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water affairs
Department:
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DEVELOPMENT OF RECONCILIATION STRATEGIES FOR LARGE BULK WATER SUPPLY SYSTEMS: ORANGE RIVER

URBAN SECTOR WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGY AND BUSINESS PLAN

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DEVELOPMENT OF RECONCILIATION STRATEGIES FOR BULK WATER SUPPLY SYSTEMS: ORANGE RIVER

URBAN SECTOR WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGY AND BUSINESS PLAN

SEPTEMBER 2014

Title:	***Urban Sector Water Conservation and Water Demand Management Strategy and Business***
Authors:	*Willem Wegelin, Nsika Zondo, and Zama Siqalaba*
Project Name:	***Development of Water of Reconciliation Strategies for Large Bulk Water Supply Systems: Orange River***
DWA Report No:	*P RSA D000/00/18312/5*
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Consultants: WRP Consulting Engineers (Pty) Ltd in association with Aurecon, Golder Associates Africa and Zitholele Consulting

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LIST OF REPORTS

The following reports form part of this study:

Report Title	Report number
Inception Report	P RSA D000/00/18312/1
Literature Review Report	P RSA D000/00/18312/2
International obligations	P RSA D000/00/18312/3
Current and future Water Requirements	P RSA D000/00/18312/4
Urban Water Conservation and Water Demand Management	**P RSA D000/00/18312/5**
Irrigation Demands and Water Conservation/Water Demand Management	P RSA D000/00/18312/6
Surface Water Hydrology and System Analysis	P RSA D000/00/18312/7
Water Quality and Effluent Re-use	P RSA D000/00/18312/8
Review Schemes and Update Cost Estimates	P RSA D000/00/18312/9
Preliminary Reconciliation Strategy Report	P RSA D000/00/18312/10
Final Reconciliation Strategy Report	P RSA D000/00/18312/11
Executive Summary	P RSA D000/00/18312/12
Reserve Requirement Scenarios and Scheme Yield	P RSA D000/00/18312/13
Preliminary Screening Options Agreed: Workshop of February 2013	P RSA D000/00/18312/14

GLOSSARY OF TERMS

ALC	Active Leakage Control
AZP	Average Zone Pressure
DWA	Department of Water Affairs
IDP	Integrated Development Plan
ILI	Infrastructure Leakage Index
ISP	Internal Strategic Perspective
KPI	Key Performance Indicator
LHWP	Lesotho Highlands Water Project
ℓ / c / d	Litres / Capita / Day
m^3	cubic meter
MNF	Minimum Night Flow
NWRP	DWA Directorate: National Water Resource Planning
NRW	Non-Revenue Water
ORP	Orange River Project
PRV	Pressure Reducing Valve
RPMS	Regulatory Performance Management System
SIV	System Input Volume
WC/WDM	Water Conservation and Water Demand Management
WMA	Water Management Area
WSA	Water Services Authority
WSDP	Water Services Development Plan
WSP	Water Services Provider
WTW	Water Treatment Works
WWTW	Wastewater Treatment Works
WISIP	Water Infrastructure Status and Intervention Plans

DEVELOPMENT OF RECONCILIATION STRATEGIES FOR LARGE BULK WATER SUPPLY SYSTEMS: ORANGE RIVER

Urban Sector WC/WDM Strategy and business plan

EXECUTIVE SUMMARY

Introduction

The Department of Water Affairs (DWA) has identified the need for detailed water resource management strategies as part of their Internal Strategic Perspective (ISP) planning initiative, which recommended studies to identify and formulate intervention measures that will ensure enough water can be made available to supply the water requirements for the next three to four decades.

As part of this process the need for the Reconciliation Strategy Study for the Large Bulk Water Supply Systems in the Orange River was also defined. Given the location of the Orange River System and its interdependencies with other WMAs as well as other countries, various water resource planning and management initiatives compiled during the past few years as well as those currently in progress will form an integral part of the strategy development process.

Since 1994, a significant driver of change in the water balance of the Orange River System was brought about by the storing of water in Katse Dam as the first component of the multi-phase Lesotho Highlands Water Project (LHWP). Currently Phase 1 of the LHWP (consisting of Katse, and Mohale dams, Matsoku Weir and associated conveyance tunnels) transfers 780 million cubic metres per annum via the Liebenbergsvlei River into the Vaal Dam to augment the continuously growing water needs of the Gauteng Province. Phase 2 of the LWHP comprising of Polihali Dam and connecting tunnel to Katse Dam is already in its planning stages. Polihali Dam is expected to be in place by around 2022. Flows that are currently still entering into Gariep and Vanderkloof dams wil then be captured by Polohali Dam, thus reducing the inflow to Gariep and Vanderkloof dams. This will result in a reduction in yield of the Orange River Project (Gariep and Vanderkloof dams) to such an extent that shortages will be experienced in the ORP system. Some sort of yield replacement is then required in the Orange River to correct the yield versus demand imbalance in the ORP system.The objective of the study is to develop a reconciliation strategy for the bulk water resources of the Orange River System, to ensure that sufficient water can be made available to supply the current and future water needs for a 25 year planning horison. This Strategy must be flexible to accommodate future changes in the actual water requirements and transfers, with the result that the Strategy will evolve over time as part of an on-going planning process.

Appropriate integration with other planning and management processes as well as cooperation among stakeholders will be key success factors in formulating coherent recommendations and action plans.

***The purpose of this report** is to review the contents of existing municipal water conservation and water demand management (WC/WDM) strategies and develop high-level WC/WDM strategies for key municipalities which do not already have a strategy. Based on the review, realistic estimates were made of the potential savings, cost implications and programme of implementation. This will form part of the development of possible future water demand projection scenarios.*

The following specific WC/WDM tasks, to aid future planning in the Orange River WMA, were identified:

- *Prepare a baseline of current water losses and potential savings in the Orange River WMA;*
- *Complete WC/WDM performance score cards to identify strengths, weaknesses, opportunities and threats;*
- *Identify potential interventions, complete with budgets and time lines;*
- *Prepare water balance diagrams for the municipalities under investigation complete with system yields versus demand curves with and without WC/WDM; and*
- *Develop high-level WC/WDM strategies and business plans for selected municipalities within the Orange River WMA.*

Study area

*There are 30 municipalities with a major portion of the municipality within in the Upper or Lower Orange Water Management Areas. Numerous WC/WDM strategies have been developed by these municipalities, under the DWA Rapid Response Unit (RRU) programme and Water Reconciliation Strategy Study for Large Bulk Water Supply Systems: Greater Bloemfontein Area. It was not possible to assess the potential for WC/WDM in all the remaining municipalities and therefore priority was given to municipalities adjacent to the Orange River and municipalities with the biggest potential impact. The municipalities that were investigated are summarised in **Table 1**.*

Table 1: Summary of participating municipalities

Municipal code	Municipality	Key demand centres	Category	WSA
DC08	**Siyanda DM**		**C1**	**Yes**
NC082	Kai !Garib	Kakamas, Keimoes, Kenhardt, Eksteenskuil	B3	Yes
NC083	//Khara Hais	Upington; Karos;Lambrechsdrift;Leerkrans, Leseding; Louisvalle, Ntsikelelo,Raaswater	B2	Yes
DC06	**Namakwa DM**		**C1**	**Yes**
NC061	Richtersveld	Alexander Bay, Port Nolloth	B3	Yes
NC062	Nama Khoi	Bergsig, Kleinzee, Komaggas, Nababeep, Okiep, Pelladrift, Springbok, Steinkopf, Vioolsdrif	B3	Yes
NC067	Khâi-Ma	Aggeneys, Pella, Onseepkans, Pofadder	B3	Yes

Status quo Assessment

Key performance indicators for the focus municipalities are summarised in ***Table 2****.*

Table 2: Summary of Municipal NRW KPIs

Indicator	*//Khara Hais*	*Kai !Garib*	*Nama Khoi*	*Khâi-Ma*	*Richtersveld*	*Total*
Annual input volume (million m^3/a)	*13.06*	*4.49*	*2.09*	*0.8*	*0.59*	*21.03*
Population	*93 494*	*65 869*	*47 041*	*12 465*	*11 982*	*230 846*
Number of households	*23 244*	*16 764*	*13 193*	*3 796*	*3 543*	*60 480*
% Non-revenue water	*34.4*	*29.8*	*24.0*	*15.3*	*26.3*	*31.5*
ℓ / capita / day	*383*	*187*	*122*	*176*	*135*	*250*
m^3 / household / month	*47*	*22*	*13*	*18*	*14*	*29*

//Khara Hais municipality shows a consumption of 383 l/c/d which is far above the national average of 238 l/c/d (WRC, 2012). The other municipalities show very reasonable l/c/d consumptions, which are in line with the level of service and climatic conditions. Initial indications are that there is limited scope for reducing the average consumption but considerable scope for reducing the NRW through improved metering, billing processes in some areas.

WC/WDM Potential

The targeted NRW performance indicator reductions are summarised in ***Table 5.1.***

Table 2: Summary of Targeted Non Revenue Water Key Performance Indicators

Municipality	*Current l/c/d*	*Target l/c/d*	*% l/c/d Reduction*	*Current % NRW*	*Target % NRW*	*% NRW Reduction*
//Khara Hais	*383*	*201*	*47.5%*	*34.4%*	*19.5%*	*15%*
Kai !Garib	*187*	*177*	*5.3%*	*29.8%*	*22.5%*	*7.2%*
Nama Khoi	*122*	*122*	*0%*	*24.0%*	*18.7%*	*5.3%*
Khâi-Ma	*176*	*174*	*1.1%*	*15.3%*	*10.1%*	*5.1%*
Richtersveld	*135*	*135*	*0%*	*26.3%*	*19.1%*	*7.2%*
Average	***172***	***140***	***18.6%***	***31.5%***	***19.7%***	***11.7%***

The potential savings from the focus municipalities are 6.436million m^3/a by 2017 with an additional 12.181million m^3 from other municipalities for which information is available.

Summary and Conclusions

Based on the findings of the urban water sector assessment detailed above, it is clear that there is significant scope for WC/WDM in the Orange River Supply System urban sector; which will result in both a reduction of non-revenue water and to a limited extent, the total system input volume. A serious concern however, is the pervasive limitation in institutional capacity and technical skills to embark on WC/WDM programmes in most municipalities which; should be resolved before focusing on the following interventions:

- *Municipalities should improve service delivery, as this will minimise illegal connections in some areas;*

- *Improve the availability of macro and micro management information;*
- *Improve political support through councillor awareness programmes focusing on the water business;*
- *Promotion of payment of services through continuous community awareness campaigns;*
- *Embark on schools awareness programmes promoting reporting of leaks and water wise practices;*
- *Undertake community awareness programmes that promote the value of water wise gardening;*
- *Maintain satisfactory operating pressures and install PRVs in areas experiencing high pressures and ensure that operating pressures never exceed the DWA regulatory standard of 9 bar;*
- *Provide training for meter readers and perform monthly audits to eliminate estimates and other inaccuracies;*
- *Perform meter audits and cleaning of infrastructure to improve meter reading and meter accessibility.*

Recommendations

Institutional

- *The key intervention for the municipalities will be to address the critical vacancies or shortages in human resources and skills particularly at the middle management level as well as operation and maintenance;*
- *Dedicated individuals are required in order to drive WC/WDM, which will in turn improve the availability and accuracy of management information;*
- *WC/WDM training is pertinent to support the municipal personnel in undertaking the required water loss reduction at both the management and Operations and Maintenance levels in order to improve the functioning of the water supply system as a whole.*
- *The provision of good quality water services will be crucial to ensuring improvement in cost recovery as well as cost efficiency through water savings. It is also pertinent that the lines of communication are improved between the different municipal departments specifically between the finance and technical departments in order to aid more efficient access to information; which will allow for more effective and coordinated planning.*
- *The establishment of an NRW steering committee comprising the relevant councillors, finance representatives, communication, and the technical department is recommended to facilitate improved reporting and management of NRW. Procurement processes must also be streamlined in order to enable swifter access to support structures required for operations and maintenance tasks, which are necessary to mitigate water losses in the systems.*

Financial

- *A review of the current billing and cost recovery systems is required in order to aid ease of access to the necessary billing information and reports. The training requirements in this regard must also be identified to ensure optimal operation of the system.*
- *Municipalities should undertake meter audits in order to identify unmetered connections and non-functional meters, which could, in the short term; significantly improve cost recovery. Furthermore, it is imperative that the tariff setting process include inputs from the technical*

departments, which could assist in making the tariffs increasingly effective in achieving the water use efficiency objectives.

- *Improve budgeting through prioritisation processes. National Treasury has been very vocal on the dependency of municipalities on grant funding and has emphatically expressed the need for municipalities to actively demonstrate a commitment to proper budgeting, planning and cost recovery with a focus on demand side management as a first step in managing and more effectively utilising the available resources.*
- *Implement monitoring and engagement of consumers, particularly the top consumers. An effective system to capture and refer billing related complaints and progressive payment of services in the municipalities are also required, which must be supported and preceded by proper community awareness and education, and wide spread public engagement.*

Social

- *Extensive and continuous consumer water education programmes are required which will focus on the community and institutions such as schools, which are potent avenues for the reduction of water losses;*
- *The installation of water efficient devices, as well as rainwater harvesting, is also avenues, which can further be explored for promotion and implementation in different sectors. This can aid water loss reduction at the consumer level, particularly in areas where metering and billing cannot immediately be effected, and where cost recovery is very low due to high indigent populations;*
- *Structures should also be put in place to support consumers in reporting leakage and other service related complaints, which should be captured electronically in order to allow proper tracking and analysis of water loss contributors and significant problem areas;*
- *The political leadership should ideally lead these interventions and provide substantial support in order to improve the sustainability of the community-based interventions.*

Technical

- *Measurement of the system input volumes as a first step is required to come to grips with the extent of water losses in the Municipality. Sectorisation and zone metering and monitoring is also required to aid in the micro management of the system;*
- *The installation of meters is the first step in areas where there are no meters installed. They will however be altogether useless if the information is not captured and monitored on a monthly basis. Proper record keeping is key, as well as the appropriate protection and of the existing meters*
- *Proper budgets must also be set aside for proactive infrastructure asset maintenance to avoid unmitigated system failure*
- *Passive leak detection through community reporting would greatly enhance the ability of the municipality to monitor the network and reduce water losses;*
- *There is a need for municipalities to develop digital as built drawings of the network, which must be accompanied by the updating of the asset register;*
- *Municipalities should improve service delivery, as this will minimise illegal connections in the area.*

DEVELOPMENT OF RECONCILIATION STRATEGIES FOR LARGE BULK WATER SUPPLY SYSTEMS: ORANGE RIVER

URBAN SECTOR WC/WDM STRATEGY AND BUSINESS PLAN

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URBAN SECTOR WC/WDM STRATEGY AND BUSINESS PLAN

1 INTRODUCTION

1.1 BACKGROUND

The Department of Water Affairs (DWA) has identified the need for detailed water resource management strategies as part of their Internal Strategic Perspective (ISP) planning initiative, which recommended studies to identify and formulate intervention measures that will ensure enough water can be made available to supply the water requirements for the next three to four decades.

The DWA Directorate: National Water Resource Planning (NWRP) therefore commenced the strategy development process in 2004 by initially focusing on the water resources supporting the large metropolitan clusters, followed by the systems supplying the smaller urban areas to systematically cover all the municipalities in the country.

As part of this process the need for the Reconciliation Strategy Study for the Large Bulk Water Supply Systems in the Orange River was also defined. Given the location of the Orange River System and its interdependencies with other WMAs as well as other countries (see study area description in **Section 1.3**), various water resource planning and management initiatives compiled during the past few years as well as those currently in progress will form an integral part of the strategy development process.

Major water resource infrastructure in the study area are the Gariep and Vanderkloof dams with associated conveyance conduits supporting large irrigation farming in the provinces of the Free State, Northern Cape and the Eastern Cape - through the Orange-Fish Tunnel. This system is currently almost in balance.

The Caledon-Modder System supplies water to the Mangaung-Bloemfontein urban cluster (largest urban centre in the study area). The 2 200 km long Orange-Senqu River is the lifeline for various industries, mines, towns and communities located along the way until the river discharges into the Atlantic Ocean in the far west at Alexander Bay.

Since 1994, a significant driver of change in the water balance of the Orange River System was brought about by the storing of water in Katse Dam as the first component of the multi-phase Lesotho Highlands Water Project (LHWP). Currently Phase 1 of the LHWP (consisting of Katse, and Mohale dams, Matsoku Weir and associated conveyance tunnels) transfers 780 million cubic metres per annum via the Liebenbergsvlei River into the Vaal Dam to augment the continuously growing water needs of the Gauteng Province. Phase 2 of the LWHP comprising of Polihali Dam

and connecting tunnel to Katse Dam is already in its planning stages and is expected to be in place by 2022. Flows that are currently still entering into Gariep and Vanderkloof dams wil then be captured by Polohali Dam, thus reducing the inflow to Gariep and Vanderkloof dams. This will result in a reduction in yield of the Orange River Project (Gariep and Vanderkloof dams) to such an extent that shortages will be experienced in the ORP system. Some sort of yield replacement is then required in the Orange River to correct the yield versus demand imbalance in the ORP system.

The above description illustrates the complex assortment of interdependent water resources and water uses which spans across various international and institutional boundaries that will be considered in the development of the Orange River Reconciliation Strategy.

1.2 MAIN OBJECTIVES OF THE STUDY

The objective of the study is to develop a reconciliation strategy for the bulk water resources of the Orange River System, to ensure that sufficient water can be made available to supply the current and future water needs of all the users up to the year 2040. This Strategy must be flexible to accommodate future changes in the actual water requirements and transfers, with the result that the Strategy will evolve over time as part of an on-going planning process.

Appropriate integration with other planning and management processes, as well as cooperation among stakeholders, will be key success factors in formulating coherent recommendations and action plans.

The outcomes of the Strategy will be specific interventions with particular actions needed to balance the water needs with the availability through the implementation of regulations, demand management measures, as well as infrastructure development options.

1.3 STUDY AREA

As depicted in **Figure A-1** of **Appendix A** (Map of study area), the study will focus on the water resources of the Upper and Lower Orange River Water Management Areas (WMAs), while also considering all the tributary rivers and transfers affecting the water balance of the system. This core area forms part of the Orange-Senqu River Basin, which straddles four International Basin States with the Senqu River originating in the highlands of Lesotho, Botswana in the north eastern part of the Basin, the Fish River in Namibia and the largest area situated in South Africa.

The focus area of the study comprises only the South African portion of the Orange River Basin, excluding the Vaal River Catchment. The Vaal River is an important tributary of the Orange River, but since the Vaal River Reconciliation Strategy has already been developed, the Vaal River Catchment will not form part of the study area. However, strategies developed for the Vaal River System that will have an impact on the Orange River, will be taken into account as well as the impacts of flows from the Vaal into the Orange for selected Integrated Vaal system scenarios.

The Orange River is an international resource, shared by four countries i.e. Lesotho, South Africa, Botswana and Namibia. Any developments, strategies or decisions taken by any one of the countries that will impact on the water availability or quality in South Africa must be taken into account and will form part of this study. The opposite is also applicable. If this strategy plans

anything in South Africa that will impact on any of the other countries, this impact must be considered as part of this study in terms of South Africa's international obligations.

The Orange River, the largest river in South Africa, has its origin in the high lying areas of Lesotho. The river drains a total catchment area of about 1 million km², runs generally in a westerly direction and finally discharges into the Atlantic Ocean at Alexander Bay.

The Caledon River, forming the north-western boundary of Lesotho with the Republic of South Africa (RSA), is the first major tributary of the Orange River. The Caledon and the Orange (called the Senqu River in Lesotho) rivers have their confluence in the upper reaches of the Gariep Dam.

Other major tributaries into the Orange River are:

- The Kraai River draining from the North Eastern Cape;
- The Vaal River joining the Orange River at Douglas;
- The Ongers and Sak Rivers draining from the northern parts of the Karoo;
- The Molopo and Nossob Rivers in Namibia, Botswana and the Northern Cape Province have not contributed to the Orange River in recorded history as the stream bed is impeded by sand dunes; and
- The Fish River draining the southern part of Namibia.

A separate study was also done for the Greater Bloemfontein Area i.e. Water Reconciliation Strategy Study for Large Bulk Water Supply Systems: Greater Bloemfontein Area with it's follow up continuation study currently in process. The recommendations of this strategy and its continuation study will also be taken into account in this study.

Although the Senqu River Catchment in Lesotho does not form part of the focus study area, the development in this catchment impacts directly on the water availability in the study area.

The South African portion of the Orange River Basin is currently divided in two Water Management Areas, i.e. the Upper and Lower Orange WMAs. The Upper WMA stretches from the headwaters of the Caledon River and Lesotho boundary down to the confluence of the Vaal River and the Lower Orange WMA from this point to the sea. (See **Figure A-1** in **Appendix A**). It should be noted that the DWA recently proposed that the two WMAs are managed as a unit.

1.4 PURPOSE OF THIS REPORT

The purpose of this report is to review the contents of existing municipal water conservation and water demand management (WC/WDM) strategies and develop high-level WC/WDM strategies for key municipalities which do not already have a strategy. Based on the review, realistic estimates were made of the potential savings, cost implications and programme of implementation. This will form part of the development of possible future water demand projection scenarios.

The following specific WC/WDM tasks, to aid future planning in the Orange River WMA, were identified:

- Prepare a baseline of current water losses and potential savings in the Orange River WMA;
- Complete WC/WDM performance score cards to identify strengths, weaknesses, opportunities and threats;
- Identify potential interventions, complete with budgets and time lines;
- Prepare water balance diagrams for the municipalities under investigation complete with

system yields versus demand curves with and without WC/WDM; and
- Develop high-level WC/WDM strategies and business plans for selected municipalities within the Orange River WMA.

2 WC/WDM STUDY APPROACH AND METHODOLOGY

2.1 EXISTING STRATEGIES

There are 30 municipalities with a major portion of the municipality within in the Upper or Lower Orange Water Management Areas as listed in **Appendix B**. Numerous WC/WDM strategies have been developed by these municipalities, under the DWA Rapid Response Unit (RRU) programme and Water Reconciliation Strategy Study for Large Bulk Water Supply Systems: Greater Bloemfontein Area. These studies were included in the DWA Development of Reconciliation Strategies for All Towns in the Central Region and are summarised in **Table 2.1.**

Table 2.1: Summary of existing WC/WDM strategies in the study area

Municipal code	Municipality	Key Demand Centres	WC/WDM Strategy
MAN	Mangaung Metro	Bloemfontein, Thaba Nchu, Botshabelo, Wepener, Dewetsdorp, Reddersburg, Edenburg, and Excelsior.	DWA. June 2012. Water Reconciliation Strategy Study for the Large Bulk Supply Systems: Greater Bloemfontein area.
NC072	Umsobomvu	Colesberg, Noupoort, Norvalspont	Umsobomvu municipality. March 2009. Water demand management and water conservation strategy for Umsobomvu municipality
NC073	Emthanjeni	Britstown, De Aar, Hanover	Emthanjeni Municipality. October 2004. Emthanjeni Water Demand Management Study.
NC074	Kareeberg	Carnavon	Kareeberg Municipality. 2007. Kareeberg Municipality WDM Strategy.
NC076	Thembilihle	Hopetown and Strydenburg	Thembelihle Local Municipality. October 2008. Water demand management and water conservation strategy for Thembelihle local municipality.
NC077	Siyathemba	Marydale, Niekerkshoop, Prieska	DWA Rapid Response Unit. March 2012. WC/WDM Strategy and business plan for Siyathemba Local Municipality.
NC078	Siyancuma	Bucklands, Campbell, Douglas, Griquatown	DWA Rapid Response Unit. March 2012. WC/WDM Strategy and business plan for Siyancuma Local Municipality.
NC083	//Khara Hais	Upington	Upington Municipality. 2003. Upington Bulk Water Meter Requirement Strategy.

Municipal code	Municipality	Key Demand Centres	WC/WDM Strategy
NC084	!Kheis	Groblershoop	DWA Rapid Response Unit. March 2012. WC/WDM Strategy and business plan for !Kheis Local Municipality.

The municipalities supply water to a population of 1.76million (Census 2011) of which 0.75 million reside in the Mangaung metropolitan municipality.

It was not possible to assess the potential for WC/WDM in all the remaining municipalities and therefore priority was given to municipalities adjacent to the Orange River and municipalities with the biggest potential impact. The municipalities that were investigated are summarised in **Table 2.2**.

Table 2.2: Summary of participating municipalities

Municipal code	Municipality	Key demand centres	Category	WSA
DC08	**Siyanda DM**		**C1**	**Yes**
NC082	Kai !Garib	Kakamas, Keimoes, Kenhardt, Eksteenskuil	B3	Yes
NC083	//Khara Hais	Upington; Karos;Lambrechsdrift;Leerkrans, Leseding; Louisvalle, Ntsikelelo,Raaswater	B2	Yes
DC06	**Namakwa DM**		**C1**	**Yes**
NC061	Richtersveld	Alexander Bay, Port Nolloth	B3	Yes
NC062	Nama Khoi	Bergsig, Kleinzee, Komaggas, Nababeep, Okiep, Pelladrift, Springbok, Steinkopf, Vioolsdrif	B3	Yes
NC067	Khâi-Ma	Aggeneys, Pella, Onseepkans, Pofadder	B3	Yes

2.2 MAIN SOURCES OF INFORMATION

The approach adopted combined the collection of both qualitative and quantitative data. Water balance data was obtained and consolidated from a variety of sources, including:

- DWA All Town Strategies (2012);
- DWA Water Infrastructure Status & Intervention Plan (WISIP)(2012);
- Municipal Water Services Development Plans (WSDP),
- Municipal Integrated Development Plan (IDP),
- DWA Blue Drop Reports (2012),
- DWA NIS,
- DWA Regulatory Performance Measurement (RPMS),
- Water Services Information Reference Framework,
- DWA Free Basic Water,
- WRC State of NRW in South Africa Reporting on Non-Revenue Water (WRC, 2012); and

- existing municipal information and WC/WDM strategies.

The modified IWA Water Balance for South Africa was utilised to capture and calculate the water balances for the WSAs as shown in **Figure 2.1** below. The municipalities were requested to complete a quantitative score card prior to interviews conducted by the study team, which allowed the municipality to assess the areas of WC/WDM requiring more concerted effort. Both the water balance and scorecard provide a high-level assessment of the potential for WC/WDM in the area.

<table>
<tr><td rowspan="8">System Input Volume</td><td rowspan="3">Authorised Consumption</td><td rowspan="2">Billed Authorised Consumption</td><td>Billed Metered Consumption</td><td>Free basic Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorised Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="6">Non Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorised Consumption</td></tr>
<tr><td>Customer Meter Inaccuracies</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer Meter</td></tr>
</table>

Figure 2.1: Modified IWA Water Balance

In addition to the quantitative data component, a comprehensive qualitative questionnaire was developed for discussion purposes with the municipalities. The qualitative questionnaire scorecard covers institutional, policy and bylaws, financial, social and technical aspects of the municipality. This questionnaire formed the bulk of the status quo assessment interviews conducted with the technical representatives from the municipalities under investigation, and the open-ended nature of the questions allowed the respondents to provide comprehensive information related to the perceived functioning of the municipalities. Through the discussion, the project team attempted to identify the "quick fix" projects whereby major savings can be achieved for limited capital investment.

3 STATUS QUO ASSESSMENT

3.1 DEMOGRAPHICS

The latest StatsSA Census 2011 population data were utilised and is considered the official and most up to date information available. The demographic profiles of the municipalities participating in the study are summarised in **Table 3.1**.

Table 3.1: Demographics Summary

ID	District Municipality	Local Municipality	Major City/ Town	Population 2011	Household 2011	Source
DC08	Siyanda	//Khara Hais	Upington	93 494	23 244	Census 2011
		Kai !Garib	Keimoes	65 869	16 704	Census 2011
DC06	Namakwa	Nama Khoi	Springbok	47 041	13 193	Census 2011
		Khâi-Ma	Pofadder	12 465	3796	Census 2011
		Richtersveld	Port Nolloth	11 982	3543	Census 2011
Total				**230 851**	**60 480**	

Source: Statistics South Africa Census – 2011

3.2 WATER REQUIREMENTS

The current water requirements for the municipalities in the Orange Water Supply System are summarised in **Table 3.2.**

Table 3.2: Summary of Municipal Water Requirements

Municipality	Blue Drop million m^3/a	WISIP 2012 million m^3/a	All Town 2011 million m^3/a	WSDP/IDP million m^3/a	Municipality million m^3/a	ORECONS Demand report million m^3/a	Adopted Value million m^3/a
//Khara Hais	31.5	16.1	12.8	15.9	13.06	14.644	13.06
Kai !Garib	7.5	1.4	2.2		4.49	2.237	4.49
Nama Khoi	1.7	0.01	11.6		2.09	10.9	2.09
Khâi-Ma	9.6		4.2	0.6	0.8	1.457	0.8
Richtersveld			0.7		0.59	0.767	0.59
Total							**21.03**

There are significant discrepancies between the various information sources as depicted in **Table 3.2,** which required engineering judgement combined with knowledge of the areas to assess the current water demands in the Orange River Supply System. Reasons for the discrepancies include the inclusion or exclusion of mine water and water exported to other areas. The study team adopted and utilised one value from the available sources, which appeared most credible in order to assess the current consumption for individual municipalities. What became clear from the status quo assessments is that most of the municipalities are not in a position to provide definitive water balance calculations. A few of the municipalities provided estimated values based on water treatment works and pump station capacities.

The NRW, water loss and efficiency key performance indicators for the various municipalities are summarised in **Table 3.3**. The data is highly influenced by //Khara Hais which represents 62% of the total water demand and 40% of the population.

Table 3.3: Summary of Municipal NRW KPIs

Indicator	//Khara Hais	Kai !Garib	Nama Khoi	Khâi-Ma	Richtersveld	Total
Annual input volume (million m^3/a)	13.06	4.49	2.09	0.8	0.59	21.03
Population	93 494	65 869	47 041	12 465	11 982	230 846
Number of households	23 244	16 764	13 193	3 796	3 543	60 480
% Non-revenue water	34.4	29.8	24.0	15.3	26.3	31.5
ℓ / capita / day	383	187	122	176	135	250
m^3 / household / month	47	22	13	18	14	29

//Khara Hais municipality shows a consumption of 383 l/c/d which is far above the national average of 238 l/c/d (WRC, 2012). The other municipalities show very reasonable l/c/d consumptions, which are in line with the level of service and climatic conditions. Initial indications are that there is limited scope for reducing the average consumption but considerable scope for reducing the NRW through improved metering, billing processes in some areas.

The combined water loss / NRW situation for the complete study area is shown in **Figure 3.1.**

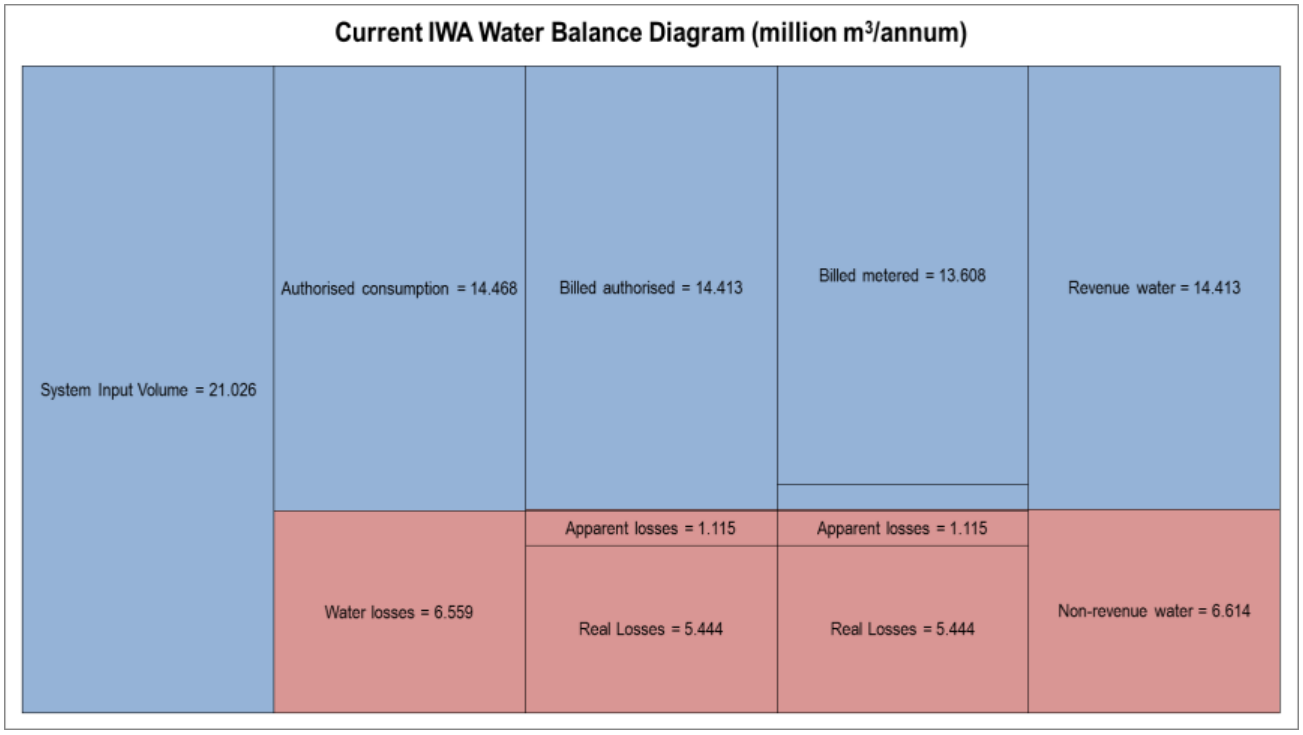

Figure 3.1: Consolidated IWA Water Balance

Based on the water balance shown in **Figure 3.1,** as well as the NRW / water loss key performance indicators for the whole supply system shown in **Table 3.4**, the estimated NRW for the Orange River Supply System is 31.5%, which is below the national average of 36.8%. This indicates that the municipalities falling within the Orange River system are moving in the right direction in terms of NRW management however, significant scope still exists for further reduction

taking into account the arid climatic conditions of the Northern Cape region. Furthermore, most of the municipal water supply systems assessed are small and reasonably formal, which allows for proper metering, billing and cost recovery to take place. This should further aid NRW / water loss reduction.

Table 3.4: Summary of Key Performance Indicators

Key performance indicator	Unit	Study average	National average*
System input volume unit consumption			
litres / capita / day	ℓ / c / d	250	235
m³ / household / month	m³ / hh / month	29	27
m³ / connection / month	m³ / conn / month	55	-
Authorised unit consumption			
litres / capita / day	ℓ / c / d	172	149
m³ / household / month	m³ / hh / month	20	17
m³ / connection / month	m³ / conn / month	38	-
Water loss indicators			
UARL : Losses / connection / day	ℓ / conn / day	36	55
CARL : Losses / connection / day	ℓ / conn / day	467	377
Infrastructure Leakage Index (ILI)	-	13.02	5.1
Losses / km mains / day	m³ / km / day	43.0	22
Non-revenue water	%	31.5%	36.8%
Unbilled Consumption	%	0.3%	-
Water Losses	%	31.2%	31.8%
Apparent losses	%	5.3%	
Real losses	%	25.9%	

*Source: State of Non-revenue water in South Africa (WRC, 2012)

3.3 OVERVIEW OF INDIVIDUAL MUNICIPAL WC/WDM STATUS

3.3.1 //Khara Hais

//Khara Hais comprises the main places of Camp Informal, Group 23 Military Village, Karos, Klippunt, Lambrechtsdrif, Leerkrans, Paballelo, Straussburg, Swartkop and Upington. These areas are largely formal with formal infrastructure, which enables proper metering, billing, and cost recovery. One of the key challenges noted in this municipality is the significant meter replacement backlogs, which have made billing a complicated and ineffective endeavour. A further challenge is the alarmingly high frequency of pipe bursts in the network, which is responsible for a significant portion of the water losses. There are limited WC/WDM measures being undertaken and there is a general lack of management information available to perform a proper assessment of the water losses and potential savings. The municipality is characterised by limited skills and capacity to implement WC/WDM however, there is significant scope for WC/WDM programmes, which will aid in improving the availability of macro management information and water loss control. This will have a positive impact on NRW reduction and improve service delivery.

3.3.2 Kai !Garib

Kai !Garib serves the main places of Alheit, Augrabies Mission, Augrabies, Bloemsmond, Cillie, Kakamas, Kanoneiland, Keimoes, Kenhardt, Lennetsville, Louisvale, Loxtonberg, Lutzburg, Marchand, Raaswater and Riemvasmaak. The level of service is mainly house connections with formal infrastructure, which enables metering, billing, and cost recovery. A large portion of the municipality is considered rural, with a significant indigent population, which leaves limited scope for further improvements in metering and billing. A significant portion of the network is old and dilapidated and must be replaced in the near future to prevent system failure. There are very limited WC/WDM activities undertaken and there is little management information available to perform a proper assessment of the water losses and potential savings. The municipality is characterised by high vacancies and limited skills to implement WC/WDM.

3.3.3 Khâi-Ma

Khâi-Ma serves the main towns of Aggeneys, Onseepkans, Pella and Pofadder. These towns are formal with proper water supply infrastructure. The level of services is mostly at RDP standard and above. The engineering department is characterised by a high vacancy rate, limited technical skills base and limited capacity building. The municipality is beleaguered by a large indigent population and limited economic activity and employment opportunities, which limits further reduction of NRW through increased metering and billing. A few WC/WDM activities have been undertaken by the municipality, including repair of internal plumbing leakage for indigent consumers due to the high levels of non-payment for services in the municipality; which are estimated to be in the order of 60%. There is currently limited management information available to perform a proper assessment of the water losses and potential savings however; the municipality is working towards improving the status quo by conducting a rudimentary water balance on a monthly basis with the assistance of the finance department.

3.3.4 Nama Khoi

Nama Khoi serves the formal areas of Buffelsrivier, Bulletrap, Carolusberg, Concordia, Kleinzee, Komaggas, Nababeep, Okiep, Springbok, Steinkopf and Vioolsdrif. The level of services is mainly RDP standard and above with a very high indigent population. There are a number of WC/WDM activities, which have been undertaken to improve on the availability of management information including monthly meetings in the technical department in order to identify and prioritise areas experiencing high water losses. Active leak detection has also been initiated which will also assist in reducing the water losses. There is limited management information available to perform a proper assessment of the water losses and potential savings however; the municipality is in the process of improving the reporting of NRW between the technical and finance department. The municipality has also identified and filled a large number of the vacancies in the water and sanitation department however; a few vacancies still need to be filled in order to have sufficient capacity and technical skills to implement WC/WDM. The municipality has significant scope for WC/WDM, which includes proactive maintenance and replacement of reticulation pipes some of which are currently very old as well as increased consumer engagement on water issues in order to aid successful implementation of comprehensive WC/WDM programmes.

3.3.5 Richtersveld

Richtersveld serves the formal towns of Alexander Bay, Eksteenfontein, Khubus, Lekkersing, McDougall's Bay, Port Nolloth and Sanddrif. The level of service is mostly individual house connections with formal infrastructure, which enable proper metering, billing, and cost recovery. The municipality is characterised by a large indigent population and limited economic activity and employment opportunities, which limits further reduction of NRW through increased metering and billing. A number of WC/WDM activities have been undertaken by the municipality, most of which have focused on Sizamile, a township located in Port Nolloth, and include repair of internal plumbing leakage, and in general, monthly zone meter monitoring and installation of telemetry systems on the reservoirs and one of the boreholes to monitor the water levels. A significant portion of the network is old and dilapidated and there are no scheduled replacement programmes in place. This must be addressed in the near future to prevent complete system failure. There is information available to perform a proper assessment of the water losses and potential savings. The current billing and cost recovery in the area is estimated to be approximately 70% to 75%. The municipality is plagued by high vacancies and very limited skills and support structures to implement WC/WDM; which must be addressed through proper budgeting and streamlining of procurement process and fleet management practices.

3.4 POTENTIAL FOR WC/WDM

Access to Potable Water: Most formal areas within the study area have access to 24-hour potable water supply. It is clear that most municipalities have made significant inroads towards achieving this target of providing a consistent water supply to consumers. This consistent supply will contribute towards preserving the water supply infrastructure and mitigating complete system failures.

Water Audit / Water Balance: Many municipalities have bulk metering systems in place but lack proper support systems to compile a water balance. There is thus significant potential for improved monitoring and control of water use in most of the municipalities in the study area. Having a firm grasp of the extent of water losses in the municipalities will assist in ensuring that monetary resources are directed towards water loss interventions that will yield the required results by addressing the low hanging fruit. The purpose is to improve efficiency, management, and cost recovery within the municipalities. The quality of the water balance audit is reliant on the consumer database and monitoring results, which are functions that cut across both the finance and technical services departments.

Bulk Metering: During the interview process, most municipalities mentioned that there are bulk meters in place however; the information obtained from the meters is seldom recorded or purposefully utilised, with the exception of a few municipalities. **Figure 3.2** below shows the state of the existing bulk meters. In many cases, the bulk meters are functional and some are relatively new but the investment is not utilised appropriately.

Figure 3.2: Example of bulk metering

Consumer Metering: Most municipalities appear to exhibit average to above average performance on consumer metering however, but when it comes to asset management; the presence of definitive policies and legislation to enforce consumer responsibilities as well as the engagement with the consumers, these elements are largely lacking. Not all municipalities within the study area have 100% consumer metering. It is understood that a few of the municipalities, find it very challenging to effect sufficient NRW reduction due to the substantial indigent populations residing in the areas as well as the inaccuracy of the consumer meters. Nevertheless, some WSAs such as Richtersveld have undertaken consumer meter cleaning and maintenance which is a very positive step towards improving the cost recovery in the area. The status of consumer meters varies in most municipalities and it is summarised as follows:

- Consumer meter age generally ranged between 1 to 50 years, most of them being older than 10 years. The accuracy of the meters is thus compromised which has a negative impact on the quantification of consumer consumption.
- All municipalities surveyed have no structured or proactive meter replacement programmes in place.
- Many of the meters are visible, above ground installations however, a large number of the installations are inside consumer properties, which makes access and reading challenging for the meter readers, as shown in **Figure 3.3**.
- Consumer meters are generally Kent class B type meters.

Figure 3.3: Examples of consumer meters

Institutional Arrangements: There are significant vacancies and skills shortages in the water and sanitation departments within the municipalities and this has a negative impact on the ability of the municipalities to provide good quality water service, and to manage the systems appropriately. Municipalities need to address the skills shortage and fill all critical vacancies to improve institutional capacity and skills to embark on WC/WDM programmes.

Community Awareness Programmes: Promotion of improved water use practices and general awareness regarding the importance of water conservation is not taking place within most municipalities in the study area. Continuous engagement with consumers and provision of information regarding WC/WDM can assist municipalities particularly with WC/WDM measures such as passive leak detection. Consumer leakage reporting and general improvement of water use efficiency would in turn improve the functioning of the water supply systems, and eradicate scheduled intermittent supply. Such programmes however need to be continuous and consistent, and fully supported by the political leaders in the communities. **Figure 3.4** below depicts some of the inefficient irrigation practices observed in the study area with water left to run down the streets during the day, further highlighting the importance of consumer engagement programmes within the Orange River Supply System.

Figure 3.4: Excessive irrigation practices

Leak Repair: Most municipalities are characterised by a low prevalence of internal plumbing leakage, and it appears that a large number of the municipalities implement internal leak repair for indigent consumers from time to time. This is deemed a very positive practice, which is evident in the generally low per capita consumption of most of the participating municipalities.

Xeriscape Gardening and Rain Water Harvesting: Despite the arid climate of the Northern Cape region, some consumers have taken it upon themselves to capture what little rainwater is available in the area as depicted in **Figure 3.5**. Another positive adaptation observed in some of the municipalities visited, was that of xeriscape gardening also shown in **Figure 3.5.** The utilisation of indigenous drought tolerant plants is very appropriate for the study area and contributes towards to the aesthetic appeal of the region without requiring large volumes of water and compromising the potable water supply.

Figure 3.5: Example of rainwater harvesting and xeriscape gardening in the Nama Khoi and Khâi-Ma Municipalities

Infrastructure Maintenance: It appears that a number of the municipalities do not have a comprehensive asset register that not only complies with MFMA requirements; but will also be a

valuable working mechanism for maintenance and refurbishment of assets. It is recommended that municipalities should adopt and implement modern GIS water and sanitation master planning and a fault reporting and repair system that will link with the consumer billing system and service level data. The asset register should also ideally contain information such as the life span of the network, location of the assets and estimated replacement value top aid proper planning and maintenance.

3.5 DRINKING WATER QUALITY

Drinking water quality has remained a significant challenge in a number of municipalities within the study area particularly in the rural supply schemes. The results from the Blue Drop assessment report 2012 revealed that some municipalities such as Khâi-Ma and Richtersveld Municipalities have performed poorly, particularly with regards to the water quality of the rural schemes with scores of 6.50% for Witbank in Khâi-Ma and 36.77% for Richtersveld as a whole. The scores reflect that there is huge scope for the improvement of drinking water quality compliance and service delivery within the study area. Mitigation measures may include increased training for water process controllers, targeted budgeting, and maintenance of the water treatment infrastructure and improved monitoring and reporting of process. The improvement of the water quality will also be essential to improve revenue recovery as generally consumers will not be willing to pay for water, which they feel is not of an acceptable standard for potable use. The quality of the raw water in the area also appears to have been compromised with significant eutrophication in the Orange River which contributes towards increasing water treatment costs as depicted in **Figure 3.6**.

Figure 3.6: Current state of the Orange River with the evident greening of the river

3.6 INDIGENT REGISTER

All Water Services Authorities that were visited mentioned that indigent registers are updated annually although the definition of indigent differs from municipality to municipality. The indigent registers in many cases do not accurately reflect the status quo within the municipalities and as a result, many consumers are not benefitting from the free basic allocation. This has a negative

impact on the planning and prioritisation processes within the municipalities. WSA's are urged to embark on community awareness campaigns and encourage consumers that qualify as indigents to register. In most municipalities, registered indigents receive the free basic services provided by the municipalities and the rest of the consumers are expected to pay for the services.

3.7 QUANTITATIVE SCORECARD

The quantitative scorecard for the Orange River Supply System is summarised in **Figure 3.7** below.

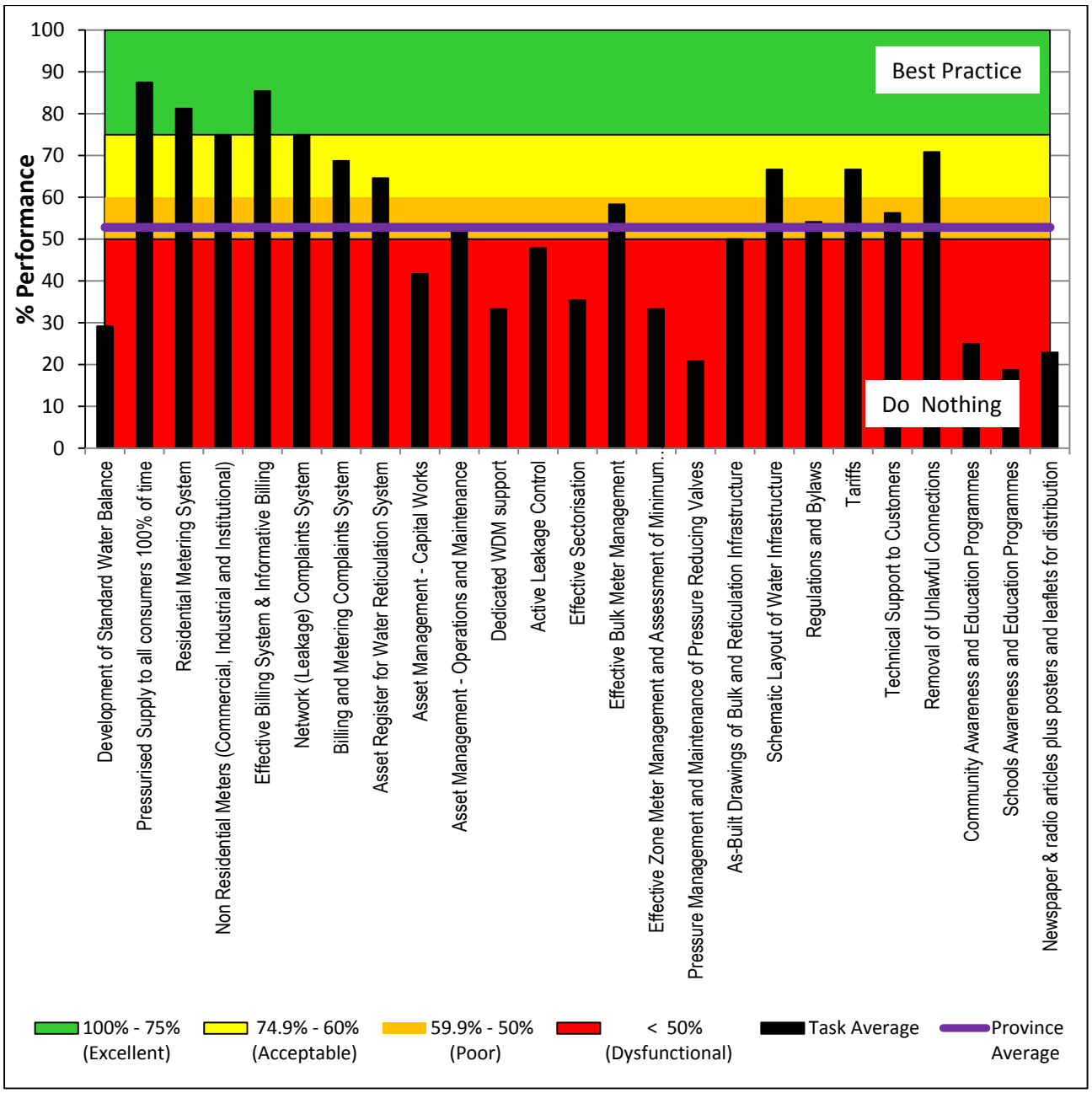

Figure 3.7: Quantitative Scorecard Assessment for the Northern Cape Municipalities

The quantitative score card suggests that the basic structures for the implementation of WC/WDM are present in most of the municipalities investigated however, what is absent, are the support structure to ensure sustained WC/WDM and good quality service delivery. The municipalities appears to exhibit average to above average performance on consumer metering however, consumer support, legislative enforcement and proactive system maintenance and leakage control are generally lacking. Furthermore, the financial tools, particularly the water tariffs; are currently not adequate to support WC/WDM and ensure that water consumption remains at acceptable levels. It is clear from the scorecard that in order to improve WC/WDM in the study area, these elements will need to be improved. This will require the establishment of WC/WDM steering committees to address these issues, which should include the consolidation of NRW and water loss information, consumer awareness and education, ensuring the budgeting for and implementation of proactive asset maintenance as well as facilitating the establishment of proper water services bylaws and policies to aid the enforcement of water loss control.

Proper rising block tariffs are also required which must be supported by the political constituencies. Payment for water services must be strongly and decisively driven by the councils to ensure that the water service provision is sustainable and to improve water security. It has been noted that in many of the municipalities, the cost of water in no way reflects the cost of service provision, which is a serious concern; as this significantly compromises the sustainability of the municipalities. This matter must be dealt with swiftly and with the seriousness warranted in order to ensure functional self-sustaining municipalities in the future. The indigent registration processes and verification in the municipalities also require further consideration. It has been observed that in various municipalities where certain settlements or areas are assumed to be indigent, consumers that have the means to pay for services migrate to these areas in order keep the cost of living low. This implies that the assumed levels of indigence may be incorrect and further contribute to the low levels of cost recovery which exacerbates the dependence of these autonomous institutions on grant funding.

4 WC/WDM STRATEGY

Very few municipalities within the study area are undertaking proactive WC/WDM activities and the most common challenge were noted to include poor institutional arrangements, lack of human capacity, limited knowledge and skills, and lack of funding to embark on WC/WDM programmes.

In order to address the current challenges and usage of water within the study area, many WC/WDM interventions can be considered for different scenarios. Each municipality within the study area has its own unique problems to some extent although the main underlying issues are often similar. Before deciding on how to address these problems, it is first necessary to understand them. An overview of all possible WC/WDM interventions is necessary so that potential savings are achieved. A full WC/WDM strategy would normally include a wide range of interventions tailored to the specific problems identified in each area. The interventions would be prioritised in such a manner that the maximum savings can be achieved for the minimum expense and the implementation would be scheduled accordingly.

A Strength, Weaknesses, Opportunities and Threat (SWOT) analysis was undertaken for each main strategic component of WC/WDM. The results from the assessment and proposed strategy is summarised in the following sections.

Institutional Assessments	Institutional Strategy
• The relationship between the municipality and politicians is good in many municipalities, however there is a lack of decisiveness and limited knowledge of the water business; • The water and sanitation departments generally have approved organograms in place but lacking human capacity and relevant skills; • Most of the municipalities lack capacity at mid management and operation and maintenance levels; • The water and sanitation departments have limited technical skills such as technicians, artisans, and qualified plumbers with limited to no WC/WDM training taking place; • There is a significant lack of vehicles and limited spares to do maintenance; • There is a good relationships between the finance and technical departments; • Functional standing committees to discuss water related issues are generally lacking.	• Undertake councillor WC/WDM induction programmes to capitalise on the existing relationship and build communication bridges between the municipalities and the customers; • Build on the existing skills base by instituting mandatory training programmes for technical staff. Invest in team building and workshop sessions incorporating the councillors and municipal management to ensure continuing high staff morale; • Advertise and fill the identified critical vacant posts; • Engage with the Department of Finance and allocate an adequate budget for the critical spares. Allocate a specific person who will be responsible for expediting equipment orders and managing quality control in terms of the procurement process; • Establish NRW steering committees comprising representatives from the technical, communications and finance departments to improve communication and access to information; • Institute monthly reporting meetings to facilitate coordinated planning and implementation of projects.
Financial Assessments	**Financial Strategy**
• In many cases meter reading is not conducted to its full potential; • The meter readings are captured manually and there are no proper audits taking place to verify the data; • Management information is generally limited with few municipalities conducting monthly water balance calculations; • Limited training is given to meter readers; • The billing is not informative in many municipalities; • The indigents get free basic water,	• Clarify and establish the minimum requirements for the appointment of meter readers and ensure that the literacy levels of the meter readers are appropriate for capturing the vital billing information. Provide a mandatory induction meter reading training course and undertake periodic spot checks to improve the accuracy of the meter reading; • Through monthly monitoring and capture of the bulk meter readings, conduct basic monthly water balance calculations with the necessary NRW KPI's included which must be developed with representatives from department of finance. This will aid improved management of revenue and NRW; • Include WC/WDM training for the meters readers to facilitate their understanding of the water business. Include infrastructure leakage reporting as part of the employment profile for the meter readers to facilitate passive and cost

which differs between municipalities; • The tariff structures in most municipalities are not cost reflective and are not built on business principles; • There are bylaws in place but they do not address WCWDM related issues and are seldom enforced;	effective leak detection; • Municipalities should consider including water conservation tips and information in the water bill. It is also recommended to display 6 months graphical consumption data on the bill to aid consumers in effectively monitoring water use; • Municipalities should monitor and update the indigent registers to improve planning and development processes; • Undertake infrastructure-cleaning programmes. Utilise the opportunity to create local ward based employment and improve asset management. This process will improve the accessibility of the meters, which are the cash register of the municipalities and simultaneously garner community support for cost recovery programmes; • Ensure that the rising block tariffs are sufficiently differentiated in cost at each level to promote WC/WDM with the highest tariff at least twice the amount of the lowest tariff; • Review the existing bylaws and ensure that they address water efficiency legislation. Develop partnerships with the credit control and legal departments as well as the SAPS and put appropriate bylaw enforcement mechanisms in place.
Social Assessment	**Social Strategy**
• Employment and economical activities in the study area are limited with seasonal agricultural based employment forming the bulk of the available employment opportunities; • Most of the municipalities are characterised by significant indigent populations and low levels of payment for services; • The departments do not have continuous community awareness programmes in place; • Consumers do not value water very highly in certain areas with the exception of municipalities such as Richtersveld which have undergone restrictions due to limitations in water availability; • Very high levels garden watering have been observed in many of the municipalities in the study area particularly //Khara Hais municipality; • There are no continuous community or schools awareness campaigns taking place.	• Focus on educating the indigent populations on efficient water use and the importance of the free basic allocation as well as its limitations. • Publicise the indigent registration programme through the community mentor programme and involve the ward councillors to assist with the verification of the indigent households; • Budget and undertake continuous annual education and awareness campaigns focusing on promoting water use efficiency. Develop simple visual material in the form of pamphlets to be attached to the water bill, which can be used to educate consumers on efficient water use. Once the initial communication has been established, consider periodically publicising water tips on local media such as radio stations and newspapers • Establish relationships with schools. Monitor their consumption on a monthly basis and undertake education and awareness. Huge benefit can be derived from this. The section 21 schools in particular should be visited, monitored and encouraged to fix leakage as the O&M budgets are operated by the school management for this category of schools. Engage with the schools through workshops and promote water conservation in the education sector.

Technical Assessments	Technical Strategy
• Bulk metering is taking place in most areas; • Some municipalities have improved on monthly reporting but in many cases, there are no monthly reports generated which is the result of poor record keeping; • All non-domestic consumers are metered in many areas while most domestic consumers are metered in the urban areas and not metered in the rural areas, • There are very limited to no meter audits taking place; • The municipalities generally do not have replacement and maintenance programmes in place for the existing installed meters; • The water supply networks are generally operated at average pressures of 2 to 4bar; • There is no pressure management taking place in the area; • There is limited zone metering taking place however, this is improving in a number of the municipalities.	• Read bulk meters on a monthly basis and capture the readings on a spreadsheet which can be updated. Monitor input volumes and other Non-Revenue Water key performance indicators; • Periodically undertake meter audits particularly for the non-domestic consumers to ensure that the meters are in proper working order, and that the consumers are billed accurately for water use; • Budget and implement meter replacement programmes particularly for bulk and non-domestic consumers. Ensure that all new meter installations where practicable are outside the properties to improve accessibility for meter reading personnel. Monitor and undertake spot checks for meter readers to ensure that the meter reading takes place regularly and accurately to improve consumer confidence in the metering and billing process; • Maintain the satisfactory operating pressure and ensure that operating pressures never exceed the DWA regulatory standard of 9 bar; • Sectorise the water supply systems into manageable sized areas or zones to enable improved monitoring of the system. Install zone meters and ensure that they are read on a monthly. The readings must be captured on spreadsheets and read on a monthly basis.

5 POTENTIAL SAVINGS FROM WC/WDM

5.1 TARGET KPI'S

The targeted NRW performance indicator reductions are summarised in **Table 5.1.**

Table 5.1: Summary of Targeted Non Revenue Water Key Performance Indicators

Municipality	Current l/c/d	Target l/c/d	% l/c/d Reduction	Current % NRW	Target % NRW	% NRW Reduction
//Khara Hais	383	201	47.5%	34.4%	19.5%	15%
Kai !Garib	187	177	5.3%	29.8%	22.5%	7.2%
Nama Khoi	122	122	0%	24.0%	18.7%	5.3%
Khâi-Ma	176	174	1.1%	15.3%	10.1%	5.1%
Richtersveld	135	135	0%	26.3%	19.1%	7.2%
Average	**172**	**140**	**18.6%**	**31.5%**	**19.7%**	**11.7%**

The NRW key performance indicators presented suggest that the greatest potential for NRW reduction in the supply system exists in //Khara Hais municipality. The per capita consumption in some cases is significantly below the national average and no further reductions in the system input volume can reasonably be achieved. Due to the limited economic activities in the area and the high levels of indigent populations residing within the Orange River Supply System, the billed metered consumption can be increased to a limited extent in certain areas in order to reduce the NRW.

5.2 TARGET WATER BALANCE

Annual projected water balances were compiled for all the participating municipalities utilising the IWA standard water balance model. The consolidated results are presented in the target water balance for the Orange River Supply System shown in **Figure 5.1** below.

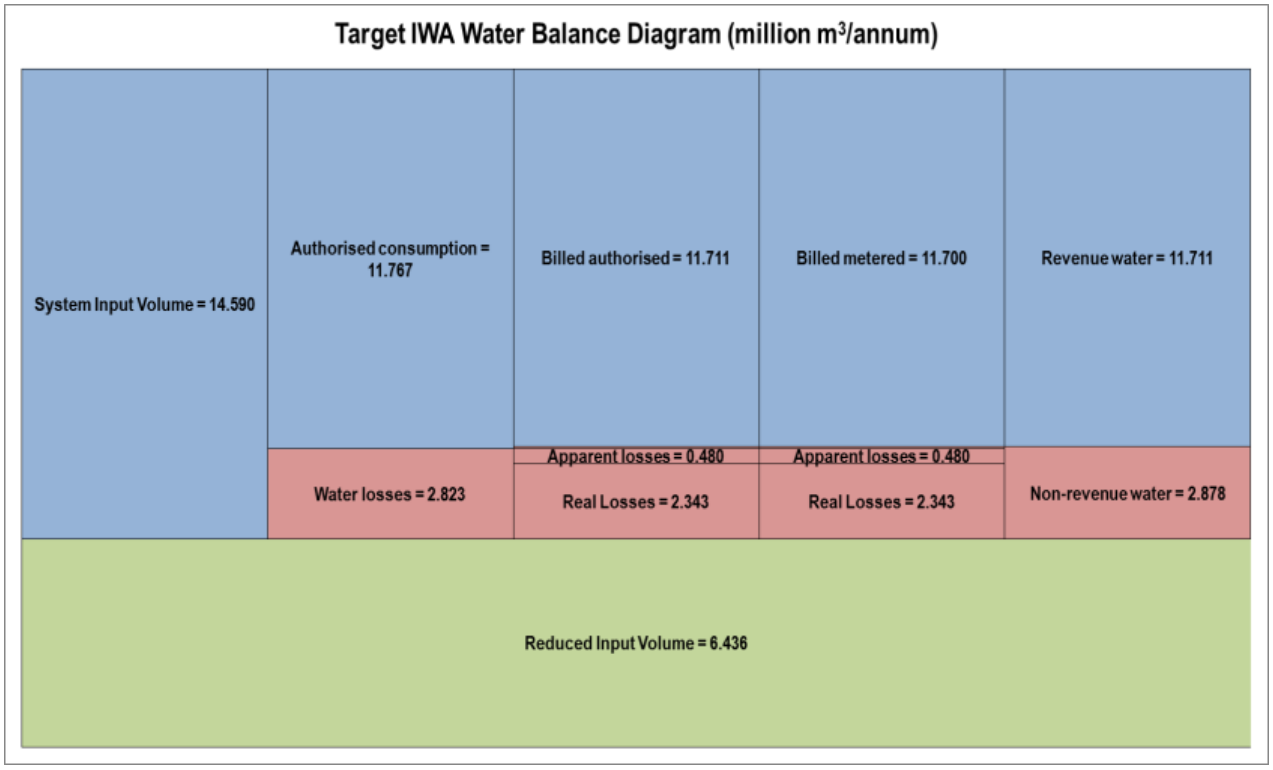

Figure 5.1: Target Water Balance for Orange River Supply System

Based on the calculations, the targeted water balance illustrates a system input volume reduction of 30.6% and NRW reduction of 11.7% from 31.5% to 19.7%. As mentioned previously, a significant reduction in the system input volume for most of the municipalities within the Orange River Supply System is not expected as the per capita consumption indicates adequate water use efficiency. The significant reduction of the average system input volume is highly influenced by //Khara Hais municipality, in which a significant reduction is required to bring the per capita consumption down to levels that are more acceptable. In general, the NRW can be reduced to more appropriate levels through improved metering and billing in a large portion of the municipalities. Most of the municipalities contain substantial formal areas where billing and

metering can take place effectively however it must be noted that some limitations do exist due to the economic challenges in the area as mentioned previously.

The potential savings for the municipalities investigated and the additional municipalities mentioned in Section 3.1 are summarised in **Table 5.2**

Table 5.2: Summary of potential savings

Municipal code	Municipality	Information source	Target date	Potential Saving million m^3/annum
NC082	//Khara Hais	This study	2017	6.204
NC083	Kai !Garib	This study	2017	0.224
NC061	Nama Khoi	This study	2017	0.000
NC062	Khâi-Ma	This study	2017	0.008
NC067	Richtersveld	This study	2017	0.000
Sub-total – focus areas				**6.436**
MAN	Mangaung Metro	Greater Bloem Recon	2016	11.000
NC072	Umsobomvu	All town strategy, 2010	2015	0.268
NC073	Emthanjeni	All town strategy, 2009	2015	0.210
NC074	Kareeberg	All town strategy, 2009	2015	0.060
NC076	Thembilihle	All town strategy, 2009	2015	0.136
NC077	Siyathemba	RRU programme	2017	0.242
NC078	Siyancuma	RRU programme	2017	0.222
NC084	!Kheis	RRU programme	2017	0.043
Sub-total – additional areas				**12.181**
Total				**18.617**

6 CRITICAL RISK FACTORS

In view of the strategy presented above, it is important to note that there are a number of key critical potential risks that exist concerning the implementation of the WC/WDM in municipalities, which are considered to be as follows:

Insufficient capacity to implement and spend allocated budgets:

One of the key problem areas which have been identified in the municipalities has not only been the deficient funding for implementation of WC/WDM measures but more importantly; the glaring lack of capacity to spend the grant funding and budgets allocated for these activities. This is a crucial risk because unless the appropriately skilled individuals are appointed to fill the correct positions, and supported with continuous training; the status quo of poor service delivery in some areas and high non-revenue water will remain unchanged for the near future.

Inadequate political will to support WC/WDM

A further pervasive risk, which has been encountered in a number of municipalities; is the distinct lack of political will to actively support the implementation of WC/WDM measures in municipalities. This fact attests to perhaps a lack of understanding of the importance and value in implementing these measures as well as a lack of urgency in some cases, as the reality of the water scarcity issues has not fully set in for some municipalities. The importance of the political support for WC/WDM cannot be stressed enough as this impacts significantly on how the consumers view water conservation, taking a cue from the political leaders and gatekeepers to the community and also affects the budgeting processes within municipalities. In the absence of such support and prioritisation; WC/WDM will neither be sustained, nor implemented successfully in municipalities.

Inadequate tariffs which do not support WC/WDM

A key concern throughout the assessments conducted has been the inadequacy of the water tariffs to not only encourage WC/WDM, but to sustain service delivery as well. Most of the municipality surveyed made mention of the fact that the cost of water charged to the consumer, in many cases does not in any way reflect the cost of providing water services. This is a pertinent risk, as municipalities have no hope of future sustainability if the revenue cannot sustain the cost of services. It is acknowledged that many municipalities are plagued by high levels of indigent populations however increased internal engagement between departments and with the political constituencies is required in order to arrive at more cost reflective tariff setting which will also encourage consumers to save water.

Inadequate billing and metering

It is a reality that billing and metering of consumers is one of the most effective measures to encourage water conservation. Whilst this is not feasible in certain areas, it has been observed that a number of municipalities are not billing and recovering revenue even in areas which are metered and can be billed. Proper billing and metering is essential for the sustainability of a municipality and for the delivery of good quality services where the infrastructure can be serviced and maintained. Unless metering and billing are implemented, municipalities run the very real risk that the water demands will continue to rise as consumers will not be encouraged to change or adapt water use practices in the absence of some consequence for wasteful behaviour.

6.1 BUDGET REQUIREMENTS

The strategy development focuses on methods to reduce water losses. Recommendations for WC/WDM measures are based on the findings of the various analyses undertaken in the participating municipalities. The assessment includes recommendations on interventions, estimated costs, and priorities.

The five year estimated budget requirements for implementing WC/WDM in the study area is summarised in **Table 6.1** and **Table 6.2**.

It is envisaged that approximately R200 million is required over a five-year period for the Orange River Supply System in order to implement the WC/WDM strategy. It is anticipated that the initial investment into WC/WDM will be relatively high in order for the implementation to proceed

however, a decline in expenditure is expected once municipalities have the WC/WDM interventions up and running; and the costs will mostly be for the maintenance of the efforts in order to sustain savings.

Table 6.1: Summary of Orange River Supply System 5 year budget requirement

Component	Type	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Institutional	CAPEX	R 1 400 000	R 200 000	R 400 000	R 0	R 0	R 2 000 000
	OPEX	R 1 715 000	R 1 715 000	R 1 715 000	R 1 715 000	R 1 715 000	R 8 575 000
	TOTAL	R 3 115 000	R 1 915 000	R 2 115 000	R 1 715 000	R 1 715 000	R 10 575 000
Financial	CAPEX	R 3 261 850	R 100 000	R 500 000	R 0	R 0	R 3 861 850
	OPEX	R 13 305 600	R 13 305 600	R 13 305 600	R 13 305 600	R 13 305 600	R 66 528 000
	TOTAL	R 16 567 450	R 13 405 600	R 13 805 600	R 13 305 600	R 13 305 600	R 70 389 850
Social	CAPEX	R 2 827 520	R 2 027 520	R 1 927 520	R 1 927 520	R 1 927 520	R 10 637 600
	OPEX	R 4 366 800	R 4 366 800	R 4 366 800	R 4 366 800	R 4 366 800	R 21 834 000
	TOTAL	R 7 194 320	R 6 394 320	R 6 294 320	R 6 294 320	R 6 294 320	R 32 471 600
Technical	CAPEX	R 10 706 352	R 9 311 352	R 7 531 352	R 6 866 352	R 6 856 352	R 41 271 760
	OPEX	R 8 705 860	R 8 705 860	R 8 705 860	R 8 705 860	R 8 705 860	R 43 529 300
	TOTAL	R 19 412 212	R 18 017 212	R 16 237 212	R 15 572 212	R 15 562 212	R 84 801 060
Total	CAPEX	R 18 195 722	R 11 638 872	R 10 358 872	R 8 793 872	R 8 783 872	R 57 771 210
	OPEX	R 28 093 260	R 28 093 260	R 28 093 260	R 28 093 260	R 28 093 260	R 140 466 300
	TOTAL	R 46 288 982	R 39 732 132	R 38 452 132	R 36 887 132	R 36 877 132	R 198 237 510

Table 6.2: Summary of budget requirements per municipality

Component	Type	Year 1	Year 2	Year 3	Year 4	Year 5	Total
//Khara Hais	CAPEX	R 5 897 922	R 5 597 872	R 4 697 872	R 4 597 872	R 4 587 872	R 25 379 410
	OPEX	R 9 840 460	R 9 840 460	R 9 840 460	R 9 840 460	R 9 840 460	R 49 202 300
	TOTAL	**R 15 738 382**	**R 15 438 332**	**R 14 538 332**	**R 14 438 332**	**R 14 428 332**	**R 74 581 710**
Richtersveld	CAPEX	R 2 300 678	R 1 061 028	R 966 028	R 703 528	R 703 528	R 5 734 790
	OPEX	R 2 329 395	R 2 329 395	R 2 329 395	R 2 329 395	R 2 329 395	R 11 646 975
	TOTAL	**R 4 630 073**	**R 3 390 423**	**R 3 295 423**	**R 3 032 923**	**R 3 032 923**	**R 17 381 765**
Khâi-Ma	CAPEX	R 2 349 760	R 1 097 460	R 1 002 460	R 739 960	R 739 960	R 5 929 600
	OPEX	R 2 421 740	R 2 421 740	R 2 421 740	R 2 421 740	R 2 421 740	R 12 108 700
	TOTAL	R 4 771 500	R 3 519 200	R 3 424 200	R 3 161 700	R 3 161 700	R 18 038 300
Kai !Garib	CAPEX	R 4 258 480	R 2 243 280	R 2 148 280	R 1 768 280	R 1 768 280	R 12 186 600
	OPEX	R 7 525 680	R 7 525 680	R 7 525 680	R 7 525 680	R 7 525 680	R 37 628 400
	TOTAL	**R 11 784 160**	**R 9 768 960**	**R 9 673 960**	**R 9 293 960**	**R 9 293 960**	**R 49 815 000**
Nama Khoi	CAPEX	R 3 388 882	R 1 639 232	R 1 544 232	R 984 232	R 984 232	R 8 540 810
	OPEX	R 5 975 985	R 5 975 985	R 5 975 985	R 5 975 985	R 5 975 985	R 29 879 925
	TOTAL	**R 9 364 867**	**R 7 615 217**	**R 7 520 217**	**R 6 960 217**	**R 6 960 217**	**R 38 420 735**
Total	CAPEX	R 18 195 722	R 11 638 872	R 10 358 872	R 8 793 872	R 8 783 872	R 57 771 210
	OPEX	R 28 093 260	R 28 093 260	R 28 093 260	R 28 093 260	R 28 093 260	R 140 466 300
	TOTAL	**R 46 288 982**	**R 39 732 132**	**R 38 452 132**	**R 36 887 132**	**R 36 877 132**	**R 198 237 510**

7 SUMMARY AND CONCLUSIONS

Based on the findings of the urban water sector assessment detailed above, it is clear that there is significant scope for WC/WDM in the Orange River Supply System urban sector; which will result in both a reduction of non-revenue water and to a limited extent, the total system input volume. A serious concern however, is the pervasive limitation in institutional capacity and technical skills to embark on WC/WDM programmes in most municipalities which; should be resolved before focusing on the following interventions:

- Municipalities should improve service delivery, as this will minimise illegal connections in some areas;
- Improve the availability of macro and micro management information;
- Improve political support through councillor awareness programmes focusing on the water business;
- Promotion of payment of services through continuous community awareness campaigns;
- Embark on schools awareness programmes promoting reporting of leaks and water wise practices;
- Undertake community awareness programmes that promote the value of water wise gardening;
- Maintain satisfactory operating pressures and install PRVs in areas experiencing high pressures and ensure that operating pressures never exceed the DWA regulatory standard of 9 bar;
- Provide training for meter readers and perform monthly audits to eliminate estimates and other inaccuracies;
- Perform meter audits and cleaning of infrastructure to improve meter reading and meter accessibility.

8 RECOMMENDATIONS

8.1 INSTITUTIONAL

- The key intervention for the municipalities will be to address the critical vacancies or shortages in human resources and skills particularly at the middle management level as well as operation and maintenance;
- Dedicated individuals are required in order to drive WC/WDM, which will in turn improve the availability and accuracy of management information;
- WC/WDM training is pertinent to support the municipal personnel in undertaking the required water loss reduction at both the management and Operations and Maintenance levels in order to improve the functioning of the water supply system as a whole.
- The provision of good quality water services will be crucial to ensuring improvement in cost recovery as well as cost efficiency through water savings. It is also pertinent that the lines of communication are improved between the different municipal departments specifically between the finance and technical departments in order to aid more efficient access to information; which will allow for more effective and coordinated planning.

- The establishment of an NRW steering committee comprising the relevant councillors, finance representatives, communication, and the technical department is recommended to facilitate improved reporting and management of NRW. Procurement processes must also be streamlined in order to enable swifter access to support structures required for operations and maintenance tasks, which are necessary to mitigate water losses in the systems.

8.2 FINANCIAL

- A review of the current billing and cost recovery systems is required in order to aid ease of access to the necessary billing information and reports. The training requirements in this regard must also be identified to ensure optimal operation of the system.
- Municipalities should undertake meter audits in order to identify unmetered connections and non-functional meters, which could, in the short term; significantly improve cost recovery. Furthermore, it is imperative that the tariff setting process include inputs from the technical departments, which could assist in making the tariffs increasingly effective in achieving the water use efficiency objectives.
- Improve budgeting through prioritisation processes. National Treasury has been very vocal on the dependency of municipalities on grant funding and has emphatically expressed the need for municipalities to actively demonstrate a commitment to proper budgeting, planning and cost recovery with a focus on demand side management as a first step in managing and more effectively utilising the available resources.
- Implement monitoring and engagement of consumers, particularly the top consumers. An effective system to capture and refer billing related complaints and progressive payment of services in the municipalities are also required, which must be supported and preceded by proper community awareness and education, and wide spread public engagement.

8.3 SOCIAL

- Extensive and continuous consumer water education programmes are required which will focus on the community and institutions such as schools, which are potent avenues for the reduction of water losses;
- The installation of water efficient devices, as well as rainwater harvesting, is also avenues, which can further be explored for promotion and implementation in different sectors. This can aid water loss reduction at the consumer level, particularly in areas where metering and billing cannot immediately be effected, and where cost recovery is very low due to high indigent populations;
- Structures should also be put in place to support consumers in reporting leakage and other service related complaints, which should be captured electronically in order to allow proper tracking and analysis of water loss contributors and significant problem areas;
- The political leadership should ideally lead these interventions and provide substantial support in order to improve the sustainability of the community-based interventions.

8.4 TECHNICAL

- Measurement of the system input volumes as a first step is required to come to grips with the extent of water losses in the Municipality. Sectorisation and zone metering and monitoring is also required to aid in the micro management of the system;
- The installation of meters is the first step in areas where there are no meters installed. They will however be altogether useless if the information is not captured and monitored on a monthly basis. Proper record keeping is key, as well as the appropriate protection and of the existing meters
- Proper budgets must also be set aside for proactive infrastructure asset maintenance to avoid unmitigated system failure
- Passive leak detection through community reporting would greatly enhance the ability of the municipality to monitor the network and reduce water losses;
- There is a need for municipalities to develop digital as built drawings of the network, which must be accompanied by the updating of the asset register;
- Municipalities should improve service delivery, as this will minimise illegal connections in the area.

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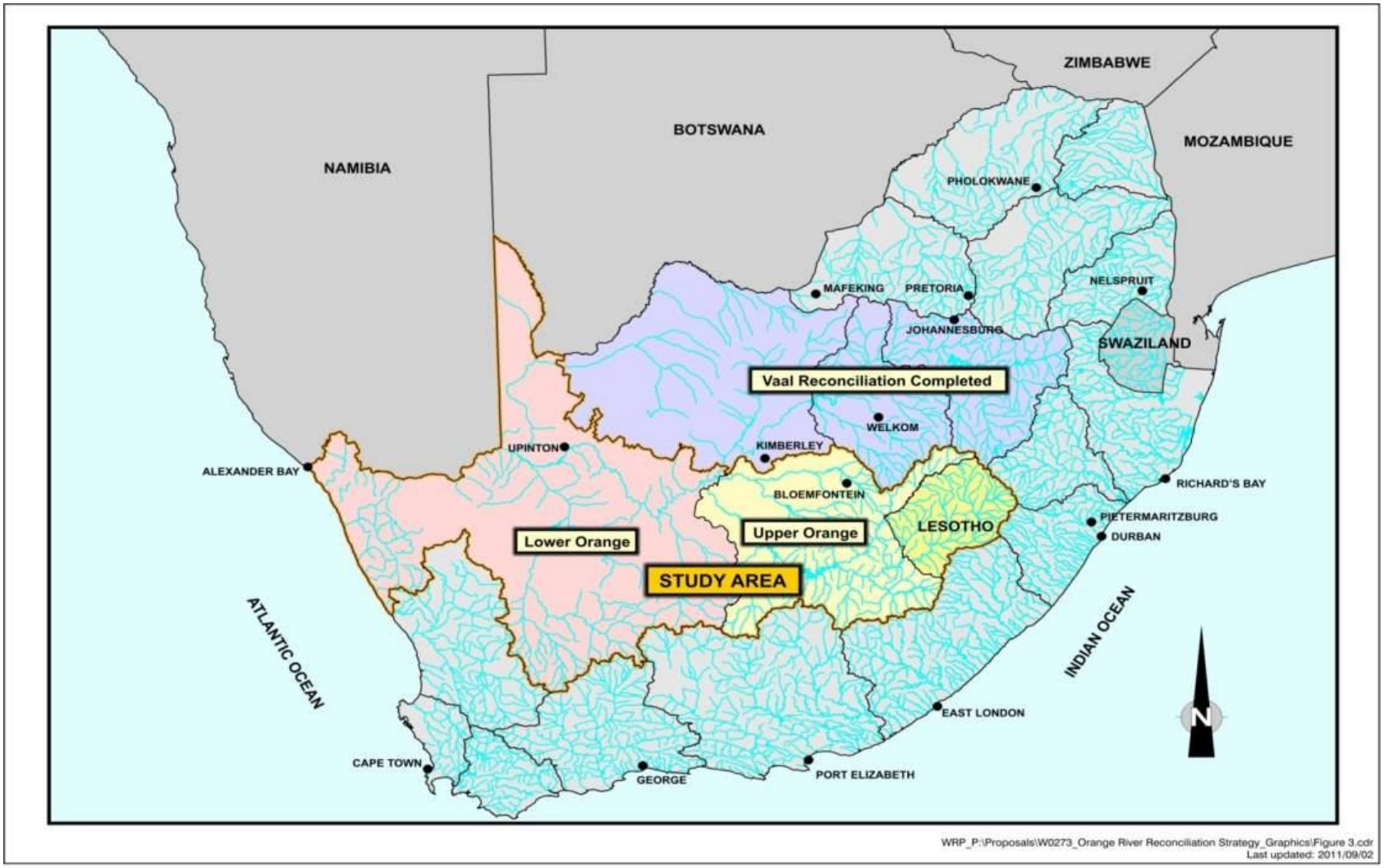
Appendix A

Map of study area



DEVELOPMENT OF RECONCILIATION STRATEGIES FOR LARGE BULK WATER SUPPLY SYSTEMS: ORANGE RIVER: PROPOSAL

Study area locality map

Appendix B

Municipalities in the Upper and Lower Orange Water Management Area

Summary of municipalities with a major portion in the Upper or Lower Orange WMA

No	Code	Municipality Name	Water Management Area	Population
1	EC133	Inkwanca Local Municipality	Upper Orange, Mzimvubu to Keiskamma, Fish to Tsitsikamma	21 971
2	EC142	Senqu Local Municipality	Upper Orange, Mzimvubu to Keiskamma	134 150
3	EC143	Maletswai Local Municipality	Upper Orange, Mzimvubu to Keiskamma	43 800
4	EC144	Gariep Local Municipality	Upper Orange, Fish to Tsitsikamma	33 677
5	FS161	Letsemeng Local Municipality	Lower Vaal, Upper Orange	38 628
6	FS162	Kopanong Local Municipality	Upper Orange	49 171
7	FS163	Mohokare Local Municipality	Upper Orange	34 146
8	FS171	Naledi Local Municipality	Upper Orange	24 314
9	FS172	Mangaung Local Municipality	Middle Vaal, Upper Orange	747 431
10	FS173	Mantsopa Local Municipality	Middle Vaal, Upper Orange	51 056
11	FS181	Masilonyana Local Municipality	Middle Vaal, Upper Orange	63 334
12	FS182	Tokologo Local Municipality	Lower Vaal, Upper Orange	28 986
13	NC061	Richtersveld Local Municipality	Lower Orange	11 982
14	NC062	Nama Khoi Local Municipality	Lower Orange	47 041
15	NC064	Kamiesberg Local Municipality	Lower Orange, Olifants / Doorn	10 187
16	NC065	Hantam Local Municipality	Lower Orange, Olifants / Doorn	21 578
17	NC066	Karoo Hoogland Local Municipality	Lower Orange, Olifants / Doorn, Gouritz	12 588
18	NC067	Khâi-Ma Local Municipality	Lower Orange	12 465
19	NC071	Ubuntu Local Municipality	Upper Orange, Lower Orange, Fish to Tsitsikamma	18 601
20	NC072	Umsobomvu Local Municipality	Upper Orange, Fish to Tsitsikamma	28 376
21	NC073	Emthanjeni Local Municipality	Upper Orange, Lower Orange	42 356
22	NC074	Kareeberg Local Municipality	Lower Orange	11 673
23	NC075	Renosterberg Local Municipality	Upper Orange, Lower Orange	10 978
24	NC076	Thembelihle Local Municipality	Upper Orange, Lower Orange	15 701
25	NC077	Siyathemba Local Municipality	Lower Orange	21 591
26	NC078	Siyancuma Local Municipality	Lower Vaal, Upper Orange, Lower Orange	37 076
27	NC081	Mier Local Municipality	Lower Orange	7 003
28	NC082	Kai !Garib Local Municipality	Lower Orange	65 869
29	NC083	//Khara Hais Local Municipality	Lower Orange	93 494
30	NC084	!Kheis Local Municipality	Lower Orange	16 637
			Total	**1 755 860**