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

WP10197

Water Requirements and Water Resources Report

Original

FINAL REPORT
December 2011

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Report no.: P WMA 04/B50/00/8310/6

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LIST OF REPORTS

Title	Report Number
Inception Report	P WMA 04/B50/00/8310/1
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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
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Glossary of Terms

Allocatable Water
Water which is available to allocate for consumptive use.

Database
Accessible and internally consistent sets of data, either electronic or hard copy with spatial attributes wherever possible.

Diffuse Irrigation
Irrigators that do not form part of a formal irrigation scheme and are abstracting water from run-of-river flows or farm dams.

Environmental Water Requirement
The quantity, quality and seasonal patterns of water needed to maintain aquatic ecosystems within a particular ecological condition (management category), excluding operational and management considerations.

IWRM Objectives
The objectives and priorities for water resource management, for a given time frame, which have been agreed by the parties as those which will best support the agreed socio economic development plans for the basin.

IWRM Plans
A set of agreed activities with expected outcomes, time frames, responsibilities and resource requirements that underpin the objectives of IWRM.

Management Information System
Systems such as GIS which provide a user friendly interface between databases and information users.

Resource Classification
A process of determining the management class of resources by achieving a balance between the Reserve needs and the beneficial use of the resources.

Acid Mine Drainage
Decanting water from defunct mines which have become polluted and acidic and that reach the resource.

Level of Assurance
The probability that water will be supplied without any curtailments. The opposite of Level of Assurance is the risk of failure.

Internal Strategic Perspective
A DWA status quo report of the catchment outlining the current situation and how the catchment will be managed in the interim until a Catchment Management Strategy of a CMA is established.

List of Abbreviations & Acronyms

CMA	Catchment Management Agency
CMC	Catchment Management Committee
CME	Compliance Monitoring and Enforcement
DPLG	Department of Provincial and Local Government
DWA	Department of Water Affairs
DWAF	Former Department of Water Affairs and Forestry
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EWR	Ecological Water Requirements (Ecological Component of the Reserve)
GDP	Gross Domestic Product
GIS	Geographical information System
IB	Irrigation Board
IDP	Integrated Development Plan
IAP	Invasive Alien Plants
ISP	Internal Strategic Perspective
IWRM	Integrated Water Resources Management
IWRMP	Integrated Water Resources Management Plan
LNW	Lepelle Northern Water Board
MAR	Mean Annual Runoff
MINWAC	Mining & Industry Water Action Committee
MY	Million Years
NWA	National Water Act (Act 36 of 1998)
NWRP	National Water Resource Planning
NWRS	National Water Resource Strategy
OWAAS	Olifants Water Availability Study
OWRDP	Olifants Water Resources Development Planning
RO	Regional Office
ROD	Record of Decisions
RWQO	Resource Water Quality Objectives
SALGA	South African Local Government Association
SDF	Strategic Development Framework
ToR	Terms of Reference
URV	Unit Reference Value
VAC	Visual Absorption Capacity
VAPS	Vaal Augmentation Planning Study
WAAS	Water Availability Assessment Study
WC/WDM	Water Conservation /Demand Management
WFGDS	Water for Growth & Development Strategy
WH	Western Highveld
WMA	Water Management Area
WMP	Water Management Plan
WQMP	Water Quality Management Plan
WQT	Water Quality Time Series Model
WRC	Water Research Commission
WRPM	Water Resources Planning Model
WRSM	Water Resource Simulation Model
WRYM	Water Resource Yield Model
WSDP	Water Services Development Plan
WTW	Water Treatment Works
WUA	Water User Association
WWTP	Waste Water Treatment Plant
WWTW	Waste Water Treatment Works

EXECUTIVE SUMMARY

The Olifants River catchment is currently one of South Africa's most stressed catchments as far as water quantity and water quality is concerned. The water requirements in the Olifants Water Management Area (WMA) have increased substantially over the last few years due to diverse activities e.g. power generation, mining, urban development, improved service delivery to rural communities, and irrigation. The potential future demand for water from the mining sector as well as rural communities is especially large and this lead to the construction of the De Hoop Dam, which will be completed in 2012. However, concerns were raised that even with the additional yield provided by the De Hoop Dam and the raised Flag Boshielo Dam, the water demands would soon outstrip the available resource. This prompted this study to develop reconciliation strategies to alleviate the current water deficits and to ensure a sustainable water supply for the next 25 years.

Reconciliation strategies entail firstly identifying an envelope of likely future water demands, determining the available water resource, then identifying possible interventions to reconcile the water demand with the available water resource into the future. The purpose of this report is to document the current and future water requirements, the water resource, and hence the current and future water balance.

The report has been structured to disseminate the information as three sub-catchments, namely the Upper, Middle, and Lower Olifants with the water demands of the Mokopane and Polokwane areas being grouped with the Middle Olifants. Within each sub-catchment, water requirements are documented for each user sector, which are Urban, Rural, Industrial, Mining, Irrigation and Power Generation. The water resource within each sub-catchment has been estimated as the yields from major dams and the resources from diffuse sources such as run-of-river abstraction, farm dams and ground water. Current water balances are presented in tabular form while future water balances are presented graphically. All water balances are before taking the ecological Reserve into account. This aspect is dealt with in a separate report.

The results of this Water Requirements and Water Resources report are summarised in the Table E1 and Figure E1 below while figures E2,E3 and E4 show the balances in the three sub-catchments, Upper, Middle and Lower Olifants.

Table E1: *Current water balance of the Olifants River Catchment (million m^3/a)*

Current Water Balance (units: million m^3/annum)

Sub-catchment	Water requirement	Water resource	Losses	Comp. Release	Water Balance
Upper	609	630	0		21
Middle	187	185	0	(19)	(21)
Lower	220	248	(5)		23
Total	1016	1063	(5)	(19)	23

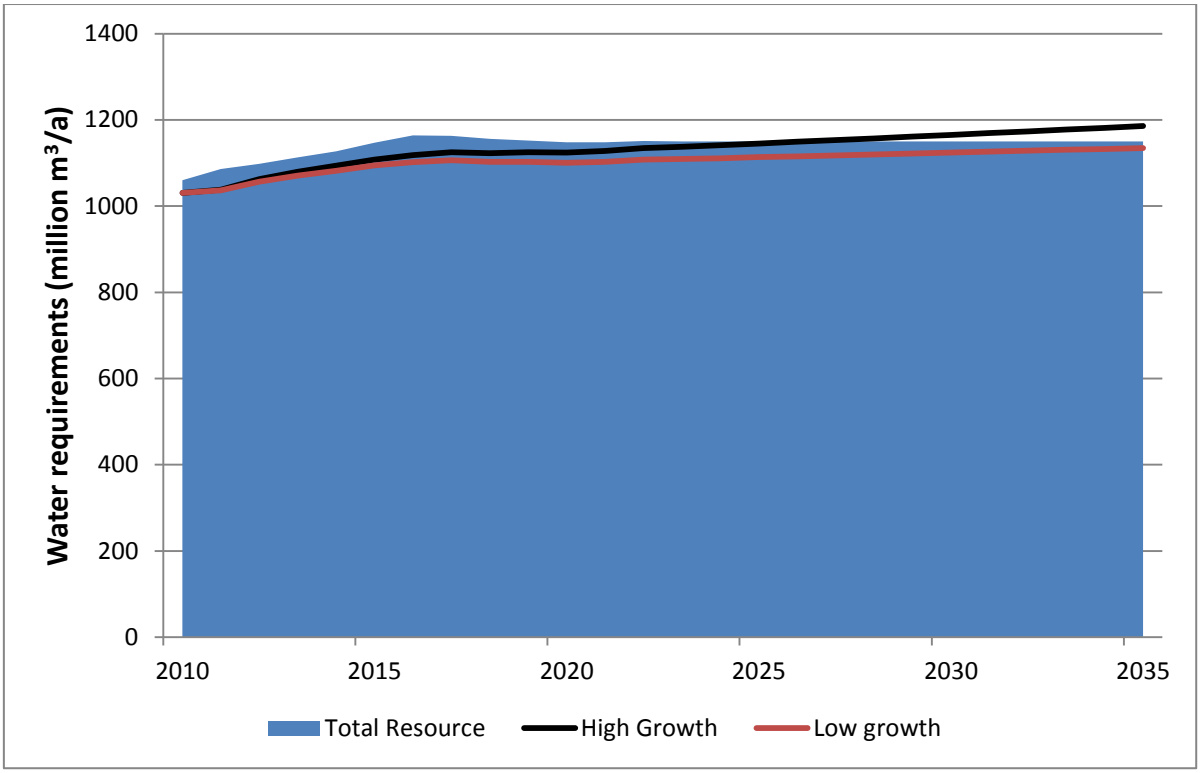

Figure E1: *Future water resource and water requirements in the Olifants River Catchment*

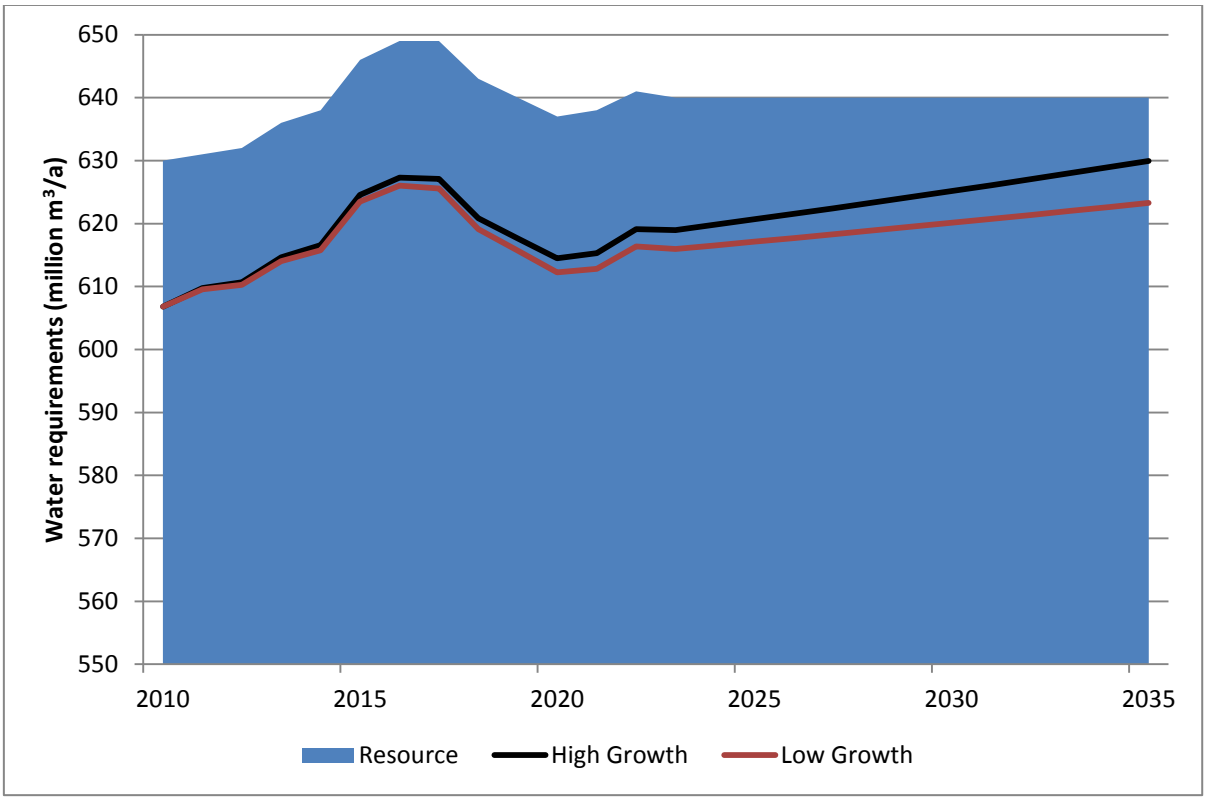

Figure E2: *Future water resource and water requirements in the Upper Olifants River Catchment*

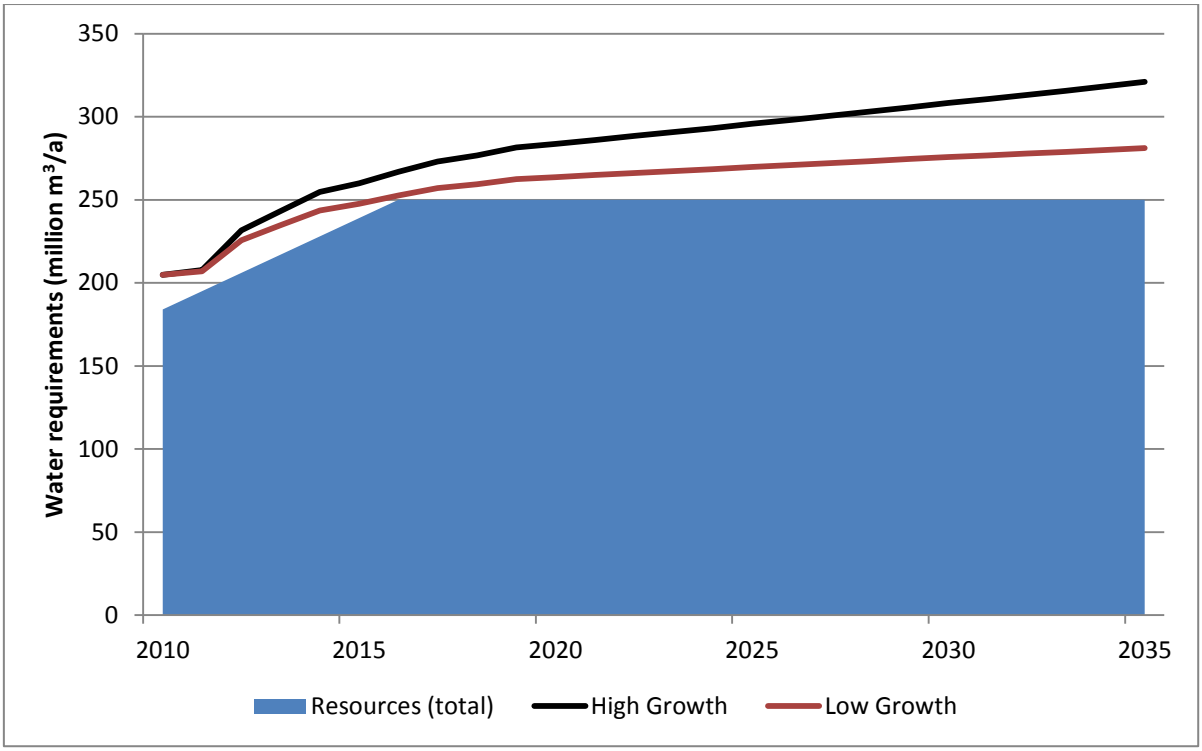

Figure E3: *Future water resource and water requirements in the Middle Olifants River Catchment*

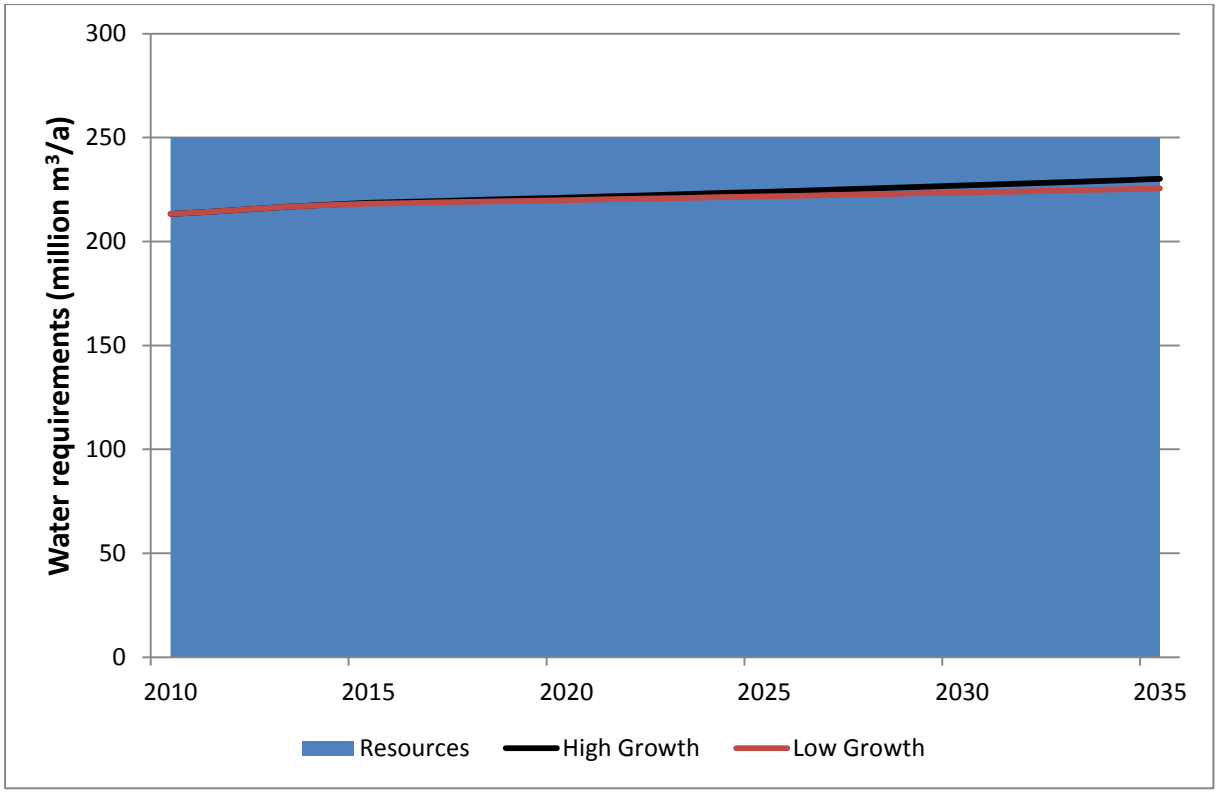

Figure E4: *Future water resource and water requirements in the Lower Olifants River Catchment*

While the water requirements and water resources presented in this report are based on the latest information available, derived from numerous recent hydrological and water resources studies as well as new information that has been sourced during the course of this study, the following uncertainties are noted:

- *Water use by irrigators not located within irrigation boards.*
- *Losses*
- *Water use by the coal mining sector in the Upper Olifants river catchment.*

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1. INTRODUCTION

1.1 PURPOSE OF THIS STUDY

The Olifants River catchment is currently one of South Africa's most stressed catchments as far as water quantity and water quality is concerned. The water requirements in the Olifants Water Management Area (WMA) have increased substantially over the last few years due to diverse activities e.g. power generation, mining, urban development, improved service delivery to rural communities, and irrigation. The potential future demand for water from the mining sector as well as rural communities is especially large and this lead to the construction of the De Hoop Dam, which will be completed in 2012. However, concerns were raised that even with the additional yield provided by the De Hoop Dam and the raised Flag Boshielo Dam, the water demands would soon outstrip the available resource. This prompted this study to develop reconciliation strategies to alleviate the current water deficits and to ensure a sustainable water supply for the next 25 years.

The study area includes the towns of Polokwane and Mokopane since Polokwane already receives water from the Olifants catchment while the intention is to supply Mokopane from the Flag Boshielo Dam. There do not appear to be other viable sources of supply to meet the growing urban demands of Polokwane and the mining demands in the vicinity of Mokopane, hence the inclusion of these towns in this study.

Reconciliation strategies entail firstly identifying an envelope of likely future water demands, determining the available water resource, then identifying possible interventions to reconcile the water demand with the available water resource into the future. Strategies can include the construction of new dams, but will certainly cover demand side options such as water conservation and demand management, reduction of unlawful use, and possibly compulsory licensing.

The impact of climate change on the hydrology of the Olifants River catchment has not been considered in this study.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to document the current and future water requirements, the water resource, and hence the current and future water balance.

1.3 REPORT STRUCTURE

The report has been structured to disseminate the information as three sub-catchments, namely the Upper, Middle, and Lower Olifants with the water demands of the Mokopane and Polokwane areas being grouped with the Middle Olifants. (See **Error! Reference source not found..)** Within each sub-catchment water requirements are documented for each user sector, which are Urban, Rural, Industrial, Mining, Irrigation and Power Generation. The water resource is then described and quantified within each sub-catchment. This includes both the yield from major dams and the resources from diffuse sources such as run-of-river abstraction, farm dams and ground water. Water balances are presented graphically with and without the impact of meeting the ecological Reserve.

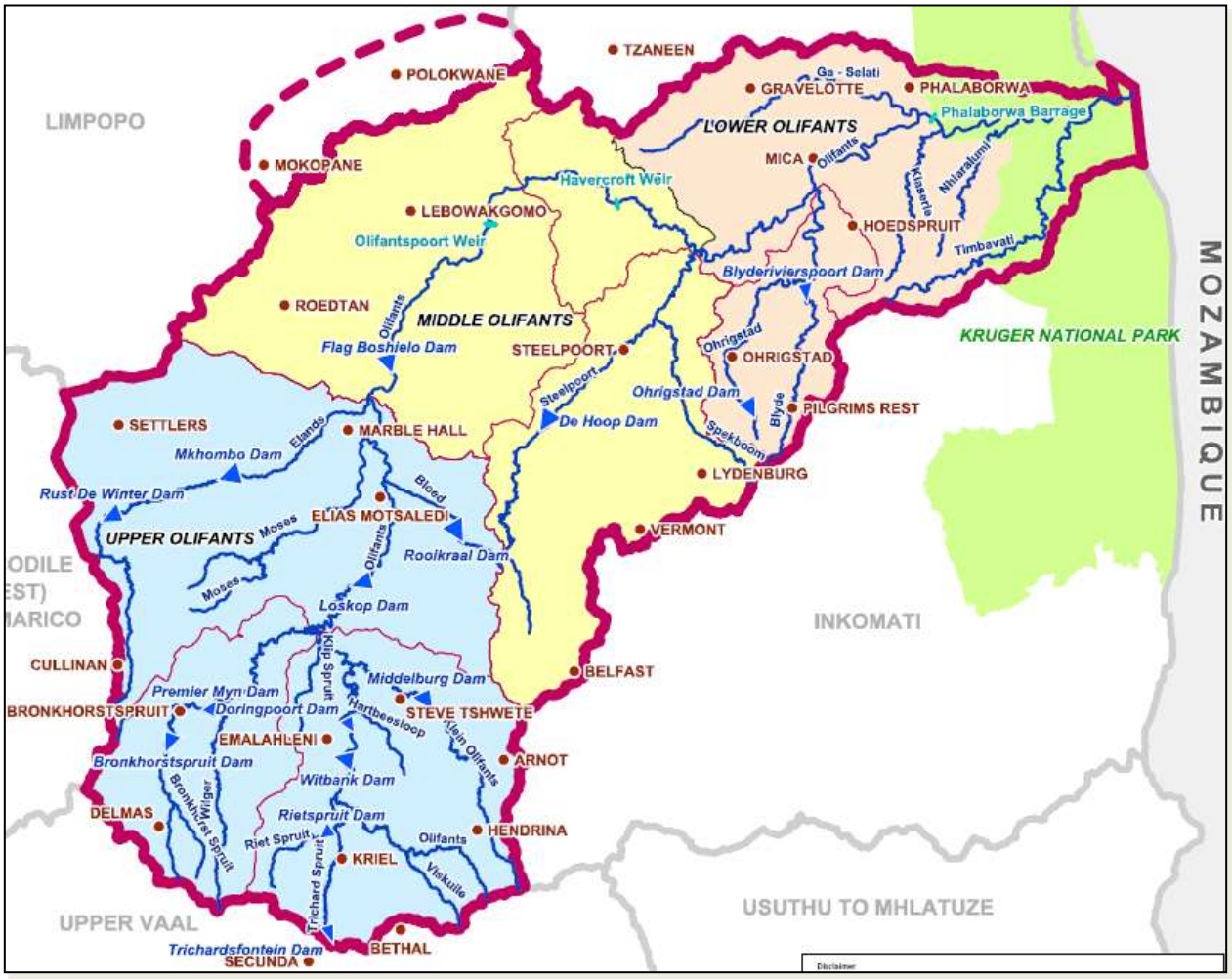

Figure 1.1: Study area with sub-catchments

2. SOURCE OF INFORMATION

The ToR for this study referred to the following previous studies from which to obtain water use and water resources information:

- Upper and Middle Olifants River Catchment: The Development of an Integrated Water Resources Management Plan (**Study 1**),
- Assessment of Water Availability in the Olifants Water Management Area by Means of Water Resource Related Models (Study 2),
- Development of Operating Rules for the Olifants River System (**Study 3**), conducted by Water Resources Planning Systems Directorate; and
- Development of Reconciliation Strategies for All Towns in the Northern Region (**Study 4**), conducted by NWRP Directorate.

A Summary Report (DWA report number P WMA 04/B50/00/8310/2) was compiled as part of this Reconciliation Strategy study which summarises the information from the above studies and well as several other relevant studies.

It is stated in the ToR that the latter All Towns study will provide water requirement projections for domestic and other users up to year 2030 as well as first order reconciliation strategies, taking into account the available water resource. Hence there was limited field work to collect primary data as part of this study. Nevertheless, the larger users were contacted in order to verify the current water requirements. The Water Services database was also used to determine rural water requirements since the All Towns Study did not cover all the small rural villages in the study area but concentrated on the urban clusters.

Other valuable sources of information were:

- The on-going monitoring of future mining water requirements being conducted as part of the Olifants River Water Resources Development Project, and
- The Lepelle North Water Board Business Plan.

3. METHODOLOGY

The methodology used to estimate the water requirements, water resource, and hence water balance (present and future) was as follows.

Water requirements were obtained from existing reports and these requirements were updated with limited field visits. Water requirements were also obtained from telephonic surveys with the larger water users. Growth in water requirements was determined from the following recent reports:

- All Town Studies (DWA, 2010),
- The Olifants Water Resources Development Project (OWRDP) (DWAF, 2006),
- The Lepelle Northern Water Business Plan (2009),
- The Framework Document Towards a Final Water Balance for the Mogalakwena Local Municipality (author unknown),
- Updating Polokwane Water Supply System Model 2010/2011, and
- The Directorate: Water Resources Planning Systems population database

The growth estimates derived from the All Towns Study (DWA, 2010) were generally accepted since this is the latest comprehensive demographic study done of the area, but in the case of Mokopane the growth rates given in the 'Framework Toward a Final Water Balance' were accepted as being more realistic.

The water requirements or water use relating to irrigation areas is difficult to quantify because some irrigators experience very low assurance of supply. The concept of a water demand or requirement becomes spurious in these cases. The intention of this Reconciliation Study is not to resolve the water shortages of irrigators who have developed, whether lawfully or otherwise, in areas where the water resource is not sufficient for the demands placed on the system. The approach taken in this study to estimate irrigation requirements was to firstly distinguish between irrigation which is controlled by irrigation boards and water user associations and irrigation that falls outside of irrigation boards, referred to further in this report as diffuse irrigation. The diffuse irrigators' assurance of supply is highly variable and often very low. It would therefore have been difficult and time consuming to estimate the individual water requirements and assurances of supply of each individual irrigator. For the purpose of this study the actual supply to the diffuse irrigators was estimated with the use of the water resource yield model (WRYM). It was then assumed that this supply also represented the diffuse irrigators' water requirements. A further refinement relating to irrigators from controlled sources (i.e. major dams) was to adjust their requirement to a 1 in 50 year requirement using long-term yield curves.

The water resource of the Olifants River catchment was obtained mostly from existing reports (DWAF, 2008, and DWA, 2010a). However, the yields of the De Hoop and Flag Boshielo Dams were re-assessed as part of this Reconciliation Study while the yield of the Phalaborwa Barrage was also determined as part of this study. Neither the yield of the farm dams nor the water available from run of river at each abstraction point was quantified as part of this study. Rather, the water use from farm dams and run-of-river was determined with the aid of a water resources model and this use was then accepted as the diffuse water resource (farm dams and run of river).

4. WATER REQUIREMENTS AND WATER RESOURCES IN THE UPPER OLIFANTS SUB-CATCHMENT

This sub-catchment covers the Olifants River and its tributaries from where they originate, down to the confluence with the Elands River. It includes Loskop Dam and its full water supply area, but it excludes Flag Boshielo Dam lower downstream in the Olifants River.

4.1 CURRENT WATER REQUIREMENTS

The following water use sectors and water requirements are described in this section:

- Urban,
- Rural
- Irrigation,
- mining,
- Industrial, and
- Power generation.

4.1.1 Urban Water Requirements

The significant towns within the Upper Olifants sub-catchment are Emalahleni, Middelburg, Bronkhorstspruit, Marble Hall, Groblersdal, Cullinan and Delmas as well as the sprawling settlements referred to as the Western Highveld.

The largest of these towns, **Emalahleni**, currently has a consumptive water use of 43,8 million m^3/a, supplied mostly from the Witbank Dam and more recently from recycled mine water decant. However, not all of this water is used by the urban sector since the municipality supplies approximately 8 million m^3/a to Highveld Steel. Hence the Urban requirement is 35,8 million m^3/a. The urban water use of Emalahleni has grown rapidly over the past five years, but it seems that rapidly increasing unaccounted for losses also contributed to this growth and that population growth or improved service delivery are not the only reasons.

The towns of **Marble Hall** and **Groblersdal** have current water demands of approximately 0.85 and 2.0 million m^3/a respectively. Both towns are supplied out of the Loskop canal.

While there is a large Water Treatment Works (WTW) at the town of **Bronkhorstspruit**, most of this treated water is destined for the Western Highveld, and only about 3.2 million m^3/a is supplied to Bronkhorstspruit. This water is all sourced from the Bronkhorstspruit Dam.

The town of **Middelburg** has a demand of 12.6 million m^3/a which is supplied from the Middelburg Dam with small contributions from the Pienaars and Kruger dams.

The town of **Cullinan** lies on the watershed of the Olifants and Crocodile West WMA and receives water from the Wilge River Dam. Approximately 4 million m^3/a is treated at the WTW in Cullinan and the water is supplied to the town of Cullinan (2 million m^3/a) and the remainder to the Cullinan Mine.

There are a number of other small towns located in the upper Olifants River catchment which receive water from outside of the catchment. The town of **Delmas** receives

approximately 1.8 million m^3/a from Rand Water (transferred for the Vaal System) and the remainder of its requirements from groundwater while the towns of Hendrina and Kriel form part of the water supply to the power stations which receive their water from the Komati and Vaal system.

The area referred to as the Western Highveld, formerly Kwandabele, is regarded as urban in the Water Services database. The southern part of the Western Highveld is supplied from the Bronkhorstspruit Dam and more recently supplemented from the Rand Water pipeline from Mamelodi. The current abstraction from the Bronkhorstspruit Dam is estimated at 16,6 million m^3/a, 3.2 million m^3/a of which is supplied to the town of Bronkhorstspruit and the remaining 13,4 million m^3/a to the Western Highveld. This southern part of the Western Highveld (WH) centred around KwaMhlanga is expected to grow rapidly and the water demand is projected to increase to 26.4 million m^3/a by 2035.

The northern part of the Western Highveld, with Siyabuswa being the main centre, consist of numerous small towns which obtain water from the Weltevreden weir located on the Elands River. This weir is supplemented from the Mkhombo Dam and there is also an allocation of 2.5 million m^3/a from the Loskop Dam although it appears as if this allocation has not been utilised for many years due to lack of maintenance of water supply infrastructure. The total current abstractions from this weir for the Siyabuswa area is estimated at 22 million m^3/a. This is limited by the capacity of the Weltevreden water treatment plant which is 60 Ml/day. The demands of this area are not expected to grow much in future. If WC/WDM can be successfully implemented, the actual use should reduce dramatically since there is huge wastage of water in this area. The water demand projections contained in the IWRMP (2009) indicated a saving of 11 million m^3/a from the 2005 demand to 2010, but none of this saving has been realised.

Table 4.1 gives the 2005 and 2010 water demands of these towns. These estimates are a synthesis of information from various sources, namely, the IWRMP (DWA, 2009), the All Towns Studies (DWA, 2010) and primary data collection carried out as part of this study.

Table 4.1: Summary of Urban demands (Upper Olifants)

Town	Water Demand (million m^3/a)	
	2005	2010
Emalahleni	28.8	35.8
Middelburg	10.3	12.6
Groblersdal/Marble Hall	2.0	2.0
Bronkhorstspruit	3.2	3.4
Cullinan	2.0	2.0
Delmas	1.8	1.8
Western Highveld (South)	13.4	13.4
Western Highveld (North)	22.0	22.0
Total	**83.5**	**93.0**

4.1.2 Rural water requirements

There are a several villages in the upper Olifants River catchment. Their source of water is not well documented but in most cases these villages fetch water from nearby streams or have access to boreholes. A list of these villages and their classification in terms of level of service is given in Appendix A-1.

Other rural water use within the Upper Olifants sub-catchment is probably limited and supplied mostly from local sources, i.e., boreholes and farm dams. This Schedule 1 use is estimated at 1 million m^3/a, but it must be noted that this is difficult to quantify since it is not necessary to register a Schedule 1 use. The Basic Human Needs (BHN) component of the Reserve is already largely catered for in the quantification of urban and rural use while the riparian rural population which relies on the BHN component of the Reserve is catered for in the estimated Schedule 1 use referred to above.

Table 4.2: Summary of rural water requirements

Location	2010 water demand (in million m^3/a)
All villages (see Appendix A-1	2.8
Schedule 1 users	1.0
Total	**3.8**

4.1.3 Irrigation Water Requirements

Based on the Integrated Water Resources Management Plan (IWRMP) and Olifants Water Availability Assessment Study (OWAAS) reports (DWAF, 2008; DWA, 2010) there is an estimated irrigated area of 695 km^2 in the Upper Olifants River catchment. Of this, 248 km^2 falls within the water user association/irrigation board's areas listed in **Table 4.3.**

Table 4.3: Irrigation within WUA and Irrigation Boards: Upper Olifants Sub-Catchment

WUA/Irrigation Board	Scheduled area (ha)	Actual area (DWAF, 2010)	Application rate (mm/a)	Current estimated demand (million m^3/a)
Bloempoort	684	551	6200	3.4
Hereford	4 466	3 426	6200	21.2
Loskop	20 952	16 059	7700	123.6
Olifants River	1 732	1 706	7600	13.0
Selons	777	189	6200	1.2
TransElands	716	1 372	7700	10.6
Rust de Winter	1200	200	7000	1.4
Total	**30 527**	**23 503**		**174.4**

The difference between these estimates is disturbing since it shows a large discrepancy between what the irrigators believe they are entitled to use and what the

DWA regional office believe irrigators are actually using. With few exceptions, the water use is less than the allocation. Where the use exceeds the allocation, this could be due to unlawful use but the lawfulness of the allocations still needs to be verified. The approach taken in previous studies was to base water availability on best estimates of present day irrigation water use and the same approach has been taken on this study.

The irrigation areas and water requirements relating to diffuse source irrigation is summarised in **Table 4.4.** The areas and water requirements were derived from the IWRMP (DWA, 2009) while the actual water use was estimated with the use of the Water Resources Yield Model that was set up as part of the IWRMP.

Table 4.4: Diffuse irrigation requirements and use: Upper Olifants Sub-Catchment

Sub area	Irrigated area (ha)	Water requirement (in million m^3/a)	Actual water use (in million m^3/a)
Witbank Dam	4 300	20.5	17.4
Middelburg dam	3 890	16.9	13.9
Bronkhorstspruit/Wilge Dam	5 717	25.7	20.2
Loskop Dam	3 900	18.2	15.9
Elands River	4 641	36.1	14.7
D/s of Loskop Dam	6 961	36.9	15.1
Total	**29 409**	**154.3**	**97.2**

Table 4.5 summarises all irrigation use allowing for assurance of supply related to controlled irrigation. The factor used to convert average use (assumed to be at a 90% assurance) to a 98% assurance is 0.87 (see Appendix C).

Table 4.5: Summary of irrigation demands: Upper Olifants Sub-Catchment (Units: million m^3/a)

Sub area	Controlled irrigation requirement		Diffuse irrigation requirement	Total irrigation requirement
	Average	1 in 50		
Witbank Dam	0		17.4	17.4
Middelburg dam	0		13.9	13.9
Bronkhorstspruit/Wilge Dam	0		20.2	20.2
Loskop Dam	0		15.9	15.9
Elands River	37.8	32.9	14.7	47.6
D/s of Loskop Dam	136.6	118.8	15.1	133.9
Total	**174.4**	**151.7**	**97.2**	**248.9**

4.1.4 Mining Water Requirements

Mining within the Upper Olifants sub-catchment consists almost entirely of coal mining, an activity which obtains most of its water requirements from their underground operations. Also, many of the coal mines have constructed their own dams from which to source water and hence quantifying the mining water requirements can be difficult. The hydrological study carried out as part of the IWRMP study (DWAF, 2009), gives the mining water requirements listed in **Table 4.6**.

Table 4.6: Mining water requirements in the Upper Olifants Sub-Catchment

Sub-area	Water requirement (million m^3/a)	
	Supplied from groundwater	Supplied from surface water
Witbank Dam	10.3	5.6
Middelburg Dam	2.3	0.7
Bronkhorstspruit/Wilge Dam	0.0	2.0
Loskop Dam	4.6	0.0
Elands River		0.5
Total	**17.2**	**8.8**

4.1.5 Industrial Water Requirements

It is often difficult to quantify industrial water requirements because industries are generally supplied from municipalities and not separately licensed. The only two industries within the Upper Olifants sub-catchment with clearly defined water requirements are Highveld Steel, who obtains their water from Witbank Dam via the Emalahleni Municipality and Gouda/Festival Farms near Bronkhorstspruit. The demands are summarised in **Table 4.7**.

Table 4.7: Industrial demands in the Upper Olifants Sub-Catchment

Industry	Water requirement (million m^3/a)
Highveld Steel	8.0
Columbus Steel	0.4
Middelburg Ferrochrome	0.2
Kanhym	0.2
Gouda/Festival Farms	0.4
Total	**9.2**

4.1.6 Power Generation Requirements

There are several large power stations located in the Upper Olifants sub-catchment which have large water requirements related to the cooling process. All of these power stations are supplied from either the upper Komati or the Vaal Systems. In addition to this, the new Kusile power station is being constructed near Witbank. This new power station will use a dry cooling process which will use much less water than the existing

wet-cooled power stations. Hence, once Kusile comes on line in 2014 the water demands for power generation will drop slightly.

The estimated supply to the existing power stations is estimated at 228 million m^3/a.

4.2 FUTURE WATER REQUIREMENTS

4.2.1 Urban

The water requirements of the urban sector has grown rapidly in the upper Olifants sub-catchment, increasing from 46.3 million m^3/a to 55.8 million m^3/a over a period of only 5 years. Based on the All Towns study (DWA, 2010), this growth has not been driven by population growth but seems rather to be more related to increased losses, especially within the Emalahleni Municipality. Projections of future growth within the urban and rural sector are summarised in **Table 4.8**.

These growth projections are based on population growth and realistic per capita consumption, including improved service delivery up to 60 ℓ/person/day. It does not allow for losses to grow and in this sense assumes some success in WC/WDM. This is the approach taken in the All Towns studies.

Table 4.8: High and low growth scenarios for Urban Water Requirements

Town	Water requirement	Growth (%)	
	2010	High	Low
Emalahleni	35.8	0.7%	0.5%
Middleburg	12.6	0.9%	0.6%
Siyabuswa	22.0	0%	0%
KwaMhlanga	13.4	2.0%	1.5%
Bronkhorstspruit	3.2	1.5%	1.0%
Weighted average		0.83%	0.59%

The growth in urban and domestic use is presented graphically in **Figure 4.1**.

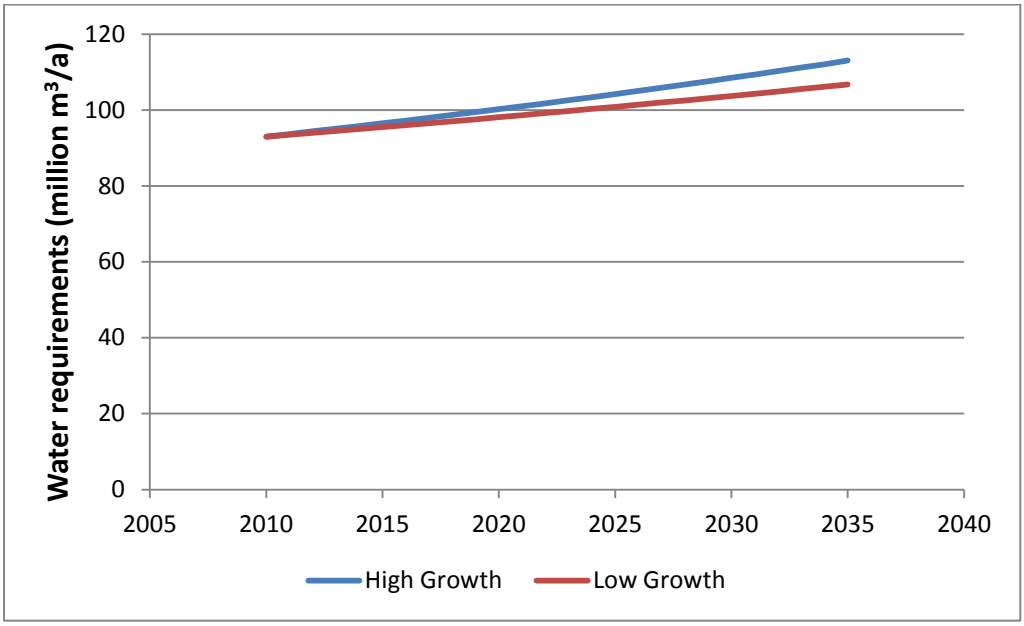

Figure 4.1: Growth in urban water requirements

4.2.2 Rural

Only a few of the villages in the Upper Olifants are classified by Water Services as service level C which is the target level of service assumed for this Reconciliation Strategy. The assumption has been made that water service to these villages will be improved up to a level of 60 l/person/day over the next 5 years after which the growth projection is based on the growth rate for this area given in the All Towns report. The high and low growth scenarios are shown in **Figure 4.6.**

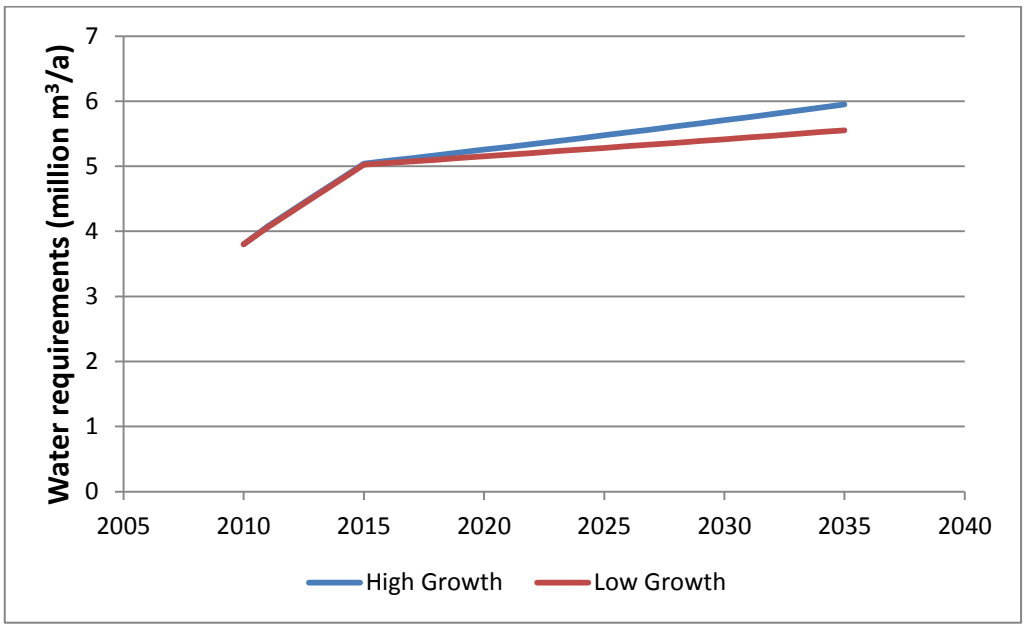

Figure 4.2: Water Balance of the Upper Olifants River Catchment

4.2.3 Power Generation

Eskom have provided estimates of the future water requirements of the six existing power stations within the Olifants River catchment as well as the new power station which is under construction. The requirements grow initially, but then decline, probably due to the new power stations which use less water as they are coming on line. See **Figure 4.3**.

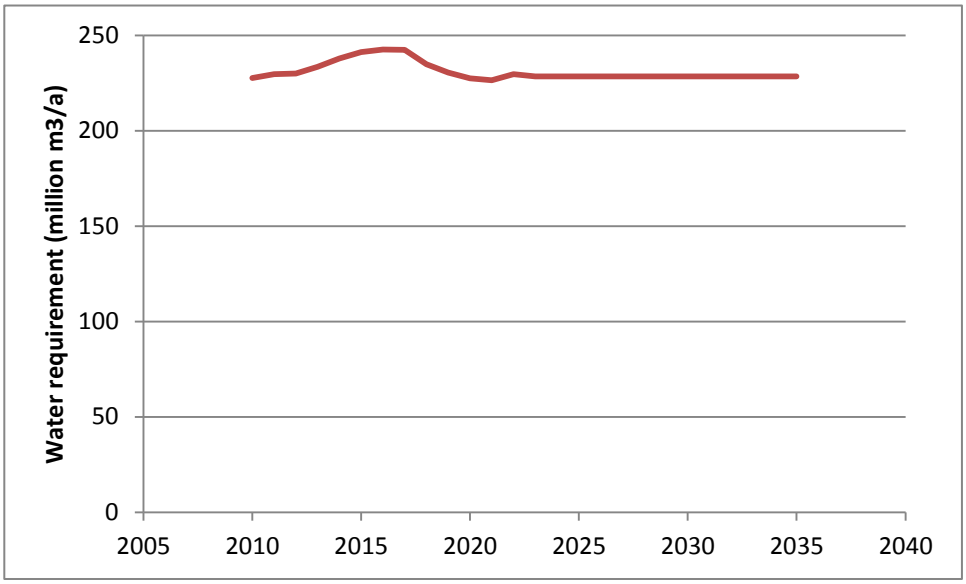

Figure 4.3: Growth in Strategic Water use

4.2.4 Mining water use

Mining water use in the Upper Olifants catchment consists almost entirely of coal mining. Coal mines in this area generally have a small water use on start-up but once even moderate excavation depths are reached, there is excess water in the mine which has to pumped out. According to Coleman (2011), the water use estimated for coal mines given in the IWRMP report (DWA, 2009) are now probably over-estimated since water use by these mines are reducing over time.

With regard to future mining activities, Gunther (2011) reiterates that coal mines in the upper Olifants catchment suffer from excess water and hence the water requirements of the coal mining sector is decreasing and not increasing. A good example of this is the proposed new coal mine planned to serve the new Kusile power station which will reportedly not use any surface water but rather use water from neighbouring coal mines during the start-up phase,

It is recommended that water use of coal mines be monitored and as this decreases the water that is freed up must be de-registered and formally freed up for re-allocation or left for the ecological Reserve.

4.2.5 Other water use

The water requirements of other water user sectors within the Upper Olifants sub-catchment are not expected to grow significantly in future.

While the irrigation sector would certainly take up more water if it was available, the reality is that owing to the stressed nature of the catchment there is no surplus water available. It is also very unlikely that the irrigation sector will be able to afford the very high cost of making additional water available within the Olifants WMA.

The coal mining activities within this sub-catchment could increase slightly with the completion of the new Kusile power station, but these mines generally make use of groundwater for their mining activities and are not net consumers of water.

There are no known plans for major industrial development that will require significant quantities of water. Such industries would not be encouraged in the Olifants River WMA due to the water shortage.

4.3 WATER RESOURCES

4.3.1 Yields from dams

The water resources of the Upper Olifants River sub-catchment have been harnessed by the construction of several large dams. The yields of these dams are given in **Table 4.9**. For the purpose of this reconciliation study, the 1 in 50 year yield has been used as an indicator of the available yield.

Table 4.9: Yields of major dams

Dam	Natural MAR (million m^3/a)	Full supply capacity (million m^3)	Historical yield (million m^3/a)	1 in 50 year yield (million m^3/a)
Bronkhorstspruit	44.7	58.0	16.9	23.5
Witbank	165.1	104.0	29.5	33.0
Middelburg	53.5	47.9	12.6	14.0
Wilge	114.0	1.6	6.7	8.0
Loskop	521.8	374.3	153.6	167.6
Rust de Winter	25.5	27.3	9.8	11.7
Mkhombo/Weltevreden	59.8	205.8	11.7	14.0
Total			**240.8**	**271.8**

Source: IWRMP (DWA, 2008)

4.3.2 Yield from farm dams and run-of-river

The yield from farm dams and run-of-river (to meet abstractions that are taking place) was estimated to be 104 million m^3/a. A breakdown of this resource into sub-areas within the Upper Olifants sub-catchment is given in **Table 4.10** together with an indication of the assurance of supply associated with this resource.

Table 4.10: Diffuse water resources in the Upper Olifants River catchment

Sub area	Irrigation (million m^3/a)	Assurance	Mining	Assurance	Total
Witbank Dam	17.4	High	6.1	High	23.5
Middelburg dam	14.0	High	0.7	High	14.7
Bronkhorstspruit/Wilge Dam	20.2	High	0.0	High	20.2
Loskop Dam	15.9	High	0.0	High	15.9
Elands River	14.7	Very Low	0.0	High	14.7
D/s of Loskop Dam	15.1	Very Low	0.0	High	15.1
Total	**97.3**		**6.8**		**104.1**

4.3.3 Transfers in

The water used by the power stations located within the Olifants is all transferred in from the Usuthu, Komati and Vaal systems.

This resource balances out the requirements and therefore the power stations do not affect the water balance of the Olifants WMA.

Rand Water also transfers water to the Delmas (1.8 million m^3/a) and a pipeline has recently been constructed to transfer water from Mamelodi to the southern parts of the Western Highveld. This new pipeline has a capacity of 10.9 million m^3/a but was not operational in 2010 which is the date accepted in this report for the current water balance. This transfer is therefore accepted as a future water resource and not a current water resource.

4.3.4 Groundwater

It is assumed that rural water users that are not supplied from a particular scheme are sourcing their water from groundwater. Hence the currently developed groundwater resource in the Upper Olifants sub-catchment is at least 2.8 million m^3/a, equivalent to the rural water use. The water used for coal mining is generally sourced from the workings and can be considered to be a groundwater use. This mining use is estimated at 17.2 million m^3/a. The total estimated groundwater use (and hence the currently developed resource) is therefore 20 million m^3/a.

4.3.5 Other sources

A recent initiative by Anglo Coal is to treat the effluent from several coal mines near Emalahleni to a potable standard and sell this water to Emalahleni. Currently the Anglo Coal reclamation works supply 7.6 million m^3/a to Emalahleni while a new plant is being constructed by Optimum Coal to supply a further 5.0 million m^3/a. As far as the water balance for Emalahleni is concerned, this water is an additional resource, while if the Olifants River catchment is considered as a whole, it is argued that this water would have flowed into the Loskop Dam and become available as yield there and hence should not be considered as additional yield to the system as a whole. A detailed analysis carried out by Golder Associates (Coleman, 2010), suggested that of this additional supply of 12.6 million m^3/a, approximately one third is additional yield to the

system as a whole. Hence the additional yield created by these reclamation works is approximately 4.2 million m^3/a.

The question that has been addressed in this Reconciliation Strategy is how much additional water can be sourced from mine water decant in the future? Some work on this was carried out as part of the IWRMP study (DWA, 2009), and the conclusion is that as much as 45 million m^3/a will decant by 2035. See Figures 4.4 and 4.5. The WRC report No 1628/1/11 "Prediction Of How Different Management Options Will Affect Drainage Water Quality And Quantity In The Mpumalanga Coal Mines Up To 2080" by Coleman et al, April 2011 gives lower values up to 36.5 million m^3/a, but the graphs of Figures 4.4 and 4.5 is the latest information available.

Whether or not this water is additional yield or water that would have flown down the river in any event is being widely debated. The groundwater specialists that carried out this work (Coleman, et al, 2011) are of the opinion that all new mine decants will be additional water and additional yield. The reason for the increase in MAR is the reduction in evapo-transpiration losses from soil moisture due to more rapid infiltration into the mined areas.

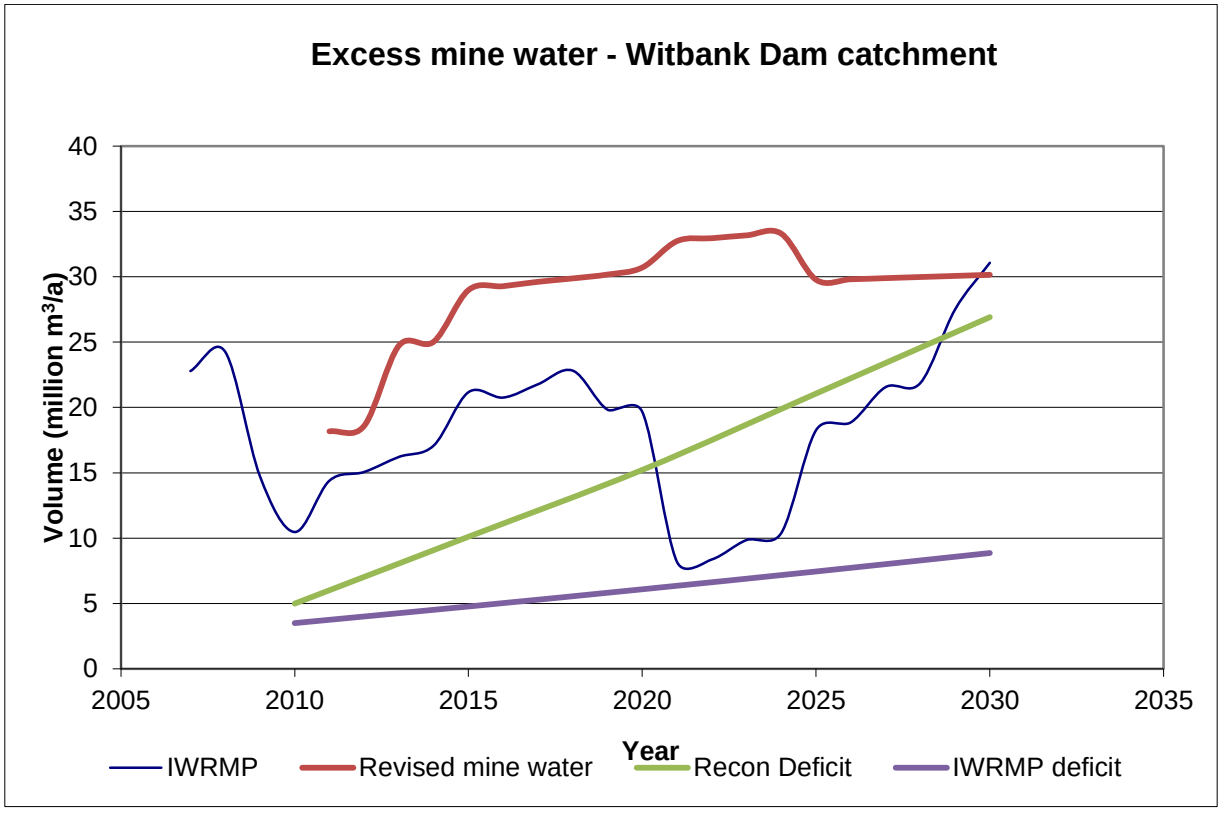

Figure 4.4: Excess water from coal mines in the Witbank Dam catchment
Source: Golder Associated, 2011

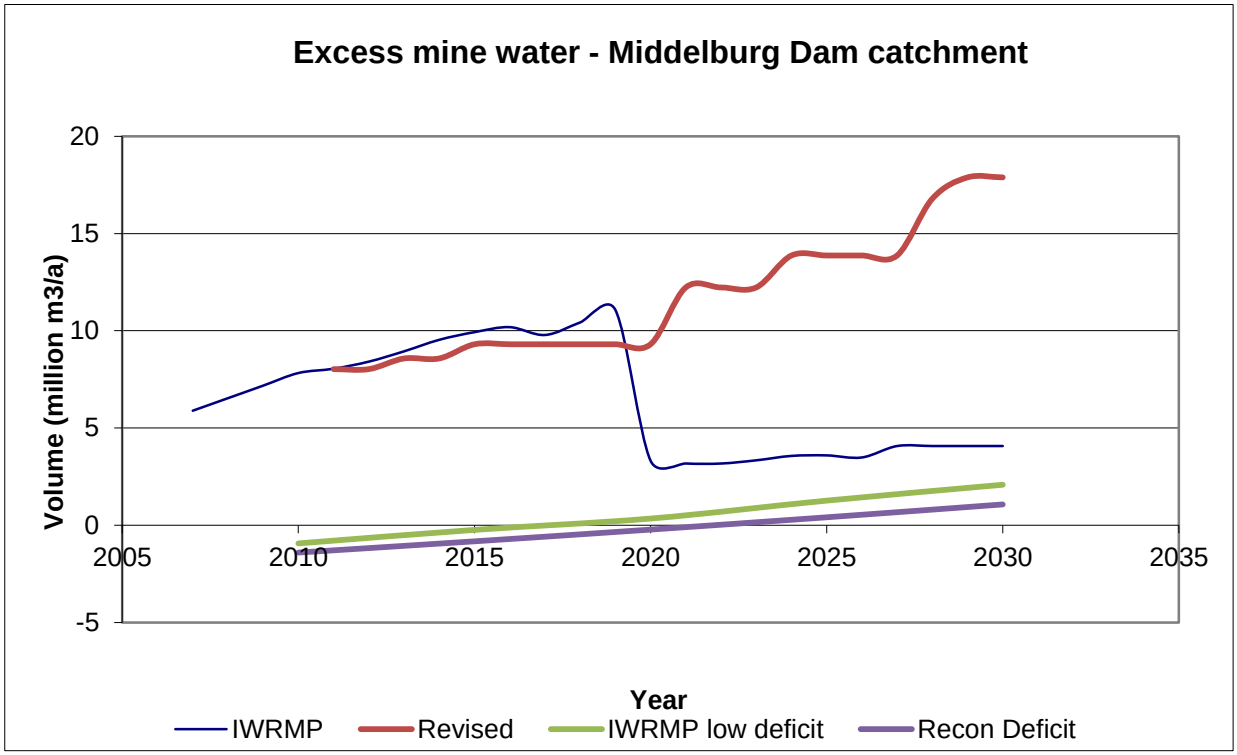

Figure 4.5: Excess water from coal mines in the Middelburg Dam catchment
Source: Golder Associated, 2011

In July 2011 Anglo appointed a consultant to look into this possible additional water resource in more detail. The results of this detailed analysis were not available at the time of compiling this Water Requirements and Water Resources report. For the purpose of this study therefore, the decant information of **Figure 4.4** and **Figure 4.5** has been used. This possible future water resource has however been factored into the reconciliation strategy by means of a reconciliation option scenario (see report P WMA 04/B50/00/8310/9 of this study) because of the divergence of opinion on whether it will realise and also because this additional water is linked to expensive treatment costs and cannot be regarded as an unconditional additional yield.

The current excess water decant in the catchments of Witbank and Middelburg Dams can be read off the graphs of **Figure 4.4** and **Figure 4.5** as 18 million m^3/a and 8 million m^3/a respectively. It was assumed that the additional yield of 4.2 million m^3/a as a result of the Emalahleni Water Reclamation Plant and the Optimum plant comes from this excess water decant and that the rest (i.e. 21.8 million m^3/a) would have been part of the system runoff in any event. The incremental future decant can then be regarded as direct additional yield. In the case of the Witbank Dam catchment this value is approximately 12 million m^3/a and of the Middelburg Dam catchment 10 million m^3/a, i.e. approximately 22 million m^3/a in total over a period of 20 years. This probable additional yield will be used as an option input in the water reconciliation model to determine the desired water balance scenario on which the reconciliation strategy will be based.

It is critical that a monitoring system is put in place as soon as possible in order to remove the uncertainties over time. This will be a recommendation of the reconciliation strategy.

4.3.6 Summary

A summary of the water resources of the Upper Olifants River catchment is given in **Table 4.11.**

Table 4.11: Summary of the water resource if the Upper Olifants

Source	Yield available (million m^3/a)
Dams	272
Diffuse (farm dams and run-of-river abstraction)	104
Transfers in • To Eskom • To urban users	 228 2
Other sources	4
Groundwater	20
Total	**630**

4.4 WATER BALANCE

The current water balance of the Upper Olifants is presented in **Table 4.12** while the future water balance is shown in **Figure 4.2**.

Table 4.12: Water Balance within the Upper Olifants River catchment

	Major dams	Diffuse source	Transfers In	Groundwater	Other source	Total
Water Resource	272	104	230	20	4	630
Water requirements						
• Urban	87		2		4	93
• Rural	0	1	0	3		4
• Strategic			228			228
• Industrial	9					9
• Mining	2	7		17		26
• Irrigation	152	97				249
Sub-total	250	105	230	20	4	609
Balance	**22**	**(1)**	**0**	**0**	**0**	**21**

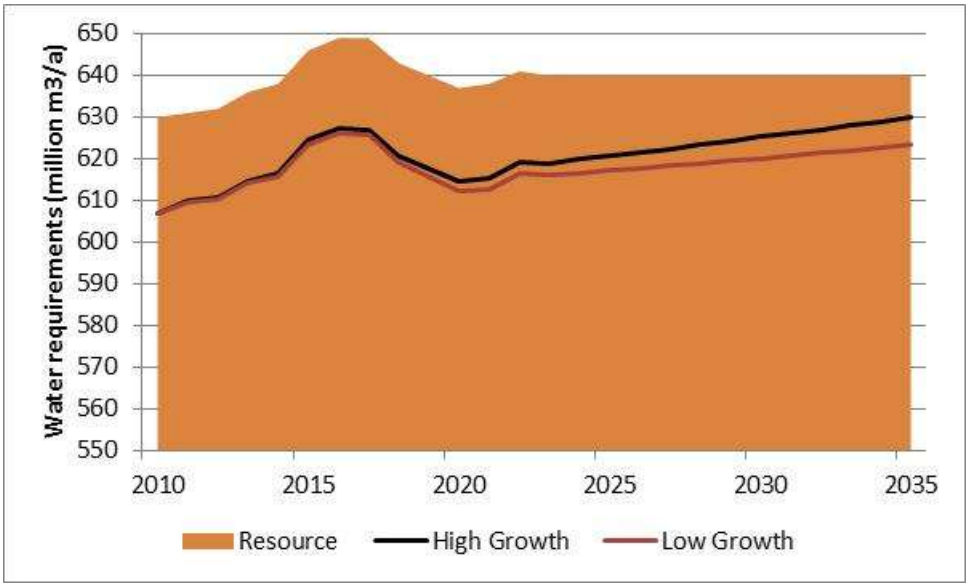

Figure 4.6: Water Balance of the Upper Olifants River catchment

The Upper Olifants Sub-Catchment is currently experiencing a significant surplus. However, a problem in this sub-catchment is that the water resources are not evenly distributed. There is surplus water in the Rust De Winter Dam while Emalahleni is stressed, with water demands exceeding the available resource.

5. MIDDLE OLIFANTS

The Middle Olifants Sub-Catchment stretches from the confluence of the Olifants and Elands Rivers down to the point where the Steelpoort River flows into the Olifants River. The whole of the Steelpoort and Spekboom River Catchments are therefore included. The towns of Polokwane and Mokopane will also be supplied from this sub-catchment.

5.1 CURRENT WATER REQUIREMENTS

The water requirements of the water use sectors are described in the following sections.

5.1.1 Urban Water Requirements

There are several towns which can be considered as urban requirements within the Middle Olifants sub-catchment. These are **Lebowakgomo, Polokwane, Mokopane, Burgersfort, Lydenburg** and **Belfast**. Polokwane and Mokopane have sources of supply other than the Olifants River catchment but the growth in demand of these towns will need to be met from the Olifants. The supply to Polokwane and Lebowakgoma from the Olifants is via the Olifantspoort scheme which is currently delivering approximately 15.3 million m^3/a. The supply to Polokwane from this scheme is currently 7.0 million m^3/a while Lebowakgoma utilise approximately 8.3 million m^3/a. See **Table 5.1**.

Polokwane and Mokopane is complex in that they receive water from sources other than the Olifants River and are therefore dealt with in detail below,

Polokwane
The total water demand in 2010 was estimated to be 34.3 (DWA, 2011).

The allocation to Polokwane from the Ebenaezer Dam is only 12 million m^3/a and it has therefore been assumed that in future the difference between Polokwane current abstractions from the Ebenaezer Dam and their allocation as well as the growth in demand will need to be sourced from the Olifants River catchment. Currently the demand on the Olifants river is therefore 10.4 million m^3/a while only 7.0 million m^3/a is being supplied.

Mokopane
The town of Mokopane (which includes Mahwelereng) is currently supplied from the Doornrivier Dam and from well fields. The intention is to meet the growth in water demand of this area from the Olifants River in future as part of the ORWRDP. The rural supply and supply to the mines will however be supplied from the Olifants River via the Flag Boshielo Dam and this is discussed in sections 5.1.2 and 5.1.4 respectively.

Table 5.1: Summary of Urban demands (Middle Olifants)

Town	Water Demand (million m^3/a)	
	2005	2010
Polokwane	30.0	34.2
Mokopane	8.0	8.2
Lebowakgoma	6.8	8.3
Burgersfort	1.2	1.5
Lydenburg	2.2	3.2
Belfast	0.8	0.9
Total	**49.0**	**56.3**

5.1.2 Rural Water requirements

Within the Middle Olifants Sub-Catchment, specifically the Sekukhune area, there are numerous villages which have been treated as rural water areas for the purposes of this study. Currently many of these villages obtain their water from groundwater or a local source but the level of service is inadequate. One of the aims of the Olifants Water Resources Development Project, which includes the construction of the De Hoop Dam, is to supply many of these villages with water from the new dam.

Only five rural water supply schemes were included in the All Towns Study (DWA, 2010). These are the Makhuduthamang, Leeufontein, Fetagoma, Lebelolo North, and Olifantspoort South. The Water Services database on the other hand list approximately 492 villages (see Appendix A-2) with approximately 54% of the rural population below the 60 l/person/day standard used in this Reconciliation Study. Some of larger villages include Tafelkop with a water requirement of 1.5 million m^3/a and Jane Furst with a demand of 0.74 million m^3/a. The total estimated water requirements, based on current levels of service, is estimated to be 21.4 million m^3/a.

The intention is to supply the rural water requirements of the Mogolakwena Municipality from the Olifants River in future as part of the ORWRDP. This scheme identified 300 villages within the Mogolakwena Municipality, some as far away as Glen Alpine. The current water demand of these villages is estimated to be 8.9 million m^3/a.

Table 5.2 summarised the current and future demands of these rural areas.

Table 5.2: Summary of rural water demands (Middle Olifants)

Location	Water Demand (million m^3/a)
	2010
Sekukhune	12.5
Mogalakwena	8.9
Schedule 1 use	**1.0**
Total	**22.4**

5.1.3 Irrigation Water Requirements

Water User Associations and, to be transformed Irrigation Boards are not as abundant or as active in the Middle Olifants sub-catchment as the Upper Olifants sub-catchment. The irrigation boards that are still operating are listed in **Table 5.3.** Current estimated water demands were determined with the use of the WRYM which was set up as part of the OWAAS study (DWA, 2010a).

Table 5.3: Water User Associations/Irrigation from Irrigation Boards: Middle Olifants Sub-Catchment

WUA/Irrigation Board	Schedule area (ha)	Actual area (DWAF, 2010)	Application rate (mm/a)	Current estimated demand (million m^3/a)
Groot Dwars	786	606	7 156	4.3
Waterval	2 436	917	7 000	18.5
Spekboom	-	535	10 392	5.6
Laer Spekboom	2 643	1 573	5 000	7.9
Central Steelpoort	549	288	7 164	2.0
Central Olifants	2 338	-	7 700	18.0
Total	**8 752**			**56.3**

Diffuse irrigation is summarised in **Table 5.4.**

Table 5.4: Diffuse irrigation requirements and use: Middle Olifants Sub-Catchment

Sub area	Irrigated area (ha)	Water requirement (million m^3/a)	Actual water use (million m^3/a)
U/s of De Hoop Dam	2 278	15.1	14.7
D/s of De Hoop Dam	247	2.0	1.9
Spekboom (B42)	876	6.9	4.1
Olifants (B51)	3 100	9.2	6.9

Sub area	Irrigated area (ha)	Water requirement (million m^3/a)	Actual water use (million m^3/a)
Olifants (B52)	325	1.0	0.6
Olifants (B71)	2 313	33.5	3.2
Total	**9 139**	**67.7**	**31.4**

The total irrigation requirements, adjusted to a 98% assurance, are shown in **Table 5.5**.

Table 5.5: Summary of irrigation demands: Middle Olifants Sub-Catchment (Units: million m^3/a)

Sub area	Controlled irrigation requirement		Diffuse irrigation requirement	Total irrigation requirement
	Average	1 in 50		
U/s of De Hoop Dam	0	0	14.7	14.7
D/s of De Hoop Dam	6.3	5.5	1.9	7.4
Spekboom (B42)	32.0	28.2	4.1	32.5
Olifants (B51)	0	0	6.9	6.9
Olifants (B52)	18.0	15.8	0.6	16.4
Olifants (B71)	0	0	3.2	3.2
Total	**56.3**	**49.5**	**31.4**	**81.1**

5.1.4 Mining Water Requirements

The Middle Olifants sub-catchment, which includes the Mogolakwena DMarea, is characterised by platinum mining. Pressure to expand platinum mining in this area led to the ORWRDP and the construction of the De Hoop Dam, but the economic downturn in 2008 has slowed down this demand. Water use by the mining sector is difficult to quantify because mines are reluctant to reveal how much water they use since this is an indicator of their production. A comprehensive survey of water use by the mines to be included in ORWRDP area of supply was conducted as part of the ORWRDP. This survey concluded that the water use by the mining sector at that time was about 17 million m^3/a, comprised as follows:

- Steelpoort area (diffuse sources): 7 million m^3/a.
- Steelpoort area (Olifants River via the Havercroft Weir): 6 million m^3/a.
- Mogolakwena mines: 4 million m^3/a.

The above water use estimates were updated as part of this Reconciliation study and are categorised in the Steelpoort area (mainly groundwater use), the mine supplied from the Olifants River, and the mines located near Mokopane.

Steelpoort Area

Table 5.6 gives a breakdown of the water supply to these mines.

Table 5.6: Mines in the Steelpoort Area receiving water from diffuse sources

Highveld steel and Vanadium	Groundwater	1.56	Registered use. Actual use not known
Xstrata (Helena and Thorncliffe)	Groundwater	0.37	Registered use. Actual use not known
Xstrata (Lion Chrome)	Der Brochen Dam	0.68	Measured use
Assamang Chrome	Groundwater	0.10	Measured use
Anglo	Groundwater	2.91	Registered use. Actual use not known
Aquarius Platinum	Der Brochen Dam	0.19	Registered use. Actual use not known
Two River Platimum	Dwars River	0.76	Measured use
Samancor Chrome	Groundwater	2.61	Registered use. Actual use not known
Samancor Ferrochrome	Groundwater	0.65	Registered use. Actual use not known
TOTAL		**9.83**	

Olifants River via the Havercroft Weir

This system is operated by Lebalelo Water and according to its CEO Mr Ossie Rosouw they are currently supplying approximately 7 million m^3/a to mines in the Middle Olifants. These mines are listed in **Table 5.7**.

Table 5.7: Water Requirements of mines in the Middle Olifants Sub-catchment that are currently supplied from Havercroft Weir

Mine	Water requirement (million m^3/a)
Mototolo	1.83
Modikwa	2.56
Twickenham	3.36
TOTAL	**7.75**

Mines in the Mogolakwena DM near Mokopane

The mines in the Mogolakwena DM located near Mokopane as listed in **Table 5.8**, obtained their water from groundwater in the past but are also now making use of effluent from Polokwane as well as rainwater harvesting.

Table 5.8: Water requirements of mines in the Mogalakwena DM area

Overysel	Groundwater	0.77
Blinkwater	Groundwater	0.80
Commandodrift	Groundwater	0.51
Sandsloot	Rain water harvesting	0.51
Piet Potgietersrus	Polokwane effluent	2.56
Doornkraal	Polokwane effluent	5.11
TOTAL		**10.26**

The current estimate water use by mines in the Middle Olifants sub-area is therefore approximately 28 million m^3/a.

5.1.5 Industrial Water Requirements

There is no significant industrial water use within the Middle Olifants River catchment.

5.1.6 Forestry

There are limited areas of commercial forestry within the Olifants River catchment. The areas are concentrated in the high rainfall areas around Belfast. The estimated afforested area in the Middle Olifants sub-catchment is 91.1 km^2 which reduces the runoff by an estimated 3.5 million m^3/a (DWAF, 2010a). This streamflow reduction has been taken into account when calculating the available yield.

5.2 FUTURE WATER REQUIREMENTS

5.2.1 Urban and rural water requirements

The urban and rural water requirements within the Middle Olifants river catchment will grow with improved service delivery, but more significant are the future water demands of Polokwane and Mokopane that will need to be supplied from the Middle Olifants. Polokwane is currently supplied from the Olifantspoort works located on the Olifants River downstream of the Flag Boshielo Dam while their future demands will be supplied from De Hoop Dam. Mokopane currently has its own sources (Doorndraai Dam and effluent from Polokwane) but the intention is to supply rural communities in the Mogalakwena Municipality from the Flag Boshielo Dam via Phase 2B of the ORWRDP.

The growth of water demand in Polokwane and Mokopane was estimated as part of the ORWRDP (DWAF, 2005). These water demand projections were only carried out to the year 2020 and assumed very high growth, as summarised in **Table 5.9.**

Table 5.9: Growth in urban water requirements in Polokwane and Mokopane

Town	2005 water use	Low growth	High growth
Mokopane	10.0	3.8%	4.7%
Polokwane	23.8	4.0%	4.7%

These growth rates seem very high compared to the much lower growths obtained from the All Towns Study (DWA, 2010) and various Water Services reports. The growth rates for this study have therefore been obtained from recent Water Services studies (DWA, 2011) and an internal unpublished DWA report referred to only as the 'Framework Document toward a Final Water Balance for Mogalakwena Local Municipality).

Projections of future growth within the urban and rural sector are summarised in **Table 5.10.**

Table 5.10: High and low growth scenarios for urban water requirements

Town	Water requirement	2035	
	2010	High growth	Low growth
Polokwane	34.3	56.3	44.0
Mokopane	8.3	19.5	12.0
Lebowakgoma	8.3	12.0	10.6
Burgersfort	1.5	5.8	5.1
Lydenburg	3.2	4.6	4.1
Belfast	0.9	1.3	1.2
Total	**56.5**	**99.5**	**77.0**

The growth in urban water requirements are presented graphically in **Figure 5.1.**

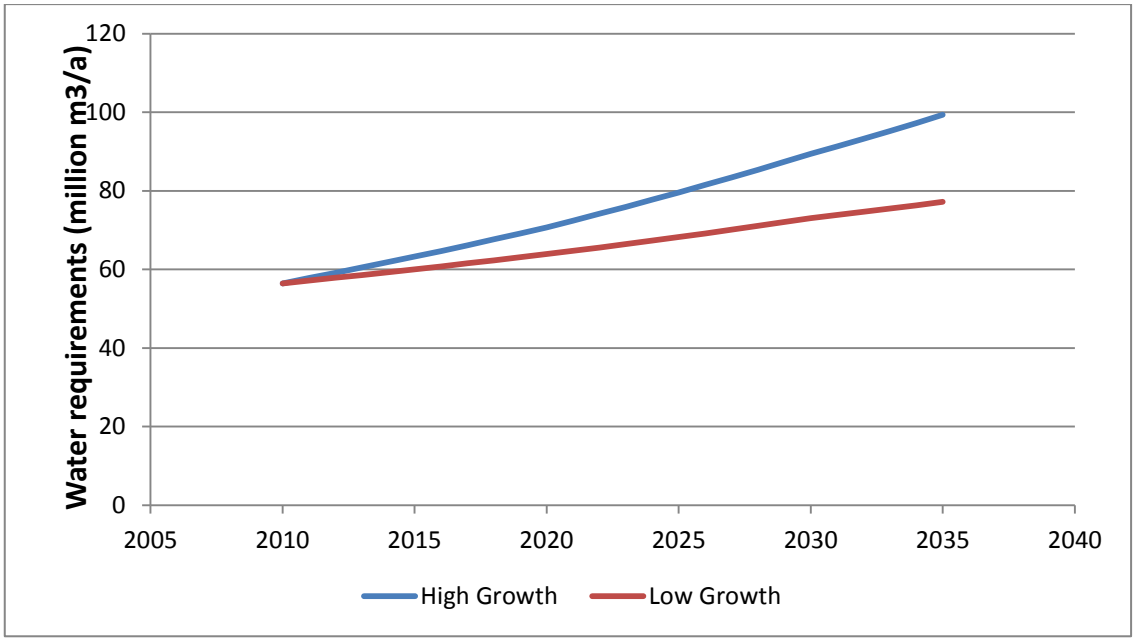

Figure 5.1: Growth in urban water requirements

The growth in rural water requirements is summarised in **Table 5.11** and shown in **Figure 5.2.** The growth in Sekukhune area was obtained from typical growth rates in this area given in the All Towns studies while the growth rate in the Mogolakwena rural areas were taken from the 'Framework Document toward a Final Water Balance for Mogalakwena Local Municipality' which estimates growth to be between 1 and 2.5%.

Table 5.11: Growth in Rural water requirements in the Middle Olifants

Location	Water requirements	2035	
	2010	High growth	Low growth
Sekukhune	12.5	21.3	16.5
Mogolakwena	8.9	16.4	11.5
Schedule 1 use	1.0	1.0	1.0
Total	**22.4**	**38.7**	**29.0**

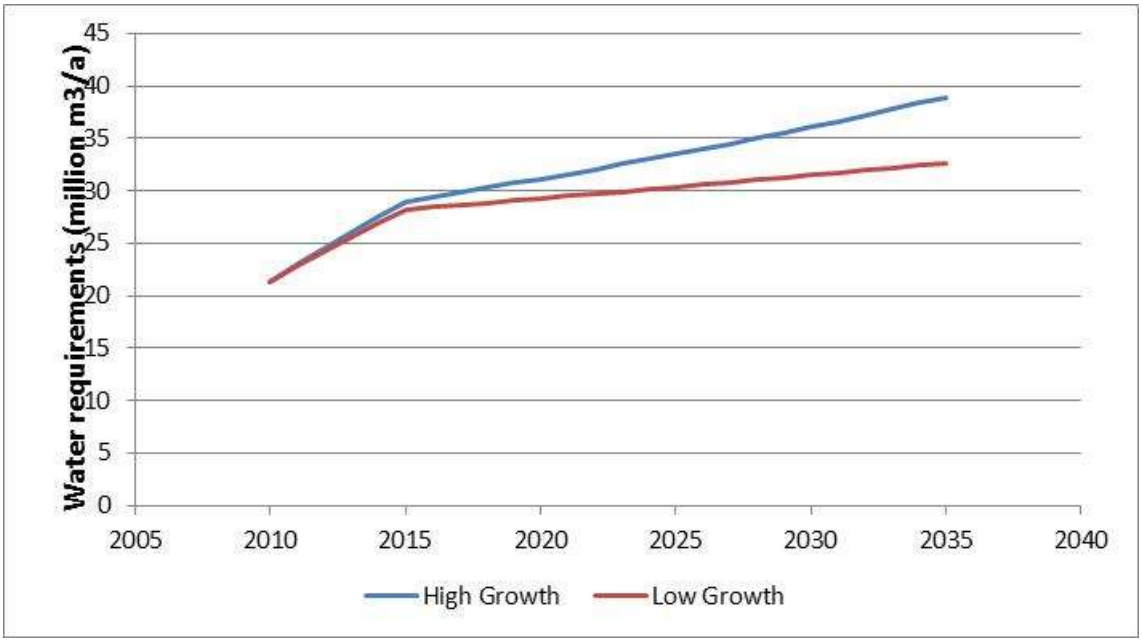

Figure 5.2: Growth in rural water demands in the Middle Olifants catchment

5.2.2 Future Mining Water Requirements

Mining water requirements within the Middle Olifants River catchment and their likely growth were determined as part of the ORWRDP and these estimates were used to develop a preliminary strategy. However, due to the severe economic downturn in 2008, the mining developments and their associated water demands were delayed by approximately 3 years (Bierman, 2010). An updated estimate of the mining water requirements was obtained from Bierman and these are summarised in **Table 5.12** and shown in **Figure 5.3.** It should be noted that these water requirements are substantially less than those used in the OWRDP.

Table 5.12: High and low growth scenarios for mining water requirements (in million m^3/a)

Location	Water requirement	2035	
	2010	High	Low
Mokopane	10	28	24
Polokwane	0.0	3.7	3.0
Lebowakgoma	0.0	3.6	2.9
Steelpoort	18.0	57.1	43.3
Total	**28.0**	**92.4**	**73.2**

Source: Bierman, 2011.

Note that the ORWRDP did not have a high and low scenario and only projected water requirements until 2030. The ORWRDP estimated mining water requirements for 2030 are 91 million m^3/a.

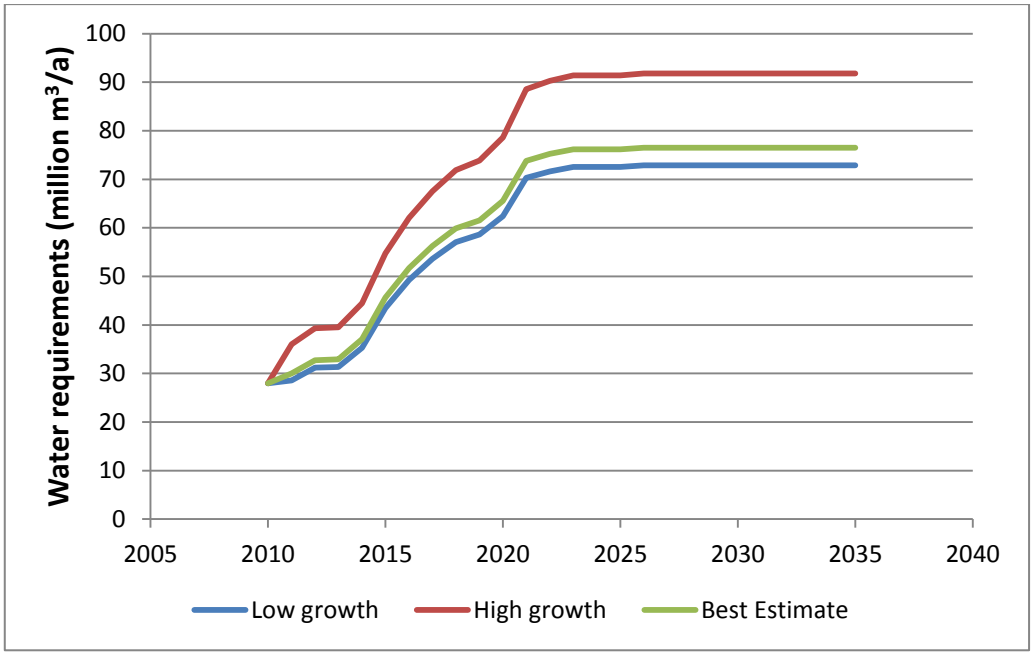

Figure 5.3: Growth in mining water requirements

5.2.3 Future irrigation water requirements

While DWA's policy is not to make further water allocations to the irrigation sector, the exception is irrigation schemes which fell into disrepair and are being re-vitalised by the Department of Agriculture. Such a scheme is the irrigation located downstream of the Flag Boshielo Dam. This scheme has an allocation of 18 million m^3/a, but is currently only using 13 million m^3/a. It is assumed that in the not-too-distant future the full 18 million m^3/a will be utilised and the reconciliation strategy must allow for this water use.

5.3 WATER RESOURCE

5.3.1 Yield from dams

There is currently only one large dam in the Middle Olifants River Sub-Catchment, namely the Flag Boshielo Dam, although the De Hoop Dam is nearing completion. However, since this study includes the water supply to Polokwane and the Mogolakwena Municipality, the water resources available to Polokwane and Mogalakwena have been included in this table.

The water resources situation of Polokwane is summarised as follows:

- Dap Naude Dam: 6.2 million m^3/a
- Ebenaezer Dam: ~15.4 million m^3/a
- Olifants River: ~7 million m^3/a

The allocation to Polokwane from the Ebenaezer Dam is however on 12 million m^3/a and for water balance purposes this lower figure has been assumed, the implication

being that the difference between the current abstraction and the allocation will need to be supplied from the Olifants River.
The surface water resources situation of Mogalakwena is as follows:

- Doorndraai Dam: 4.38 million m3/a (allocation)

Table 5.13 include the yield from De Hoop Dam.

Table 5.13: Yield from major dams

Dam	Natural MAR (million m^3/a)	Full supply capacity (million m^3)	Historical yield/allocation (million m^3/a)	1 in 50 year yield (million m^3/a)
Flag Boshielo	712	179	53	56
De Hoop	134	347	65	66
Buffelskloof	28.4	5.4	14.7	14.7
Der Bruchen	17.5	9.0	8.3	8.3
Belfast	13.3	5.5	5.7	5.7
Lydenburg	6.4	1.1	2.5	2.5
Dap Naude	15.4	2.0	6.2	6.2
Ebenaezer	48.9	69.1	12.0	12.0
Doorndraai	21.6	44.2	4.38	4.38
Total			**171.8**	**175.8**

5.3.2 Yield from farm dams and run-of-river

The yield from farm dams and run-of-river (to meet abstractions that are taking place) was estimated to be 31.4 million m^3/a. A breakdown of this resource into sub-areas within the Middle Olifants Sub-Catchment is given in **Table 5.14,** together with an indication of the assurance of supply associated with this resource.

Table 5.14: Diffuse resources in the Middle Olifants River catchment

Sub area	Irrigation (million m^3/a)	Assurance
U/s of De Hoop Dam	14.7	High
D/s of De Hoop Dam	1.9	High
Spekboom (B42)	4.1	High
Olifants (B51)	6.9	High
Olifants (B52)	0.6	High
Olifants (B71)	3.2	High
Total	**31.4**	

5.3.3 Transfers in

There are no transfers into the Middle Olifants River catchment, *per se,* but effluent is transferred from Polokwane to mines located near Mokopane and is considered as an additional resource.

5.3.4 Groundwater

The currently utilised groundwater resource of the Middle Olifants sub-catchment is not well documented but it has been assumed that villages that are not supplied by a water supply scheme must be obtaining their water from groundwater. The rural water requirements within the Sekukhune DM is given in **Table 5.2** as 12.5 million m^3/a of which approximately 4 million m^3/a is supplied from the Flag Boshielo Dam and a further 2 million m^3/a from Olifantspoort South scheme. The remaining 6.5 million m^3/a is assumed to be the currently utilised groundwater resource within the Sekukhune DM. In addition, there are significant groundwater resources in the vicinity of Polokwane and Mokopane that supply water to the urban and rural sector. The details of these groundwater resources are as follows:

- Polokwane wellfields: 5.7 million m^3/a
- Wellfields near Mokopane: 9.6 million m^3/a

Groundwater is also used extensively by the mines located in this area. The actual is difficult to quantify but the registered use is as follows:

- Steelpoort area: 8.2 million m^3/a
- Mokopane area: 2.1 million m^3/a

The total groundwater use within the Middle Olifants sub-area is therefore approximately 35 million m^3/a.

5.3.5 Summary of water resource

A summary of the water resources of the Middle Olifants River sub-catchment is given in **Table 5.15:** Summary of the current water resource of the Middle Olifants River Sub-Catchment

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Table 5.15: Summary of the current water resource of the Middle Olifants River Sub-Catchment

Source	Yield available (million m^3/a)
Major dams	110
Diffuse (farm dams and run-of-river abstraction)	32
Groundwater	35
Total	**177**

5.4 WATER BALANCE

5.4.1 Current

Two water balances have been determined for the Middle Olifants sub-catchment and are shown in **Table 5.16** and **Table 5.17**. Firstly, the current balance without the De Hoop Dam, to indicate the water deficit which is the motivation for constructing this dam, and secondly the current 2035 balance with the additional yield made available from the De Hoop Dam. Note that the 2035 balance is based on the high growth scenario. However, by the time De Hoop dams has filled and the full yield is realised, the water demands within the Middle Olifants sub-catchment will have increased substantially, and this sub-catchment could remain in deficit even after the completion of the De Hoop Dam. See **Figure 5.4**.

Table 5.16: Current Water Balance within the Middle Olifants Rivet catchment (before De Hoop Dam) (Units are million m^3/a)

	Major dams	Diffuse source	Transfers In	Ground water	Total
Water Resource	110	32	8	35	185
Water requirements					
• Urban	48	0	0	10	58
• Rural	6	1	0	15	22
• Mining	9	0	8	10	27
• Irrigation	49	31	0	0	80
Sub-total	112	32	8	35	187
Compensation Release	19	0	0	0	19
Balance	**-21**	**0**	**0**	**0**	**-21**

Table 5.17: Growth Water Balance (2035) within the Middle Olifants River catchment (With De Hoop Dam) (Units are million m^3/a)

	Major dams	Diffuse source	Transfers In	Ground water	Total
Water Resource	176	32	8	35	251
Water requirements					
• Urban	90	0	0	10	100
• Rural	23	1	0	15	39
• Mining	74	0	8	10	92
• Irrigation	49	31	0	0	80
Sub-total	236	32	8	35	311
Compensation release	19	0	0	0	19
Balance	**-60**	**0**	**0**	**0**	**-60**

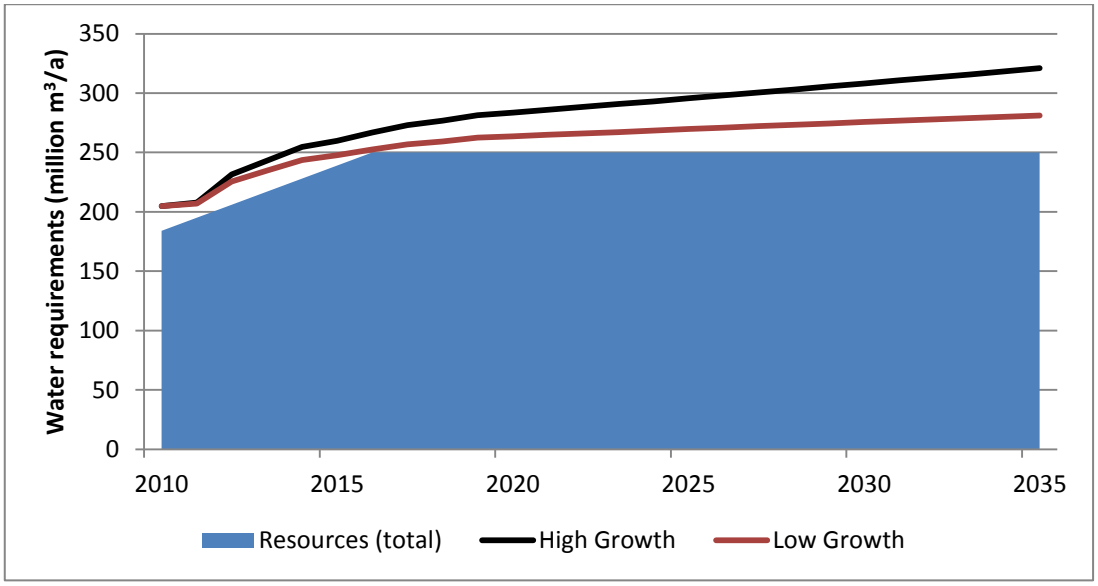

Figure 5.4: Water Balance of the Middle Olifants River catchment

6. LOWER OLIFANTS

The Lower Olifants Sub-Catchment stretches from the Olifants/Steelpoort Rivers confluence down to the RSA/Moçambique boundary. It includes The Blyde River catchment.

6.1 CURRENT WATER REQUIREMENTS

The water requirements of the water use sectors are described in the following section.

6.1.1 Urban Water Requirements

There are only two significant towns within the Lower Olifants River Sub-Catchment, namely, Phalaborwa and Hoedspruit. **Phalaborwa** is the larger of these towns with a current water demand of 24.5 million m^3/a (Lepelle Northern Water, 2009). This water is currently abstracted from the Phalaborwa Barrage but can be supplemented by releases from the Blyderivierpoort Dam. Other smaller towns such as Gravellote, Ohrigstad, Pilgrims Rest and Mica have an estimated combined water requirement of approximately 1 million m^3/a**.**

These water requirements are summarised in **Table 6.1.**

Table 6.1: Summary of Urban demands (Lower Olifants)

Town	Water Demand (million m^3/a)	
	2005	2010
Phalaborwa	18.0	24.5
Hoedspruit	2.3	2.4
Other small towns	1.0	1.0
Total	**22.3**	**28.9**

While a comparison of 2005 and 2010 water demands indicates rapid growth, this is probably not the case and is a result of under-estimates of water use in 2005.

6.1.2 Rural water requirements

The All Towns Study (DWA, 2010) does not refer to any rural settlements within the Lower Olifants River sub-catchment. The Water Services database was therefore used to estimate these water requirements based on estimated population and level of service. The Water Services database list 124 villages with 82% of the population not receiving water to RDP standards. The estimated current rural water demand is 2.7 million m^3/a.

6.1.3 Irrigation Water Requirements

Irrigation within Water User Associations/irrigation boards is summarised in **Table 6.2**.

Table 6.2: Irrigation from Irrigation Boards: Lower Olifants sub-catchment

Irrigation Board	Schedule area (ha)	Actual area (DWAF, 2010)	Application rate (mm/a)	Current estimated demand (million m^3/a)
Ohrigstad (B60)	1 857	2 675	7 000	25.8
Blyde River (B60)	8 604	7 863	9 900	89.9
Klaseri (B73)	786	200	9 900	2.0
Selati (B72)	722	1 218	9 900	1.3
Total	**11 969**	**11 956**		**119.0**

Note that the current estimated water demand was determined with the aid of the WRYM setup as part of the OWAAS study (DWAF, 2010a) and is generally higher than the allocated water requirements.

According to the OWAAS (DWA, 2010a), there is also a considerable amount of uncontrolled irrigation within the Selati River catchment. This irrigation, together with diffuse irrigation along the Olifants and Blyde Rivers are shown in **Table 6.3.**

Table 6.3: Diffuse irrigation requirements and use: Lower Olifants Sub-Catchment

Sub-Area	Irrigated area (ha)	Water requirement (million m^3/a)	Actual water use (million m^3/a)
Olifants/Selati (B72)	5 549	51.1	35.3
Blyde River (B60)	2 934	23.7	6.3
Olifants (B73)	50	0.4	0.3
Olifants (B71)	2 313	35.9	1.4
Total	**10 846**	**111.1**	**43.3**

The total irrigation requirements, adjusted to a 98% assurance, is summarised in **Table 6.4.**

Table 6.4: Summary of irrigation demands: Lower Olifants Sub-Catchment (Units: million m^3/a)

Sub area	Controlled irrigation requirement		Diffuse irrigation (use)	Total irrigation requirement
	Average	1 in 50		
Olifants/Selati (B72)	1.3	1.2	35.3	36.5
Blyde River (B60)	115.7	106.4	6.3	112.7
Olifants (B73)	2.0	1.8	0.3	2.1
Olifants (B71)	0.0	0.0	1.4	1.4
Total	**118.0**	**108.8**	**46.3**	**155.7**

6.1.4 Mining Water Requirements

There is intense mining in and around Phalaborwa, consisting mostly of Copper and Phosphates. These mines have large water requirements which are currently supplied from the Phalaborwa Barrage on the Olifants River, supplemented from the Blyderivierpoort Dam if required. There is also a small gold mine located near Gravelotte that obtains its water from the Groot Letaba River catchment. The mining water requirements are summarised in **Table 6.5.**

Table 6.5: Mining water requirements in the Lower Olifants River Catchment

Mine	Water Requirements
Phalaborwa Mining	10
Foskor	19
Murchison Mine	3
Total	**32**

6.1.5 Industrial Water Requirements

There is no significant industrial water use in the Lower Olifants Sub-Catchment.

6.1.6 Forestry

There are significant areas of afforestation in the upper reach of the Blyde River catchment. The total estimated area is given in the OWAAS report (DWA, 20010a) as 186 km^2 with a streamflow reduction of 18.9 million m^3/a. This streamflow reduction has been taken into account when estimating the available yield.

6.1.7 Ecological Water requirements

Ecological water requirements are dealt with in detail in a separate report but it is important to note that the current operating rule is to allow a minimum flow of 0.5 m^3/s except in the months of September and October in which the minimum flow requirement is 1.0 m^3/s. This flow is monitored at the Mamba weir in the Kruger National Park.

6.2 FUTURE WATER REQUIREMENTS

6.2.1 Urban water use

The urban water use is dominated by Phalaborwa with its current requirement of 24.5 million m^3/a. The water supply to this town is managed by Lepelle Northern Water and in the absence of any detailed study of the future water requirements of this town, the estimates made by Lepelle Water (up to 2015) have been used. Thereafter (2015 to 2035), growth rates typical of the remainder of the Olifants River catchment have been used.

Table 6.6 summarises the current and future water requirements of the urban sector in the Lower Olifants River sub-catchment.

Table 6.6: High and low growth scenarios for urban water requirements

Town	Water requirement	2035	
	2010	High	Low
Phalaborwa	24.5	38.2	34.2
Hoedspruit	2.3	3.3	2.9
Total	**26.8**	**41.5**	**37.1**

Figure 6.1 illustrates the high and low growth scenarios in urban water requirements graphically.

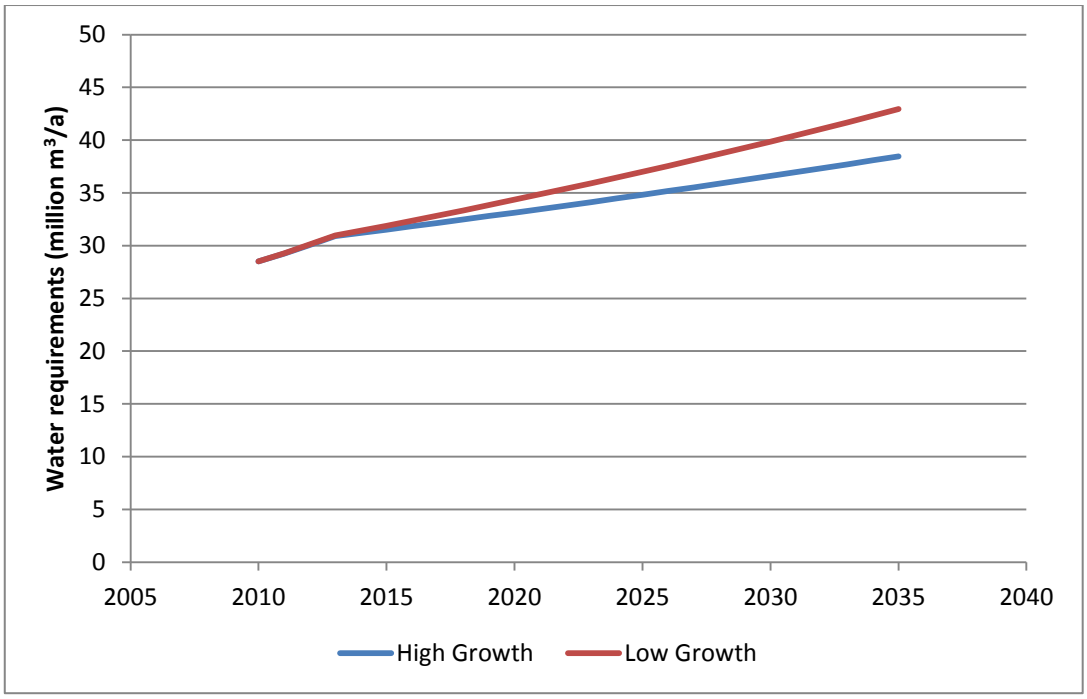

Figure 6.1: Growth in urban water requirements in the Lower Olifants River Sub-Catchment

6.2.2 Growth in rural water requirements

The growth in rural water requirements has been assumed to be the same as that in Sekukhune. Based on this, the rural water requirements could grow from the current 2.7 million m^3/a to between 5.3 and 5.6 million m^3/a. See **Figure 6.2.**

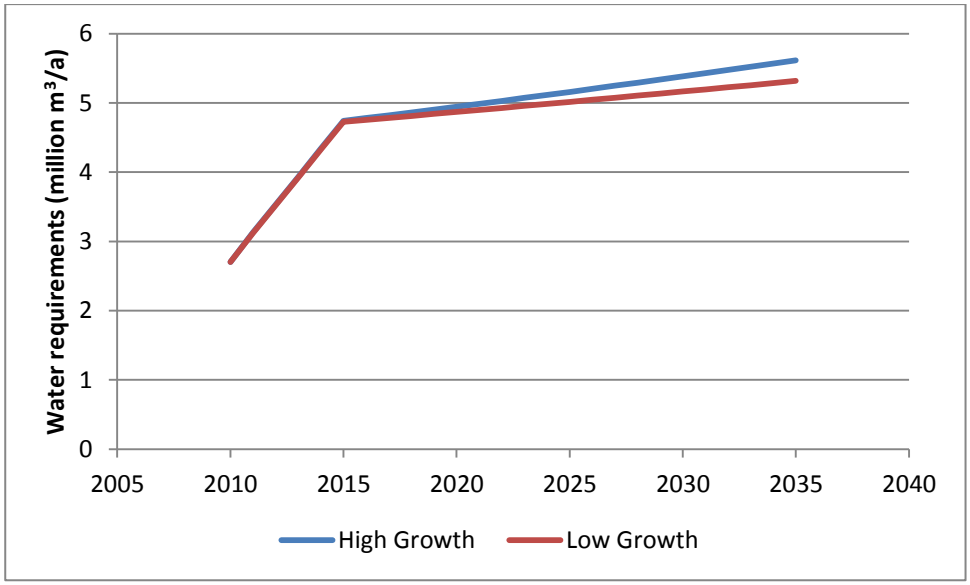

Figure 6.2: Growth in rural water requirements

6.2.3 Other water use

No growth in water requirements is expected in the irrigation and mining sectors. There is however currently a feasibility study into a bio-fuels plant to be located at Hoedspruit in progress, but the water requirements of this plant are not known at this stage and no application has been made as yet for a water use licence.

6.3 WATER RESOURCE

6.3.1 Yield from dams

There are currently only two large dams in the Lower Olifants River Sub-Catchment, namely the Blyderivierpoort Dam and the Ohrigstad Dam, both located in the Blyde River catchment. The yields of these dams are given in **Table 6.7.**

The Phalaborwa Barrage, while limited in capacity and severely silted up, also has a significant yield due to the largely unregulated flow from the Spekboom catchment and the catchment downstream of the De Hoop Dam. Also, any spills from the Flag Boshielo and Blyderivierpoort dams flow into the Phalaborwa Barrage. The yield available at the Barrage has not been determined before and was therefore determined as part of this Reconciliation Strategy. The assumption was made that the yield available from the Barrage is ***after*** supplying a minimum flow of 0.5 m^3/s at the Mamba weir within the Kruger National Park, except in the September and October when the minimum flow requirement is 1.0 m^3/s. This is an interim operating rule that has been agreed to at the Olifants River Forum and applies until a rule to implement the full Reserve has been agreed upon.

Table 6.7: Yield from major dams

Dam	Natural MAR (million m^3/a)	Full supply capacity (million m^3)	Historical yield (million m^3/a)	1 in 50 year yield (million m^3/a)
Blyderivierpoort	354	54.6	110	130
Ohrigstad • Alone • System	16.0	13.2	 9.9 18.9	 20
Phalaborwa Barrage	1 807	5.7	42	49
Total				**199**

6.3.2 Yield from farm dams and run-of-river

The yield from farm dams and run-of-river (to meet abstractions that are taking place) was estimated to be 44 million m^3/a. A breakdown of this resource into sub-areas within the Lower Olifants sub-catchment is given in **Table 6.8** together with an indication of the assurance of supply associated with this resource.

Table 6.8: Diffuse resources in the Lower Olifants River Sub-Catchment

Sub area	Irrigation (million m^3/a)	Assurance
Olifants (B71)	2	Very low
Olifants/Selati (B72)	35	Low
Blyde River (B60)	6	Very low
Olifants (B73)	0	N/A
Total	**43**	

6.3.3 Groundwater

It is assumed that rural water requirements are met from groundwater. The currently groundwater resource is therefore approximately 3 million m^3/a.

6.3.4 Transfers in

There are a few small transfers into the Lower Olifants River catchment from the Groot Letaba River catchment to rural settlements located in the Selati River catchment (near the northern boundary of the Olifants catchment), as well as a transfer of 1.8 million m^3/a to the Murchison Gold Mine located near the town of Gravelotte. The total transfer is approximately 3.1 million m^3/a. This is unlikely to grow in future due to the stressed nature of the source catchment.

6.3.5 Summary of water resource

A summary of the water resources of the Lower Olifants River sub-catchment is given in **Table 6.9.**

Table 6.9: Summary of the water resource of the Middle Olifants River catchment

Source	Yield Available (million m^3/a)
Major dams	199
Diffuse (farm dams and run-of-river abstraction)	43
Transfers in • To mines • To rural users	2 1
Groundwater	3
Total	**248**

6.4 WATER BALANCE

6.4.1 Current

Table 6.10 presents the current water balance of the Lower Olifants River catchment.

Table 6.10: Current Water Balance within the Lower Olifants River Sub-Catchment (Unites are million m^3/a)

	Major dams	Diffuse source	Transfers In	Ground water	Total
Water Resource	199	43	3	3	248
Water requirements					
• Urban	28				28
• Rural			1	3	4
• Mining	29		2		31
• Irrigation	109	43			152
Sub-total	166	43	3	3	215
Losses					(5)
Balance	**33**	**0**	**0**	**0**	**28**

The water balance of the Lower Olifants sub-catchment indicates a significant surplus. This surplus is however based on current water abstractions by Lepelle Northern Water of about 57 million m^3/a and not the allocation of 87 million m^3/a. Of this allocation, 36 million m^3/a is from the Olifants while the remaining 51 million m^3/a is from the Blyderivierpoort Dam. Lepelle Northern Water are reluctant to utilise water from the Blyderivierpoort Dam due to the perception that the losses between this dam and the Phalaborwa Barrage where the water is abstracted are large. Recent detailed studies (DWAF, 2010b) indicate that these losses are small, in the order of 5 to 6 million m^3/a. Provided this system is operated as intended, then the surplus situation should prevail at least until operating rules to implement the ecological Reserve have been formulated and implemented.

The future water balance is shown graphically in **Figure 6.3.**

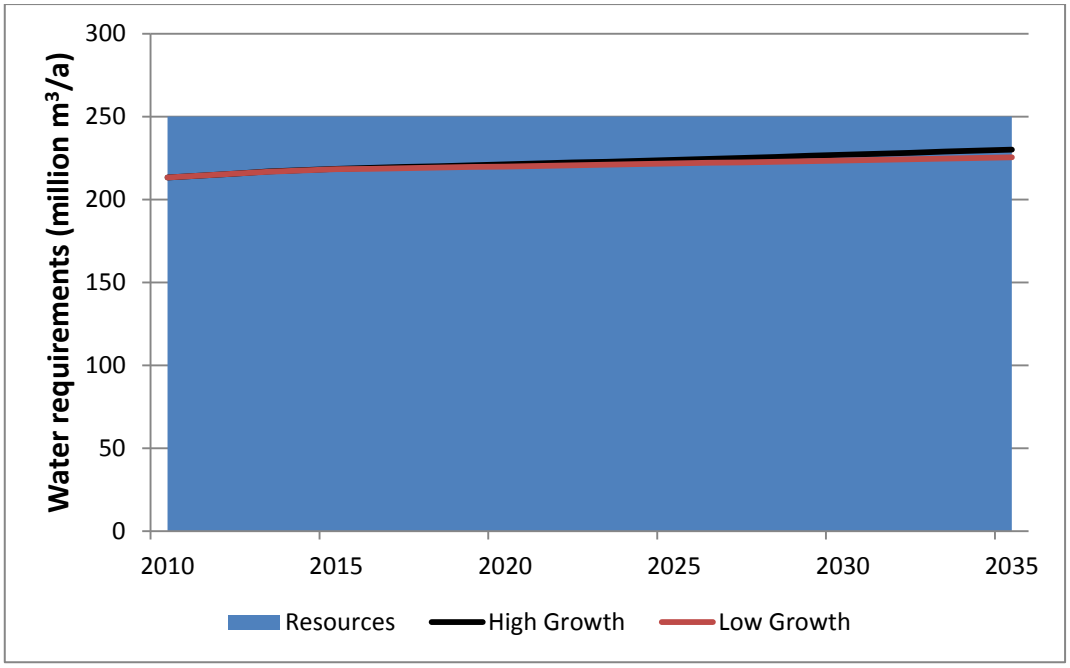

Figure 6.3: Water Balance of the Lower Olifants River Catchment

7. WATER BALANCE FOR THE ENTIRE OLIFANTS RIVER CATCHMENT

Sections 4, 5 and 6 presented water balances for the Upper, Middle and Lower Olifants River catchment. This section presents the water balance for the whole study area, which includes the future water demands of Polokwane and Mokopane. This section presents the water requirements, water resource and water balance for the whole study area.

Table 7.1 summarises the water requirements for the whole study area.

Table 7.1: Summary of water requirements (units: million m^3/a)

Sub-catchment	Power Generation	Industrial	Urban	Rural	Mining	Irrigation	Total
Upper	228	9	93	4	26	249	609
Middle	0	0	56	22	28	81	187
Lower	0	0	29	3	32	156	220
Total	**228**	**9**	**178**	**29**	**86**	**486**	**1016**

The water resource of the Olifants River catchment is summarised in **Table 7.2.**

Table 7.2: Summary of the water resources of the Olifants River catchment (units: million m^3/a)

Sub-Catchment	Major dams	Diffuse source	Transfers In	Other sources	Ground water	Total
Upper	272	104	230	4	20	630
Middle	110	32	8	0	35	185
Lower	199	43	3	0	3	248
Total	**581**	**179**	**241**	**4**	**58**	**1063**

The current water balance (without De Hoop Dam) is shown in **Table 7.3.**

Table 7.3: Current Water Balance (units: million m^3/a)

Sub-catchment	Water requirement	Water resource	Losses	Comp. Release	Water Balance
Upper	609	630	0		21
Middle	187	185	0	(19)	(21)
Lower	220	248	(5)		23
Total	1016	1063	(5)	(19)	**23**

The future situation for the whole study area, assuming no interventions, is shown in **Figure 7.1.**

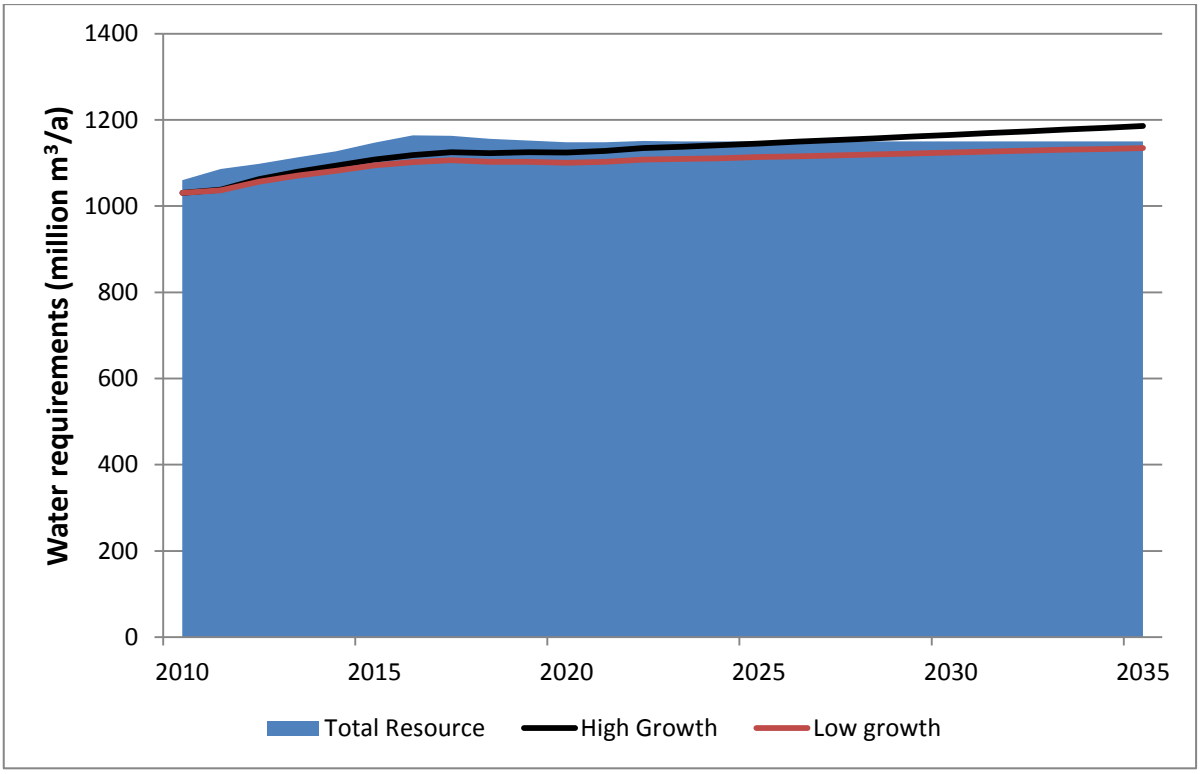

Figure 7.1: Water Balance of the Olifants River catchment

8. DEVELOPMENT OF RECONCILIATION STRATEGIES

The water balance for the Olifants River catchment as a whole indicates a small surplus in 2010, which change to a deficit in 2035. However, this balance does not take into account the Ecological Reserve requirements. Preliminary estimates of the Reserve requirements based on the Internal Strategic Perspective (DWAF, 2004) indicated a reduction in system yield of about 200 million m^3/a at an assurance of 98%. Part of this Reserve requirement is already factored into the water balances presented in this report in that the yield of the De Hoop Dam (66 million m^3/a) is after allowing for the Reserve.

A more detailed evaluation of the impact of the ecological flow requirements has been carried out as part of this Olifants Reconciliation Strategy. This is reported on in detail in the Reserve Requirement Scenarios and Scheme Yields Report which is one of the deliverables of this Reconciliation Strategy Study, but this detailed assessment can be summarised as follows:

- Reduction in yield due to ecological Reserve with 2002 EMC: 183 million m^3/a.
- Reduction in yield due to ecological Reserve with revised EMC: 220 million m^3/a

Taking into account that approximately 30 million m^3/a of the Reserve is already assumed to be supplied from the De Hoop Dam, the impact of the Reserve (with the revised EMC) is approximately 190 million m^3/a.

Reconciliation strategies which are being considered are:

- Implementing the Reserve partially with acceptance of the associated risk
- Water conservation and demand management
- Water re-use and recycling
- Changing (and controlling) the assurance of supply
- Compulsory licensing
- Water trading
- Groundwater development
- Importing of treated effluent from the East Rand
- Removal of Invasive Alien Plants
- Raising of the Blyderivierpoort Dam
- A new dam at one of various sites on the Lower Olifants River
- Importing water from Vaal Dam

While the above strategies consider the Olifants River catchment as a whole, internal strategies are required to distribute the water that is available within the Olifants River catchment better, i.e. moving water from areas of surplus to areas of deficit. The internal strategies are as follows:

- Gravitate, via a new pipeline, unused water from the Rust De Winter Dam to the northern villages in the Western Highveld.

9. RECOMMENDATIONS

While the water requirements and water resources presented in this report are based on the latest information available, derived from numerous recent hydrological and water resources studies as well as new information that has been sourced during the course of this study, the following uncertainties are noted:

- Water use by irrigators not located within irrigation boards.
- River losses
- Water use by the coal mining sector in the Upper Olifants river catchment

It is recommended that:

- All water use, but especially water use by the irrigation sector, is verified.
- River losses are quantified through detailed hydraulic studies.
- Water use by coal mines is monitored.

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APPENDIX A: Rural Water use

Appendix A-1: Upper Olifants River

Village	Quaternary catchment	Water services category	Population	Water use l/person/day	million m3/a	Full Service
LUKAU	B32F	C	6 949	60	0.152	0.152
A RE AGANENG	B32F	C	3 830	60	0.084	0.084
ELANDSLAAGTE	B32F	C	8 453	60	0.185	0.185
MATHULA	B32F	C	4 043	60	0.089	0.089
TAFELKOP	B32J	C	45 079	60	0.987	0.987
LEEUFONTEIN	B32J	C	7 238	60	0.159	0.159
MOHLALAOTWANE	B32J	C	7 294	60	0.160	0.160
VAN DER MERWES KRAAL	B32J	C	7 868	60	0.172	0.172
SYFERFONTEIN	B32J	D	2 893	25	0.026	0.063
DIKGALAOPENG	B32J	D	1 570	25	0.014	0.034
GROBLERSDAL	B32D	D	2 552	25	0.023	0.056
PAARDENFONTEIN	B32F	D	400	25	0.004	0.009
RONDEBOSCH	B32F	D	1 112	25	0.010	0.024
SEHLAKWANE	B32F	D	2 802	25	0.026	0.061
THABALEBOTO NORTH	B32F	D	757	25	0.007	0.017
THABALEBOTO SOUTH	B32F	D	968	25	0.009	0.021
VLAKFONTEIN	B32F	D	2 520	25	0.023	0.055
ZAAIPLAATS	B32F	D	108	25	0.001	0.002
MOEDING	B32J	D	1 288	25	0.012	0.028
LETEBEJANE	B32J	D	1 149	25	0.010	0.025
MANAPSANE	B32J	D	3 332	25	0.030	0.073
MARBLE HALL	B31J	D	1 554	25	0.014	0.034
MATHUKHUTHELA	B31J	D	1 286	25	0.012	0.028
NTWANE	B32H	D	553	25	0.005	0.012
GREENSIDE	B11G	D	1 563	25	0.014	0.034
PHOENIX	B11F	D	970	25	0.009	0.021
SCHOONGESICHT	B20F	D	4 125	25	0.038	0.090
SPRINGBOK	B11G	D	1 402	25	0.013	0.031
TWEEFONTEIN	B11F	D	1 034	25	0.009	0.023
VAN DYKSDRIF	B11B	D	2 360	25	0.022	0.052
WOLWEKRANS	B20G	D	31 212	25	0.285	0.684
GREENSIDE	B11G	D	1 195	25	0.011	0.026
BANK 2 & 5	B11H	D	1 836	25	0.017	0.040
BLINKPAN	B11B	D	990	25	0.009	0.022
DOUGLAS	B11G	D	1 412	25	0.013	0.031
HENDRINA POWER STATION	B12B	D	542	25	0.005	0.012
HOPE VILLAGE	B11B	D	990	25	0.009	0.022

Village	Quaternary catchment	Water services category	Population	Water use l/person/day	million m3/a	Full Service
KOMATI	B11B	D	301	25	0.003	0.007
KOORNFONTEIN	B11B	D	2 119	25	0.019	0.046
RIETKUIL	B12B	D	2 824	25	0.026	0.062
VLAKLAAGTE	B32J	E	959	10	0.004	0.021
AQUAVILLE	B32H	E	182	10	0.001	0.004
KHATHAZWENI	B32H	E	292	10	0.001	0.006
MASOYENG	B32H	E	191	10	0.001	0.004
MICHIPISANE	B31H	E	46	10	0.000	0.001
PULENG A	B31H	E	359	10	0.001	0.008
PULENG B	B31H	E	212	10	0.001	0.005
SELEBANENG	B31H	E	379	10	0.001	0.008
BLACKHILL	B11G	E	144	10	0.001	0.003
COALVILLE	B11F	E	583	10	0.002	0.013
KLIPPOORTJIE	B11F	E	72	10	0.000	0.002
NEW LARGO	B20G	E	392	10	0.001	0.009
SAAIWATER	B11F	E	487	10	0.002	0.011
VAN DYKS	B11B	E	585	10	0.002	0.013
WITBANK NU	B11K	E	619	10	0.002	0.014
FRISCHGEWAAGD	B11G	E	285	10	0.001	0.006
ARNOT POWER STATION	B12B	E	414	10	0.002	0.009
DRIEHOEK	B12B	E	120	10	0.000	0.003
EIKEBOOM	B12C	E	145	10	0.001	0.003
BRONKHORSTSPRUIT FARMS A	B20C	F	1 315	10	0.005	0.029
BRONKHORSTSPRUIT FARMS B	B20C	F	2 491	10	0.009	0.055

Appendix A-2: Rural water use in the Middle Olifants River

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
GA-NCHABELENG	B52E	C	7 933	60	0.174	0.174
GA-NKWANA	B52E	C	4 900	60	0.107	0.107
JAGLUST	B52E	C	5 183	60	0.114	0.114
MOHLALETSI	B52E	C	6 376	60	0.140	0.140
MOHLALETSI EXT	B52E	C	5 284	60	0.116	0.116
MPHANAMA	B52B	C	10 013	60	0.219	0.219
SESESEHU	B52E	C	4 909	60	0.108	0.108
MONSTERLUS TOWN	B41E	C	9 175	60	0.201	0.201
SEPHAKU	B51B	C	7 779	60	0.170	0.170
STERKFONTEIN	B51B	C	6 993	60	0.153	0.153
ELANDSKRAAL	B51E	C	14 815	60	0.324	0.324
ALVERTON	B41K	C	9 017	60	0.197	0.197
BOTHASHOEK	B41K	C	9 282	60	0.203	0.203
DRIEKOP	B41J	C	6 298	60	0.138	0.138
GA-MAESENG	B41J	C	5 032	60	0.110	0.110
GA-MANOKE	B41J	C	4 461	60	0.098	0.098
GA-MASHA	B41H	C	5 978	60	0.131	0.131
GA-MOTODI	B41H	C	4 913	60	0.108	0.108
GA-RANTHO	B41H	C	4 872	60	0.107	0.107
KGAUTSWANA	B41H	C	6 616	60	0.145	0.145
MALOKELA	B41H	C	6 403	60	0.140	0.140
MAMPURU	B41H	C	8 905	60	0.195	0.195
MAPHOPHA	B41H	C	5 309	60	0.116	0.116
PRAKTISEER	B41K	C	11 992	60	0.263	0.263
BATAU	B41K	C	7 369	60	0.161	0.161
GA MOLAPO	B52D	C	5 741	60	0.126	0.126
PHASWANA	B52D	C	5 051	60	0.111	0.111
DITHABANENG	B52D	C	4 556	60	0.100	0.100
GA-RAKGWATHA	B51G	C	6 628	60	0.145	0.145
KHURENG	B51E	C	6 308	60	0.138	0.138
LEBOWAKGOMO TOWNSHIP	B52D	C	6 325	60	0.139	0.139
MADISA DI TORO	B52D	C	4 741	60	0.104	0.104
MAGATLE	B51G	C	5 792	60	0.127	0.127
MAKWENG	B51G	C	4 708	60	0.103	0.103
MASITE	B52G	C	4 261	60	0.093	0.093
MIDDELKOP	B52D	C	6 156	60	0.135	0.135
MOGOTO	B51E	C	18 587	60	0.407	0.407
MOLETLANE	B51E	C	13 266	60	0.291	0.291

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
SELETENG	B52D	C	13 452	60	0.295	0.295
GA PHAHLA	B51H	C	6 510	60	0.143	0.143
GA MARISHANE	B51H	C	7 358	60	0.161	0.161
GA MOLOI	B51H	C	5 229	60	0.115	0.115
GLEN COWIE	B51H	C	6 085	60	0.133	0.133
JANE FURSE	B52B	C	22 374	60	0.490	0.490
KOTUPU	B52B	C	4 937	60	0.108	0.108
MAKGERU	B41H	C	4 744	60	0.104	0.104
MANGANENG	B52B	C	5 568	60	0.122	0.122
NGWARITSI	B41E	C	5 480	60	0.120	0.120
PHOKWANE	B51H	C	15 195	60	0.333	0.333
SEKWATI	B51H	C	12 603	60	0.276	0.276
SCHOONOORD	B51H	C	13 888	60	0.304	0.304
SEPANAPUDI	B52A	D	1 815	25	0.017	0.040
TAUNG	B41K	D	1 201	25	0.011	0.026
GA-MAESELA	B52E	D	1 615	25	0.015	0.035
GA-MAESELA	B52E	D	1 129	25	0.010	0.025
GA-MANOTWANE	B52J	D	1 668	25	0.015	0.037
GA-MASHA	B41H	D	2 065	25	0.019	0.045
GA-MMELA	B41H	D	935	25	0.009	0.020
GA-NKWANA EXT	B41H	D	1 361	25	0.012	0.030
GA-RADINGWANA	B52B	D	2 500	25	0.023	0.055
GA-SELEPE	B52J	D	3 351	25	0.031	0.073
GA-SEROKA	B52E	D	2 615	25	0.024	0.057
LEDINGWE	B52E	D	802	25	0.007	0.018
LERAJANA	B52E	D	1 050	25	0.010	0.023
MABOKOTSWANE	B52E	D	1 343	25	0.012	0.029
MAESELA-MAHLABAPHOOKO	B52E	D	747	25	0.007	0.016
MAHLABENG	B52E	D	723	25	0.007	0.016
MAKOPA	B52E	D	452	25	0.004	0.010
MALOMANYE	B52G	D	805	25	0.007	0.018
MANOGE	B52E	D	1 178	25	0.011	0.026
MAPULANENG	B52E	D	1 936	25	0.018	0.042
MAROPENG	B52E	D	681	25	0.006	0.015
MASEHLENG	B52E	D	765	25	0.007	0.017
MOEIJELIJK	B52E	D	449	25	0.004	0.010
MOGABANE	B52E	D	527	25	0.005	0.012
MOHLALETSI EXT	B52E	D	1 228	25	0.011	0.027
MONAMETSI	B52J	D	549	25	0.005	0.012

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
MPHAANENG	B52G	D	663	25	0.006	0.015
PASCHASKRAAL	B52E	D	611	25	0.006	0.013
PELANGWE	B52E	D	927	25	0.008	0.020
PHAGENG	B52B	D	595	25	0.005	0.013
ROSTOK	B52B	D	897	25	0.008	0.020
TSHIBENG	B52B	D	1 483	25	0.014	0.032
ATOK PLATINAMYN RESIDENSIEEL	B52B	D	456	25	0.004	0.010
BB-KLOOF	B52B	D	1 038	25	0.009	0.023
DINDELA	B51A	D	2 397	25	0.022	0.052
GA-PHETLA	B41E	D	578	25	0.005	0.013
HLOGOTLOU	B41D	D	1 198	25	0.011	0.026
HOLNEK	B41D	D	449	25	0.004	0.010
JEIJE	B41D	D	3 517	25	0.032	0.077
JERUSALEM	B51A	D	2 648	25	0.024	0.058
KOSINI	B41D	D	980	25	0.009	0.021
LEGOLANENG	B51B	D	2 097	25	0.019	0.046
MAGUKUBJANE	B41E	D	802	25	0.007	0.018
MMOTWANENG	B41E	D	1 501	25	0.014	0.033
MOGAUNG	B41E	D	2 281	25	0.021	0.050
MOTSEPHIRI	B41E	D	1 968	25	0.018	0.043
NKOSINI	B41E	D	2 640	25	0.024	0.058
ROOSSENEKAL	B41C	D	370	25	0.003	0.008
TALANE	B41D	D	930	25	0.008	0.020
DITHOLONG	B51B	D	2 308	25	0.021	0.051
DOORNPOORT	B51E	D	2 406	25	0.022	0.053
GA-MASHA	B41H	D	1 294	25	0.012	0.028
MABITSI A	B51B	D	2 174	25	0.020	0.048
MABITSI B	B51B	D	678	25	0.006	0.015
MAKGATLE	B51B	D	670	25	0.006	0.015
MAKGATLE A	B51B	D	1 182	25	0.011	0.026
MAKGATLE B	B51B	D	1 415	25	0.013	0.031
MAMPHOKGO NORTH	B51B	D	2 318	25	0.021	0.051
MAMPHOKGO SOUTH	B51B	D	3 278	25	0.030	0.072
MANOTELWANENG	B51A	D	603	25	0.006	0.013
MMOTWANENG	B41E	D	2 132	25	0.019	0.047
MOGALATSANA	B41E	D	1 202	25	0.011	0.026
MOGANYAKA NORTH	B41E	D	2 098	25	0.019	0.046
MOGANYAKA SOUTH	B41E	D	2 138	25	0.020	0.047
MOHLOTSHI	B51C	D	959	25	0.009	0.021

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
MOOIHOEK	B51C	D	2 028	25	0.019	0.044
MOOMANE SOUTH	B51C	D	1 577	25	0.014	0.035
MOTSELEOPE	B51C	D	935	25	0.009	0.020
NGWALEMONG A	B51B	D	1 722	25	0.016	0.038
NGWALEMONG B	B51B	D	692	25	0.006	0.015
PHETWANE	B51C	D	846	25	0.008	0.019
SERITENG	B51B	D	1 843	25	0.017	0.040
TOMPI SELEKA AGRI COLLEGE	B51B	D	450	25	0.004	0.010
TSIMANYANE	B51A	D	991	25	0.009	0.022
VAALBANK	B51B	D	1 320	25	0.012	0.029
WELTEVREDE	B51B	D	1 463	25	0.013	0.032
CROSSING	B41J	D	986	25	0.009	0.022
DITHABANENG	B52D	D	2 122	25	0.019	0.046
GA MAAPEA	B41H	D	1 344	25	0.012	0.029
GA MAEPA	B41H	D	1 725	25	0.016	0.038
GA MAHLOKWANE	B41H	D	1 510	25	0.014	0.033
GA MAKHWAE	B41H	D	731	25	0.007	0.016
GA MAKOFANE	B41H	D	3 238	25	0.030	0.071
GA MALEKANA	B41H	D	3 656	25	0.033	0.080
GA MMAMOGOLO	B41H	D	729	25	0.007	0.016
GA RIBA	B41J	D	2 833	25	0.026	0.062
GA SEPEKE	B41J	D	915	25	0.008	0.020
KOTOLLO	B41J	D	553	25	0.005	0.012
LEPELLE	B41J	D	604	25	0.006	0.013
MABOTSHA	B41K	D	4 011	25	0.037	0.088
MADIKANE	B41K	D	498	25	0.005	0.011
MAHLASHI	B41K	D	1 575	25	0.014	0.034
MAKGALANE	B41K	D	768	25	0.007	0.017
MAKGOPA	B41K	D	483	25	0.004	0.011
MAKGWARENG	B41K	D	2 137	25	0.020	0.047
MALAENENG	B41K	D	980	25	0.009	0.021
MAMPURU EXT	B41K	D	1 448	25	0.013	0.032
MANTOPI	B41K	D	1 212	25	0.011	0.027
MANYAKA	B41K	D	1 500	25	0.014	0.033
MAPODILE	B41K	D	2 090	25	0.019	0.046
MARARENG	B41K	D	1 012	25	0.009	0.022
MARETLWANENG	B41K	D	824	25	0.008	0.018
MASAKENG	B41K	D	1 811	25	0.017	0.040
MASEVEN	B41K	D	2 098	25	0.019	0.046

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
MASHIBISHANE	B41K	D	1 156	25	0.011	0.025
MATOKOMANE	B41K	D	596	25	0.005	0.013
MATSAKANE	B41K	D	491	25	0.004	0.011
MATSIRI	B41K	D	4 210	25	0.038	0.092
MOHLOPE	B41K	D	1 166	25	0.011	0.026
MOKOBOLA	B41K	D	2 821	25	0.026	0.062
MONTWANENG	B41K	D	2 111	25	0.019	0.046
MOOIHOEK	B41K	D	3 058	25	0.028	0.067
MOPHALEMA	B41K	D	3 794	25	0.035	0.083
MOTLAILANE	B41K	D	543	25	0.005	0.012
MOTSHANA	B41K	D	3 052	25	0.028	0.067
PHIRING	B41K	D	1 014	25	0.009	0.022
PHIRING EXT 1	B41K	D	597	25	0.005	0.013
PIDIMA	B41K	D	1 150	25	0.010	0.025
RADIMPSHE	B41K	D	520	25	0.005	0.011
SAMCOR RESIDENTS	B41K	D	1 595	25	0.015	0.035
SEHLAKU	B41J	D	1 156	25	0.011	0.025
SEHUNYANE	B41J	D	1 599	25	0.015	0.035
SERORONG	B41J	D	1 751	25	0.016	0.038
STAS	B41J	D	2 239	25	0.020	0.049
TAUNG	B41K	D	2 352	25	0.021	0.052
TAUNG EXT 1	B41K	D	239	25	0.002	0.005
TOKAKGOMO A	B41K	D	3 004	25	0.027	0.066
TOKAKGOMO EXT	B41K	D	779	25	0.007	0.017
TWICKENHAM	B41K	D	2 088	25	0.019	0.046
THUSANANG	B41K	D	458	25	0.004	0.010
BOLAHLAKGOMO	B51E	D	3 576	25	0.033	0.078
BOOMPLAAS	B52D	D	3 695	25	0.034	0.081
BYLDRIFT	B51G	D	2 185	25	0.020	0.048
DROOGTE	B51E	D	3 586	25	0.033	0.079
GA MAKGOBA	B51E	D	2 031	25	0.019	0.044
GA MATHABATHA	B51E	D	2 745	25	0.025	0.060
GA MMAMOGWASA	B51E	D	2 713	25	0.025	0.059
GROOTFONTEIN	B51E	D	1 285	25	0.012	0.028
HWELERENG	B52A	D	1 552	25	0.014	0.034
HWELESANENG	B52G	D	1 839	25	0.017	0.040
KGAPHANADI	B52G	D	956	25	0.009	0.021
KGWARIPE	B51E	D	1 855	25	0.017	0.041
KLIPHEUVEL	B51E	D	1 954	25	0.018	0.043
LEBOWAKGOMO	B52D	D	784	25	0.007	0.017

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
BUSINESS						
LEDWABA	B52A	D	2 285	25	0.021	0.050
LEKURUNG	B52D	D	3 351	25	0.031	0.073
LENTING	B52A	D	2 060	25	0.019	0.045
LESETSI	B52E	D	809	25	0.007	0.018
MABOKOTSWANE	B52E	D	527	25	0.005	0.012
MADIKELENG	B52E	D	1 066	25	0.010	0.023
MADISALEOLO	B52E	D	3 050	25	0.028	0.067
MAKURUNG	B52D	D	3 427	25	0.031	0.075
MAKUSWANENG	B52E	D	3 842	25	0.035	0.084
MAPATJAKENG	B51G	D	1 651	25	0.015	0.036
MARALALENG	B51G	D	664	25	0.006	0.015
MARULANENG	B52A	D	2 326	25	0.021	0.051
MASESELENG	B52A	D	835	25	0.008	0.018
MATIBELA	B51G	D	1 538	25	0.014	0.034
MATOME	B51G	D	2 874	25	0.026	0.063
MEHLARENG	B51G	D	3 186	25	0.029	0.070
MMAKOTSE	B52A	D	1 578	25	0.014	0.035
MMASHADI	B52A	D	1 164	25	0.011	0.025
MOLAPO MATEBELE	B52A	D	549	25	0.005	0.012
MOOIPLAAS	B52B	D	648	25	0.006	0.014
MOROTSE	B52A	D	1 030	25	0.009	0.023
MOTANTANYANA	B52A	D	739	25	0.007	0.016
MOTSERERENG	B52A	D	709	25	0.006	0.016
NAAUWPOORT	B52G	D	430	25	0.004	0.009
PATOGA	B52G	D	1 370	25	0.013	0.030
PHOSIRI	B52D	D	684	25	0.006	0.015
RAFIRI	B52D	D	3 118	25	0.028	0.068
ROOIBOSBULT	B51G	D	492	25	0.004	0.011
SEKGOPHOKGOPHONG	B51G	D	3 000	25	0.027	0.066
SEROBANENG	B52G	D	1 094	25	0.010	0.024
SESWIKANENG	B52A	D	589	25	0.005	0.013
THAMAGANE	B52D	D	863	25	0.008	0.019
TOOSENG	B52A	D	2 611	25	0.024	0.057
GA MAMPANA	B51C	D	2 180	25	0.020	0.048
GA MOKADI	B51C	D	701	25	0.006	0.015
HWAFENG	B51C	D	1 832	25	0.017	0.040
MABINTWANE	B51C	D	1 888	25	0.017	0.041
MAHLOLWANENG	B51C	D	1 098	25	0.010	0.024
MAKHUTSHO	B51C	D	1 860	25	0.017	0.041

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
RAMPHELANE	B51C	D	1 955	25	0.018	0.043
DINOTSI	B52E	D	1 041	25	0.009	0.023
DIPHAGANE	B52E	D	3 223	25	0.029	0.071
EENZAAM	B41E	D	2 935	25	0.027	0.064
GA-MACHACHA	B52A	D	478	25	0.004	0.010
GA MAILA MAPITSANE	B52A	D	1 234	25	0.011	0.027
GA MAILA SEGOLO	B52A	D	2 853	25	0.026	0.062
GA MALAKA	B51H	D	1 858	25	0.017	0.041
GA MASHABELA	B51H	D	4 222	25	0.039	0.092
GA MOGASHOA MANAMANE	B51H	D	3 463	25	0.032	0.076
GA MOGASHOA SENKGAPUDI	B51H	D	3 592	25	0.033	0.079
GA MOHLALA	B51H	D	1 044	25	0.010	0.023
GA-MOLEPANE	B51H	D	3 163	25	0.029	0.069
GA RATAU	B51H	D	4 051	25	0.037	0.089
GA SEKELE	B51H	D	559	25	0.005	0.012
GA TISANE	B51H	D	924	25	0.008	0.020
GLEN COWIE	B51H	D	1 951	25	0.018	0.043
GLEN COWIE EXT 2	B51H	D	691	25	0.006	0.015
GOODHOPE	B51H	D	592	25	0.005	0.013
KGARUTHUTHU	B51H	D	541	25	0.005	0.012
KOME	B51C	D	1 088	25	0.010	0.024
LEGOTONG	B51C	D	1 053	25	0.010	0.023
LEHLAKONG	B51H	D	1 806	25	0.016	0.040
LEKOROKORWANENG	B41K	D	496	25	0.005	0.011
LOBETHAL	B41K	D	800	25	0.007	0.018
MADIBANENG	B52B	D	3 516	25	0.032	0.077
MALEGALE	B52B	D	1 630	25	0.015	0.036
MALOPE	B51G	D	1 118	25	0.010	0.024
MANGINENG	B51G	D	721	25	0.007	0.016
MANGOANYANE	B51G	D	681	25	0.006	0.015
MANOTOU	B51G	D	472	25	0.004	0.010
MANTLHENYANE	B51G	D	293	25	0.003	0.006
MAOLOLO	B51G	D	574	25	0.005	0.013
MARAGANENG	B51C	D	476	25	0.004	0.010
MARE	B41E	D	1 199	25	0.011	0.026
MARULANENG	B52A	D	3 845	25	0.035	0.084
MASANTENG	B51C	D	1 303	25	0.012	0.029
MASERUMULE PARK	B51C	D	2 841	25	0.026	0.062
MASESHEGWANE	B51C	D	1 539	25	0.014	0.034

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
MASHEHLANENG	B51C	D	1 467	25	0.013	0.032
MASITE	B52G	D	3 171	25	0.029	0.069
MATHAPISA	B51C	D	944	25	0.009	0.021
MATHIBENG	B52B	D	993	25	0.009	0.022
MATLAKATLE	B51H	D	2 607	25	0.024	0.057
MMAKGWABE	B51C	D	1 310	25	0.012	0.029
MMATSEKELE	B51H	D	181	25	0.002	0.004
MODIKETSI	B51H	D	1 692	25	0.015	0.037
MOGALADI	B51C	D	3 339	25	0.030	0.073
MOGALADI EXT 3	B51C	D	2 365	25	0.022	0.052
MOGODI	B51C	D	1 171	25	0.011	0.026
MOGORWANE	B51C	D	559	25	0.005	0.012
MOHLAREKOMA	B51H	D	3 101	25	0.028	0.068
MOHLODING	B51H	D	1 395	25	0.013	0.031
MOHWELERE	B51H	D	2 093	25	0.019	0.046
MOKWETE	B51H	D	2 312	25	0.021	0.051
MOLAPONG	B51H	D	474	25	0.004	0.010
MOLEBELEDI	B51H	D	1 156	25	0.011	0.025
MOOMANE NORTH	B51H	D	481	25	0.004	0.011
MORIPANE	B51H	D	561	25	0.005	0.012
MOSWANYANENG	B51C	D	879	25	0.008	0.019
PATANTSWANE	B51H	D	1 930	25	0.018	0.042
PATANTSWANE B	B51H	D	1 110	25	0.010	0.024
PHUSHULANG	B51H	D	583	25	0.005	0.013
SEHUSWANE	B51C	D	631	25	0.006	0.014
SEMAHLAKOLE	B51C	D	535	25	0.005	0.012
SERAGENG	B51C	D	1 633	25	0.015	0.036
STOKING	B51C	D	1 256	25	0.011	0.028
THABAMPSHE	B51C	D	4 157	25	0.038	0.091
THABANAPITSI	B51C	D	1 430	25	0.013	0.031
THABENG	B51C	D	816	25	0.007	0.018
THOTO	B51H	D	3 387	25	0.031	0.074
TIKATHON	B51H	D	769	25	0.007	0.017
TSOPANENG	B51H	D	527	25	0.005	0.012
TSWAING	B52D	D	836	25	0.008	0.018
VLAKPLAAS	B52D	D	400	25	0.004	0.009
BOTSHABELO	B52D	D	297	25	0.003	0.007
KLIP	B52D	D	528	25	0.005	0.012
KROKODILHEUVEL	B52D	D	1 837	25	0.017	0.040
HENDRIKSDAL	B42B	D	12 200	25	0.111	0.267

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
UITKYK	B51H	E	199	25	0.002	0.004
FORONG	B52B	E	170	60	0.004	0.004
GA-MOKGOTHO	B52B	E	350	60	0.008	0.008
LEKGWARENG	B52B	E	57	60	0.001	0.001
MOSOTSI	B52B	E	232	60	0.005	0.005
SENTLHANE	B52B	E	99	60	0.002	0.002
SENTLHANE EXT	B52B	E	51	60	0.001	0.001
SEOKODIBENG	B52B	E	32	60	0.001	0.001
SHENYANENG	B52B	E	229	60	0.005	0.005
SHUBUSHUBU	B52B	E	237	60	0.005	0.005
TSWERENG	B52B	E	288	25	0.003	0.006
GA-BANENG	B52B	E	368	25	0.003	0.008
GA-MATLALA	B52B	E	439	25	0.004	0.010
GA-NCHABELENG EXT	B52B	E	381	25	0.003	0.008
GA-ORIA	B52B	E	430	25	0.004	0.009
MAHLABENG EXT 1	B52B	E	188	25	0.002	0.004
MAKOPA	B52B	E	386	25	0.004	0.008
MAKURWANENG	B52B	E	258	25	0.002	0.006
MALOGENG	B52E	E	82	25	0.001	0.002
MASHEGENG	B52E	E	127	25	0.001	0.003
MASHILAVELE	B52E	E	272	25	0.002	0.006
MASHUNG	B52E	E	92	25	0.001	0.002
MASILABELA	B52E	E	81	10	0.000	0.002
MASWENENG	B52E	E	120	10	0.000	0.003
MMABULELA	B52J	E	401	10	0.001	0.009
MMABULELA EXT 1	B52J	E	70	10	0.000	0.002
MMABULELA EXT 2	B52J	E	82	10	0.000	0.002
MMABULELA EXT 3	B52J	E	28	10	0.000	0.001
MMABULELA EXT 4	B52J	E	53	10	0.000	0.001
MMASIKWE	B52J	E	281	10	0.001	0.006
MONAMETSANA	B52J	E	113	10	0.000	0.002
MOOIPLAAS	B52B	E	198	10	0.001	0.004
PASCHASKRAAL EXT 1	B52B	E	218	10	0.001	0.005
PETSA	B52G	E	51	10	0.000	0.001
RAMALLANE	B52G	E	64	10	0.000	0.001
RAMALLANE EXT	B52G	E	25	10	0.000	0.001
ROSTOK EXT 1	B52G	E	57	10	0.000	0.001
SEFATENG	B52J	E	11	10	0.000	0.000
THABANAYASESO	B52A	E	304	10	0.001	0.007
THOBEHLALE	B52A	E	70	10	0.000	0.002

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
TSIDINTSI	B52A	E	288	10	0.001	0.006
BOTSHABELO	B52A	E	113	10	0.000	0.002
MATILO	B51B	E	489	10	0.002	0.011
GA-MMELA	B51B	E	161	10	0.001	0.004
GORU	B51A	E	298	10	0.001	0.007
HINLOPEN	B51B	E	298	10	0.001	0.007
MAKHUTSO	B51A	E	369	10	0.001	0.008
BALOTSANENG	B41K	E	281	10	0.001	0.006
DIPURURUNG	B41K	E	304	10	0.001	0.007
GA KHOWANE	B41K	E	158	10	0.001	0.003
GA KOBE	B41K	E	141	10	0.001	0.003
BOERBOOMSKRAAL	B42G	E	38	10	0.000	0.001
BUFFELSHOEK - A	B42G	E	38	10	0.000	0.001
BUFFELSHOEK - B	B42G	E	327	10	0.001	0.007
DIFAGATE	B42G	E	37	10	0.000	0.001
DITHABANENG	B52D	E	264	10	0.001	0.006
DITHABANENG	B52D	E	409	10	0.001	0.009
DITHABANENG EXT	B52D	E	133	10	0.000	0.003
DITHOLONG	B51B	E	359	10	0.001	0.008
DITHWAIING	B51B	E	179	10	0.001	0.004
GA MAKGOPA	B51B	E	698	10	0.003	0.015
GA MAKGOPA EXT 1	B51B	E	93	10	0.000	0.002
GA MAPEA	B51B	E	383	10	0.001	0.008
GA MASHABELA	B51B	E	3 620	10	0.013	0.079
GA MOTENE	B51B	E	143	10	0.001	0.003
GA RATAU	B51B	E	364	10	0.001	0.008
HABENG	B51B	E	454	10	0.002	0.010
HLALANEKAHLE	B51B	E	321	10	0.001	0.007
KALKFONTEIN - B	B51B	E	38	10	0.000	0.001
LEFAHLA	B51B	E	217	10	0.001	0.005
LENKWANENG	B51B	E	93	10	0.000	0.002
LEOLO	B51B	E	325	10	0.001	0.007
MAGEMENG	B51B	E	354	10	0.001	0.008
MAGOLEGO	B51B	E	288	10	0.001	0.006
MAKGAKE	B51B	E	255	10	0.001	0.006
MAKGWARENG	B51B	E	383	10	0.001	0.008
MALAENENG EXT 1	B51B	E	78	10	0.000	0.002
MALEKGWARANA	B51B	E	371	10	0.001	0.008
MANTSAKANE	B51B	E	325	10	0.001	0.007
MANTSAKANE EXT 1	B51B	E	67	10	0.000	0.001

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
MAOTSI	B51B	E	75	10	0.000	0.002
MASEHWANENG	B51B	E	100	10	0.000	0.002
MASHAMTHANE	B51B	E	241	10	0.001	0.005
MODIMOLLE	B52E	E	280	10	0.001	0.006
MODUBENG	B52E	E	325	10	0.001	0.007
MOHLAKE	B52E	E	180	10	0.001	0.004
MOSEGO	B52E	E	123	10	0.000	0.003
MOTSEPULANA	B41K	E	123	10	0.000	0.003
NKOSI	B41K	E	93	10	0.000	0.002
PHIRING EXT 2	B41K	E	116	10	0.000	0.003
PRETORIA FARM	B41K	E	354	10	0.001	0.008
PULASENG	B41K	E	444	10	0.002	0.010
SEHWITING	B41K	E	222	10	0.001	0.005
TAUNG EXT 2	B41K	E	116	10	0.000	0.003
THABANENG	B41K	E	249	10	0.001	0.005
WINTERVELD MINE	B41J	E	83	10	0.000	0.002
MAADISWANE	B41J	E	34	10	0.000	0.001
MAAKGONGYWANE	B41J	E	209	10	0.001	0.005
TIDINTITSANE	B41J	E	295	10	0.001	0.006
STOFFBERG	B41B	E	805	10	0.003	0.018
WAPADSKLOOF	B41A	E	387	10	0.001	0.008
DITABONGONG	B52A	E	76	10	0.000	0.002
LEKHUSWANENG	B52A	E	154	10	0.001	0.003
LEKURUNG EXT	B52A	E	21	10	0.000	0.000
LETLHOKWANENG	B52A	E	179	10	0.001	0.004
MAGWANENG	B52A	E	47	10	0.000	0.001
MAHLAOKENG	B52A	E	125	10	0.000	0.003
MAKOPENG	B52A	E	26	10	0.000	0.001
MALEMANG	B52D	E	349	10	0.001	0.008
MATINKANE	B52A	E	56	10	0.000	0.001
MOSETAMONG	B52D	E	96	10	0.000	0.002
NAAUWPOORT A	B52D	E	81	10	0.000	0.002
NAAUWPOORT B	B52D	E	66	10	0.000	0.001
NAAUWPOORT EXT 1	B52D	E	81	10	0.000	0.002
RAPOTELA	B52D	E	175	10	0.001	0.004
ROOIBOKBULT	B52D	E	243	10	0.001	0.005
SAMPSE	B52D	E	76	10	0.000	0.002
TSWAING	B52D	E	245	10	0.001	0.005
DISESANE	B52D	E	424	10	0.002	0.009
DIHLABENG	B51H	E	166	10	0.001	0.004

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
GA MAGOLEGO	B51H	E	298	10	0.001	0.007
GA MALAKA B	B51H	E	378	10	0.001	0.008
GA MALOA	B51H	E	34	10	0.000	0.001
GELUKS LOCATION A	B51H	E	385	10	0.001	0.008
HLAHLANE	B51H	E	331	10	0.001	0.007
KA MABULE	B51H	E	448	10	0.002	0.010
KANAAN A	B51H	E	541	10	0.002	0.012
KANAAN B	B51H	E	154	10	0.001	0.003
KGWARIPE	B51E	E	331	10	0.001	0.007
MAGOLAPONG	B51E	E	320	10	0.001	0.007
MAHLOMOLA	B51E	E	367	10	0.001	0.008
MAMPE	B51E	E	98	10	0.000	0.002
MATLAKATLE B	B51E	E	363	10	0.001	0.008
MATLAKATLE C	B51E	E	310	10	0.001	0.007
MMOTWANENG	B41E	E	248	10	0.001	0.005
MOCHADI	B41E	E	363	10	0.001	0.008
NEBO	B51A	E	312	10	0.001	0.007
NKOTOKWANE	B52E	E	248	10	0.001	0.005
PHELINDABA	B52E	E	650	10	0.002	0.014
SEKELE	B52B	E	385	10	0.001	0.008
SEPHOTO	B51C	E	226	10	0.001	0.005
TLAME	B51H	E	125	10	0.000	0.003
VLAKPLAAS B	B51H	E	332	10	0.001	0.007
ZOETVELDEN	B51H	E	331	10	0.001	0.007
EMKHONDWENI	B51H	E	351	10	0.001	0.008
KLIPSPRUIT	B51H	E	95	10	0.000	0.002
KLIPSPRUIT FARM	B51H	E	308	10	0.001	0.007
VEEPLAATS AGRI. COLLEGE	B51H	E	95	10	0.000	0.002
BOSHOEK	B42C	E	1 102	10	0.004	0.024
OLIFANTSHOEK	B42G	E	474	10	0.002	0.010
KLIPSPRUIT	B42G	E	870	10	0.003	0.019
SEKELE	B52B	E	385	10	0.001	0.008
SEPHOTO	B51C	E	226	10	0.001	0.005
TLAME	B51H	E	125	10	0.000	0.003
VLAKPLAAS B	B51H	E	332	10	0.001	0.007
ZOETVELDEN	B51H	E	331	10	0.001	0.007
EMKHONDWENI	B51H	E	351	10	0.001	0.008
KLIPSPRUIT	B51H	E	95	10	0.000	0.002
KLIPSPRUIT FARM	B51H	E	308	10	0.001	0.007

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
VEEPLAATS AGRI. COLLEGE	B51H	E	95	10	0.000	0.002
BOSHOEK	B42C	E	1 102	10	0.004	0.024
OLIFANTSHOEK	B42G	E	474	10	0.002	0.010
KLIPSPRUIT	B42G	E	870	10	0.003	0.019
MMOTWANENG	B41E	E	248	10	0.001	0.005
MOCHADI	B41E	E	363	10	0.001	0.008
NEBO	B51A	E	312	10	0.001	0.007
NKOTOKWANE	B52E	E	248	10	0.001	0.005
PHELINDABA	B52E	E	650	10	0.002	0.014
SEKELE	B52B	E	385	10	0.001	0.008
SEPHOTO	B51C	E	226	10	0.001	0.005
TLAME	B51H	E	125	10	0.000	0.003
VLAKPLAAS B	B51H	E	332	10	0.001	0.007
ZOETVELDEN	B51H	E	331	10	0.001	0.007
EMKHONDWENI	B51H	E	351	10	0.001	0.008
KLIPSPRUIT	B51H	E	95	10	0.000	0.002
KLIPSPRUIT FARM	B51H	E	308	10	0.001	0.007
VEEPLAATS AGRI. COLLEGE	B51H	E	95	10	0.000	0.002
BOSHOEK	B42C	E	1 102	10	0.004	0.024
OLIFANTSHOEK	B42G	E	474	10	0.002	0.010
KLIPSPRUIT	B42G	E	870	10	0.003	0.019

Appendix A-3: Rural water use in the Lower Olifants River

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
MAKHUSHANE R1	B72K	C	8 591	60	0.188	0.188
MASHISHIMALE R3	B72K	C	9 335	60	0.204	0.204
MATIKO-XIKAYA	B72K	C	7 446	60	0.163	0.163
BEN A B C	B72K	C	11 649	60	0.255	0.255
GA-KGWETE	B71E	C	5 116	60	0.112	0.112
LEBOENG	B71E	C	5 636	60	0.123	0.123
MAGAKALA	B71E	C	5 841	60	0.128	0.128
RIBA CROSS	B71E	C	6 537	60	0.143	0.143
GA-MADIBA	B71D	D	908	25	0.008	0.020
HUMULANI	B72K	D	4 879	25	0.045	0.107
MAKHUSHANE R2	B72K	D	4 179	25	0.038	0.092
MASEKE	B72K	D	2 617	25	0.024	0.057
MASHISHIMALE R1	B72K	D	3 009	25	0.027	0.066
MASHISHIMALE R2	B72K	D	2 738	25	0.025	0.060
GA-MAMPA	B71C	D	1 723	25	0.016	0.038
GA-PHAHLA	B71C	D	1 936	25	0.018	0.042
GA-PHASHA	B71C	D	1 650	25	0.015	0.036
LEKGWARENG	B71C	D	787	25	0.007	0.017
SEOKODIBENG	B71C	D	1 887	25	0.017	0.041
TSWERENG	B71C	D	858	25	0.008	0.019
DIPHALE	B71E	D	2 406	25	0.022	0.053
DITOBELENG	B71E	D	511	25	0.005	0.011
GA-MAMPHAHLANE	B71E	D	1 365	25	0.012	0.030
GA-MAROGA	B71E	D	3 197	25	0.029	0.070
GA-MAROGA EXT	B71E	D	2 295	25	0.021	0.050
GA-MASETE	B71E	D	491	25	0.004	0.011
GA-MASETE EXT 1	B71E	D	483	25	0.004	0.011
GA-MASHISHI	B71E	D	3 114	25	0.028	0.068
GA-MOKGOTHO	B71E	D	1 936	25	0.018	0.042
GA-PHASHA	B71E	D	3 647	25	0.033	0.080
GA-PODILE	B71E	D	1 724	25	0.016	0.038
GA-SELALA	B71E	D	3 106	25	0.028	0.068
KGOTLOPONG	B71E	D	2 336	25	0.021	0.051
MABELANE - MAFOGO	B71E	D	911	25	0.008	0.020
MAFARAFARA	B60G	D	1 003	25	0.009	0.022
MAGABANENG	B60G	D	621	25	0.006	0.014
MAGAKALA EXT 1	B60G	D	1 740	25	0.016	0.038
MAKOPUNG	B71G	D	953	25	0.009	0.021

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
MANDELA	B71G	D	1 771	25	0.016	0.039
MOKUTUNG	B71G	D	1 032	25	0.009	0.023
MORAPANENG	B71E	D	1 523	25	0.014	0.033
MORGENZON	B71F	D	678	25	0.006	0.015
MOSHIRA	B71E	D	1 243	25	0.011	0.027
MOTLOLO	B71E	D	1 073	25	0.010	0.023
MOTLOULELA	B71E	D	1 784	25	0.016	0.039
NTSWANENG	B71E	D	3 184	25	0.029	0.070
PENGE	B71F	D	1 821	25	0.017	0.040
SEKITI	B71E	D	470	25	0.004	0.010
SEKOPUNG	B71E	D	1 267	25	0.012	0.028
SENYATHO	B71F	D	648	25	0.006	0.014
SEUWE	B71E	D	1 400	25	0.013	0.031
SHAKUNG	B71E	D	3 216	25	0.029	0.070
SWALE	B71E	D	3 092	25	0.028	0.068
TSAKANE	B71E	D	621	25	0.006	0.014
TSWENYANE	B71G	D	683	25	0.006	0.015
ANNEX A	B71G	D	477	25	0.004	0.010
GA MODUPI	B71E	D	536	25	0.005	0.012
GA MORABA	B71G	D	1 809	25	0.017	0.040
GA MPHANA	B71G	D	479	25	0.004	0.010
GA-MAMPA	B71C	D	886	25	0.008	0.019
MAFEFE	B71D	D	3 887	25	0.035	0.085
MAHLATJANE	B71B	D	3 369	25	0.031	0.074
MALETANE	B71B	D	2 548	25	0.023	0.056
MOTSANE	B71F	D	430	25	0.004	0.009
RAMONWANE	B71F	D	691	25	0.006	0.015
SHOTALALE	B71F	D	417	25	0.004	0.009
SUCCESS	B71A	D	665	25	0.006	0.015
BROOKLYN	B73A	D	1 254	25	0.011	0.027
RIVERSIDE	B71F	D	3 326	25	0.030	0.073
SEBETHA	B71F	D	1 731	25	0.016	0.038
SEBITSANE	B71F	D	1 058	25	0.010	0.023
SETEBONG	B71F	D	510	25	0.005	0.011
SETLABOSWANE	B71F	D	1 310	25	0.012	0.029
SOPEYANA	B71F	D	1 480	25	0.014	0.032
TSATANE	B71F	D	3 718	25	0.034	0.081
LERORO	B60D	D	6 434	25	0.059	0.141
MATIBIDI	B60D	D	14 513	25	0.132	0.318
MOREMELA	B60D	D	6 688	25	0.061	0.146

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
RIETSPRUIT	B60D	D	356	25	0.003	0.008
MURCHISON	B72J	E	99	10	0.000	0.002
LEGABENG	B71E	E	320	10	0.001	0.007
LEGABENG	B71E	E	44	10	0.000	0.001
LEKGWARENG	B71E	E	413	10	0.002	0.009
MAFARAFARA EXT 1	B71E	E	409	10	0.001	0.009
MAKOTASENG	B71E	E	354	10	0.001	0.008
MANAWANENG	B60H	E	371	10	0.001	0.008
MATADI	B71E	E	236	10	0.001	0.005
MATIMATSATSI	B71E	E	273	10	0.001	0.006
PLASENG	B71E	E	7	10	0.000	0.000
POUNG	B71E	E	190	10	0.001	0.004
SEBEPE	B71E	E	137	10	0.001	0.003
SEHLABENG	B71E	E	93	10	0.000	0.002
SEKITLONG	B71E	E	37	10	0.000	0.001
SEKOPUNG EXT 1	B71E	E	52	10	0.000	0.001
SWALE	B71E	E	325	10	0.001	0.007
GA-MOILA	B71C	E	125	10	0.000	0.003
MAGOPE	B71D	E	47	10	0.000	0.001
MALAKABANENG	B71B	E	212	10	0.001	0.005
MALKAPANE	B71B	E	238	10	0.001	0.005
MANHLANE	B71B	E	69	10	0.000	0.002
MANKELE	B71B	E	270	10	0.001	0.006
MAREDI	B71D	E	192	10	0.001	0.004
MAREDI EXT 1	B71D	E	106	10	0.000	0.002
MATAUNG	B71B	E	192	10	0.001	0.004
MATSOONG	B71D	E	300	10	0.001	0.007
MOSOLA	B71D	E	81	10	0.000	0.002
MOTSANE EXT 1	B71D	E	132	10	0.000	0.003
MOTSANE EXT 2	B71D	E	54	10	0.000	0.001
MPHAPE	B71D	E	266	10	0.001	0.006
PITSANENG	B71D	E	81	10	0.000	0.002
SCHILDPADNEK A	B71D	E	26	10	0.000	0.001
ZAAIKLOOF A	B71D	E	50	10	0.000	0.001
BYLDRIFT EXT	B71D	E	179	10	0.001	0.004
DUBLIN	B71D	E	156	10	0.001	0.003
HLAHLA	B71D	E	305	10	0.001	0.007
KGWARIPE EXT	B71D	E	218	10	0.001	0.005
GA-MADIBA	B71D	E	111	10	0.000	0.002

Village	Quaternary catchment	Water services category	Population	Service level l/person/day	Water use Current (million m3/a)	Full service (million m3/a)
GA MOKGOADI	B71D	E	257	10	0.001	0.006
HOEPAKRANTZ	B71D	E	345	10	0.001	0.008
KAPANENG	B71D	E	392	10	0.001	0.009
MASELESELENG	B71D	E	305	10	0.001	0.007
PITSANENG	B71D	E	242	10	0.001	0.005
POLASENG	B71D	E	293	10	0.001	0.006
TSATANE EXT 1	B71D	E	257	10	0.001	0.006
APEL CROSS	B71D	E	226	10	0.001	0.005
DOORNKRAAL	B60D	E	164	10	0.001	0.004
SKOONPLAAS	B60B	E	43	10	0.000	0.001

APPENDIX A4: LONG-TERM YIELD CURVES

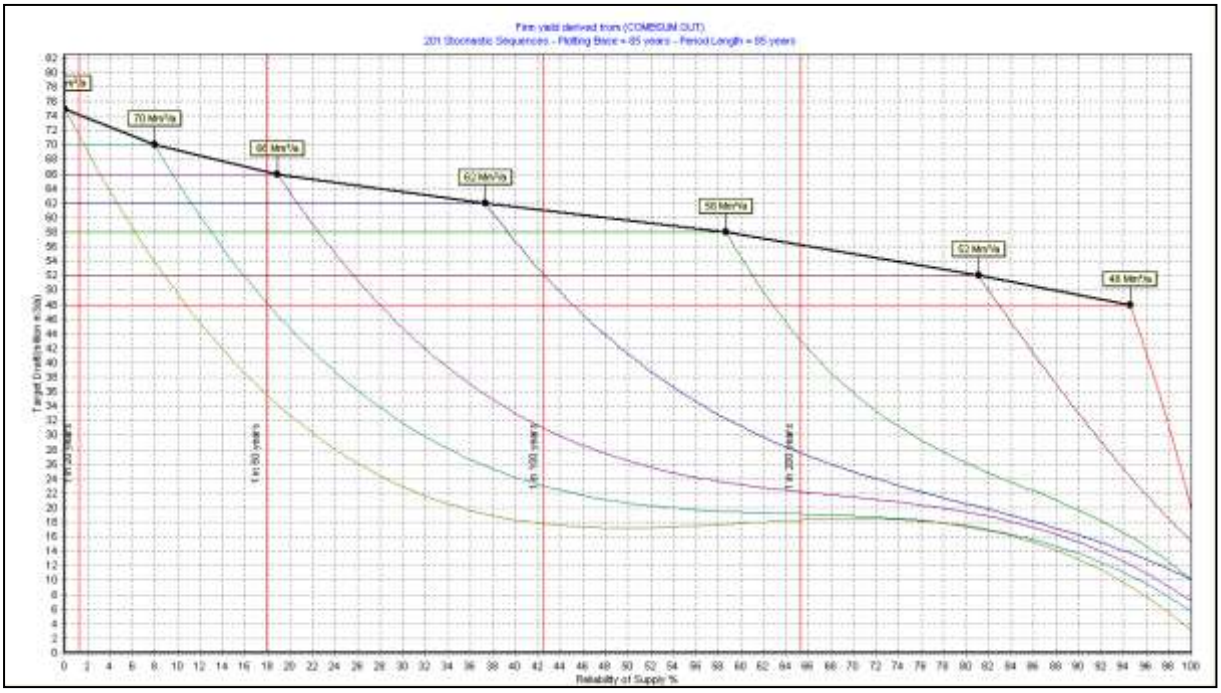

Figure A1: Long-term yield curve: De Hoop Dam

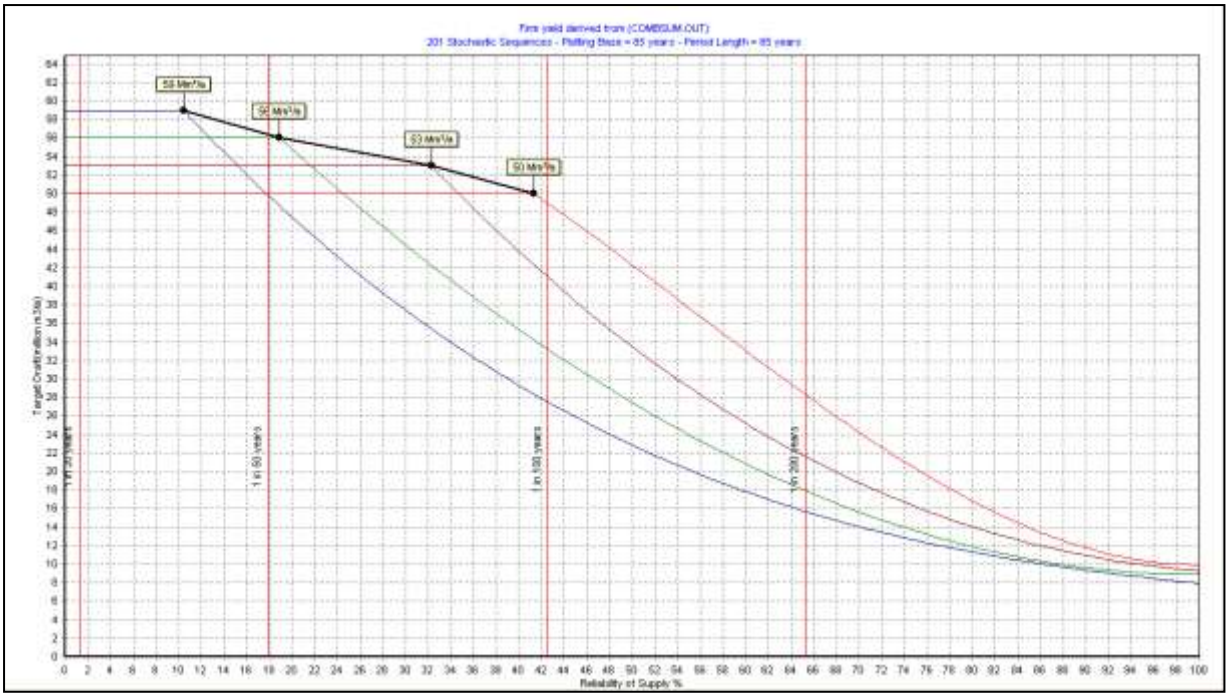

Figure A2: Long-term yield curve: Blyderivierpoort Dam

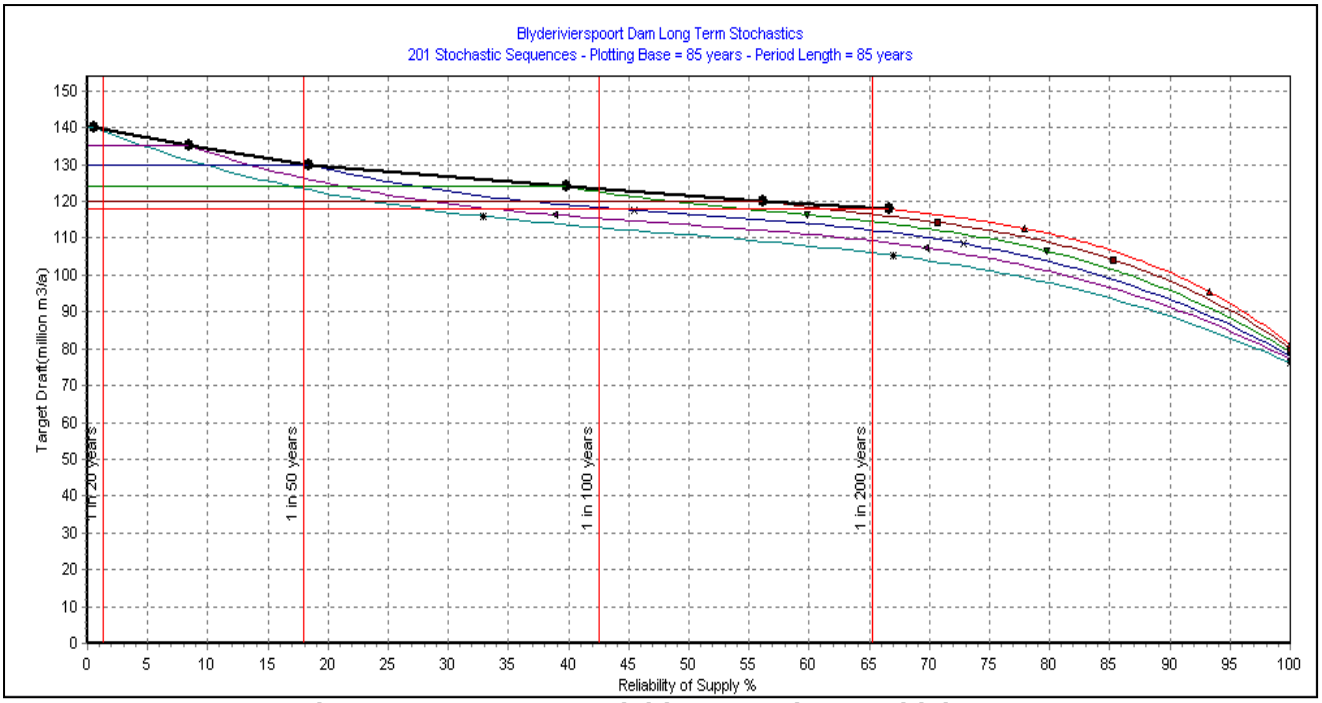

Figure A3: Long-term yield curve: Flag Boshielo Dam

APPENDIX B: Extract from the ORWRDP

Table B1: Expected low water requirements

MUNICIPALITY	SUB-AREA	NON-MINING					MINING AND BULK INDUSTRY ****					TOTAL				
		2000	2005	2010	2015	2020	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
LOW WATER REQUIREMENTS (million m^3/a)																
Mogalakwena	South *	7.4	10.0	13.3	15.5	17.6	1.9	2.7	22.7	22.7	22.7	9.3	12.7	36.0	38.2	40.3
	Rebone	0.9	1.2	1.7	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.9	1.2	1.7	1.8	1.8
	Glen Alpine Supply Area	0.2	0.2	0.3	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.4	0.5
	TOTAL	**8.5**	**11.4**	**15.3**	**17.7**	**19.9**	**1.9**	**2.7**	**22.7**	**22.7**	**22.7**	**10.4**	**14.1**	**38.0**	**40.4**	**42.6**
Polokwane	Polokwane	20.4	23.8	30.3	35.7	39.6	0.8	1.7	3.7	2.6	2.6	21.2	25.5	34.0	38.3	42.2
	Olifants - Sand Corridor	0.4	0.5	0.7	0.7	0.8	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.7	0.7	0.8
	Sub-total	20.8	24.3	31.0	36.4	40.4	0.8	1.7	3.7	2.6	2.6	21.6	26.0	34.7	39.0	43.0
	Perskebult **	1.5	2.0	2.6	2.9	3.2	0.0	0.0	0.0	0.0	0.0	1.5	2.0	2.6	2.9	3.2
	TOTAL	**22.3**	**26.3**	**33.6**	**39.3**	**43.5**	**0.8**	**1.7**	**3.7**	**2.6**	**2.6**	**23.1**	**28.0**	**37.3**	**41.9**	**46.1**
Aganang ***		3.8	5.1	7.0	7.7	8.2	0.0	0.0	0.0	0.0	0.0	3.8	5.1	7.0	7.7	8.2
Lepelle - Nkumpi	Central	6.0	7.8	10.4	11.4	12.2	1.6	4.6	8.0	9.4	9.4	7.6	12.4	18.4	20.8	21.6

Notes: * Mokopane, Mapela and Bakenberg supply areas.
** Also included in Aganang Municipal area.
*** Includes Perskebult.
**** Includes the effects of supplying sewage effluent to PPL Platinum Mine on downstream groundwater abstraction for Polokwane.

Table B2: Expected low water requirements

MUNICIPALITY	SUB-AREA	NON-MINING					MINING AND BULK INDUSTRY ****					TOTAL				
		2000	2005	2010	2015	2020	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
HIGH WATER REQUIREMENTS (million m^3/a)																
Mogalakwena	South *	7.4	10.3	14.7	17.4	20.1	1.9	2.7	22.7	22.7	22.7	9.3	13.0	37.4	40.1	42.8
	Rebone	0.9	1.2	1.7	1.8	1.9	0.0	0.0	0.0	0.0	0.0	0.9	1.2	1.7	1.8	1.9
	Glen Alpine Supply Area	0.2	0.2	0.3	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.4	0.5
	TOTAL	**8.5**	**11.7**	**16.7**	**19.6**	**22.5**	**1.9**	**2.7**	**22.7**	**22.7**	**22.7**	**10.4**	**14.4**	**39.4**	**42.3**	**45.2**
Polokwane	Polokwane	20.4	24.3	32.2	39.2	44.7	0.8	1.7	3.7	2.6	2.6	21.2	26.0	34.8	41.8	47.3
	Olifants - Sand Corridor	0.4	0.5	0.7	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.7	0.8	0.8
	Sub-total	20.8	24.8	32.9	40.0	45.5	0.8	1.7	3.7	2.6	2.6	21.6	26.5	35.5	42.6	48.1
	Perskebult **	1.5	2.0	2.7	3.0	3.3	0.0	0.0	0.0	0.0	0.0	1.5	2.0	2.7	3.0	3.3
	TOTAL	**22.3**	**26.8**	**35.6**	**43.0**	**48.8**	**0.8**	**1.7**	**3.7**	**2.6**	**2.6**	**23.1**	**28.5**	**38.2**	**45.6**	**51.4**
Aganang ***		3.8	5.2	7.2	8.1	8.9	0.0	0.0	0.0	0.0	0.0	3.8	5.2	7.2	8.1	8.9
Lepelle - Nkumpi	Central	6.0	8.0	10.9	12.2	13.4	1.6	4.6	8.9	10.1	10.1	7.6	12.6	19.8	22.3	23.5

NOTES: * Mokopane, Mapela and Bakenberg supply areas.
** Also included in Aganang Municipal area.
*** Includes Perskebult.
**** Includes the effects of supplying sewage effluent to PPL Platinum Mine on downstream groundwater abstraction for Polokwane.

APPENDIX C: Conversion to 1 in 50 year yield

Sub-catchment	Long-term yield curve applied	1 in 50 year yield	1 in 10 year yield	Conversion factor
Upper	Loskop	168	193	0.87
Middle	De Hoop	66	75	0.88
Lower	Blyderivierpoort	130	141	0.92