management
WMA	Water Management Area
WMP	Water Management Plan
WQMP	Water Quality Management Plan
WRPM	Water Resources Planning Model
WRYM	Water Resource Yield Model
WSDP	Water Services Development Plan
WUA	Water User Association
WWTP	Waste Water Treatment Plant
WWTW	Waste Water Treatment Works

EXECUTIVE SUMMARY

The Olifants Water Management Area (WMA) is one of South Africa's most stressed catchments in terms of water quantity and water quality. This WMA together with the towns Polokwane and Mokopane and their immediate surrounding areas comprise the study area.

A reconciliation strategy for the Olifants River Water Supply System needs to be developed and for this purpose the information in previous studies were collated and summarised.

Reconciliation options were identified and a Preliminary Screening Workshop with key stakeholders was held, mainly to establish which of the identified options should be investigated further.

A multi-criteria decision support tool was used to screen the identified options. The following criteria were taken into consideration:

- *Yield contribution,*
- *Capital cost,*
- *Operating cost,*
- *URV,*
- *Social impact,*
- *Biophysical impact,*
- *Management intensity,*
- *Time to implement.*

A total of 20 options were screened and will be investigated further.

As a general trend, the options with relative low capital and/or operating cost and low unit reference value (URV) contributed little to reducing the water yield deficit, whilst the capital/operating intensive options were more effective in terms of yield contribution.

An exception to this trend was the Optimising Assurance of Supply option, where it appeared that, with a little effort and cost, a significant quantity of water can become available. This needs to be investigated further.

- *The following recommendations are made:*
- *That 20 options be investigated further,*
- *That all options with criteria that scored low, (3), be carefully investigated to determine whether these criteria will prohibit the option from further investigation,*
- *That the options be ranked in order of preference,*
- *That the "quick win" options with less investment be identified to alleviate the immediate needs,*
- *That further investigation work for the longer term options that will be required as part of this study be identified and scheduled for investigation in time for the Final Reconciliation Strategy, and*
- *That the workshop results be conveyed to the broad public by means of a Newsletter.*

Table of Contents

1. INTRODUCTION

1.1 BACKGROUND

The Olifants River catchment is one of South Africa's most stressed catchments in terms of both water quantity and water. The catchment is overlap with three provinces, namely Limpopo, Mpumalanga and Gauteng. The towns of Polokwane and Mokopane will in future be sourced from the Olifants River and are included in the study area.

The water requirements in the Olifants Water Management Area (WMA) have long exceeded available yield due to diverse activities of agriculture, mining, power generation, and the steel industry. These requirements have increased substantially over the last number of years, with the mining sector growing particularly rapidly. This has brought rapid urbanisation and the expansion of manufacturing and industrial development. Further to this has come the recognition of the importance of the ecological Reserve, i.e. that rivers require, and are entitled to, a certain quantity and quality of flow. These needs are further highlighted by the position of the Kruger National Park at the bottom end of the catchment. The Kruger National Park and other wildlife reserves and recreational facilities are major income generators for the country. The Olifants River ultimately drains into Mozambique, and there are international obligations with regard to the quantity and quality of flow delivered in line with the Protocol of Shared Watercourse Systems in the Southern African Development Community.

As the trustee of the country's water resources, the Department of Water Affairs (DWA) recognises the need for a dynamic and interactive planning approach to meet future water requirements for this key area of the country and therefore a reconciliation strategy had to be developed for the study area to alleviate the current water deficits and to ensure a sustainable water supply for the next 20 years and beyond.

The strategy development will be done in two steps. A Preliminary Reconciliation Strategy will be developed as soon as possible after commencement of the study with the collected information available and a Final Reconciliation Strategy will be prepared towards the end of the study, which strategy will include the updated information and results of investigations performed during the course of the study.

The water resource status has been summarised from approximately 40 study reports into a single Summary Report (Volume 2). The Summary Report mirrored the water balance in the study area as well as the challenges that need to be overcome. A list of reconciliation options were subsequently identified. A preliminary screening of options workshop was then held with the purposes of presenting the options that had been identified so far and deciding which of these options must be further investigated.

This report provides a description of the proceedings at the preliminary screening workshop as well as the outcomes and the recommendations made by the workshop participants.

1.2 OBJECTIVES OF SCREENING

The overall objective was to understand the water resource status in the catchment, agree on the possible reconciliation options and to decide which options must be further investigated.

The sub-objectives were as follows:

- Review water resource and water use information and produce an updated water balance for the study area,
- Supplement information where gaps exist,
- Agree on the list of main concerns,
- Receive information on possible reconciliation options,
- Agree on the options screening tool and the criteria of that tool,
- Group options in “definite yes”, “possible” and “no-go” options.

1.3 REPORT LAYOUT

This report provides a brief narrative description of the preparation towards the Preliminary Screening Workshop, the workshop itself, the options considered, the evaluation tool used and the workshop findings.

All the supporting documents and the minutes of the proceedings are provided in the Appendixes of this report.

2. THE PROCESS FOLLOWED

2.1 INVITATIONS

All members of the Study Steering Committee (SSC) and the Study Management Team (SMT) were invited to the Preliminary Screening Workshop.

The water related institutions/organisations as well as district municipalities and provincial government departments are well represented on the SSC. In cases where more than one representative per institution/organisation/department on the SSC Stakeholder Database (e.g. alternates) is listed, the second person was also invited.

Invitations to the workshop were sent out by the Study Manager in DWA per e-mail. An example of such e-mail invitation is attached as **Appendix A**. The e-mails were sent out approximately one month before the event.

Closer to the day of the workshop all invitees that did not respond to the invitation were contacted telephonically. This was a time consuming and costly exercise as some people had to be phoned a couple of times. It is a point of concern that only approximately 60% of stakeholders who confirmed that they would attend, actually attended the workshop. The group that did attend was well represented and the attendance list is attached as **Appendix B.**

2.2 STARTER DOCUMENT

A 37 page Starter Document was prepared and sent out to the attendees a few days before the workshop. The Starter Document contained the following information:

- Workshop objectives,
- Agenda for the workshop,
- Summary of the status quo of the study area,
- Water management concerns for the study area,
- Information gaps as identified in the study Summary Report,
- Possible reconciliation options and a description of each possible option.

Hard copies of the Starter Document were made available at the workshop. The Starter Document is appended to this report as **Appendix C.**

2.3 DRY RUN MEETING

As part of the preparation for the Preliminary Screening Workshop, it was decided to hold a “Dry Run” for the DWA SMT members.

The presentations and possible options were evaluated by the DWA staff and suggestions were made for improvement of the presentations.

2.4 WORKSHOP PROCEEDINGS

The workshop was facilitated by one of the team members (Strategic Advisor), Mr Andrew Tanner.

The workshop proceedings are described comprehensively in the minutes of the workshop which is appended hereto as **Appendix E**.

3. THE WORKSHOP FINDINGS AND RECOMMENDATIONS

As a general trend, the options with relative low capital and/or operating cost and low unit reference value (URV) contributed little to reducing the water yield deficit, whilst the capital/operating intensive options were more effective in terms of yield contribution.

An exception to this trend was the Optimising Assurance of Supply option, where it appeared that, with a little effort and cost, a significant quantity of water can become available. This needs to be investigated further.

The following recommendations are made:

- That 20 options be investigated further,
- That all options with low scores on criteria be carefully investigated to determine whether these criteria will prohibit the option from further investigation,
- That the options be ranked in order of preference,
- That the "quick win" options with less investment be identified to alleviate the immediate needs,
- That further investigation work for the longer term options that will be required as part of this study be identified and scheduled for investigation in time for the Final Reconciliation Strategy, and
- That the workshop results be conveyed to the broad public by means of a Newsletter.

APPENDIX A

From:	Nditwani Tendani [NditwaniT@dwa.gov.za]
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To:	machele@premier.limpopo.gov.za; aswegen@dwa.gov.za; mntambf@dwaf.gov.za; Van Rooyen Johan; Van Niekerk Peter; Mabuda Solly; naa@dwa.gov.za; Naidoo Sharon; Van Den Berg Ockie; Mosefowa Kganetsi; Musekene Nndanganeni; igr@dwa.co.za; Mandaza Kennedy; Matukane Alson (PTG); Keet Marius (PTA); JanPo@daff.gov.za; mdumisane@deat.gov.za; Michael.oberholzer@dme.gov.za; jmrabodila@mpg.gov.za; dg@mpg.gov.za; sitholenl@mpg.gov.za; smaluleke@mpg.gov.za; mongwevm@ledet.gov.za; DeWittP@agric.limpopo.gov.za; bjmodipane@mpg.gov.za; nkosinm@nkangaladm.org.za; mokones@sekhukhune.co.za; mphom@gsibande.gov.za; esweeney@metsfin.com; mmathunyane@waterberg.gov.za; jburger@ledc.co.za; jburger@ledc.co.za; madishak@cdm.org.za; wmoraka@salga.org.za; gbachelor@mpg.gov.za; roelfl@magalieswater.co.za; normann@lepelle.co.za; ossie@cluesnet.co.za
Cc:	Paszczyk Gregory; Mandaza Kennedy; Kamffer Marlene; Ströh Natasha; Hernandzmaldonado Allison; Viljoen Patricia; Phahlamohlaka Tibia (BHT); Johnny Beumer; Janette van Zyl ; Nyamande Tovhowani; Mokhomola Nosisa Yvonne
Subject:	DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM : INVITATION TO THE PRELIMINARY SCREENING WORKSHOP
Attachments:	Olifants Recon Screening Workshop Reply Sheet.docx

Dear All,

A Study Steering Committee (SSC) for the above mentioned study has been established and the committee had its inaugural meeting on 5 May 2010. There are, however, a number of stakeholders who were nominated to be members of the SSC, but could unfortunately not attend the inaugural meeting. You might have attended the meeting, in which case you would have gained valuable background information on what the study entails. Attached here please find the background document on the study which was sent out with the invitations to the inaugural meeting.

One of the first steps of the study is to consider all the possible options to reconcile the water requirements and the water availability in the study area and decide which of the options should be investigated further. The study team started with reviewing all the previous water related studies in the study area and with this information it was possible to sketch a picture of the current situation, identify the current problems and challenges and identify a list of possible options to address the problems. The first phase screening of these options will be done at the Preliminary Screening Workshop which is scheduled to take place on Wednesday, 7 July 2010, in the Letaba Rest Camp in the Kruger National Park.

The objective of this workshop will be to exchange information between the Department of Water Affairs and the key stakeholders in the study area on water balances, information gaps and main concerns, to agree on possible options to reconcile water requirements and water availability and to eliminate those options which should not be given further consideration under the study.

Once again the Department of Water affairs regard you as key in this process and therefore cordially invite you to attend the scheduled Preliminary Screening workshop. Registration and tea will commence at 09h00, and the workshop will start at 09:30. A kind request is made for delegates to be punctual.

A starter document will be sent out to all the invitees one week before the workshop, i.e. during the week ending 2 July 2010.

Please complete the attached form to confirm your attendance and return to Ms Janette Van Zyl at the following e-mail address – janette.vanzyl@af.aurecongroup.com as soon as possible.

Please note that travelling costs and accommodation costs (should you wish to stay over) is for your or your organisation's own account. A lunch will be provided as part of the workshop.

We look forward to meeting with you.

Best Regards

Tendani Nditwani

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APPENDIX B

Attendance List

DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM
PRELIMINARY SCREENING WORKSHOP: 7 JULY 2010 : KRUGER NATIONAL PARK

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Title	Surname	First Name	Organisation	Position	Role on Project	Address	Telephone	Fax	Mobile	E-Mail	Signature
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DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM
PRELIMINARY SCREENING WORKSHOP: 7 JULY 2010 - KRUGER NATIONAL PARK

ATTENDANCE REGISTER

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Mr	Van Rensburg	Koos	MBB	MD					

APPENDIX C

Starter Document

DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM
WP10197

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Preliminary Screening Workshop
7 July 2010
Letaba Camp : KNP
Starter Document

A. WORKSHOP OBJECTIVES

Overall Objective: To understand the water resource status in the catchment, agree on the possible reconciliation options and to decide which options must be further investigated.

Sub-objectives

- Receive information on water balances
- Supplement information where gaps exist
- Agree on the list of main concerns
- Receive information on possible reconciliation options
- Agree on the options screening tool and the criteria of that tool
- Group options in “definite yes”, ‘possible” and “no-go” options

B. AGENDA

1. **Introduction**
2. **Process to be followed**
3. **Workshop Objectives**
4. **Catchment Overview**
5. **Current & Future Water Balance**
6. **Discussion**
7. **Water Management Concerns**
8. **Options Screening Tool**

9. **Presentation of the Options**
10. **Evaluation of Options**
11. **Agree Options**
12. **Way Forward**
13. **Closure**

C. SUMMARY REPORT

Introduction

Various studies on the Olifants WMA's ability to satisfy the water requirements both in terms of water quality and water quantity have been carried out or are currently running. There was a need to review and verify the information coming from these studies and to assemble all this information with the purpose of developing a reconciliation strategy for the Olifants River System. The strategy must cover both management and infrastructure options as well as their sequence of implementation.

The first task of the study was to prepare a Summary Report which provides a brief summary of each previous report which is regarded as relevant for the purpose of the study and which will synthesize all this information into a single status quo description of the study area.

The Summary Report, which is a bulky document, is summarized further in this brief document, in order to provide the reader a quick comprehension of the contents.

Previous Reports

Approximately 40 reports have been summarized, and these reports have been categorized in the following fields:

- Infrastructure,
- Environment,
- Water requirements and availability,
- Groundwater,
- Water use efficiency,
- System operating rules,
- Water quality, and
- Existing strategies and plans.

- A summary of each report is provided under the following headings:
- Report Title,
- Purpose of the report,
- Major findings,
- Relevance to the study.

Study Area Characterisation

All the separate report summaries have then be assembled and synthesized into a single characterization description of the study area. This is briefly summarized below.

Description of the Area

- The study area follows the boundaries of the proclaimed Olifants Water Management Area (WMA) with the towns Polokwane and Mokopane included.
- The Olifants WMA's size is 54 570 km2.
- The study area transbound 3 Provinces, 8 District- and 25 Local Municipalities.

- The study area includes Traditional Authority areas. The largest portion of the population live in rural settlements spread over very large areas in the WMA. The study area and the vast area of rural settlements are shown on the map in Figure 1.

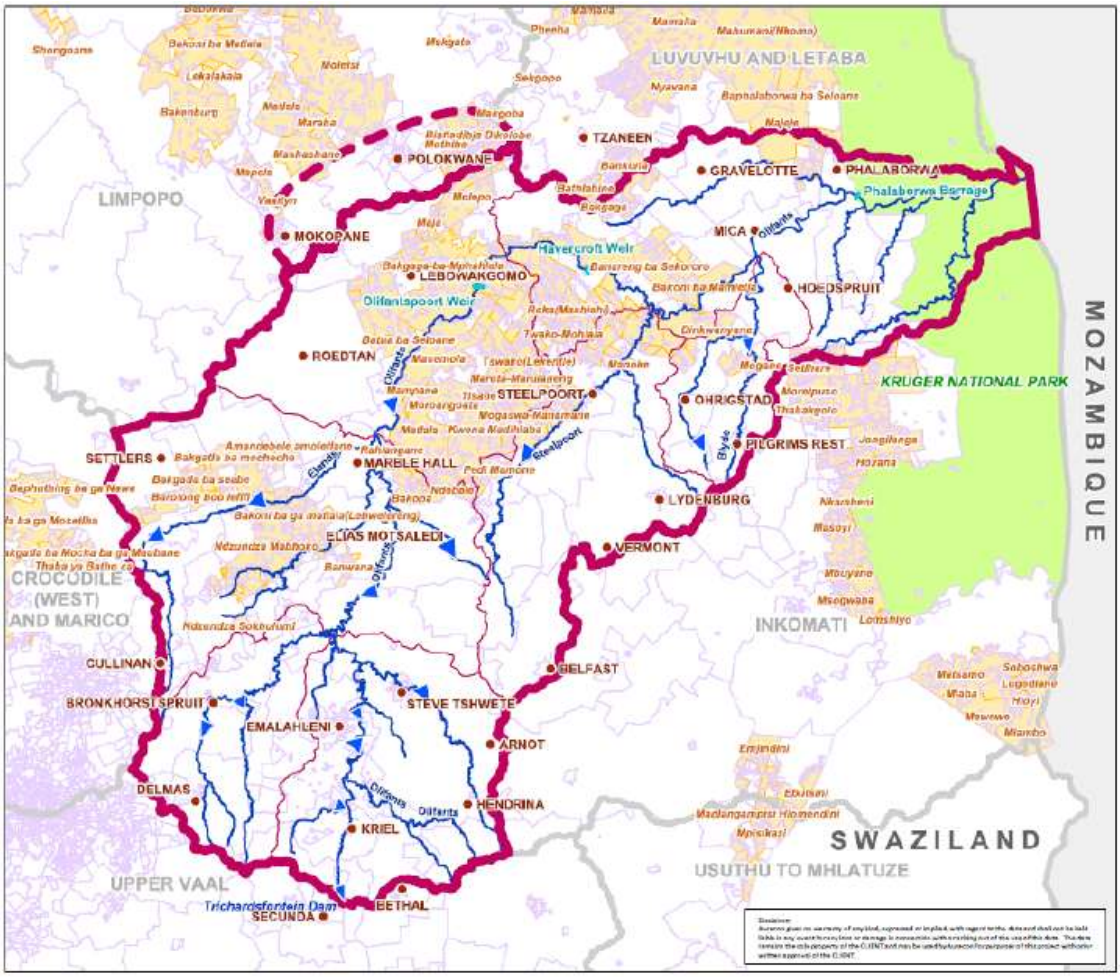

Figure 1: Study Area showing the rural settlements

- The WMA comprises at least 15 different conservation areas, including the KNP at the far end of the catchment, just before the Olifants River flows into Moçambique.
- The topoghraphy along the WMA varies. The area contains Highveld and a large open flat area, referred to as the Springbok Flats. These areas are divided from the Lowveld by the escarpment which consists of various hills and mountain terrain.

Climate

- Average rainfall varies over the area from 325 mm/annum to 750 mm/annum with rainfall up to 1 000 mm/annum on the escarpment.
- The mean annual evaporation for the catchment ranges from 1 300mm to 1 700mm.

Population

- The population of the area is over 3 million people (including Polokwane and Mokopane), of which approximately 2/3 live in the rural areas and the remainder in the urban areas. The population of Polokwane and Mokopane is 168 000 and 89 000 respectively.

Economic Activities

- The main economic sectors in the study area are mining, agricultural activities and tourism with a little bit of forestry.
- The majority of the mines in the study area are coal mines.

There are also a number of mines which can be categorized as platinum group mines and thirdly a few that work other metals, i.e. copper, gold, iron, etc. The mines can be seen on the map shown in **Figure 2.**

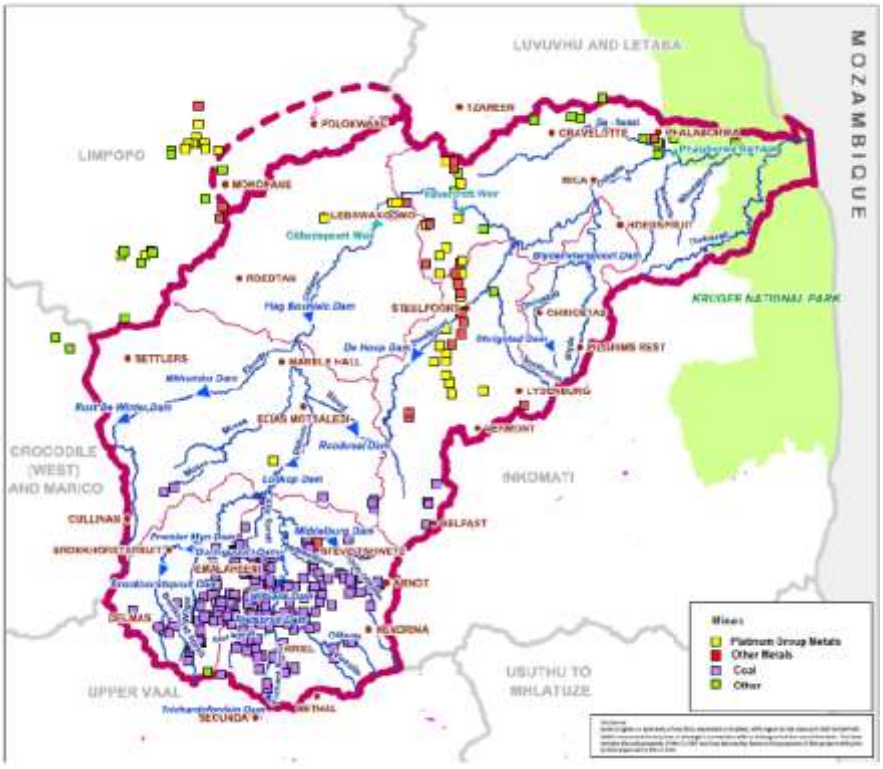

Figure 2: Mining in the study area

- The total irrigation area is approximately 102 000 ha of which 51 000 ha is scheduled under irrigation boards and water user associations.
- The tourism sector has been identified as one of the growing sectors in the study area. The Kruger National Park is situated along the most eastern edge of the WMA. Fourteen other conservation areas are in the study area of which some are situated adjacent to the KNP. Popular tourist attractions in the area are inter alia the Three Rondawels, Bourkes Luck Potholes, Gods Window and the Pinnacle. Dam basins such as the one at Loskop Dam also have potential to increase in popularity as tourist attractions.

Water Supply infrastructure

Several water storage dams have been built in the study area of which Loskop Dam and Flag Boshielo Dam are the largest. The bigger dams are owned by the DWA, and a few are also state owned but are municipal dams, e.g. Witbank and Middelburg Dams. A few dams are privately owned, e.g. Premier Mine and Rietspruit dams.

The Flag Boshielo Dam has been raised over the past five years and the Department of Water Affairs is currently busy constructing the De Hoop Dam on the Steelpoort River. New pipeline infrastructure from De Hoop and Flag Boshielo dams will link with existing pipelines which will enable water supply to all the new mining developments and to Polokwane and Mokopane.

Water Transfers in and out

There are several water transfer schemes in and out of the Olifants River Catchment. These are presented in **Table 1.**

Table 1: Water Transfers in and out of the Olifants Catchment (2010 estimate)

From/To	In	Out
Metsweding		5 million m^3/a
Vaal	77 million m^3/a	
Usutu	51 million m^3/a	
Komati	100 million m^3/a	
Polokwane		9 million m^3/a
Total	**228 million m^3/a**	**14 million m^3/a**

All the transfers into the catchment occur in the Upper Olifants, and are mainly utilised for cooling water for power generation by the Eskom power stations. The transfer out to Metsweding occurs from the Upper catchment, whereas the transfer to Polokwane occurs from the Middle Olifants.

Water Balance

The current and future (2030) water balances are shown in **Table 2**

Table 2: Current and Future (2030) Water Balances

(all values in million m^3/a)

	Upper Olifants	Middle Olifants	Lower Olifants	TOTAL
Current Requirements	461	161	250	873
Current Availability	391	167	308	866
Current Water Balance	-70	6	58	-7
Ecological Reserve	80	60	60	200
Water Balance with Reserve met	-150	-54	-2	-207
2030 Requirement	497	278	276	1 051
2030 Availability	391	288	308	988
2030 Water Balance with Reserve	-186	-49	-28	-263

Possible Interventions

Interventions to improve water availability and water quality in the Olifants WMA will require both physical (structural) measures and management interventions.

Possible interventions which could be considered are:

Structural

- New dams,
- Groundwater schemes,
- Water transfer schemes,

- Water reuse schemes,
- Desalination schemes,
- Water reclamation schemes, and
- Upgrading irrigation canals.

Management

- Compulsory Licensing,
- Water conservation and demand management,
- Water reuse (e.g. grey water for gardening),
- Rain water harvesting,
- Saline water for stock drinking and salt tolerant crop irrigation,
- Operating rules for supply systems,
- Removal of invasive alien plants,
- Reduction in assurance of supply, and
- Water trading.

Information Gaps

The Summary Report lists all information which could not be obtained in any one of the previous reports. These are summarized in Section E.

D. WATER MANAGEMENT CONCERNS FOR THE STUDY AREA

Concern 1: Water quality problems as a result of industries, mining and irrigation.

Explanation: Mining activities in the upper parts of the Olifants Catchment cause drainage of acidic water into the rivers. Serious acid conditions prevail in the Klipspruit and Kromdraaispruit catchments due to failed neutralization plants. The sulphate concentrations exceed the Resource Water Quality Objectives (RWQO) in a number of catchments. The TDS and sulphate concentrations in the Witbank, Middelburg and Loskop Dams have been increasing since 1970. Sulphate load will have to be removed from the system to arrest the increase.

The sources of pollution are not only mines but also power stations and industries. The trophic status of the rivers and dams are mesotrophic. Four of the five major WWTPs discharge into streams which flow directly into the upper end of the Loskop Dam. This has resulted in eutrophic conditions in the dam with periodic blue green algae blooms.

Many of the mines are filling with water and have reached a stage where they are generating excess water that needs to be managed. This excess mine water is in excess of the contribution that would be made naturally by the mined catchment area. Mine water treatment and reclamation is being pursued by a number of mines using desalination technologies to treat mine water to potable standards. The Emalahleni Mine Water Reclamation Plant (MWRP) is operational and the Optimum MWRP is under construction.

Return flows from irrigation lands contain high salt loads and increase the salinity of the receiving streams. The water entering the main stem of the Olifants River via Flag Boshielo Dam is already salinised to such an extent that it exceeds the Target Water Quality Range for TDS for more than 50% of the time.

Concern 2: Sewage effluent from municipalities does not meet the water quality standards.

Explanation: Waste water treatment plants in the catchment are performing poorly and are overloaded, resulting in discharge of organics, phosphate and amonia into the Olifants River.

Concern 3: Mining operations in the catchment – Increase in water requirements.

Explanation: The growth in the mining industry has increased the water requirements in the catchment significantly. The De Hoop Dam and pipeline infrastructure will satisfy the water requirements for some time, but if the mining industry keeps growing, further water augmentation schemes will be required. The mining industry brings wealth to the area and water supply to the mines should be supported. However, the industry can also cause a series of pollution problems, as mentioned in Concern 1.

Concern 4: Growing water requirements – Urban and Rural.

Explanation: The total population in the study area exceeds 3 million people. The added towns to the study area, Polokwane and Mokopane have populations of 168 000 and 89 000 respectively. The majority of the people live in rural areas and the households are situated over a wide spread area. These households are greatly dependent on groundwater, but groundwater yields in 90% of the study area are relatively low (between 0.1 ℓ/s – 1.0 ℓ/s). Augmenting the water supply to the rural households is therefore a problem. Some areas will soon be serviced from the pipelines from De Hoop and Flag Boshielo Dams, but only areas on the pipeline routes to Polokwane and Mokopane can be reached.

The growing mining industry causes an increase in water demands in urban centres and municipalities must cater for these population growths.

Concern 5: Further Water transfers, in and out will be required.

Explanation: The Olifants River Catchment is dependent on a number of other catchments and the Limpopo WMA has a growing dependency on the Olifants catchment.

There are several water transfer schemes in and out of the Olifants River Catchment. These have been presented in **Table 1.**

All the transfers into the catchment occur in the Upper Olifants, and are mainly utilised for cooling water for power generation by the Eskom power stations. The transfer out to Metsweding occurs from the Upper catchment, whereas the transfer to Polokwane occurs from the Middle Olifants.

The pipeline which is planned for Mokopane from Flag Boshielo Dam will have a capacity to convey 40 million m^3/a to the town.

The water transfer to Polokwane which is currently 9 million m^3/a, is also expected to increase in the near future.

Concern 6: No further water allocations to the Irrigation Sector

Explanation: The irrigation sector consumes approximately 70% of all water use in the catchment. In view of the negative water balance (See Concern 8), any further developed yield should be made available to the environment and other higher priority water users.

It is not the intention to cut the existing water allocations to the irrigation sector in the catchment to such extent that this will have a ripple effect in terms of job losses and poverty.

The DWA's objectives in terms of the Water Allocation Reform programme where equity to access for water is promoted, also places an increasing demand on the available water.

Concern 7: Invasive Alien Plants

Explanation: Invasive Alien Plants (IAPs) such as Black Wattle have taken the space of various indigenous plants. The alien plants use more water than indigenous plants and reduces the surface water runoff in the rivers. It is estimated that approximately 440 km^2 of the catchment area is infested with IAPs.

Concern 8: Ecological Water Requirements

Explanation: The ecological water requirement component of the Reserve was determined more than 10 years ago and will be updated as part of this study. However, in order to maintain the lower stretch of the Olifants River (the portion that runs through the KNP) in a Category B, a water requirement of 400 million m^3/a in the form of low flows and freshets was determined. If the lower part of the river is allowed to deteriorate to Category C, 300 million m^3/a will be required. The B Category requirement is equivalent to a 98% assurance of supply of 200 million m^3/a.

This ecological requirement results in a current water deficit of 207 million m^3/a and, if no interventions are implemented, it will result in a future water deficit of 263 million m^3/a in 20 years' time, because of the growth in water requirements.

Concern 9: Meet the international obligations.

Explanation
A treaty between the Governments of the Republics of South Africa and Portugal relating to Massingir Dam was signed in 1971. The Treaty was taken over by Moçambique.

E. INFORMATION GAPS

1. Rural Water Use

It does not appear as if rural water use was captured in previous studies. This could be important in future should DWA decide to improve water services to rural areas through supply from any of the large dams rather than rely on local resources such as farm dams and groundwater. The majority of the population within the catchment are located in rural areas. The future water requirements between urban and rural areas need to be separated and determined in this study.

2. Alien and Invasive Vegetation

No spatial data was available to determine the extent of coverage of alien and invasive plants (IAPs) within the catchment. IAPs contribute to losses in the system. The removal of IAPs is important both to biodiversity and to reduce losses from the system. The removal of IAPs won't necessarily significantly reduce losses, but it will contribute to the systems efficiency.

3. Mining Sector

- WCDM Report for Mining

  As part of the separate project for the Development of a comprehensive water conservation and water demand management strategy and business plans, a report for various sectors (Irrigation and Power Generation) as well as for Emalahleni and Lebowakgomo Municipalities was reviewed.

  Mining has been identified in the status quo as a key user of water, a major economic contributor and the major polluter of water resources in the catchment. However, a water conservation and demand management report was not reviewed as part of the WCDM project. A report referring to the mining sector has not been identified in the other reports, and may not exist.

- Water requirements report for mining and future mining activities.

  Although mining sector water requirements are included in the water balances, there is limited detailed breakdown of this water use. There are increased mining activities in the Dilokong Corridor, however the growth in water requirements for this area is unknown.

4. Forestry Sector

Little reference has been made to the water requirements of the forestry sector within the catchment. Similarly, the forestry sector has been omitted from the economic contributions within the catchment.

5. Tourism Sector

Little or no reference has been made in previous studies to the water requirements tourism within the catchment. Water quality is of significant importance to tourism, due to the direct impact to the environment of poor water quality. There is a high concentration of game and nature reserves and conservation areas in the Lower catchment. Although the water requirements may be low, the importance of water quality to the sector is very high. Similarly, tourism has been omitted from the economic contributions within the catchment.

6. Non-conventional Sources of Water

Very little reference is made to the use of non-conventional sources of water. The catchment includes a leading example of acid mine water reclamation for domestic potable use, however no other examples are included. While non-conventional sources of water don't necessarily contribute additional yield to the overall system, it does reduce demand for potable water and improves water quality discharges.

7. International Requirements

The Treaty does not stipulate any cross border flow requirements. No other water resource Agreements between South Africa and Moçambique have been identified. Both countries are signatories to the revised SADC Protocol on shared water courses. Any future agreements between South Africa and Moçambique would take precedence over local requirements.

8. Agriculture

The actual use is not known, neither has the appropriate assurance of supply been confirmed. We need to know the required assurance of supply. For example 100% of the allocation for say 70% of the time and the minimum requirement to ensure survival of the permanent crops, say 50% of the allocation for 98% of the time.

9. Reserve

No information exists of how the Present Ecological State of the river changed over the last 10 years. The Reserve has not yet been implemented and all the available water is being used. We need to establish in some detail the flows and durations, drought low flows, as well as the maintenance low flow and freshets, especially under critical conditions.

F. POSSIBLE RECONCILIATION OPTIONS

Reducing Water use in the Basin

1. Compulsory Licensing
2. Increased Efficiency in the irrigation sector including WCDM

3. WCDM Urban Sector,
4. WCDM in Mining,
5. Reduction in Bulk Infrastructure Losses from Regional Schemes
6. Removing Alien Invasive Plants,
7. Integrated System Operating Rules,

Reducing Transfers out of the Basin

8. Alternative or reduced supplies for Mokopane and Polokwane from the Olifants,

Increasing Supply

Transfers-in:

9. Transfer treated sewage effluent from sewage treatment works in the Vaal Basin,
10. Transfer raw water directly from Vaal Dam,
11. Transfer desalinated seawater to the WMA,
12. Expand Rand Water Supply to Emalahleni, Steve Tshwete and Bronkhorstspruit,

Possible New Dams:

13. New Dam on the Mainstream Olifants River,
14. Blyderivierspoort Dam Raising,
15. Smaller Dams to supply water,
16. Off channel storage dam on one of the tributaries with pumping from the Olifants.

Groundwater and Rainwater Harvesting:

17. Groundwater options,
18. Rainwater Harvesting.

Water Quality Improvement Options:

19. AMD treatment plants (similar to the Emalahleni AMWR plant),
20. Re-using Sewage Effluent.

Reducing Water Use in the Basin

1 Compulsory Licensing

1.1 Introduction

The environmental water requirements in the Olifants Catchment are not being met because the water requirements exceed the water availability. One way of correcting this situation is to reduce the water requirements through a process of Compulsory Licensing.

1.2 Option Description

The procedure for compulsory licensing is described in Section 43 to 48 of the National Water Act (Act 36 of 1998). The process is started when the responsible authority (in this case the Minister in view of the fact that CMA has not yet been established), issues a notice in the Government Gazette that water users must apply for licenses within a certain period of time.

The procedure allows the Minister to consider all license applications and with cognisance of the water availability, reduce and reallocate the available water in fair and equitable manner.

The procedure makes provision for the compilation of a proposed allocation schedule and any water user will have the opportunity to object to his/her new water allocation within 60 days after the proposed allocation schedule has been published in the Government Gazette. After considering all objections, the Preliminary Allocation Schedule must be published and after a prescribed appeal period the Preliminary Schedule becomes the Final Allocation Schedule.

The Compulsory Licensing process can become a long and tedious process. An alternative to this process would be where the Minister levies an additional water use charge on all water users and on the use of all water originating in the Olifants River Catchment in terms of Section 57 of the NWA. This levy must be in accordance to the pricing strategy which provides for inter alia setting water use charges for achieving the equitable and efficient allocation of water (Section 56 (c) of the NWA). The financial contributions of all the water users will be ring-fenced and used to buy out water entitlements from those water users who are willing to sell, e.g. by tender process. This process can then be continued until the necessary water balance is achieved. This alternative may be more acceptable to the water users insofar that not all users have to sacrifice a portion of their water entitlement.

1.3 Option Yield

It is foreseen that the water requirements can be reduced by at least 100 million m^3/a at 98% assurance of supply.

Theoretically the compulsory licensing process or the water use charge for the equitable and efficient allocation of water can be taken to the point where the water requirements and water availability are in balance. The Section 43 – 48 (NWA) process, must however, obtaining the full reduction in water use through compulsory licensing should be viewed as a last resort after other options such as WCDM, reuse of water, removing invasive alien plants, etc., has been implemented. It is foreseen that for the variant on compulsory licensing, where the market mechanism is needed, WCDM will follow naturally as users recognise the actual value of water. E.g. irrigation farmers can decide to improve their efficiency in order to sell part of their entitlement. This variant on compulsory licensing can therefore be implemented immediately, before any of the other options.

1.4 Cost of the Process

For the compulsory licensing options where each water user will have to sacrifice a portion of his/her entitlement, the cost will be relatively low. Cost items could be the appointment of a PSP to do the validation and verification of existing lawful water use, assess water availability and the cost of staff to handle the large number of license applications. The cost of the disbenefits (i.e. loss of production, labour, etc.) might be hidden and should also be taken into account.

For the alternative where the water use charge is increased to make provision for the equitable and efficient allocation of water, the cost will be the cost of the sum of the water entitlements that needs to be bought. It can however, be reasonably expected that the low value water will be sold first and therefore that the economic impact will be much less.

1.5 Time for Implementation

A full compulsory licensing process has not really been applied yet but it is expected that it can easily take four years to implement. The alternative will depend on the time it will take to implement the levies and raise the sum of money for the water entitlements but could be quicker than the Section 43 – 48 process.

1.6 Social Impacts

Compulsory licensing is a painful process that can cause much unhappiness amongst the water users. It may have an economic impact on all water users that have to curtail their water use. The alternative where water entitlements are being bought might have less of an impact but all water users will pay the additional portion of the water use charge.

The impact has been provisionally rated medium.

1.7 Biophysical Impacts

No impacts are foreseen.

1.8 Management Intensity

The Compulsory licensing process described in S43 – 48 requires a huge amount of human energy and has a high management intensity. The alternative process will require less management intensity. The overall management intensity for the Compulsory Licensing option is therefore evaluated as “medium”.

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2 Increased Efficiency of Water Use in the Irrigation Sector including WCDM

2.1 Option Layout

This option applies to all scheduled and unscheduled irrigation areas in the Olifants River catchment.

2.2 Option Description

The irrigation sector is by far the largest water user in the Olifants River catchment, with an estimated requirement of 622 million m3/annum, comprising 71% of the water requirements within the catchment. Any percentage reduction in water use in this sector will therefore have a significant effect on the total water requirements within the catchment.

Three main areas for improving efficiency of water use or water conservation and demand management can be considered:

- Optimising the assurance of supply so that the available resource is used to achieve the greatest benefit,
- Reduce losses in the bulk supply canals and reticulation systems,
- More efficient irrigation after farm edge supply.

Although there are operating rules, including curtailments, in place for some schemes there are formally no agreed assurances of supply for all of the irrigators in the Olifants catchment, but volumes of water are allocated to the supplied, "when available". This is unsatisfactory to the user and the supplier. A process to agree assurances of supply should be started, between the users and the DWA to agree assurances of supply for each type of irrigation.

The reduction of losses in the bulk supply canals and reticulation systems can be achieved by a variety of actions and much work has been done on the maintenance of some schemes. The main problems identified are canal leaks. The earth canals can be replaced with concrete linings or pipelines as was done for the Blyde River Irrigation Board. Existing concrete canals that leak should be sealed by replacing worn panels or by applying sealants on the joints.

An action to identify sources of losses would be to install meters at all unmetered supply points and overflows to the river, and to replace/repair all faulty meters.

More efficient irrigation after farm edge supply is the responsibility of each irrigation farmer. This can be done in various ways, e.g. upgrading of the irrigation system, better scheduling, switching over to crops which use less water but yield higher incomes, etc. A practice which has applied up to now is that, since allocations are by volume, (and not by hectares of irrigation), any saving in water use benefit the irrigation farmer. They can then expand the area of irrigation, should they succeed in using less water per hectare.

In a stressed catchment such as the Olifants where water deficits occur in various Sub-catchments, this practice becomes questionable. A give-and-take approach should be followed here between the irrigation farmers and the allocating authorities who must look after the protection of the resource and ensure the implementation of the EWRs.

One way of achieving this is by reducing the irrigation farmers' assurance of supply. This should be done with great care so that the irrigator, after having applied her/his WCDM measures remains at the same economic level as before.

Applying increased tariffs will encourage the efficient use of water.

A steep sliding scale for water tariffs so that it becomes very expensive to use the last, say 10% of the allocated water quota, could be considered.

2.3 Option Yield

The current system yield modelling assumes a 98% assurance of supply for all sectors and users with no rules for curtailment in terms of drought. The increased yield, or reduction in shortfall, can only be determined once agreed, or preliminary, assurances of supply are applied. A 10% increase has been assumed.

The yield from reducing bulk system losses and more efficient water use must take account of the fact that return flows will be reduced. It also depends on the condition of the existing canals and the current efficiency of the irrigation beyond farm edge.

These are unknowns and a survey to determine this will require a major effort which is beyond the scope of this study. However, significant areas of irrigation are using water very efficiently. If 10% of the irrigation water use is saved, it would mean an annual volume of 60 million m³/a, which is substantial.

2.4 Unit Reference Value

It is not possible to determine a cost for the betterment works on the canals without knowing the condition of the canals. The condition can also vary from canal to canal.

The cost of the Blyde farmers' pipelines was R236 million (2005 prices) for a total length of 120km and varying in size from 1.5m diameter to small diameter. This works out at + R33000 / ha or R3.00 up to R6.00/m³. It is safe to say that the patching and repair of existing concrete canals will be much cheaper.

The cost of improved on farm efficiency will vary from farm to farm.

2.5 Time for Implementation

Agreeing provisional assurances of supply must be carried out within 12 months while formal agreements should be in place within 24 months.

Implementation for the reduction in losses on bulk water supply canals can take many years as the work has to be done in a 2-3 weeks dry period each year. At least 10 years has to be allowed

More efficient irrigation beyond farm edge is normally phased in over a period of five years.

2.6 Social Impacts

No social impacts are foreseen. Major construction work could create short term job opportunities

2.7 Biophysical Impacts

No biophysical impacts are envisaged.

2.8 Management Intensity

The reduction in bulk losses is quite management intensive and the success of more efficient irrigation beyond farm edge depends on the cooperation of each irrigator. A high management intensity has been assigned.

3 WCDM Urban Sector

3.1 Introduction

As water is a scarce resource, it needs to be used in an efficient and effective manner. Legislation has been put in place in South Africa to ensure that this requirement is met. Through WCDM, the objective is to ensure the optimal use of water and to minimise water wastage.

The various WCDM options are presented as individual options in this document. However, one or a combination of the options would be appropriate to achieve an objective in a particular area.

3.2 Option Description

The most recent information on the potential for WCDM is contained in a study entitled "The Development of a Comprehensive Water Conservation and Water Demand Management Strategy and Business Plans: Emalahleni Municipality" undertaken for the Department of Water Affairs. The Strategy developed for Emalahleni Municipality focuses on Loss Management as well as more efficient water use. Examples of loss management and efficient water use initiatives are listed below.

- Loss management
  - Pressure management
  - Retrofitting and removal of wasteful devices
  - Improved management (sectorisation, metering, billing, legislation)
  - Mains replacement
  - Leak detection and repair

This primarily applies to the water distribution system but losses from the sewer system, pipes, overflows from manholes and pumpstations, etc., can also lead to losses and pollution of the resource.

- Improved efficiency
  - Public awareness
  - Efficient appliances: (washing machines, toilet cisterns etc)
  - Low flow shower heads
  - Water efficient gardens
  - Pricing and payment collection.

3.3 Option Yield

It is very difficult to determine what the total water saving potential is in all the urban areas in the Olifants River System. As detailed information exists for the Emalahleni Area, this information has been used as the basis for the calculations and it is assumed that a similar type and magnitude of water saving would also exist in all the other urban areas. **Table 3.1** below shows the potential for WCDM in Emalahleni area and provides as estimate of the savings potential in the whole Olifants River System.

Table 3.1: Possible Savings in Water Use

AREA	Loss Management Million m^3/a (% of water req.)	Improved Efficiency Million m^3/a (% of water req.)	Approx. Current Water Requirement Million m^3/a
Witbank, Clewer, Ogies and Phola (without replacement programme)	7.3 (21.7%)	2 (6%)	33.6
Witbank, Clewer, Ogies and Phola (with replacement programme)	12.4 (37%)	2 (6%)	33.6
All Urban Areas in Olifants River System	33.8 (21.7%)	9.4 (6%)	156

The estimated possible saving is thus 43 million m^3/a.

3.4 Unit Reference Value

In order to obtain an order of magnitude of the URV's applicable for the implementation of WCDM interventions, the URVs were developed for the interventions identified in the Emalahleni Municipality (Witbank and Clewer only) WCDM study. The results are given in **Table 3.1.**

Table 3.2: Unit Reference Values

ITEM	Pressure management Discount Rate 8 %	Active Leak Control with pressure management Discount Rate 8 %	Tariff Management and Public awareness Discount Rate 8 %
Total Saving (million m^3/a)	3.76	5.24	1.9
Total capital cost (R million)	R 11	R 16.3	R 3.4 initially and R 1.7 every 5 years
Annual operating cost (R mill /annum)	R 0.38	R 1.94	R 0.42
NPV Cost (R million)	13	32.75	9.7
Unit Reference Value (R/m^3)	0.36	0.63	0.53

3.5 Time for Implementation

Every Local Authority should develop a WCDM strategy with an implementation timetable. The total savings could be phased in over a period of 5 to 10 years dependent on the intervention.

3.6 Social Impacts

WCDM initiatives are labour intensive by nature, and therefore have the ability to generate a large number of semi-skilled and skilled employment opportunities.

There should not be any negative impacts.

3.7 Biophysical Impacts

This option will have no known implications for the natural environment.

3.8 Management Intensity

It is imperative that all local Municipalities implement WCDM interventions as it is unlikely that new supply interventions will be constructed until existing water is used effectively and efficiently.

Any WCDM initiative normally has a high management intensity and it has been rated as such.

4 WCDM in Mining

4.1 Option Layout

Mines are spread over significant sections of the study area but primarily in the upper and middle Olifants.

4.2 Option Description

This option considers the possibility of water conservation and demand management within the mining sector.

While there have been studies into the water use efficiency of the municipal and irrigation sectors, the water use efficiency of mines has not been investigated. However, many of the mines, especially the coal mines located in the upper Olifants sub-catchment, make use of water extracted as part of their de-watering process and do not have a consumptive use.

The other large mining operations, namely, platinum mining in the Steelpoort, Middle and Lower Olifants sub-catchment, are limited in their operations by water availability and hence recycle as much of their water as possible. The efficiency of these mines is considered to be high and no substantial savings are expected to be achieved from the platinum mines.

The copper and phosforus mines located in Phalaborwa are a large consumptive user of water, with an allocation of approximately 22 million m3/annum. The efficiency of the water use of these mines is not known and will need to be investigated as part of this study. We have also ascertained that certain mines in Phalaborwa might close down over the next few years, resulting in more water becoming available. This needs to be investigated further.

This option will thus focus on the future water requirement of the mines in Phalaborwa.

4.3 Option Yield

There is no information on possible evidence of water savings due to increased efficiency in the mining sector or mine closures. However, the mines located near Palaborwa warrant further investigation.

4.4 Unit Reference Value

Not known at this point in time.

4.5 Time for Implementation

It is foreseen that WCDM measures for mines can be implemented within 2 years. The timing for mine closures must be determined.

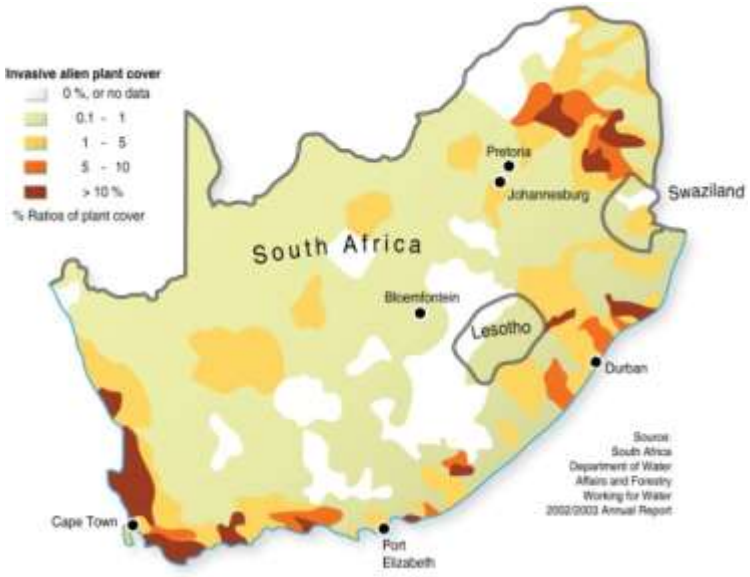
4.6 Social Impacts

No social impacts are foreseen on WCDM measures. Closing down of mines will result in job losses, but the closure is not because of water resource constraints

4.7 Biophysical Impacts

No impacts are envisaged.

4.8 Management Intensity



Management intensity is regarded as low.

5 Reduction in Bulk infrastructure Losses from Regional Schemes

The previous sections discuss possible losses and WCDM in the irrigation, urban and mining sector. Possible losses in bulk infrastructure which supplies two or more users and which is operated by a regional authority, such as a Water Board, should also be assessed and eliminated as far as possible.

6 Removing Alien Invasive Plants

6.1 Option Layout

6.2 Option Description

The recently completed reports on the hydrology of the Olifants River catchment indicate that there are large areas of invasive alien plants (IAPs) in this the study area. This consists mostly of wattle trees. Removing these IAPs will increase the runoff from the catchment which in turn will increase the yield of the dams downstream of the IAPs.

Estimates of the areas of IAPs are given in the hydrology reports as follows:

- Upstream of Loskop Dam: 213 km^2
- The remainder of the catchment: 225 km^2

From a water resource perspective, clearing activities should focus on those areas in which maximum benefit from increased surface water runoff will be achieved. Clearing within the riparian zone and upstream of storage dams is favoured.

6.3 Option Yield

An assessment of the impact of removing IAPs on the available yield from dams was carried out as part of the recently completed Water Resources Availability Assessment of the Olifants River catchment. This analysis indicated that removing all the IAPs from the upstream of the Loskop Dam will increase the yield of this catchment by only 2.3 million m^3/annum. An analysis of the remainder of the Olifants catchment (Steelpoort, Blyderiver, Middle and Lower Olifants) has not yet been completed but assuming a similar increase in yield/ha an estimate of the total increase in yield in the Olifants system due to the removal of all alien vegetation is 4.6 m3/annum.

Further work is being undertaken to improve the assessment of the water consumed by IAPs.

6.4 Unit Reference Value

Clearing costs vary, depending on the species, concentration and density of the infested areas. For the purposes of this URV calculation it was assumed that the cost to clear wattles of medium density (including follow up and herbicides) was in the order of R 2 800/ha (Marias , 2004 escalated to 2010 by 6% per annum).

The preliminary estimated URV for alien vegetation clearance in the Olifants system is given in the table below.

ITEM	Discount Rate 8 %
Total capital cost (R million)	122
Annual operating cost (R million /annum)	2
NPV Cost (R million)	105
Unit Reference Value (R/m^3)	2.5

6.5 Time for Implementation

The programme for the clearance of the alien vegetation could be undertaken incrementally and based on the budget and resources available. It is anticipated that to clear all the 438 km^2 identified would take in excess of 5 years.

6.6 Social Impacts

The IAPs in the Olifants River catchment are mostly Wattle. These trees are used by rural communities for fuel and building material. The social impact of removing IAPs which are being used productively therefore needs to be considered. It is suggested that some of the IAPs should be reclassified and registered as woodlots rather than removed.

No fatal flaws have been identified, but removal of all IAPs is probably not possible.

The main socio-economic benefit associated with clearing of invasive alien plants is job creation.

The impact has been rated low.

6.7 Biophysical Impacts

The following environmental benefits are associated with clearing of invasive alien plants :

- improved biodiversity;
- reduced erosion through improved ground cover and reduction in fire hazard.

The prevention of further spread of invasive alien plants is to be encouraged.

The impact should be positive.

6.8 Management Intensity

Management intensity is relatively low but a constant effort over the duration of 5 years is required.

7 Integrated System Operating Rules

7.1 Option Layout

This option will include all the schemes within the study area.

7.2 Option Description

The dams within the Olifants River are currently all operated independently with no consideration of the state of storage of other dams or the system as a whole integrated system. It is probable that operating rules, which consider the conjunctive use of all resources within a systems context, and detailed information on the timing and location of water requirements (similar to the systems used in the Orange, Komati and Crocodile (East)) basins, could make more efficient use of the available resource.

The integrated operating rules, together with agreed assurances of supply, would enable curtailments in times of drought to be applied effectively and consistently throughout the catchment. A study on the Blyde sub-catchment has been done and is currently being updated. A further study to develop operating rules for the whole catchment is in progress and the results will be incorporated into this Reconciliation Strategy when available.

7.3 Option Yield

It is not yet certain which additional yield will be made available through the implementation of an integrated systems operating rule. The application of agreed assurance of supply to users will definitely improve with better indications of the risk and extent of restrictions in the short to medium term.

7.4 Unit Reference Value

Not known at this stage. It is predicted to be low.

7.5 Time for Implementation

2 Years.

7.6 Social Impacts
None

7.7 Biophysical Impacts
None anticipated.

7.8 Management Intensity
This option will require some additional management within the catchment. An operating system has been developed and installed in the Crocodile River (East) catchment and requires an engineer to maintain and run the system, utilising approximately half his time. The Olifants system will be more complex and might require a full time engineer.

However, this can be considered low.

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8 Alternative or reduced supplies to Mokopane and Polokwane from the Olifants

The thinking behind this option was either to reduce the demands in Mokopane and Polokwane or to augment the water supply in the Limpopo WMA from sources other than the Olifants, thus reducing the demand on the Olifants System. Polokwane has implemented extensive WCDM for a number of years and the system is thought to be quite efficient. The current status, and that of Mokopane should be established and WCDM intensified if appropriate.

The Botswana Government is apparently currently planning a pipeline from the Zambesi to Gaborone and a possibility could be to enter into a joint scheme with the Botswana Government and supply Polokwane and Mokopane.

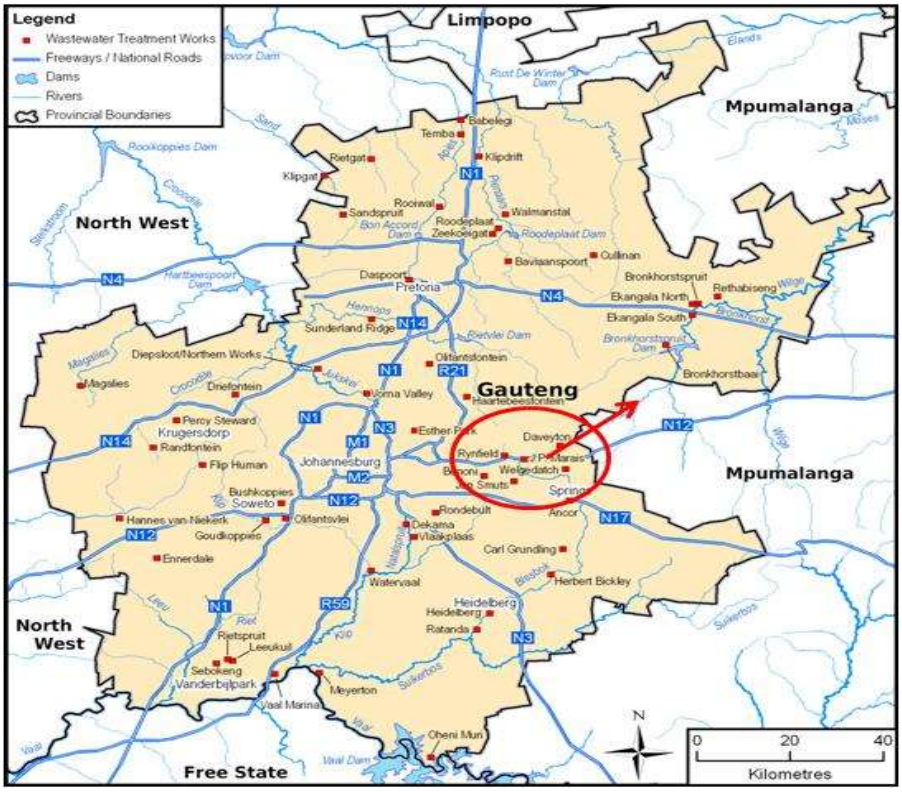
This option was not priced as there was not enough information available on the Botswana initiative and the planning of such an option would fall beyond the scope of this study. However, indications are that the URV for water from the Zambezi could be of the order of R51/m^3. Lower URV might result from a possible shared scheme.

Increasing Supply
Transfers-in:

9 Transfer treated sewage effluent from sewage treatment works in the Vaal Basin

A number of possible sources (waste water treatment works) exist in the Vaal basin. For the purposes of this initial assessment it has been assumed that water from waste water treatment works on the East Rand would be used. Their location is shown on the figure below. Other locations could be considered if this option is to be considered further.

9.1 Option Layout



9.2 Option Description

There are a total of 12 waste water treatment works in Ekurhuleni, which discharge their treated effluent into various tributaries of the Vaal River. It is possible to pump this water over the catchment divide into a tributary of the upper Olifants river. For this assessment the seven most suitable works were selected.

While the water is assumed to comply with the “general standard”, this is considered to be unacceptably high in nutrients to discharge into the Olifants system, so provision has been made for tertiary treatment of the effluent so as to have a maximum phosphate content of 0.1 mg/l.

Details of the envisaged scheme are shown in **Table 9.1**, from which it can be deduced that the effluent will as far as possible be pumped from one WWTW to another, with a central collection point at Daveyton. From there the effluent will be treated before being pumped over the divide to the Olifants catchment to a point about 10 km north of Delmas. The discharge point has not yet been investigated in terms of the receiving stream’s capacity, so it might be necessary to move the discharge point further downstream or to undertake river protection measures.

Table 9.1: WWTW taken into consideration and transfer costs

WWTW	Location	Capacity	Assumed Yield[1]		Pipeline							Pumps	Dam	Cost	URV
		(Ml/d)	(x10^6 m^3/a)	(m^3/s)	Destination	(m^3/s)	km	Start El	High pnt	End El	Diam	(kW)	(Ml)	(R Million)	(R/m3)
Daveyton	Daveton	16	4.7	0.148	Discharge pt	1.213	21.6	1590	1633	1536	900	650	17	301	0.81
JP Marais	Benoni	15	4.4	0.139	Daveyton	0.445	9	1597	1629	1590	600	310	6	96	0.67
Rynefield	Benoni	13	3.8	0.120	JP Marais	0.120	3.9	1605	1608	1597	300	62		35	1.05
Benoni	Benoni	10	2.9	0.093	JP Marais	0.093	9.7	1653	1657	1597	300	27		65	2.32
Jan Smuts	Brakpan	10	2.9	0.093	JP Marais	0.093	7.2	1602	1605	1597	400	48		53	1.25
Welbedacht	Springs	35	10.2	0.324	Daveyton	0.620	7	1577	1607	1602	700	424	9	96	0.62
Ancor	Springs	32	9.3	0.296	Welbedacht	0.296	12.5	1573	1601	1577	500	260		121	1.44
		131	38.3	1.213			70.9							466	3.83[2]
Tertiary Treatment Works at Daveton WWTW: capacity 136 Ml/day														657	3.48
													TOTAL (Excl VAT)		1 123	7.31

(1) Assumed equal to 80% of capacity

(2) Weighted averages accumulated along the route

This option will mean that the next Augmentation System will be required sooner than otherwise. That cost must still be assessed.

9.3 Option Yield

The seven treatment works have been selected based on their capacities and their location relative to the Olifants catchment. They are listed in Table 9.1. Their actual current and likely future discharges have not been investigated at this stage, and only their design capacities are known. Because of the seasonal peaks typical of effluent discharges, it has been assumed that 80% of the capacity will be available to transfer on a continuous basis. The combined yield of the selected works is then 38.3 million m^3/annum.

9.4 Unit Reference Value

Preliminary estimates of costs and URVs for this option are also given in Table 9.1.

While this scheme obviously lends itself to being implemented in phases, it has been assumed at this stage that the entire scheme will be implemented at once.

9.5 Implementation Time

4 Years.

9.6 Social Impacts

- The scheme is located mainly in urban areas and it is assumed that pipes can be located in street reserves with no need to relocate people.
- New servitudes will be required across private farmland for about 20 kilometres between Daveyton and the discharge point.

No fatal flaws have been identified and the impact is provisionally assessed as low.

9.7 Biophysical Impacts

Eutrofication conditions may develop in Bronkhorstspruit Dam if the treated waste water is not subjected to a tertiary treatment process. Good quality assurance will be necessary to ensure that phosphate contents are kept to a minimum.

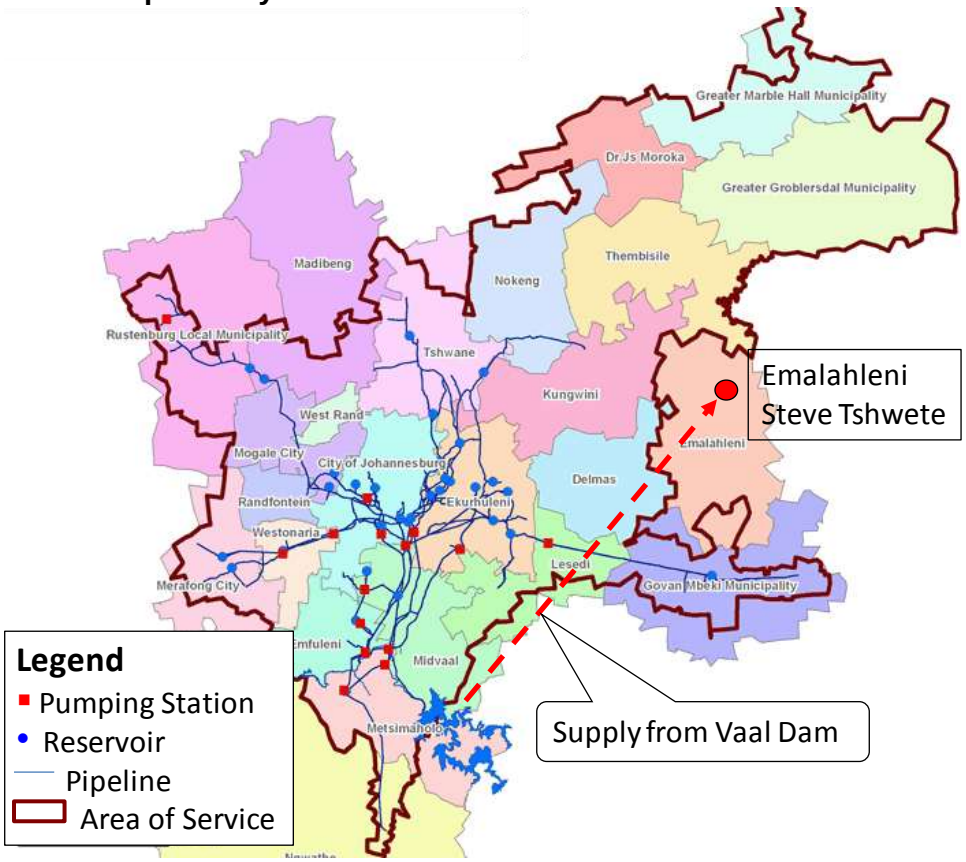
No other impacts have been identified but the other biophysical impacts of the inter basin transfer should be assessed. The overall impact is provisionally rated as medium.

9.8 Management Intensity

The management intensity can be regarded as "medium". The tertiary treatment plant and pumping mains will require constant attention.

10. Transfer raw water directly from Vaal Dam

10.1. Option Layout



10.2. Option Description

In this option the scheme that has been conceptualised is the abstraction of 100 million m^3/annum of raw water from Vaal Dam and pumping the water to the Emalahleni/Steve Tshwete area. This scheme would entail abstraction works, pump stations and laying a pipeline for approximately 160 km.

10.3. Option Yield

This option will make an additional 100 million m3/annum available by 2011 and meet the growth in demand en Emalahleni and Steve Tshwete until 2030.

10.4. Unit Reference Value

The URV for this option is based on conceptual costing. The total capital cost is estimated at about R3 billion. This transfer would, in turn, require augmentation of the Vaal River System from the Orange River. The capital costs of that augmentation could be of the order of R4 billion but would have a yield in excess of 100 million m^3/a.

The operating costs assumed that Eskom's tariff would increase in real terms by 25% per annum for the next 2 years. The operating costs include the current Vaal River raw water tariff which is applicable to all users. The URV is likely to be in excess of R10/m^3.

10.5. Time for Implementation

10 Years, but not before augmentation of the Vaal System is commissioned.

10.6. Social Impacts

The impacts along the pipeline will depend on the rating but can be expected to be low to medium. However, there will be job creation during construction and limited permanent employment.

The impacts of the scheme to augment the Vaal will depend on the option chosen but will include a large dam so the impacts can be expected to be medium.

10.7. Biophysical Impacts

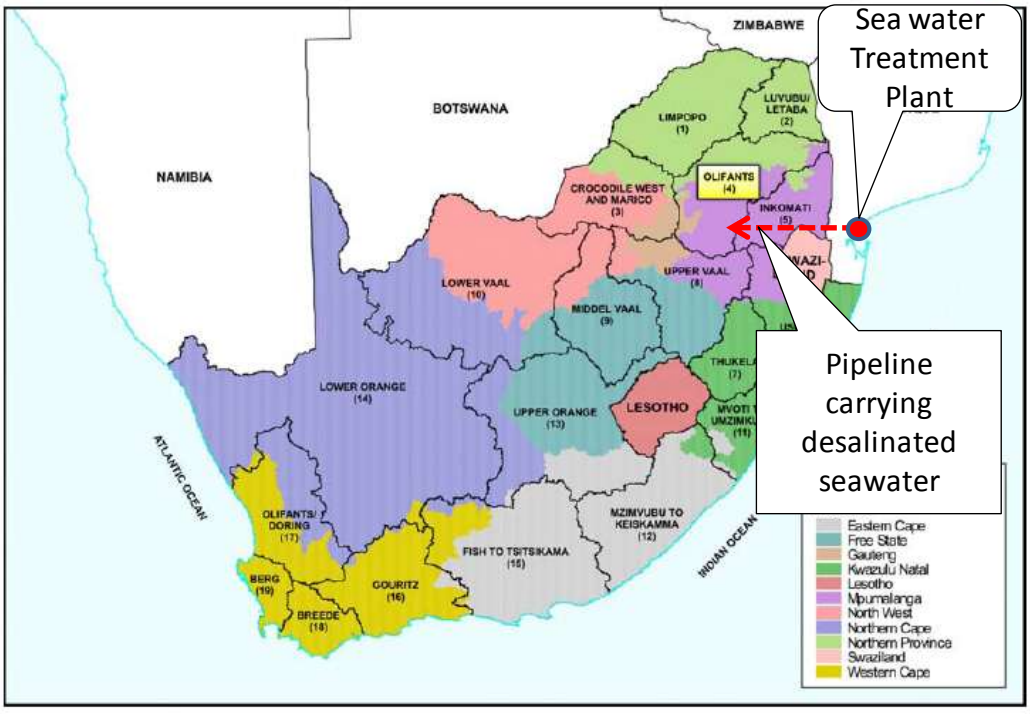
There will be some impacts, primarily along the pipeline route. The impacts of the inter basin transfer of raw water and possible species has not been investigated. The impact is provisionally rated medium, until further studies have been undertaken.

10.8. Management Intensity

Assessed as medium due to the operation of at least two pumpstations and a long pipeline.

11. Transfer desalinated seawater to the WMA

11.1 Option Layout



11.2 Option Description

When all water resources within the catchment are fully utilised and neighbouring catchments can no longer afford to transfer more water to the Olifants catchment, one has to think of bringing in desalinated seawater from the coastal areas.

The nearest coastline is the Moçambican coast line. It will therefore be necessary to negotiate with the Moçambican government and to reach an agreement for taking a pipeline across their land. The Moçambican government might be interested in sharing the pipeline which will have the benefit of scale.

The sea as resource can supply all the needs and the limitation will therefore not be the availability of the resource, but rather the cost of bringing the water to the catchment.

A desalination plant has to be erected next to the coast line and the water needs to be treated at the abstraction point. Environmental impact assessments are required to ensure that the saltwater, effluent that goes back to the sea will not have any negative impacts.

The water can be piped all the way to the Olifants catchment or it can be taken only to a point in the Komati catchment in which case users in the Komati can use the desalinated sea water and the equivalent volume of fresh water from the Komati can be transferred to the Olifants.

11.3 Option Yield

The option yield needs to be optimised and is dependent on the affordability of the users, whether the pipeline is shared by other users along the way, etc.

11.4 Unit Reference Value

The URV provided for this option in the recent DWA study, "Assessment of the Ultimate Potential and Future Marginal Cost of Water Resources in South Africa", has been used. This URV must be regarded as indicative and more accurate cost estimates will have to be prepared if this option has to be pursued.

The URV given in the report is R44.00/m^3.

11.5 Time for Implementation

All other local options must first be exhausted before this one is considered. It is foreseen that pre-construction lead time will be approximately 5 years and that construction would be a similar period

11.6 Social Impacts

A pipeline servitude over a very long distance will have to be expropriated. This may be disruptive to many. The impact is provisionally assessed as medium.

11.7 Biophysical Impacts

No biophysical impacts are foreseen in the Olifants catchment itself, but the pipeline may cross ecological sensitive land and the saltwater return flows back to the sea may have negative impacts.

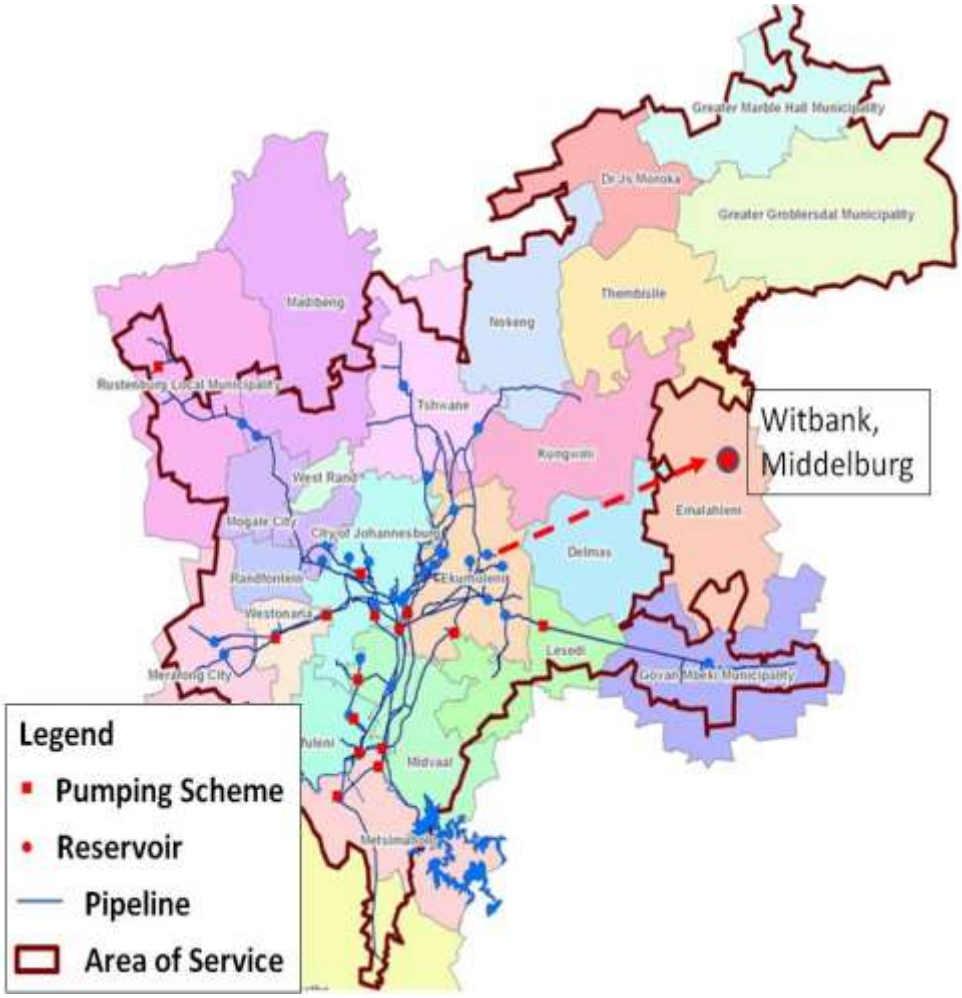
The impact is provisionally assessed as medium.

11.8 Management Intensity

The management intensity is regarded as medium to high during planning and construction and medium when the scheme is operating. It is foreseen that a telemetry system will be required for the management and that several employees are required for the smooth operation and maintenance of the project.

12. Expand Rand Water supply to Emalahleni, Steve Tshwete and Bronkhorstspruit

12.1 Option Layout



12.2 Option Description

A further option to source additional water for the Olifants River from the Vaal River system would be to expand the Randwater raw water supply and treatment system and pump potable water to the Emalahleni/Steve Tshwete area to replace the existing potable water supply in those towns.

The Vaal river system would also require augmentation.

Significant new infrastructure would be required to treat and transfer the water. This would largely duplicate existing treatment infrastructure.

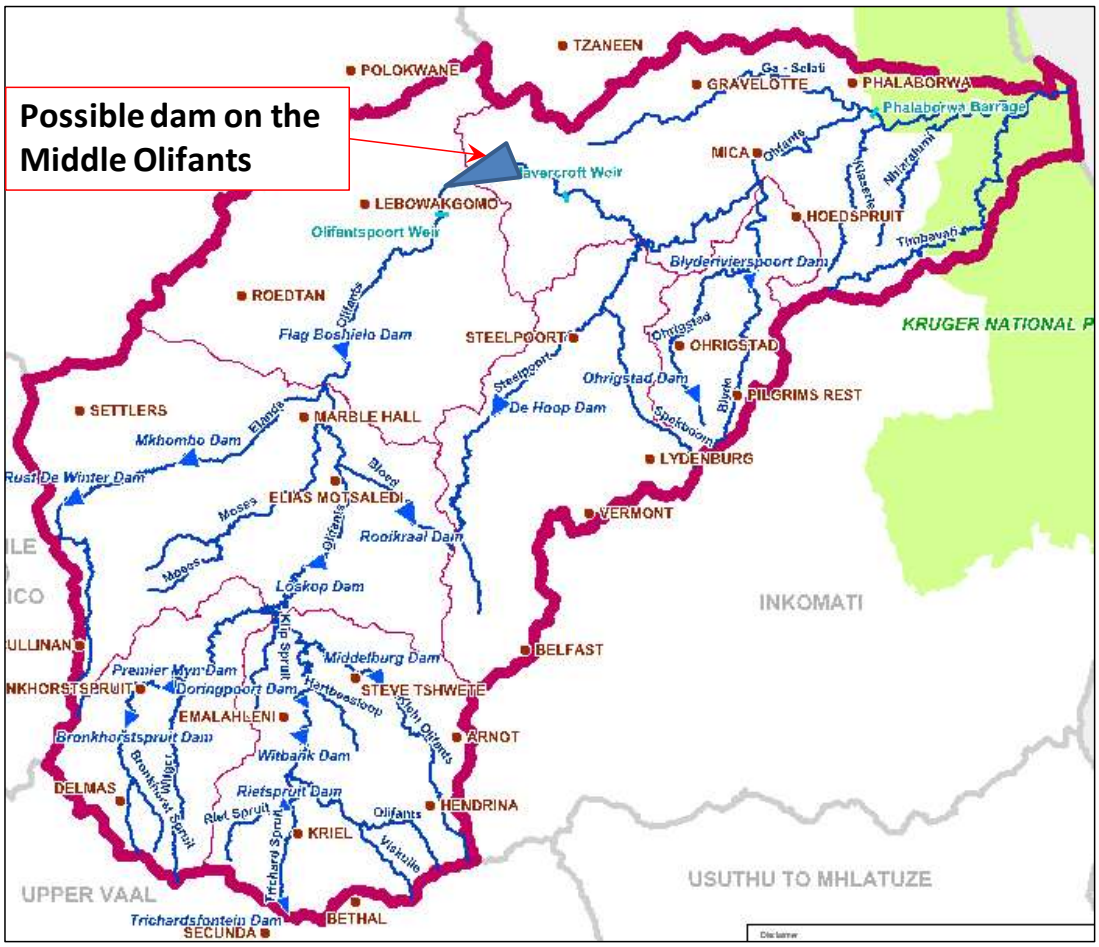
Transferring raw water from the Vaal the Olifants basin appear preferable. This option has not been considered further.

Possible New Dams:

13. New Dam in the Mainstream Olifants River

13.1 Option Layout

Some possible dam sites have previously been identified on the Olifants river and other sites might be possible. For the purpose of this screening, a site on the Middle Olifants at Rooiport has been used.



13.2 Option Description

In 1993 and again in 2001, DWA undertook a feasibility study for a possible dam on the Olifants river at Rooipoort, but found that the dam was not very favourable for a number of reasons:

- The yield was relatively small because of the many upstream dams
- Geotechnical investigations established that the dam had particularly unfavourable foundations
- The dam flooded two provincial roads which would cost as much to relocate as the cost of the dam wall
- The dam flooded all or part of some 12 villages, requiring relocation of more than 300 households.

In 2007 DWA undertook a study to compare the Rooipoort dam with the proposed De Hoop dam on the Steelpoort river. It was found that for the same construction cost, the De Hoop dam yield was twice as much as the Rooipoort dam, and did not have the serious social impacts as the Rooipoort dam. The De Hoop site was therefore selected, and the dam is currently under construction.

It has recently been suggested that a dam at a site some 10 to 20 km downstream of Rooipoort might be mor`e favourable, with a slightly higher yield, being downstream of the Mohlapitse tributary, and with relatively few social impacts, but this has not been studied at this time.

From a study of 1: 50 000 maps, other possible dam sites have been identified on the Olifants river, including immediately downstream of the Steelpoort river confluence. These and other alternative sites will be studied if a dam on the main river is an option for further study.

It should be noted that, as the dam moves downstream, the yield increases but the natural high flows required by the environment reduce and larger releases are required.

13.3 Option Yield

Based on previous studies, the maximum yield of a dam at Rooipoort would be 55 million m^3/a.

13.4 Costs and Unit Reference Value

Capacity	450 million m^3
Cost	R 1.1 Billion
Yield	55 million m^3/a
URV	R 3/m^3

13.5 Time for Implementation

10 – 12 years

13.6 Social Impacts

Any dam on the Middle Olifants River similar to the Rooipoort site might require the relocation of households together with schools, businesses, etc and could also inundate significant areas of irreplaceable agricultural land. The impact is provisionally assessed as high.

13.7 Biophysical Impacts

Assuming the EWR is supplied the impact should be low, depending on the site.

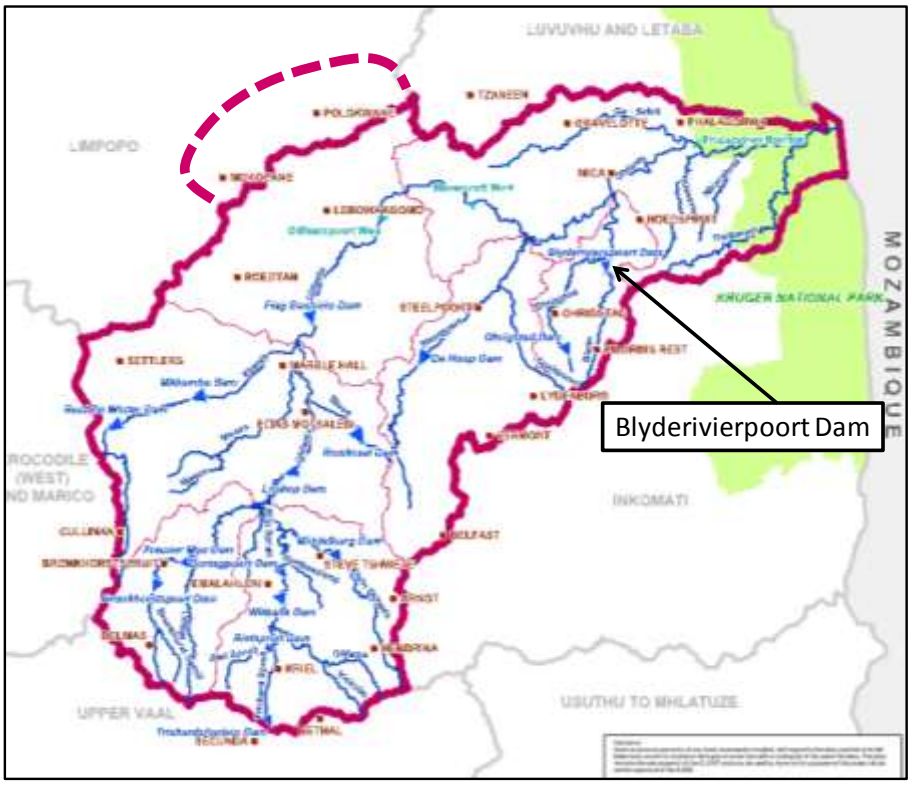
13.8 Management Intensity

This is assessed to be low.

14. Blyderivierspoort Dam raising

14.1 Option Layout

The location of the Blyderivierspoort Dam is shown on the map.



14.2 Option Description

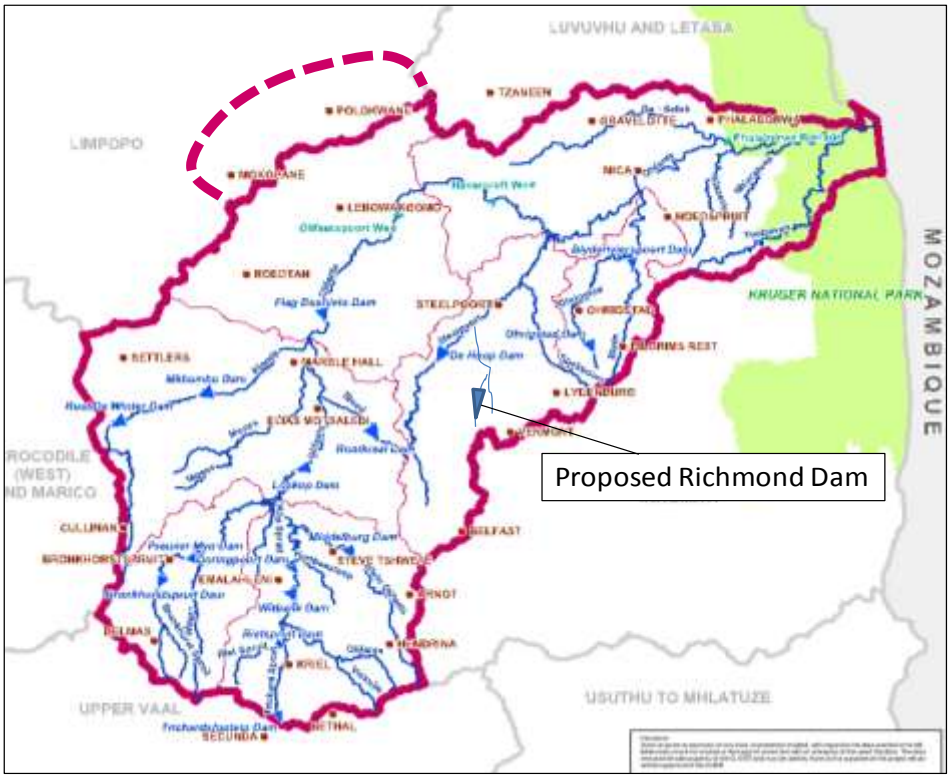
The Blyderivierspoort dam is a concrete gravity arch dam 50m high with a capacity of 54.6 million m^3, which is only about 20% of the MAR. This indicates that significantly greater yield can be obtained by raising.

The topography allows the dam to be raised by a maximum of 55m, although a saddle dam will be required for raisings for more than about 30m This option has not been assessed yet, but it is recommended that it should be considered.

15. Smaller Dams to supply water

15.1 Option Layout

Options exist to construct one or more smaller dams to meet the needs of specific water users. An example of this is the Richmond Dam proposed by Anglo Platinum and it is used as an indication of the costs and benefit that might be achieved.



15.2 Option Description

A design and cost estimate was prepared by Anglo Platinum for the Richmond dam on the Klein Dwars river. The dam comprises a 33 m high embankment dam and is intended to supply the Der Brochen mine.

15.3 Option Yield

The yield has been calculated 2.55 million m^3/a after releasing the EWR.

15.4 Costs and Unit Reference Values

Cost	R 120 Million
Yield: After EWR	2.55 million m^3/a
URV: After EWR	R 1.14/m^3

15.5 Time for Implementation

4 Years.

15.6 Social Impacts

The dam has minimal social impacts.

15.7 Biophysical Impacts

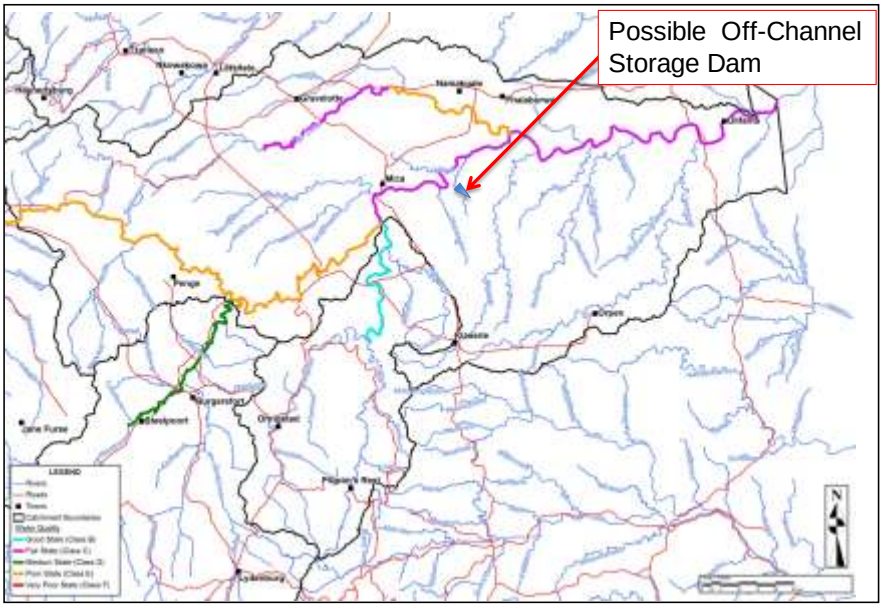
The dam has no significant biophysical impacts.

15.8 Management Intensity

The dam has low management intensity.

16. Off Channel storage dam on one of the tributaries with pumping from the Olifants

16.1 Option Layout



16.2 Option Description

It has been established that supplying the EWR is extremely problematic in the Olifants river, especially through the Kruger National Park (KNP) where higher flows are required to maintain a higher ecological category than further upstream. One option of contributing to the EWR through KNP without reducing the availability of water for upstream users, is to build a dam specifically for this purpose.

It is envisaged that such a dam would be relatively small compared to other dams which have been considered. However, a dam on the main stem would silt up very quickly with the high silt load in the Olifants River. An-off channel dam would be a better solution in terms of dealing with the silt.

It is envisaged that the scheme would comprise a low weir and pump station on the Olifants river, pumping to a dam which would probably be located on a small tributary near its confluence with the Olifants river. The dam's outlet(s) would need to have considerable capacity to release elevated flows which could be required.

If the dam is to be built solely for the benefit of the KNP, then there would be merit in siting the dam within or very close to the park to simplify the operation of a relatively complex system.

Such a scheme would result in somewhat decreased high flows downstream of the weir during pumping for very short durations, but increased flows for longer durations when low flows of better quality are required and can be released. The scheme would therefore allow the limited water available be managed to the optimum benefit of the downstream river.

Without knowledge of what EWRs might be released from upstream dams, and a detailed study to determine the durations of periods when flows in the main stem can be diverted or pumped to the tributary, it is not possible to estimate the size of the scheme.

16.3 Option Yield

This scheme would not increase the reliable yield of the Olifants river system but would rather just allow better management of the available water. It is therefore inappropriate to talk about the schemes "yield" but would rather be described by the capacity of the dam. As explained above, no attempt has been made to estimate the optimum capacity.

16.4 Costs and Unit Reference Values

As the dam is not intended to supply on a continuous basis, the term "yield" is not appropriate. A URV has therefore not been calculated and a detailed modelling exercise will be required to quantify its benefits.

Construction costs have been estimated as follows:

Off-channel dam	R120 million
Weir on Olifants	50
Pumps and pipeline to dam	76
Total	**R246 million**

16.5 Time for Implementation

4 Years.

16.6 Social Impacts

No fatal flaws have been identified and the impacts are expected to be low.

16.7 Biophysical Impacts

- The main positive impact, and the purpose of the scheme, would be the effects of better management of the low flows on the ecology of the Olifants river through KNP
- The main negative impact would be the results of the weir on the Olifants river on migration of certain species, but this could be largely mitigated.
- Another impact would be the major change of habitat in and around the area inundated by the dam.

On balance, it has provisionally been assessed as low.

16.8 Management Intensity

The scheme involves the operation of a sophisticated pump station, and requires expert knowledge of the riverine ecology to optimise the times of pumping and release of water.

It has provisionally been assigned a medium rating.

17. Groundwater options

17.1 Option Layout

The Malmani dolomite outcrops to the east of the Pretoria Series strata forming a wide arc as shown in the Figure.

17.2 Option Description

The Malmani dolomite area considered encompasses the dolomites along the escarpment. There are no villages or settlements on the dolomites as it is a mountain area. It would exclude the Zebediela area where groundwater is abstracted for irrigation and the aquifer is considered stressed.

The main use of groundwater would be for rural domestic use and water for food security in locations where there is a demand close to a high yielding aquifer. The availability of power and the viability of renewable energy sources are potential limitations. Selective exploration will have to be done to establish the most feasible options to abstract water from the dolomite and transfer it to areas in need.

17.3 Option Yield

A study by SATAC of the water availability in the Olifants reported that recharge studies indicate recharge of up to 20% of the mean annual precipitation (MAP). The rainfall in the area is 560 to 620 mm per annum. Assuming a recharge of 20% and rainfall of 580 mm the calculation shows recharge of 82 Mm3/a in this area of dolomite. The ability to abstract this water and the development from boreholes in the most suitable location will restrict the proportion of this total available for abstraction to about 60% translating to 50 Mm3/a.

However, the aquifer currently feeds springs with a significant contribution to the base flow of the rivers and abstraction should be limited to that which is acceptable in terms of the impact on base flows.

17.4 Unit Reference Value

A number of boreholes and reticulation systems into the rural settlements are required. It depends to a large extent on the area and number of villages that need to be serviced and a proper cost estimate is difficult on a desk top basis. The scheme will cost in the order of R10 – R20 million and the URVs are expected to be low.

17.5 Time for Implementation

3 Years

17.6 Social Impacts

- Benefits of water available to rural towns and villages outside the dolomite area.
- Less water treatment than surface water.

The impact is considered positive to low.

17.7 Biophysical Impacts

If the abstraction is limited to that which will have an acceptable impact on base flows for the biophysical environment then limited environmental impact foreseen.

17.8 Management Intensity

The groundwater management will require a real time water level recording system that should be evaluated on a daily basis to ensure no over-abstraction that may result in ground stability be impacted. Protection zones around the wellfield will be necessary and daily inspection of the wellfield.

The overall assessment is medium.

18. Rainwater harvesting

18.1 Option Layout

The potential for rainwater harvesting is applicable throughout the study area.

18.2 Option Description

Background information was obtained from the Western Cape Water Reconciliation Study Report (Interventions - 2007), the WRP Study Proposal Document for water harvesting, the Water Reconciliation Strategy Study for the KwaZulu Natal coastal metropolitan areas and the Water Reconciliation Strategy Study for the Algoa Water Supply Area.

This option comprises the collection of rainwater from roofs, primarily for toilet flushing. The collection of rainwater for supplementing of garden water use, is deemed as an extension of this option and would be applicable mostly to thei high income group which is the largest gardening water users. The latter extension, in turn, could be supplemented by the phasing in of grey water re-use.

The option, is a supply augmentation option or potable water replacement option.

The most benefits can be obtained where there is no reliable source of relatively unpolluted water for domestic use and for reducing the demand on the potable systems.

Rain water harvesting could also be used in the rural areas and the large rural areas within the Olifants catchment could benefit from this option. Although this option description was aimed mainly at the urban middle to high income groups, this description could also serve as indicative for the rural low income group. The URVs will however be much higher because of the smaller rooftop areas.

Storage tanks available in the market, have been designed to add special feature value to properties and not to deface and devaluate when put into practice.

The costs of the infrastructure required to implement this option vary significantly from installation to installation, depending on the roof configuration and the location of the toilets.

18.3 Option Yield

The determination of the potential yield was based on a rainfall gauge within the Olifants catchment area (Emalahleni Municipality Raingauge 0515412). The potential yield for this option is affected by the combination of rainfall patterns, roof areas utilised and storage volumes supplied. The input information and results of the calculations are given below.

- Roof Area = 100 m^2 roof area
- Losses = 10%
- Tank Storage Capacity = 5 m^3
- Draw off = 200 L/day
- Annual volume harvested = 41 m^3

The supply option, due to its initial direct capital layout requirements, will be limited to middle and high income groups.

18.4 Unit Reference Value

The URVs for this option is based on an assumption of the capital costs to be incurred for supply & installation of 5 m^3 tanks and connector works. The URV calculation per household is based on a discount rate of 8% applied for a 50 year period.

Item	Discount Rate 8%
Total capital cost ®	13,500
Annual operating cost (R / annum)	150
NPV Cost (R)	13,000
Unit Reference Value (Rm^3)	34

Note: To opt for a smaller storage tank, will yield less water per annum, will increase the URV values and increase the time of dependence on the municipal water supply system.

18.5 Time for Implementation

Very short lead time of installation on an individual house by house basis. It may take a number of years to implement on a town wide basis. This could be expedited if the requirement for a rainwater tank is made part of the Municipality's bylaws.

18.6 Social Impacts

Due to the high costs of rainwater tanks and the installation thereof, poor and middle income groups would most likely be unable afford this option without subsidies. In addition, due to the current economic conditions and trends, the size of these two groups would most likely increase over the next few years, potentially hampering the effectiveness of this scheme. Also, changes in weather systems due to climate change could result in droughts occurring more frequently, increasing demand and pressure on water resources, making this a more attractive option to consumers.

18.7 Biophysical Impacts

None identified

18.8 Management Intensity

For maximum benefit this option would need to be incorporated in the Municipality's bylaws and would have to be enforced for any new dwellings constructed. Management intensity is provisionally assigned a low rating.

Water Quality Options:

19. AMD treatment plants (similar to the Emalahleni AMWR plant)

19.1 Option Layout

The possibility for reclaiming acid mine drainage water predominantly exists in the upper part of the catchment.

19.2 Option Description

Acid mine drainage is associated with mining activities where the mines dewater their works in order to be able to extract coal. This is associated with both underground and open cast mining.

The relatively high permeability of open and rehabilitated open cast mines and effective management or operation of the underground storage either below the mining area or in the abandoned mine workings, can increase the system yield without treatment. However, the contaminated nature of the water makes treatment or dilution essential. The treatment of the drainage water on its own is thus aimed at solving a water quality problem, and has no effect on the water balance.

If the treated mine water is used for urban supply purposes and this reduces the importation of water from the Vaal River, then it reduces the return flows and availability of water in the Olifants River Catchment.

A reclamation plant has been commissioned that treats mine drainage water to potable standards and then supplies the treated water to Emalahleni.

The treatment process consists of pre-treatment followed by ultrafiltration and reverse osmosis. The reject from the first stage is then treated in the same way, as is the reject from the second stage. This three stage process renders the plant highly efficient, and the ultimate reject amounts to about 1%. This is then disposed of through a solar evaporation facility.

19.3 Option Yield

The plant has an installed capacity of 25 Ml/day (about 9 million m^3/a) and produces a product water with a salinity of less than 300 mg/l. This is well within the drinking

water standard of 450 mg/l. The capacity of the plant is scheduled to be doubled in the near future.

19.4 Unit Reference Value

The operating cost of the plant amounts to R 3.55/m^3, while the capital recovery cost over 15 years at 12% comes to R 3.20/m^3. Total cost is therefore R 6.75/m^3 at 2008 price levels.

The above represents the cost of treatment only, but to potable standard. Once the cost of collecting the drainage water, disposing of the waste and delivery to the Emalahleni distribution reservoir is added, the total cost comes to R12/m^3. Emalahleni pays R4.65/m^3 for the water based on the cost of alternative supplies.

The unit reference value for treating acid mine drainage to a stage where it could be discharged to the environment is probably about R 7.5/m^3 at 2009 price levels.

The mines have a responsibility for managing their AMD.

19.5 Time for Implementation

Implementation of an additional plant can be effected within a two year period, allowing for design, tendering and construction.

19.6 Social Impacts

No fatal flaws have been identified and it is rated as low.

19.7 Biophysical Impacts

The quality of the water in the receiving water bodies will improve so the impact is positive.

19.8 Management Intensity

The plant requires a high level of skilled manpower to operate, and it has provisionally been assigned a rating of medium.

20. Re-use of Sewage Effluent

Use of Treated Sewage Effluent for the Irrigation of Sport Fields, Golf Courses and Municipal gardens

20.1 Option Layout

This option can only be applied in the bigger towns such as Emalahleni, Steve Tshwete, Polokwane and Mokopane.

20.2 Option Description

The use of urban wastewater for irrigation purposes is a centuries old practice that is receiving renewed attention with the increasing scarcity of fresh water resources in many arid and semi-arid regions. Driven by rapid urbanization and growing wastewater volumes, wastewater is widely used as a low-cost alternative to conventional irrigation water.

It may be argued that the treated waste water of the Municipalities is currently being released in the rivers and is being abstracted again for irrigation. However, if the municipality uses the sewage water themselves for the irrigation of their sports fields, there will be an overall saving of potable water as potable water is currently being used for the irrigation of these fields. The municipality can, in this manner reserve

treatment capacity for future potable water requirements and postpone the expansion of their treatment works.

One option is a mobile treatment unit which is placed at the nearest sewerage manhole next to the sport field and the treated sewage water is then pumped into the sprinkler system of the field. The sludge coming from the mobile treatment plant goes back to the sewer where it flows to the municipal treatment plant.

This methodology is used successfully in Melbourne, Australia and a picture of the mobile treatment plant is shown in **Figure 20.1** below.

Fig 20.1: Sewage treatment, Melbourne

20.3 Option Yield

It is estimated that approximately 1 million m^3 potable water per town can be saved by applying this method.

20.4 Unit Reference Values

The costs and unit reference have to be determined but the URV is expected to be low.

20.5 Time for Implementation

Immediately – within 1 year.

20.6 Social Impacts

None

20.7 Biophysical Impacts

None

20.8 Management Intensity

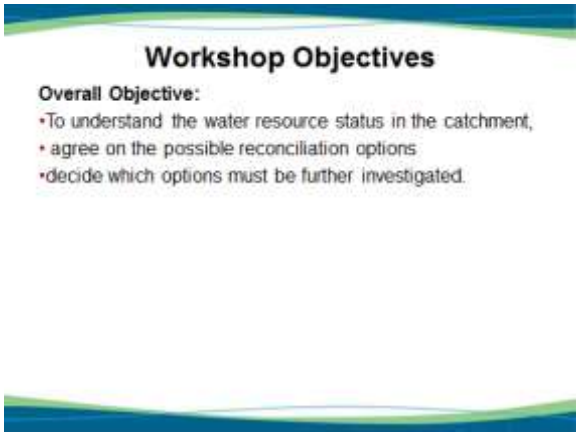
It is foreseen that 1 operator will be required and a truck driver that will move the treatment plant from one point to another.

This is relatively high for the yield and a rating of medium has been assigned to it.

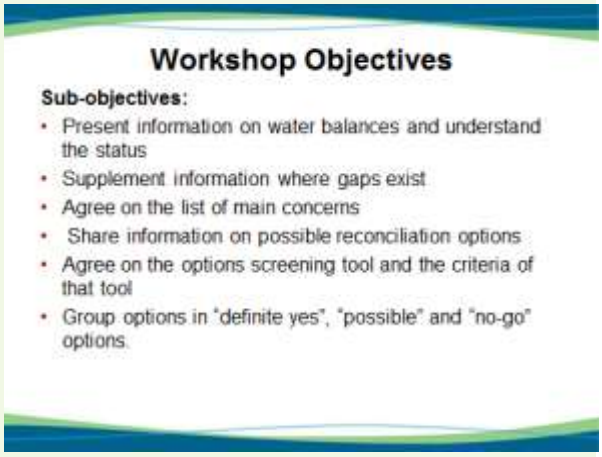
APPENDIX D

Presentation


Development of a Reconciliation Strategy for the Olifants River Water Supply System
Preliminary Screening Workshop
7 July 2010
water affairs
ILISO
aurecon


Workshop Objectives
Overall Objective:
•To understand the water resource status in the catchment,
• agree on the possible reconciliation options
•decide which options must be further investigated.


AGENDA
1. Introduction
2. Process to be followed
3. Workshop objectives
4. Catchment overview
5. Current & future water balance
6. Discussion
7. Water management concerns
8. Options screening tools
9. Presentation of the options
10. Evaluation of options
11. Agree options
12. Way forward
13. Closure


Workshop Objectives
Sub-objectives:
• Present information on water balances and understand the status
• Supplement information where gaps exist
• Agree on the list of main concerns
• Share information on possible reconciliation options
• Agree on the options screening tool and the criteria of that tool
• Group options in "definite yes", "possible" and "no-go" options.

Overview of the Study Area Status

Preliminary Screening Workshop
7 July 2010

Climate

- Average rainfall varies over the study area from 325 to 750 mm/annum and up to 1000 mm/annum on the escarpment
- Mean annual evaporation varies from 1 300 to 1 700mm

Study Area

Olifants WMA (55 000 km²)

Plus

Polokwane and Mokopane

Mean Annual Runoff

Catchment	Natural Mean Annual runoff	
	(million m3/a)	% (of total)
Steelpoort	343	18
Blyde	386	20
Elands	120	6
Main stem	1091	56
Total	**1940**	

Urban and Rural Population (Year 2000 - DWA ISP Report)

	Urban	Rural	Total
Upper Olifants	597 882	125 126	723 008
Middle Olifants	231 226	1 353 223	1 584 449
Steelpoort	28 352	184 547	212 899
Lower Olifants	54 691	208 074	262 765
Total	912 151	1 870 970	2 783 121

Polokwane – Rural and Urban – 168 000
Mokopane – Rural and Urban – 89 000
From current All Towns Study survey

Economic Activities

- Main economic sectors are:
  - Mining
  - Agricultural Activities
  - Tourism

Mines in the Study Area

Tourism

- WMA comprises at least 15 conservation areas
- Various resorts
- Popular tourist attractions
- KNP at downstream end
- Tourism Sector doesn't use much water – income per m³ therefore high
- Tourism however dependent on the EWRs.
  - Quantity
  - Quality

Agricultural Water Use

- Irrigation uses 70% of total water use in catchment
- Total area of scheduled irrigation: 59 229 ha
  - Out of Loskop and upstream 62%
  - Blyde River 19%
  - Rest of catchment 19%
- Quotas per ha vary from 5 000 – 9 900 m³/ha – most quotas in the order of 7 500 m³/ha
- No clarity on assurance of supply

Information Gaps

- Water requirements – Rural Water Use
- Extent and coverage of Invasive Alien Vegetation
- Mining Sector
  - No report on WCDM
  - Limited information on water requirements for mining
- Extent and water requirements for Forestry
- Water quality requirements for Tourism
- Very little reference to non-conventional water sources
- International requirements
- Agriculture – Actual use and Assurance of Supply
- Reserve – Changes in the PES over the last 10 years

Possible Reconciliation Options

Preliminary Screening Workshop
7 July 2010

Options Considered (Continued)

- Increasing supply: possible new dams
  - New dam on mainstream of Olifants River
  - Blyderivierspoort Dam raising
  - Smaller dams to supply water
  - Off channel storage dam on one of the tributaries with pumping from the Olifants
- Increasing supply: Groundwater and rainwater harvesting
  - Groundwater options
  - Rainwater harvesting

Options Considered

- Reducing water use in the basin
  - Compulsory licensing
  - Increased efficiency in the irrigation sector including WCDM
  - WCDM in the urban sector
  - WCDM in mining
  - Reduction in bulk infrastructure losses from regional schemes
  - Removing alien invasive plants
  - Integrated system operating rules

Options Considered (Continued)

- Increasing supply: Water quality improvement options
  - AMD treatment plants (similar to Emalahleni AMWR plant
  - Re-using sewage effluent

Options Considered (Continued)

- Reducing transfers out of the basin
  - Alternative or reduced supplies for Mokopane and Polokwane from the Olifants
- Increasing supply: Transfers in
  - Transfer treated sewage effluent from sewage treatment works in the Vaal basin
  - Transfer raw water directly from Vaal dam
  - Transfer desalinated seawater to the WMA
  - Expand Rand Water supply to Emalahleni, Steve Tshwete and Bronkhorstspruit

Reducing Water Use In The Basin

Compulsory licensing (continued)	
Biophysical impacts	None are foreseen
Management intensity	High for process as legislated in s43-s48 Medium for alternative process

Compulsory Licensing

- Option Description
  - Two alternatives:
    - Curtail all users following the process in S 43-48 of the NWA
    - Levy additional water use charge to finance the buying out of water entitlements from willing sellers

Increased Efficiency of Water Use in the Irrigation Sector

Option description:

- Optimising Assurance of Supply
  - Currently scheduled irrigators have each been allocated a volume of water / annum
  - Water balance assessments assume 98% assurance of supply, which is too high for all forms of irrigation
  - A open process to agree assurances of supply should be started
- Cost, Social Impacts, Biophysical Impacts, Management Intensity and Time for Implementation are all regarded as "Low"

Compulsory licensing	
Option yield	100 million m³/a can be freed up
URV	Can be regarded as "medium". Costs will inter alia comprise surveys, water availability assessments, administration, loss of production and/or labour (for 1st alternative), Cost of water entitlements (for 2nd alternative)
Implementation time	Uncertain: 3-4 years
Social impacts	1st Alternative where all users are curtailed - High 2nd Alternative where some water entitlements are bought from willing sellers: Medium

Increased Efficiency of Water Use in the Irrigation Sector (Continued)

Option description

- WCDM
  - Reduce losses in bulk supply canals and reticulation systems
    - Replace canals with pipelines
    - Repair concrete linings and seal canals
    - Install meters and maintain existing ones
  - More efficient irrigation after farm edge supply (Individual irrigator responsibility), e.g.
    - Upgrading irrigation system
    - Improved scheduling
    - Crops which use less water but yield higher incomes

Increased Efficiency of Water Use in the Irrigation Sector: WCDM	
Option yield	A 10% saving has been assumed, i.e. ± 60 million m³
URV	Uncertain; condition of canals and extent of work unknown URV for Blyde pipelines R 3 to R 6 per m³
Implementation time	Long, can only work inside canals during dry periods
Social impacts	None foreseen. Possible short term job opportunities will be positive.
Biophysical impacts	None foreseen
Management intensity	Reduction in bulk losses is management intensive Beyond farm edge losses – many individuals - High

WCDM in the Urban sector (Continued)	
Social impacts	Positive: employment opportunities No negative impacts
Biophysical impacts	No impacts
Management intensity	Mobilisation of teams and public cooperation require high management intensity

WCDM in the Urban Sector

- Option description
  - Based on DWA Directorate: Water Use Efficiency report for Emalahleni Municipality
  - Loss Management, e.g.
    - Pressure management
    - Leak detection and repair
  - Improved efficiency, e.g.
    - Public awareness
    - Pricing and payment collection

WCDM in Mining

- Option description
  - Little information available. Perception is that mines maintain high water use efficiencies
  - This option is considering some Phalaborwa mines that are about to close down or have already done so

WCDM in the Urban sector	
Option yield	All Urban Areas in the Olifants River System • Loss Management – 34 million m³ / a (22%) • Improved Efficiency – 9 million m³ / a (6%) • Total 43 million m³ / a
URV	URVs, examples • Pressure management R 0.40 / m³ • Leak control with pressure management R 0.60 / m³ • Tariff management and public awareness R 0.50 / m³
Implementation time	On average: Implementation phased in from 5 to 10 years

WCDM in mining	
Option yield	• No information and needs to be further investigated • Total water use of Phalaborwa mines is 22 million m³/a: will be a % of this use
URV	Not known at this point in time: Is expected to be “Medium”
Implementation time	Within 2 years. Timing for mine closures must be determined
Social impacts	None
Biophysical impacts	None
Management intensity	Regarded as “low”

Removing Alien Invasive Plants

- Option description
  - Estimates u / s Loskop 213 km²
  - Remainder of catchment 225 km²
  - Mainly black wattle

Integrated System Operating Rules	
Option yield	Relatively low
URV	Not known at this stage. Predicted to be low.
Implementation time	2 years
Social impacts	None anticipated
Biophysical impacts	None anticipated
Management intensity	One full time engineer required. Considered to be "Low" in management intensity

Removing alien invasive plants	
Option yield	Up to 4.6 million m³ / a
URV	R 2.50 / m³
Implementation time	> 5 years
Social impacts	Job opportunities and firewood: Positive
Biophysical impacts	Positive: • Improved biodiversity • Reduced soil erosion
Management intensity	Relatively low

Reducing Transfers Out Of The Basin

Integrated System Operating Rules

- Option description
  - Will include all schemes within the study area
  - This option entails the development of operating rules, which consider the conjunctive use of all resources within a systems context
  - Would enable curtailments in times of drought to be applied effectively and consistently throughout the catchment

Alternative or Reduced Supplies to Mokopane and Polokwane from the Olifants

- Option Description:

Water could perhaps be transferred from the Zambesi River to Limpopo WMA and the supplies to Polokwane and Mokopane rather be augmented with that water than Olifants water.

URV estimated to be in the order of R 51 / m³

Possibility of a Joint project with Botswana

Increasing Supply: Transfers In

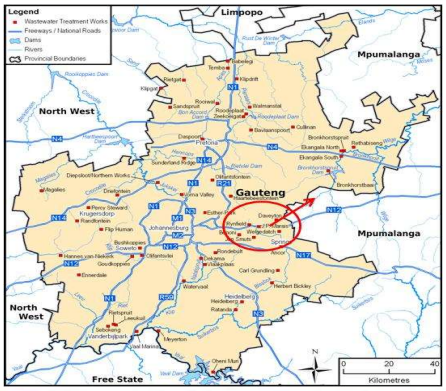
Transfer treated effluent from the Vaal basin	
Option yield	7 Selected WWTWs can yield 38 million m³/a
URV	R 7.31 / m³
Implementation time	Could be phase, but if done all at once it will take approximately 4 years to implement
Social impacts	Servitudes will be required across private farmland
Biophysical impacts	Eutrofication conditions may develop in Bronkhorstspruit Dam if treated waste water is not subjected to a tertiary treatment process
Management intensity	Can be regarded as “medium”. Tertiary treatment plant and pumping mains will require constant attention

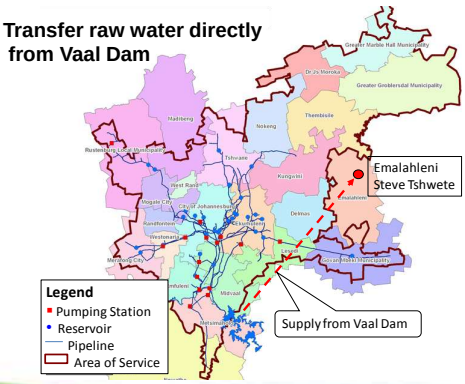
Transfer treated sewage effluent from sewage treatment works in the Vaal Basin

- Option Description
  - Collect treated waste water from waster water treatment works in Ekurhuleni
  - Treat this water another time (tertiary treatment) to further reduce the phosphate concentration
  - Pump this water over the catchment divide and release it in the Olifants catchment just north of Delmas

Transfer raw water directly from Vaal Dam

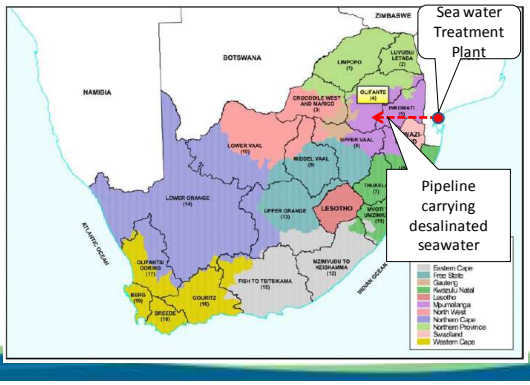
- Option Description
  - 100 million m³ Raw water abstracted out of Vaal Dam
  - Pumped to Emalahleni and Steve Tshwete
  - Scheme would entail abstraction works, pump stations and laying a pipeline for approximately 160 km





Transfer raw water directly from Vaal Dam	
Option yield	100 million m³/a by 2011
URV	Likely to be in excess of R 10 / m³. Capital cost of this scheme is ± R 3 billion. The scheme will have to contribute to Vaal augmentation from Orange River (± 4 billion)
Implementation time	10 years – can only follow after commissioning augmentation of the Vaal system
Social impacts	Pipeline – suggest "medium" rating: job opportunities and pipeline servitudes Vaal augmentation – suggest "medium" rating: will depend on the option chosen

Transfer desalinated seawater to the WMA



Transfer raw water directly from Vaal Dam (continued)	
Biophysical impacts	Impacts uncertain. Impacts on possible species have not been investigated. Suggest provisional rating as "medium"
Management intensity	Suggest "medium" rating due to operation of at least two pump stations and a long pipeline.

Transfer desalinated seawater to the WMA	
Option yield	Could be high. Need to be optimised: dependant on affordability of users and whether project is shared by other users.
URV	R 44 / m³ (Source: study "Assessment of the Ultimate Potential and Future Marginal Cost of Water Resources in SA")
Implementation time	10 years – pre-construction lead time ± 5 y; construction ± 5 y
Social impacts	Suggest "medium" rating: Pipeline servitudes over a very long distance. job opportunities may have a positive impact.

Transfer desalinated seawater to the WMA

- Option Description
  - Abstract seawater from the nearest coastline, i.e. Moçambique
  - Erect a desalination plant next to the coastline
  - Pump desalinated seawater through a pipeline to the Olifants catchment
  - Scheme would entail seawater abstraction works, seawater desalination plant, pump station, booster pump stations and pipeline of few hundred kilometres

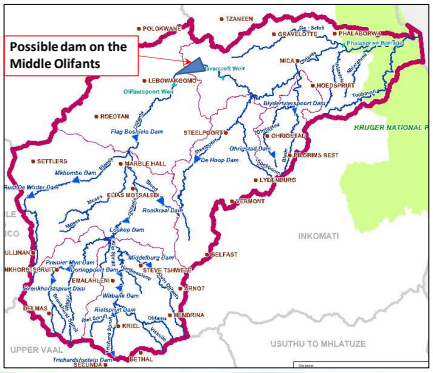
Transfer desalinated seawater to the WMA (continued)	
Biophysical impacts	Suggest provisionally as "medium" - No impacts on the Olifants catchment itself. - Pipeline may cross ecological sensitive land. - Saltwater return flows back into the sea may have negative impacts.
Management intensity	Regarded as "medium" to "high" during planning and construction and "medium" while operating.

Increasing Supply: Possible New Dams

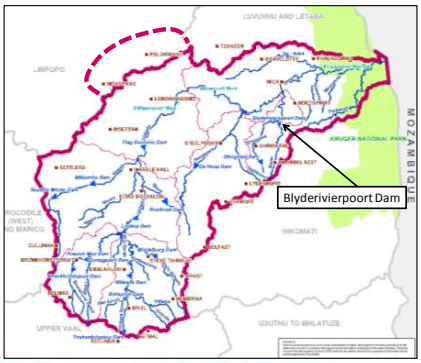
Blyderivierspoort Dam Raising

- Option Description
  - Current dam is a concrete gravity arch dam, 50 m high, with a capacity of 55 million m³.
  - Current capacity is approximately 20% of Blyde River MAR
  - Topography allows dam to be raised by 55m
  - Saddle dam will be required for raisings > 30 m

New Dam in the Mainstream of the Olifants River



Blyderivierspoort Dam Raising



New dam in the mainstream of the Olifants River	
Option yield	55 million m³/a: The further downstream the higher the MAR and the possible yield
URV	R 3 / m³: 450 mill m³ capacity @ R1.1 billion
Implementation time	10 – 12 years
Social impacts	Regarded as “high”. Relocation of households, schools, etc. Inundation of agricultural land.
Biophysical impacts	Regarded as “low”, assuming that the EWR is supplied.
Management intensity	Regarded as “low”.

Blyderivierspoort Dam Raising	
Option yield	Not yet determined as yet.
URV	Not yet determined as yet. Use dam on Olifants mainstream as indicative.
Implementation time	10 years
Social impacts	Not assessed as yet. Anticipated to be “low”
Biophysical impacts	Not assessed as yet. Anticipated to be “low”, if EWR is supplied.
Management intensity	Regarded as “low”.

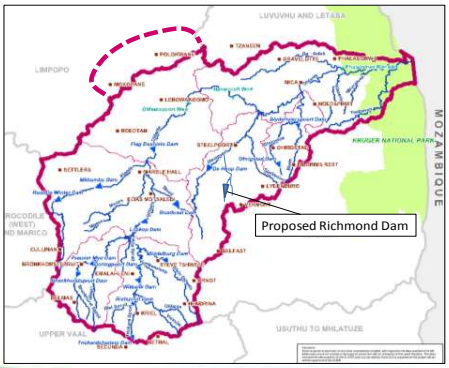
Smaller Dams to Supply Water

- Option Description
  - Construct one or more smaller dams to meet the needs of specific water users.
  - Assessment is based on the Richmond Dam proposed for Anglo Platinum for which a cost estimate and URV figure was available

Off Channel Storage Dam On One Of The Tributaries With Pumping From The Olifants

- Option Description
  - Purpose of dam will be to contribute to the EWR in the lower stretches of the Olifants River.
  - Dam could be relatively small. Silting problem will not be as severe as a small dam on the main stem.
  - Scheme would comprise a low weir on the Olifants River with a pump station, a relatively short rising main to the small dam on the tributary.
  - Scheme cannot be sized without knowing the EWR and durations of periods when flows in the main stem can be diverted to the tributary

Smaller Dams to Supply Water



Off Channel Storage Dam On One Of The Tributaries With Pumping From The Olifants	
Option yield	Purpose of scheme is not to increase the yield but rather to allow better management of the available water
URV	URV not applicable. Total scheme cost estimated on R246 million
Impl time	4 years
Social impacts	Minimal
Biophysical impacts	Minimal. Improved management of the low flows is seen as a positive
Management intensity	Regarded as "medium": - Operation of a pump station - Knowledge of riverine ecology to optimise times of pumping and release of water

Smaller Dams to Supply Water	
Option yield	Approximately 2.5 million m³
URV	"Low", R 1- R 2 / m³
Implementation time	4 years
Social impacts	Minimal
Biophysical impacts	None
Management intensity	Regarded as "low".

Groundwater and Rainwater Harvesting

Groundwater Options

- Option Description
  - One option that can be looked at is the Malmani dolomites along the escarpment
  - No villages or settlements on the dolomites – mountain area
  - A regional groundwater scheme can be developed to supply rural domestic water to nearby settlements
  - Available yield is estimated as high as 50 million m³ / a
  - Actual abstraction will probably be lower – in line with the water requirements of the local population.
  - Availability of electrical power might be a limitation.

Rainwater Harvesting

- Option Description
  - Option comprises the collection of rainwater from the roof tops.
  - Existing water supply can be augmented with this option.
  - The option description focuses on urban middle to high income groups.
  - The option can also be applied in rural areas, but it will be less efficient there because of the smaller on average roof top area.

Groundwater Options

Rainwater harvesting	
Option yield	41 m³ / a per household
URV	R34 / m³ - even higher for rural areas
Implementation time	May take a number of years to implement on a town wide basis.
Social impacts	Expensive for low income households. Incentives, e.g. subsidy system a possibility
Biophysical impacts	None identified
Management intensity	Regarded as "low". Could become "medium" if rainwater harvesting is enforced for all new houses through Municipal By-laws or if subsidy system is introduced for rural poor.

Groundwater Options	
Option yield	Estimated as high as 50 million m³. Must be further investigated
URV	Expected to be "Low". Capital cost in the order of R10 – R20 million
Implementation time	3 years
Social impacts	Only benefits -Water available to rural towns and villages - Less water treatment than for surface water
Biophysical impacts	Limited if abstraction causes acceptable reduction in base flow
Management intensity	Regarded as "medium". Real time water level recording and careful monitoring required.

Water Quality Improvement Options

Acid Mine Water Treatment Plants

- Option Description
  - Possibilities predominantly in the upper parts of the catchment.
  - Acidic water draining from the coal mines is treated to potable or other standards.
  - The yield of the system can be increased.
  - Emalahleni Water Reclamation Plant is a successful example.

Reuse of Sewage Effluent

- Option Description
  - Option concept is that municipalities treat their sewage water and use it for their sport fields, golf courses, municipal gardens, etc.
  - Potable water requirements of municipalities can be reduced in this manner.
  - Raw sewage water is abstracted from a manhole nearby the sport field, treated with a package treatment plant and the treated water is then pumped directly into the irrigation system
  - Sludge goes back into the manhole into the sewage stream where it will be treated further down in the municipal sewage treatment works.

Acid mine drainage treatment plants	
Option yield	9 million m³ / a for Emalahleni plant. Can easily be replicated.
URV	R12 / m³
Implementation time	2 years per unit such as Emalahleni plant
Social impacts	None
Biophysical impacts	Positive impact. Quality of water in the receiving bodies will improve.
Management intensity	High level skilled manpower required. Overall management intensity regarded as “medium”

Reuse of sewage effluent	
Option yield	1 million m³ / a for bigger municipalities.
URV	Expected to be “low”
Implementation time	Immediately – within 1 year
Social impacts	None
Biophysical impacts	None
Management intensity	Regarded as “medium” for relatively small yield. One operator and one truck driver (to move package plant from point to point) is required.

APPENDIX E

Minutes of Meeting

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

CHIEF DIRECTORATE:
INTEGRATED WATER RESOURCE PLANNING

DIRECTORATE: NATIONAL WATER RESOURCE PLANNING

DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE OLIFANTS RIVER WATER SUPPLY SYSTEM (ORS)

MINUTES OF THE PRELIMINARY SCREENING WORKSHOP

Date: 7 July 2010

Venue: Letaba Rest Camp – Kruger National Park

Time: 09: 00 – 13:30

PRESENT

T Nditwani, DWA, National Water Resource Planning - North,	Chairperson	(TNd)
A Tanner, Aurecon	Facilitator	(AT)
K Mandaza, DWA, National Water Resource Planning - North		(KM)
O Van Den Berg, DWA, Options Analysis – North		(OvdB)
S Van Jaarsveld, DWA, Options Analysis - North		(SvJ)
J Beumer, Aurecon		(JB)
S Mallory, IWR Water Resources		(SM)
M Van Veelen, ILISO		(MvV)
D Timm, Aurecon		(DT)
J Van Aswegen, DWA, Regional Office, Mpumalanga		(JvA)
KG Moabelo, DWA, Water Use Efficiency		(KGM)
R Cai, DWA, Water Resource Planning Systems : Systems Operation		(RC)
T Nyamande, DWA, Resource Directed Measures : Resource Classification		(TN)
M Keet, DWA, Water Quality Management, Gauteng Regional Office		(MK)
J Potgieter, National Dep. of Agriculture		(JP)
MNJ Gouws, Department of Agriculture, Limpopo		(MG)
S Macevele, DWA, Mpumalanga, Regional Office		(SMa)
O Rossouw, Lebalelo Water Users Association		(OR)
S Mudau, Chamber of Mines, Environmental Advisor		(SMu)
R Mabalane, Chamber of Mines, Policy Analyst		(RM)
T Gyedu-Ababio, SANPARKS – KNP		(TGA)
M Makhweyane, Ehlanzeni District Municipality		(MM)
D Kruger, AGRI South Africa – Middelburg		(DK)
K van Rensburg, MBB Nelspruit		(KvR
MB Mboweni, Mpumalanga Department of Agriculture and Rural Development Administration, Nelspruit		(MBM)
V Mongwe, Department of Economic Development, Environment & Tourism, Limpopo		(VM)
T Baker, ILISO		(TB)
L September, ILISO	Secretary	(LS)
C Masogo, Aurecon		(CM)

APOLOGIES:
P Van Niekerk, DWA, Integrated Water Resource Planning
KW Mosefowa, DWA, Water Use Regulation
G Paszczyk, DWA, National Water Resource Planning, North
D Mthembu, National Department of Environmental Affairs
V Mahlangu, Nkangala District Municipality
M Mathuynyane, Waterberg District Municipality
M Mokhoabane, Gert Sibande District Municipality
W Moraka, SALGA – National : Water & Sanitation
K Hlebeya, House of Traditional Leaders, Mpumalanga Province
D Mahlobo, Head of Department of Cooperative Governance and Traditional Affairs : Mpumalanga Province
A Van Der Merwe, Eskom
N Nokeri, Lepelle Water
L Ngomane, Chuma Development Consultants cc
BJ Modipane, House of Traditional Leadership, Mpumalanga

		Action
1.	**Opening & Welcome** Nditwani, Chief Water Resource Planner: National Water Resource Planning (NWRP) North: Department of Water Affairs (DWA) welcomed attendees to the Preliminary Screening Workshop for the Development of a Reconciliation Strategy for the Olifants River Water Supply System Study (ORS). He presented the project objectives (cf. **Appendix G**). In his introductory remarks, Mr. Nditwani explained that members of the study team had identified a number of options to reconcile supply and demand of water in the study area, and the aim of the workshop would be to determine which options were worth investigating further. Mr. Nditwani's introduction, all attendees briefly introduced themselves and stated their interest in the project.	
2.	**Process to be followed** The workshop facilitator, Mr. Tanner presented the process to be followed.	
3.	**Workshop objectives** Mr. Tanner presented the workshop objectives (cf. **Appendix G**). He requested attendees to come forward with any relevant information that may be incorporated into the study.	
4.	**Catchment Overview** Mr. Beumer's presentation provided an overview of the study area status. His presentation focused *inter alia* on the activities within the	

study area, water sources, water uses and information gaps identified (cf. **Appendix H**).

Mr. Beumer encouraged all attendees to assist in filling those information gaps with any relevant information. The following feedback was received: — All

- There are gaps in Water Conservation and Demand Management (WCDM) information for the mining sector. DWA Directorate Water User Efficiency is responsible for developing guidelines for WCDM in mining. Mr. Beumer committed to follow up with Mr. Paul Herbst. — JB
- It was pointed out that the study team, when determining water quality (WQ) requirements for tourism, should also look at the WQ requirements for conservation. The Olifants River Forum does not have specific WQ objectives and relies on the national guidelines. The Kruger National park (KNP) however has WQ objectives (dating from the late 1990s) which can be used.
- Some work has been done (field surveys) and information is available with respect to the Reserve and changes in the Present Ecological Status (PES). The team will follow up with Dr. Gyedu-Ababio regarding information on the evolution of the PES. — MvV
- Mr. Andrew Deacon has useful information regarding the ecological component of the study. That part of the study has however not yet commenced and further information will become available when it starts. Mr Deacon is also part of the study team.
- The state of infrastructure such as canals, is not fully known and relevant team members will have to ensure that this data is acquired and to quantify the losses and identify possible remedial actions. It was suggested that the Loskop Irrigation Board was one of the best areas to focus on for the study. Contact can be made with Mr. Johan van Stryp. — SM, DT
- 27 mines are currently taking part in a project and had been liaising with Mr. van den Berg to clarify their water use needs. Although the water use licences have not been issued as yet by DWA, the water use information is available on request. — SM

Mrs. Nyamande requested the scope of work for the study (*i.e.* ORS). A copy of the Inception Report would be made available to her. — JB

5. Current and Future Water Balance

Mr. Mallory gave a presentation on water demands and water supply in the catchment.

The subsequent discussion covered the following topics:

- Eskom's water demands: Even though Eskom's needs do

not affect the water balance of the catchment as water comes from other catchments (Vaal, Usutu and Komati), Eskom's water demands were still included in the study since its power stations are located in the study area.

- Water efficient power stations: Water efficient technologies are too costly to retrofit to existing power stations. Cleaner technologies also require more water.

- Closing down of Eskom power stations: Eskom will eventually start closing down some of its older power stations (water cooled ones), which could make some of the water available that is currently being transferred into the Olifants catchment, However, this is not viewed a medium term option, as Eskom do not foresee closing stations within the next 20 years.

- Allocation of water from the de Hoop Dam: A concern was expressed that water from the dam is already over allocated, and that no water is left for the conservation of the environment. This was however put into perspective as the yield analysis for the dam has indeed taken account for the implementation of the Reserve.

- The water requirements of mining activities in the Waterberg area in the vicinity of Mokopane: These water requirements have been taken into account in the planning, as well as the water transfer scheme from Flag Boshielo Dam to Mokopane.

- The validation and verification of water use process: The DWA completed a validation study in and is currently busy with a water use verification process which will identify lawful and unlawful water uses.

- The inclusion of Metsweding District Municipality (DM) in the study: Metsweding DM receives water from the catchment and is included in the study in terms of water transferred to it. Metsweding will become part of the City of Tshwane.

Mr. Tanner reiterated the necessity to work together to reach a satisfactory water situation for all in the catchment.

6. Discussion

No further discussions took place at that stage.

7. Water Management Concerns

Dr. van Veelen's presentation on water management concerns dealt

with, *inter alia*: water quality issues, water transfers, and invasive alien plants.

The subsequent discussion revolved mainly around the Reserve and implementation thereof:

- The Reserve is the only right to water, and should be allocated before any other use.
- Implementation of the Reserve: The whole of the catchment must contribute equitably to the Reserve. Only the normal maintenance flow is a controlled release through the dams; large floods go through the system anyway.
- Conflict between the old 1956 Water Act and the 1998 NWA: The NWA 1998 recognises all existing water uses in terms of the old 1956 Act but also introduces the concept of the Reserve. The challenge now is to manage the implementation of the Reserve and minimise the disruptions to social and economic life.
- Link between the study and the current review of the National Water Resource Strategy (NWRS): There are two parallel processes, namely the review of the NWRS and the development of the National Groundwater Strategy (NGS). The resource protection part of NWRS involves getting the views of stakeholders on how to implement the Reserve, and notably, how to curtail water uses. The DWA is not obliged to pay compensation if curtailment is as a result of the Reserve implementation, however, if curtailment is a result of over allocation of water, compensation can be paid. It is possible to argue either way and the DWA will have to manage curtailments with this in mind.
- There will be a presentation on the ecological Reserve at the next stakeholder meeting. JB/MvV

The question was asked whether climate change will be considered as part of the study and aligned with the recent Copenhagen conference resolutions. The ORS does not contain any reference to the work of professor Schultz on climate change. Some of the modelling done on the Olifants catchment however used his ACRU model. The scope of the study however, does not include climate change. DWA

8.	**Options Screening Tool** Mr. Tanner presented the screening criteria and options identified (cf. Slide with criteria and options in starter document – **Appendix C**). The various options were divided into two main categories i.e. Reducing Demand and Increasing Supply. The "Increasing Supply" category was then further subdivided into the following groups: Transfers In, Possible New Dams, Pump Schemes, Groundwater/Rainwater Harvesting and Water Quality Options.

	The following criteria were used for the evaluation: yield; capital cost; operational cost; Unit Reference Value (URV); social impacts; biophysical impacts; management intensity and time for implementation. Provision was also made in the multi-criteria spreadsheet to flag a particular option as a "fatal flaw". Cloud seeding as an option was suggested from the floor and it was decided to add this option to the list.	JB
9.	**Presentation of the options** (cf. **Appendix I**)	
9.1	**Options to reduce water use**	
9.1.1	**Compulsory Licensing:** Mr. Beumer presented the compulsory licensing option. The implementation time for this option was deemed optimistic and the spreadsheet was amended to reflect an implementation time of 5 years or more. The operating cost of this option was also increased to reflect the high costs of continuous management after implementation. Clarification of institutional responsibilities with respect to the management of the compulsory licensing process, as well as enforcement, was regarded as critical for the success of this option.	JB
	In response to a question on the ecological benefits of this option, it was stated that all of the options have the main objective to make water available in order to be able to implement the ecological Reserve. This is not mentioned in each option description.	
9.1.2	**WCDM in the Irrigation Sector**. Mr Beumer presented this option and mentioned that assurance of supply should be taken into consideration when allocating water. This means that a water user will not always receive his/her full water allocation and will have to curtail water use in times of drought. Farmers already know how to adapt to these conditions where they succeed in keeping their permanent crops alive with the rationed water. If the yield analysis take the assurance of supply, which is agreed by all users, into account, the water balance results will look more favourable. As far as irrigation is concerned, the benefit of getting water under pressure should be highlighted. Regarding incentives for users to implement WCDM measures, the current practice is that farmers who save water are free to use the remaining water to farm larger tracts of land.	
9.1.4	**WCDM in the Urban Sector:** Mr. Mallory presented this option. It was pointed out that in many cases the infrastructure is not in a	

good state of repair, which results in high maintenance costs. Water savings are expected through maintenance and retrofitting. The URV for this option is on the quantity of water saved, and not on the total water quantity. The URV criterion was adjusted to 'medium' in the spreadsheet.

Discussions on pressure management ensued and clarifications were given. The URV figures were based on the Emalahleni WCDM report which will have to be verified. JB/SM

9.1.5 **WCDM in the Mining Sector:** Mr. Mallory also presented this option. Mines already use the best techniques available; some mines are currently using less than the water that has been allocated to them. Provided these water savings are permanent, consideration will be given as to how these savings can be re-allocated. SM

9.1.6 **Removing of Alien Invasive Plants (AIPs):** Removing AIP was the last option that was presented by Mr Mallory. Although the cost of this option is critical and an accurate estimate is essential, there is currently no consensus on the methodology used to calculate the water quantity that can be freed up. It will be calculated using the methodology accepted by DWA, which is currently under discussion. SM

9.1.7 **Reducing Transfers out of the Basin:** Mr Beumer explained this option and pointed out that if Limpopo Water Management Area (WMA) could get its water from somewhere else (e.g. Zambesi River) for Polokwane and Mokopane, the Olifants WMA water, earmarked for transfer to these areas, could be reallocated. This option will be expensive though. The evaluation was accepted.

9.2. **Increasing Supply : Transfers In**

9.2.1 **Transferring treated sewage effluent from the Vaal Basin**: Mr. Timm presented this option. The high cost of this option is partially due to the fact that, in the short term, the Ekurhuleni Municipality will not be improving the quality of its effluent and the cost of tersiary treatment will have to be carried by the scheme.

This study should inform the Vaal River Reconciliation Strategy Study of this possibility. DT

9.2.2 **Transferring raw water directly from the Vaal Dam:** Mr. Timm also explained the possible option to transfer water directly from the Vaal Dam. In the Vaal catchment, everyone pays the same price for water, regardless of where the user is located, whereas in the Olifants, the user will have to pay the Vaal water price plus the price

of distributing water to the point where it is used in the Olifants Catchment. This aspect requires further consideration. DT

9.2.3 **Transferring desalinated seawater to the WMA:** This option was presented by Mr. Beumer who pointed out that this is a very expensive option but that it has to be considered for comparison purposes. The URV is based on the recent DWA study "Assessment of the Ultimate Potential and Future Marginal Cost of Water Resources in South Africa". The evaluation was accepted.

9.3 Possible new dams

9.3.1 **New dam on the mainstream of the Olifants River:** Mr. Timm presented this option, and explained how the provisional evaluation was done. This was accepted.

9.3.2 **Raising of the Blyderivierspoort Dam:** This option was also presented by Mr. Timm. On a question whether more water could be made available for irrigation, Mr Timm responded that additional water obtained from raising the dam would be used to implement the Reserve, rather than for users.

9.3.3 **Building smaller dams on tributaries:** The provisional evaluation was accepted by the workshop participants after this option had been explained by Mr. Timm.

9.3.4 **Off-channel storage on one of the tributaries with pumping from the Olifants:** The provisional evaluation for this option was also accepted by the workshop participants after the option had been explained by Mr. Timm.

9.4 Groundwater and rainwater harvesting

9.4.1 Groundwater:

9.4.2 Rainwater Harvesting:

Both the above options were presented by Mr. Beumer and the workshop participants accepted its evaluations.

9.5 Water quality improvement options

9.5.1 **Acid mine drainage treatment plants:** Dr. van Veelen explained this option. Regarding the distribution of costs, the mine carries the cost of treating the water and the municipality pays the cost of the water bought from the plant.

9.5.2 **Reuse of sewage effluent:** This option was also presented by Dr. van Veelen and its provisional evaluation was accepted by all.

10. Evaluation of options

Mr. Tanner presented a table summarising the different options and

their evaluations.

11. Agreement on options

The participants agreed on the options presented and the added option of cloud seeding. No other options were brought forward. Attendees were again urged to come forward with any comments on the options or ideas for options after the workshop.

12. Way forward

The project team will investigate the options that came out as most favourable further. One of the deliverables is a preliminary strategy that will focus on immediate options. This will be followed by the final strategy that will incorporate long term options.

13. Closure

Mr. Nditwani thanked everyone for attending the workshop and providing their input, and adjourned the workshop at 13:30.

Distribution: All attendees and apologies

Minutes confirmed as a true record of the meeting

_____ _____

DWA : T NDITWANI : STUDY MANAGER **DATE**

APPENDICES:

Appendix C: Rating Criteria and Options

Appendix G : Workshop objectives

Appendix H: Catchment overview

Appendix I: Presentation of the options

APPENDIX F

Evaluation Results

RATING SYSTEM
Colour Rating Index
1. Favourable
2. Moderately Favourable
3. Unfavourable

A - REDUCING WATER USE

Option	Fatal Flaw?	Yield (Mm^3/a)	Capital Cost Mill (R)	Opera-tional Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
1 - Compulsory Licensing		100	?							
Rating		1	2	1	1	3	1	2	2	
Comments on further Information requirements:										
2 - Increased efficiency of water use in the Irrigation Sector; Optimising Assurance of Supply		60	Small	Small	Low	Low	None	Low	< 2 Y	
Rating		1	1	1	1	1	1	1	1	
Comments on further Information requirements:										
3 - Increased efficiency of water use in the Irrigation Sector; WCDM for Irrigation		60	100 - 500	Small	Low	None	None	Medium	> 10 y	
Rating		1	2	1	1	1	1	2	3	
Comments on further Information requirements:										
4 - WCDM Urban Sector		43	40	3	Low	None	None	High	5 - 10 y	
Rating		1	1	1	1	1	1	3	3	
Comments on further Information requirements:										
5 - WCDM in Mining		< 10	<100	Low	?	None	None	Low	2-5 y	
Rating		3	1	1	2	1	1	1	2	
Comments on further Information requirements:										
6 - Reduction Bulk Infrastr Losses										
Rating		3	2	1	2	1	1	1	2	
Comments on further Information requirements:										
7 - Removing Alien Invasive Plants		4	>100	2	2,5	Low, Benefits	Positive	Low	> 5 y	
Rating		3	2	2	1	1	1	1	3	
Comments on further Information requirements:										
8 - Improved Operating Rules		20 ?	Low	Low	Low	None	None	Low	2-5 y	
		3	1	1	1	1	1	1	2	
Comments on further Information requirements:										

B - REDUCING TRANSFERS OUT

Option	Fatal Flaw?	Yield	Capital Cost	Opera-tional Cost	URV	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
		(Mm3/a)	(R)	(R)	(R/m^3)					
9 - Alternative or reduced supplies for Polokwane & Mokopane		50	High	High	40	Medium ?	Medium	Medium	> 10 y	
	Rating	1	3	3	3	2	2	2	3	

C - TRANSFERS IN

Option	Fatal Flaw?	Yield (Mm^3/a)	Capital Cost (R)	Operational Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
10 - Transfer treated sewage effluent from Vaal Basin		**38**	**1100 + Vaal**	Medium ?	3.5 + Vaal	Low	Medium	Medium	4 y	
Rating		1	3	2	2	1	2	2	2	
Comments on further Information requirements:										
11 - Transfer raw water directly from Vaal Dam		**100**	**2000 + Vaal**	76	> 5	Medium	Medium	Medium	10 y +	
Rating		1	3	3	2	2	2	2	3	
Comments on further Information requirements:										
12 - Transfer desalinated seawater to the WMA		**Unlimited**	**High**	High	44	Medium	Medium	Medium	10 y +	
Rating		1	3	3	3	2	2	2	3	
Comments on further Information requirements:										
13 - Expand Rand Water Supply to Emalahleni, Steve Tshwete and Bronkhorstspruit										
Rating		1	3	3	3	2	2	2	3	
Comments on further Information requirements:										

D - POSSIBLE NEW DAMS

Option	Fatal Flaw?	Yield (Mm^3/a)	Capital Cost (R)	Operational Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
14 - New dam on the mainstream Olifants River		55	1100	Low	3	High	Low	Low	10 - 12 y	
Rating		1	3	1	1	3	1	1	3	
Comments on further Information requirements:										
15 - Blyderivierspoort Dam Raising										
Rating		1	3	1	1	1	1	1	3	

Option	Fatal Flaw?	Yield (Mm^3/a)	Capital Cost (R)	Operational Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
16 - Smaller dams on tributaries		2,5	120	Low	Low	Low	Low	Low	< 5 y	
Rating		3	2	1	1	1	1	1	2	
Comments on further Information requirements:										
17 - Off channel storage dam on one of the tributaries with pumping from the Olifants		N/A	250	Medium	?	Low	Low	Medium	4 y	
Rating		2	2	2	2	1	1	2	2	
Comments on further Information requirements:										

E - GROUNDWATER AND RAINWATER HARVESTING

Option	Fatal Flaw?	Yield (Mm^3/a)	Capital Cost (R)	Opera-tional Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
18 - Groundwater options		20 ?	10-20	< 1		None	None	Medium	3 y	
Rating		2	1	1	1	1	1	1	1	
Comments on further Information requirements:										
19 - Rainwater harvesting		< 2	650	7,5	34	Beneficial	None	Low	< 2 y	
Rating		3	3	3	3	1	1	1	1	
Comments on further Information requirements:										

F - WATER QUALITY IMPROVEMENT OPTIONS

Option	Fatal Flaw?	Yield (Mm^3/a)	Capital Cost (R)	Operational Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
20 - AMD treatment plants (similar to the Emalahleni AMWR)		9	?	35	8	None	Positive	Medium	2-4 y	
Rating		3	2	3	2	1	1	2	2	
Comments on further Information requirements:										
21 - Reuse of Sewage Effluent		3	3	1,5	0,5	None	None	Medium	1 y	
Rating		3	1	2	1	1	1	2	1	
Comments on further Information requirements:										

G - OTHER OPTIONS

Option	Fatal Flaw?	Yield (Mm^3/a)	Capital Cost (R)	Opera-tional Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	POST WORKSHOP COMMENTS
Rating		0	0	0	0	0	0	0	0	
Comments on further Information requirements:										
Rating		0	0	0	0	0	0	0	0	
Comments on further Information requirements:										

SUMMARY									
Option	Yield (Mm^3/a)	Capital Cost (R)	Operational Cost (R)	URV (R/m^3)	Social	Biophysical	Management Intensity	Time for Implementation	Warrants further study? Yes / No / & Comment
A - REDUCING WATER USE									
1 - Compulsory Licensing	1	2	1	1	3	1	2	2	
2 - Increased efficiency of water use in the irrigation	1	1	1	1	1	1	1	1	
3 - Increased efficiency of water use in the irrigation Sector: WCDM for Irrigation	1	2	1	1	1	1	2	3	
4 - WCDM Urban Sector	1	1	1	1	1	1	3	3	
5 - WCDM in Mining	3	1	1	2	1	1	1	2	
6 - Reduction Bulk Infrastr Losses	3	2	1	2	1	1	1	2	
7 - Removing Alien Invasive Plants	3	2	2	1	1	1	1	3	
8 - Improved Operating Rules	3	1	1	1	1	1	1	2	
B - REDUCING TRANSFERS OUT									
9 - Alternative or reduced supplies for Polokwane & Mokopane	1	3	3	3	2	2	2	3	
C - TRANSFERS IN									
10 - Transfer treated sewage effluent from Vaal Basin	1	3	2	2	1	2	2	2	
11 - Transfer raw water directly from Vaal Dam	1	3	3	2	2	2	2	3	
12 - Transfer desalinated seawater to the WMA	1	3	3	3	2	2	2	3	
13 - Expand Rand Water Supply to Emalahleni, Steve Tshwete and Bronkhorstspruit	1	3	3	3	2	2	2	3	
D - POSSIBLE NEW DAMS									
14 - New dam on the mainstream Olifants River	1	3	1	1	3	1	1	3	
15 - Blyderivierspoort Dam Raising	1	3	1	1	1	1	1	3	
16 - Smaller dams on tributaries	3	2	1	1	1	1	1	2	
17 - Off channel storage dam on one of the tributaries with pumping from the Olifants	2	2	2	2	1	1	2	2	
E - GROUNDWATER AND RAINWATER HARVESTING									
18 - Groundwater options	2	1	1	1	1	1	1	1	
19 - Rainwater harvesting	3	3	3	3	1	1	1	1	
F - WATER QUALITY IMPROVEMENT OPTIONS									
20 - AMD treatment plants (similar to the Emalahleni AMWP)	3	2	3	2	1	1	2	2	
21 - Reuse of Sewage Effluent	3	1	2	1	1	1	2	1	
G - OTHER OPTIONS									
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0									