Report number: ORASECOM 003/2009

SHARING THE WATER RESOURCES OF THE ORANGE SENQU RIVER BASIN

Feasibility Study for the Development of a Mechanism to Mobilize Funds for Catchment Conservation

CONSERVATION FUND ASSESSEMENT REPORT
- Identification of key mitigation measures

JUNE 2009

PREPARED BY:

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Executive Summary

This report forms part of the final deliverables for the Feasibility Study for the Development of a Mechanism to Mobilize Funds for Catchment Conservation. This report is to be read in conjunction with the Business Case report which details the organisational/institutional and financial models for proposed ORASECOM Conservation Fund.

The Orange-Senqu River originates in the highlands of Lesotho and stretches over 2 300km from the source to its month on the Atlantic Ocean. The river system is one of the largest river basins in Southern Africa with a total catchment area of 850,000km^2 inside Lesotho, Botswana, Namibia and South Africa.

The basin contends with several issues which arise from the extensive alteration and utilisation of its water resources. There are considerable management challenges which have arisen from the competing demands and intricate socio-economic drivers within the basin. Thus, in order to enhance the conservation of the catchment's water and related natural resources, the ORASECOM Secretariat invited tenders in April 2008 for the project: "*Feasibility Study for Development of Mechanism to Mobilize Funds for Catchment Conservation*" with the tender being subsequently awarded to Pegasys Strategy and Development (Pty) Ltd in September 2008. The feasibility level project required identification of conservation issues in the basin and that innovative mechanisms for the development of a fund to finance conservation measures be investigated and developed into a business case.

This project comprised three phases, namely a 2-month inception phase, a 3-month consultative phase and a 2-month reporting phase. The inception phase reviewed available information and experience in order to scope the project and an appropriate role of ORASECOM.

Following extensive review of literature as well as discussions with the ORASECOM Commissioners, the Desert Research Foundation and Kalahari Conservation Society, the following areas were identified as being key considerations in conservation of the Orange-Senqu River basin's resources:

- The threat to water **resource availability**
- The decline in **water quality**
- Alteration of the **flow regime/hydrology**
- Soil erosion and wetland **degradation**
- The invasion of **alien species**

These issues were presented to the ORASECOM steering committee and basin stakeholders at the Inception Phase workshop. The priority issues were then identified as those relating to:

- The threat to water **resource availability**
- The decline in **water quality**
- Alteration of the **flow regime/hydrology**

A key part of the Inception Phase was the development of criteria for the selection of conservation measures as well as indicators for monitoring the impact and success of any mitigation measures. The criteria which were developed were grouped according to:

- Recognition of the conservation issue as a significant transboundary concern.
  - for two or more of the riparian states
  - having significant impact across national borders
- Significance / importance of the conservation issue.
  - ecological impact of the issue on aquatic systems and catchment functioning
  - social impact on people in the basin, particularly the poor
  - economic impact within the region, a country or local area
- Relevance of the issue for strengthening ORASECOM.
  - flagship project requiring joint action across national boundaries
  - solution within the financial constraints of ORASECOM
  - piloting or initiation focus, rather than routine operational implementation

These and the proposed performance indicators were also presented at the Inception Phase workshop, affording basin stakeholders and the ORASECOM Steering Committee the opportunity to comment on- and refine them.

The Consultation phase followed and its assessment unpacked the three priority conservation areas in order to examine their status, determine whether there were ongoing activities to address them, and to identify possible mitigation initiatives that may be suitable for ORASECOM. Seventeen initiatives were identified and were categorized in terms of those addressing the water quantity, water quality, flow regime challenges. The initiatives were:

- Those addressing the **water quantity**

1. Water Conservation and Demand Management in the town of Kuruman
2. Water Conservation and Demand Management in the town of Mafikeng
3. Water Conservation and Demand Management in the town of Upington
4. Partnership in the Richtersveld Community Water Partnership programme
5. A study on the potential for increased efficiency of water use in agriculture
6. A study on the long term yield of the Taung dam and the potential for it to supply other uses, however following the consultation workshop, it was confirmed that a utilisation study had already been conducted by the DWAF South Africa in July 2008.

- Those addressing the **water quality**

7. Support for the upgrading and refurbishment of various wastewater treatment works
8. Collection and treatment of mining decant threatening the Cradle of Humankind World Heritage Site.
9. Rehabilitation of the Klip River wetlands
10. Rehabilitation of the Klip River wetlands by addressing the upstream contamination of
11. An assessment/study of the basin's long-term water quality requirements.
12. An assessment of basin water quality models to analyse and predict the drivers of water quality changes.
13. Development of basin wide phosphate guidelines, pertaining to domestic and recreational water use.

- Those addressing the **altered flow regime**

14. Support to the Lower Orange River Transfontier Conservation Area (LOTCA) Invasive Alien Plant Management Programme
15. Coordination of management of the Orange River Mouth estuary
16. Addressing the mining and specifically removal of spoil dumped in and around the estuary
17. Support to the Black Fly Control programme

Both the Inception and Consultation phases and their workshops confirmed that localized issues and issues which have a clearly assigned responsible party should not be a central element of Orasecom's conservation strategy. Rather, it was evident that the ORASECOM Conservation Fund should serve the interests of a basin-wide plan.
Following from the discussions with the ORASECOM Legal task Team and Council held in April 2009 in Windhoek, it was resolved that the final decision on what conservation issues to address will thus be identified arising from the Basin Plan.

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List of abbreviations:

COWEP	Community Water Efficiency Programme
CSIR	Centre for Scientific and Industrial Research
DEAT	Department of Environmental Affairs and Tourism
DWAF	Department of Water Affairs and Forestry (South Africa)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IWRMP	Integrated Water Resources Management Plan
LHWP	Lesotho Highlands Water Project
LOCTA	Lower Orange Transfrontier Conservation Area
LORMS	Lower Orange River Management Study
MAWF	Ministry of Agriculture, Water & Forestry (Namibia)
ORASECOM	Orange-Senqu River Commission
ORRS	Orange River Replanning Study
SANPARKS	South African National Parks
SDM	Sustainable Development through Mining
TDA	Transboundary Diagnostic Analysis
WC/WDM	Water Conservation and Water Demand Management
WMA	Water Management Area
WRC	Water Research Commission (RSA)
SANBI	South African National Biodiversity Institute

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1 Introduction

1.1. Background

ORASECOM has initiated a study to examine potential water-related conservation activities in the Orange-Senqu River basin. Since implementation of such programmes would have cost implications, there is a corresponding need to develop a mechanism to ensure that funds are mobilised on a continuous basis to meet these costs.

The main objective of this feasibility level study is to 'propose a mechanism for the mobilisation of funds for the conservation of the basin's water and associated natural resources'. This document is one part of the second of three reports which form part of the overall ORASECOM commissioned project titled, "*Feasibility Study for Development of Mechanism to Mobilize Funds for Catchment Conservation".*

This document forms part of the final deliverable for this project and is a conclusion of the 3-month Consultation Phase which comprised detailed investigations and identification of potential conservation initiatives as well as the development of a business case for funding mechanisms. The Consultation Phase recommended measures which will provide financial sustainability to both ORASECOM's core functions and the environmental sustainability of developments within the basin.

The Consultation Phase followed on the Inception Phase which identified the main conservation issues in the Orange-Senqu River basin. The Inception Phase report also presented an international review of funding mechanisms, a discussion on the institutional arrangements for ORASECOM and potential models for the conservation fund.

A key part of the Inception Phase was the development of criteria for the selection of conservation measures as well as indicators for monitoring the impact and success of any mitigation measures. These were presented at an Inception Phase workshop, affording basin stakeholders and the ORASECOM Steering Committee the opportunity to comment and to refine the proposed selection criteria and monitoring indicators. The criteria were used in this report to prioritise the potential conversation projects within the basin. This prioritisation process was reviewed at the Consultation Phase workshop held in March 2009 in Pretoria, South Africa where the PSC and various stakeholders considered the proposed initiatives as well as their relative scoring. The workshop confirmed the approach that localized issues and issues which have a clearly assigned responsible party should not be a central element of Orasecom's conservation strategy. In addition, basin wide issues ranked higher than most other issues and it was evident from the workshop that the Fund should serve the interests of a basin-wide plan.

The proposed initiatives had been presented as a means to view a basin wide plan, i.e. by highlighting the sort of issues that ORASECOM should be funding. It was agreed that ORASECOM has a role to play in filling certain gaps, specifically that ORASECOM could be involved in establishing pilot projects in order to demonstrate an untested technology or approach.

1.2. Purpose of document

This document is part of the final deliverable of this project and is derived from the Conservation Fund Assessment Report which focused on the identification and prioritisation of potential mitigation measures for key water-related conservation challenges in the Orange-Senqu Basin. A draft priority rating of the identified mitigation measures is presented, which was tested in the Consultative Phase workshop held in early March 2009. The proposed business case for funding mechanisms is presented in a separate document.

2 Identification of potential conservation initiatives

2.1 Selection of priority challenges

The extensive review of literature and preliminary consultations undertaken in the Inception Phase established five main conservation challenges in the Orange-Senqu River basin. Of these five issues, some have localized impacts whilst others have transboundary implications. These main challenges identified in the basin are:

- The threat to water **resource availability**
- The decline in **water quality**
- Alteration of the **flow regime/hydrology**
- Soil erosion and wetland **degradation**
- The invasion of **alien species.**

At the end of the Inception Phase, the Steering Committee and stakeholders were engaged in a workshop to identify the highest priority water-related conservation challenges in the Orange-Senqu River basin. Whilst issues pertaining to soil erosion and wetland degradation as well as the invasion of alien species were acknowledged as being significant, it was felt that these were of a lower priority than the other three areas. The areas below were identified as the *highest priority* challenges for the basin:

- Water resource availability
- Water quality, and
- Alteration to the flow regime.

As communicated in the Inception Phase report, the nature of these challenges in terms of their causes and impacts were described and summarised as follows:

Conservation issue	Cause	Impact	Area/country of origin	Other countries impacted
Water availability	High demands and abstractions, particularly in agriculture	Availability concerns for downstream countries; Low flow in estuary	South Africa (Lower Vaal & parts of the Lower Orange)	Namibia
Water quality	Poorly managed waste water treatment works, industrial effluent and agricultural run-off	High nutrient levels resulting in eutrophication	South Africa (Lower Vaal & parts of the Lower Orange)	Namibia
	Pollution from mining and industry	High levels of salinity and heavy metal pollution		
Altered flow regime	Reservoir operations, high rates of abstraction	Flow regime inappropriate to ecological requirements; low flow in estuary	South Africa	Namibia
	Black fly infestation	High costs in cattle losses		

Conservation issue	Cause	Impact	Area/country of origin	Other countries impacted
	Reed invasion	Increased black fly population, altered habitat, flow and siltation patterns, and fire hazard.		
	Poor control of water hyacinth	De-oxygenation, interference with recreational use and dam operation		

Table 1 Summary of priority conservation areas in terms of cause and impact
Source: Inception Phase Report

As is evident from Figure 1, the Orange-Senqu river basin is often addressed in terms of its Upper, Middle and |Lower sub-basins as reflected in the graphic below. This enables better consideration of different issues pertaining in different areas. The Vaal river basin is often quoted separately due to the nature of its operation as a virtually closed system.

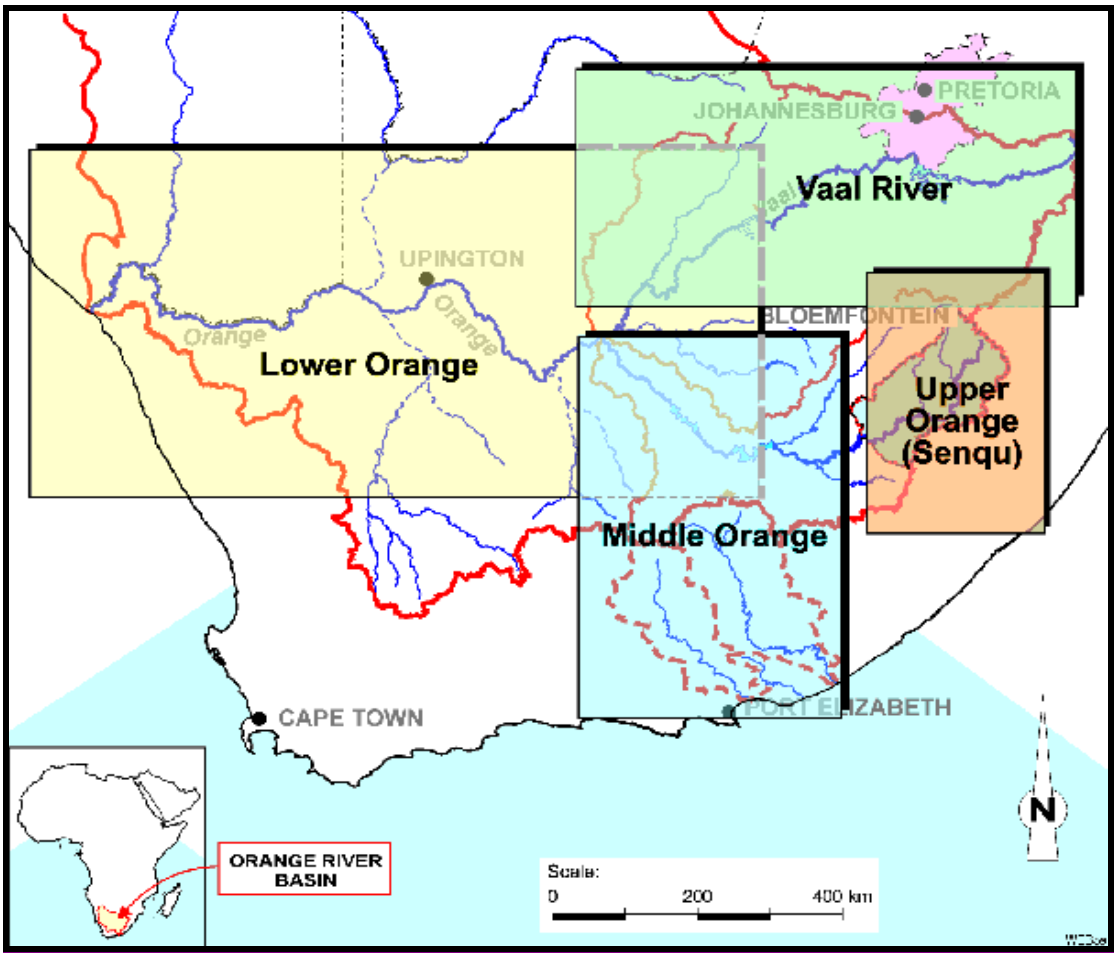


Figure 1 Orange-Senqu River sub-basins
Source: www.dwaf.gov.za/orange

2.2 Consultations undertaken

This study undertook to examine the status of the conservation issues in the basin, to understand whether there are current activities in place to address them, whether there have been or are studies being conducted in terms of addressing them, and to identify possible mitigation projects that may be suitable for ORASECOM to take on. In this process, existing literature and studies were consulted, supported by consultations with various sector role-players (listed at the end of this document in Appendix D).

The following sections address each of the key priority areas, examining in more detail the specific conservation challenges and the potential mitigation measures, as well as the current status of actions to deal with the challenges.

2.3 Water resource availability

The Inception report highlighted that water resource availability in the basin is greatly influenced by agricultural, municipal and industrial demands. The Transboundary Diagnostic Analysis and GTZ IWRM study report current and future *consumptive* demands to be as follows:

	Expected Consumptive Water Demand (Mm^3/a)			
Year	2005	2015	2025	
	South Africa			
Irrigation	3273	3381	3381	
Domestic, Industrial & Mining	2115	2266	2487	
Total	**5388**	**5647**	**5868**	
	NAMIBIA			
Irrigation	118.81	217.32	303.52	
Domestic, Industrial & Mining	40.19	71.68	73.48	
Total	**159**	**289**	**377**	
	LESOTHO			
Irrigation	9	9	9	
Domestic, Industrial & Mining	11	14	17	
Total	**20**	**23**	**26**	
	BOTSWANA			
Total	**7.4**	**7.7**	**7.75**	
TOTAL CONSUMPTIVE DEMAND FOR THE ORANGE-SENQU	**5574.4**	**5966.7**	**6278.75**	

Table 2 Predicted future demands for the Orange-Senqu river basin
Source: Adapted from figures supplied in the TDA and GTZ IWRM study

South Africa accounts for 96.6% of consumptive water use with Namibia accounting for just under 3% of water use (2005 figures). Water use in Lesotho and Botswana is comparatively less with approximate water use being 0.3% and 0.1% respectively.

As indicated in the above, a steady increase in *consumptive* water demand is anticipated in the basin with agriculture accounting for a significant portion of current and projected demand.

Although the Lower Orange River area receives very little rainfall, a significant amount of irrigation still takes place in the region, as is the case in the Upper and Middle Orange River areas.

In the Vaal river basin however, agricultural water use is comparatively less, with irrigation requirements accounting for 35% (DMM Development Consultants, Golder Associates Africa et al. 2006) of the almost 2 800 million m3/a currently required in the system (WRP Consulting Engineers, Jeffares & Green et al. 2007). The urban sector accounts for most consumptive water use in this basin with historical increases in water use a result of the increasing urban population and expanding economic activities in the Gauteng Province of South Africa (DMM Development Consultants, Golder Associates Africa et al. 2006).

2.3.1. Municipal demand

As alluded to earlier, most of the combined urban, industrial and mining water use takes place in South Africa with the most of the municipal water use taking place within the Vaal[1] river sub-basin. This means that Rand Water supply area is the largest water user in the Vaal river basin.

The aforementioned Vaal River Reconciliation Study had several objectives one of which was to develop water requirement and return flow scenarios based on water use assessments in the urban sector of Gauteng. The study also sought to determine the potential for water conservation and demand management in the urban sector as well as identify options for reuse of water. The study developed a range of population growth projection scenarios - the most likely scenario was determined to be 'Scenario B' which was based on Statistics South Africa population estimates. 'Scenario B' excludes the effects of water conservation and water demand management, but considers the expected eradication of unlawful irrigation use (WRP Consulting Engineers, Jeffares & Green et al. 2007).

The following illustrates the resulting projected water requirement for the Rand Water supply area:

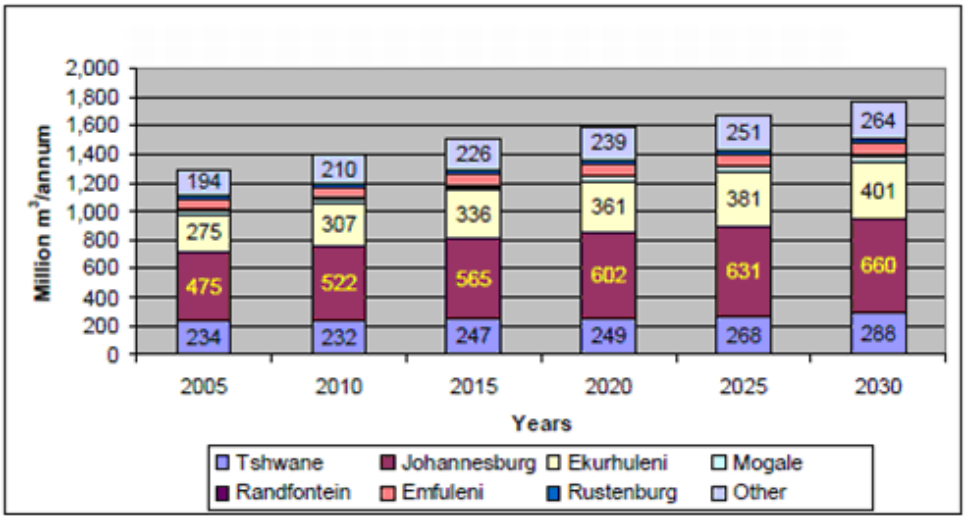


Figure 2 Projected water requirements for the Rand Water supply area
Source: Vaal River System: Large Bulk Water Reconciliation Strategy. DWAF, South Africa 2006

[1] The Vaal river basin and its water management areas is illustrated in Appendix A

As indicated in the figure above, the study anticipates significant growth in water required in the Rand Water supply area. The study also assessed the volume of losses in the system and concluded that on average approximately 25% losses are experienced within the Rand Water supply area (WRP Consulting Engineers, Jeffares & Green et al. 2007). By addressing these losses and implementing water conservation and demand management measures, the study found that this projected water demand could be reduced by 13% to 27% (WRP Consulting Engineers, Jeffares & Green et al. 2007).

Ongoing initiatives and proposed conservation initiatives

Following the impetus brought on by the findings of the Vaal River Reconciliation study, DWAF, South Africa has set itself the target of reducing demand in the Vaal River system by 15% by 2013. R150 million has been budgeted by the DWAF, South Africa for projects around water use efficiency in 2009/2010, in addition to budgets for this purpose already set aside at local government level.

Several projects around water use efficiency have already been started in the municipalities of the Vaal River basin. Most noteworthy is the Sebokeng Pressure Management project which commenced in 2005 at a cost of R5 million with its payback period being three months. The project achieved significant savings of 3.5 million m^3 in the first six months.

A major challenge in the Vaal River municipalities, as with other areas, is the lack of accurate and reliable water balance and consumption information. Few municipalities have sufficient technical expertise to run effective asset management programmes, or sufficient funding to undertake the necessary maintenance and rehabilitation.

The GTZ IWRM study noted that there was potential to improve the efficiency of water use within the mining towns of Alexander bay, Oranjemund and Rosh Pinah. The study cited significant wastage since residents in these towns receive unmetered water, free of charge. Consultations undertaken for this assessment were unable to determine the extent of wastage and exact scope of intervention required in these towns, however it was found some efforts have already gone into demand management in the town of Upington (in the Lower Orange River area). This largely involved a macro-level assessment of the unaccounted for water, the installation of ten bulk meters and the development of a leak reduction strategy. While specific details around the cost and nature of the work required were not available, the consultant that undertook this initial work stated that there was definite scope for further demand management interventions in Upington.

Similarly, extensive studies have been undertaken to determine the potential for savings through demand management in the towns of Kuruman and Mafikeng.

The town of Kuruman is located on the borders of South Africa's Northern Cape and North West provinces and within the catchment of the Molopo River, a tributary of the Orange River. The Molopo River catchment is indicated in the graphic below.

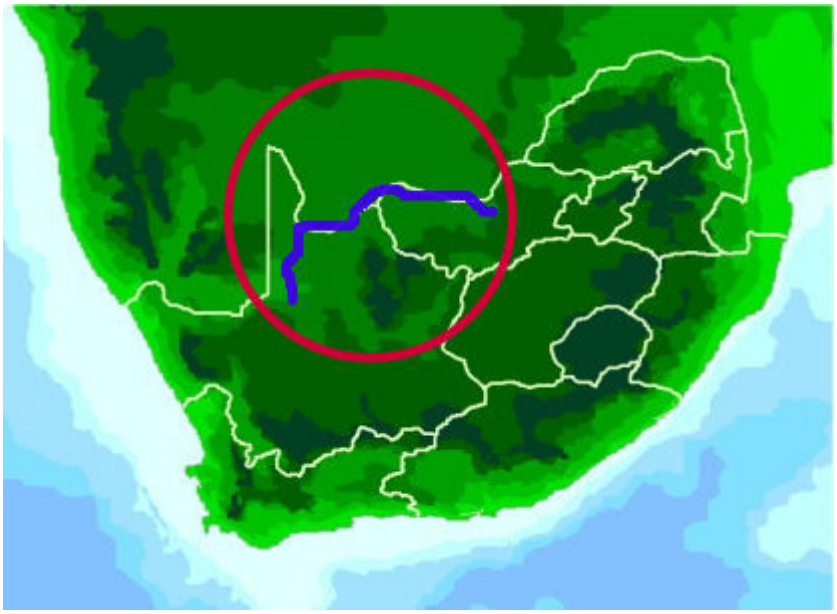


Figure 3 Molopo River Catchment
Source: www.ewisa.co.za/misc/RiversSA/defaultm.htm

The region is fairly arid and relies significantly on groundwater sources.

In the case of water conservation and demand management in the town of Kuruman, an immediate requirement is a survey of the current status of water services infrastructure. The existing infrastructure is fairly old, leading to significant losses. There is scope for work of the following nature:

- Conducting of water audits and determination of the water balance
- Leak repair/retrofitting
- Pressure logging and possible pressure reduction
- Consumer awareness

The town of Mafikeng in the North West province of South Africa also relies on the Molopo River for its domestic and agricultural needs. According to a study undertaken by the DWAF, South Africa, the Upper Molopo River catchment has a deficit of between 12 and 19 million m3/a, which is largely attributed to over-abstraction of groundwater for irrigation and domestic use. The study states that the allocation of water for the Mafikeng Local Municipality from the Grootfontein groundwater compartment is approximately 8,8 million m3/a, however the Local Municipality, which is the largest source of demand, abstracts approximately 11 million m3/a, i.e. in excess of the abstraction license.

Consultations undertaken indicate that scope exists for the implementation of water conservation and demand management in the Mafikeng Local municipality, again relating to the repair of leaks, pressure logging and reduction as well as raising consumer awareness on the importance of water conservation. The aforementioned DWAF, South Africa study further recommends verification of existing water use, particularly in irrigation as well as establishing if this use is lawful or not.

It was also stated that, given that the Grootfontein compartment is a transboundary aquifer, the ongoing ORASECOM review of the Molopo-Nossob groundwater resources is a valuable step in ensuring sustainability of the water resource.

The implementation of municipal water conservation initiatives is the responsibility of the municipalities, but the DWAF, South Africa is providing both funding and support to the process, and will soon be developing regulations to drive the process further.

Another initiative currently underway is the series of projects under the Community Water Efficiency Project (COWEP). The programme is a joint initiative between South African National Parks (SANPARKS) and the DWAF, South Africa and involves the roll out of water efficiency projects in arid areas usually adjacent to or within national parks and usually with a heavy reliance on groundwater abstraction.

Areas where the COWEP programme has been implemented include the Namaqua National Park and Augrabies Falls National Parks. Typically the programme entails the following:

- training of voluntary youth members for awareness raising campaigns in their respective communities
- training of participating households on how to read water meters and monitor their consumption
- assisting with monitoring of water consumption during the implementation phase of the programme
- repairing of leaks and retrofitting of domestic plumbing where required and
- the promotion of efficient water use practices to grow organic vegetables, herbs, and medicinal plants for personal consumption and income generation.

In all cases, the COWEP programme engages with the local municipality and any other relevant stakeholders.

It is understood that the rollout of a programme has been planned for the four communities living in the Richtersveld area (Appendix C). The challenge however, is that the programme needs to be rolled out in all four communities simultaneously, but there are insufficient funds for this. Thus, the rollout of the Richtersveld programme has been put on hold until such time that funds become available.

This type of community water efficiency programme has strong potential for rollout in both the Namibian and Botswana portions of the Orange River basin. Although SANPARKS only operate in South Africa, there is some potential to export the mechanisms of the COWEP programme to other parts of the basin, and there may well be a role for ORASECOM in this regard, in association with the relevant authorities in the three riparian states.

2.3.2. Mining and Industry demand

As stated in the GTZ IWRM study, mining and industrial demands in the Orange River System (excluding the Vaal river system) are a relatively small component of the total demand. The impact of water conservation and demand management within this sector is therefore said to have marginal impact on the overall water use.

Ongoing initiatives and proposed conservation initiatives

Representatives of mining and industry who were consulted for this assessment did, however, indicate that their primary concern was assurance of their supply. Representatives from Sasol indicated strong interest, and willingness to participate in initiatives (WC/WDM in particular) that would maintain high assurances of supply for strategic industries such as themselves.

2.3.3. Agricultural demand

As alluded to earlier, agriculture accounts for most of the consumptive water use in the Orange-Senqu river basin. The data provided in Figure 3 indicates that irrigation agriculture accounts for approximately 60% of consumptive water use, with almost 97% of this taking place within the South African part of the basin.

In the Botswana part of the basin, the main economic activity is livestock farming (A Earle, D Malzbender et al. 2005) with the main uses for water in the region being domestic and stock watering (WRP Consulting Engineers, Jeffares & Green et al. 2007). These demands are mainly met through groundwater abstraction (A Earle, D Malzbender et al. 2005)

Although *a*griculture plays a significant role in Lesotho's economy, most of this is at a small scale (A Earle, D Malzbender et al. 2005) and irrigation is limited (Food and Agriculture Organisation (FAO)). As was stated in the Inception Phase report, the reliance is on rain-fed agriculture instead.

Irrigation agriculture accounts for most of Namibia's consumptive water use with irrigation development highly dependent on flow regulation from dams in South Africa. Irrigation agriculture takes place in the area downstream of the Hardap and Naude Dams and on the irrigation schemes along the Lower Orange River. The most noteworthy of these schemes are at Noordoewer/Vioolsdrift along the Orange River and Aussenkehr. According to the GTZ IWRM study, it is anticipated that 1 000 hectares of land will be brought under irrigation at the proposed Tandjieskoppe Scheme at Noordoewer in the next few years.

Ongoing initiatives

A pilot study on improving agricultural water use efficiency was recently conducted on the Crocodile River system. The study found that the assumption of inefficient water use in irrigation was not always valid since in many cases irrigators *had* already improved their water use efficiency substantially. This was driven largely by rising costs of fertiliser, which inadvertently increased water-use efficiency as farmers were unlikely to over-irrigate in order to minimise fertiliser use.

Insufficient information exists on the status of water use for irrigation in the Orange-Senqu Basin, and further work needs to be done to understand the potential for increased efficiency of water use, taking into account issues pertaining to soil type, technological options, and crop type. Such studies should also take into account the potential impact of climate change on water use in the basin as this area may well experience significant impacts from rising temperatures and changing rainfall patterns.

2.3.4. Ongoing initiatives around unlawful water use

A major problem in the Vaal River system is the unlawful irrigation water use taking place mainly upstream from the Vaal Dam. According to the DWAF, South Africa, indications are that as much as 240 million m^3/a of water use is illegal, i.e. due to violations of water use licenses or unauthorized withdrawals.

The DWAF, South Africa is currently undertaking measures to address unlawful water use and these include a validation and verification process in the Upper Vaal River area, which was 80% complete at the time of writing. The department is in the process of appointing consultants in the Middle and Lower Vaal areas. The department is also rolling out a programme to deal with illegal abstraction (initially focused on the upper Vaal River), which commenced with a high profile water compliance 'blitz enforcement week' at end of November 2008. Following this campaign, twenty directives have been issued to an illegal abstractor.

The validation and verification process will determine the extent of existing lawful water use. The process employs remote sensing techniques (satellite, aerial photographs, etc) to determine if the volume of water use registered by irrigators is accurate, i.e. valid and that the volume of water use registered is lawful (verification).

Box 1: Environmental Flow requirements

Currently, ecological requirements for the river mouth are met through releases from Vanderkloof Dam and amount to just under 290 million m^3/a. However several recent studies including the GTZ IWRM study highlight that this is based on a fairly outdated methodology. The more recent Lower Orange River Management study found a high level estimate of ecological requirements to be in the order of 1062 million m^3/a.

However, this was determined on the basis low confidence (rapid) studies and interviews conducted during this assessment suggest an urgent need for a comprehensive study for determining the ecological water requirements for the Orange River basin as a whole.

A key recommendation drawn from the consultations is that, any further rehabilitation efforts at the Orange River Mouth estuary will have to be preceded by a high confidence determination of environmental requirements for the river and mouth. This will ensure that rehabilitation efforts are supported and maintained by meaningful releases.

Box 1 Current status of Environmental flow requirements

Another factor which emerged during consultations is the current under-utilisation of Taung Dam, situated on the Harts River in the Lower Vaal River area. The dam was built in order to support resource poor farmers and to irrigate a planned 14 000ha of land. However, the irrigation plans were never developed, partly due to a lack of infrastructure for conveying water from the Taung Dam to the areas with irrigation potential.

A recommendation from the consultations is that some study needs to be undertaken in order to understand the long term yield of the Taung dam and whether the dam cannot be used to supply water uses other than irrigation. A recent UNESCO study also suggested exploring whether the dam could be managed in order to release the unused water to dilute downstream water which has a high concentration of salts due to agricultural return flows.

At the consultation workshop, DWAF South Africa representatives pointed out and confirmed that a utilisation study had already been conducted by the DWAF South Africa in July 2008.

2.3.5. Summary of possible and proposed interventions

Thus, based on the review of literature and consultations, the possible and proposed interventions to address the challenge of water availability in the Orange-Senqu River basin, which may be appropriate for ORASECOM to support are:

- Water Conservation and Demand Management in the town of Kuruman
- Water Conservation and Demand Management in the town of Mafikeng
- Water Conservation and Demand Management in the town of Upington
- Partnership in the Richtersveld COWEP programme and extension to Namibia and Botswana
- Study on the potential for increased efficiency of water use in agriculture, taking into account issues pertaining to soil type, technological options, and crop type.
- Study on the long term yield of the Taung dam and the potential for it to supply other uses (although, subsequent consultation workshop confirmed that this study was complete).

2.4 Water quality

The Inception Report referred to the issues of heavy metal pollution, bacterial contamination and Persistent Organic Pollutants and briefly discussed their impacts as well as the absence of consistent and centralised monitoring of the sources of this pollution. The issues pertaining to salinity and eutrophication in parts of the basin were also discussed in the Inception Report. During this Consultation Phase however, the issues that were consistently identified as the key water quality issues in the basin were the levels of salinity and nutrient loads.

The parameters for measuring water quality are salinity (measured in terms of electrical conductivity), sulphate concentration and nutrient concentration (measured in terms of nitrate and phosphate load).

As was discussed in the Inception phase report, the surface water quality in the Upper and Middle Orange River areas is generally considered good. In the Vaal River area, nutrient and salt loads are marked due to mining and industrial discharges as well as untreated municipal effluent. The Inception phase report also reported that nitrate levels in the Lower Orange River area were found in several studies to be high, which suggested nutrient enrichment from agriculture. The Integrated Water Resources Management Plan conducted by GTZ also found an increase in salinity along the lower reaches of the river due to irrigation return flows and evaporative losses along the river.

Thus the major water quality issues centre on **mining and industrial activities**, **municipal discharges** and **activities of irrigation.**

2.4.1. Major water quality challenges associated with mining and industrial activities

Mining activities predominantly take place in the Vaal River basin with less pollution associated with mining or industrial activity in the Lower Orange River as most industrial activity, of which there is little, is situated away from the in the vicinity of the river (ORASECOM 2008).

The areas in the Vaal River basin where water quality is of major concern include the area of the Vaal Barrage, Middle Vaal River and Lower Vaal River downstream of the confluence with the Harts River (Van Vuuren L 2008). The water in the Vaal Dam is still of relatively good quality due to the transfer of water from the Lesotho highlands. According to the basin TDA, the Vaal Barrage catchment contributed nearly half of the salt load recorded in the entire upper Vaal WMA over the 20 year period ending September 1995 - the causes being direct mine discharges of dewatering water into the Vaal River (WRP Consulting Engineers, Jeffares & Green et al. 2007) and its tributaries.

Coal mining in the Upper Vaal area supports petrochemical and power generation industries (WRP Consulting Engineers, Jeffares & Green et al. 2007). The TDA found that diffuse runoff and seepage from these industries is the major cause for the decline in water quality in the Upper Vaal area. The location of these areas is indicated in Appendix A at the end of this document.

One of the greatest concerns which emerged during the consultations is in the West Rand area (which falls within the Vaal River basin) of the Witwatersrand mining basin. The latter is an extensive geological region in South Africa and is the heartland of the South African gold mining industry. This area is shown in Appendix B at the end of this document.

Extensive mining activities have led to contamination and acidification of (Vaal river system) groundwater within the mining basin (Naicker K, Cukrowska E et al.). Acidification (or acid mine drainage) takes place due to the oxidation of pyrite[2] (FeS_2) contained within mine tailings dams.

The severity and implications of mining decant in the West Rand basin became evident in August 2002 when polluted groundwater from a disused mine shaft in the Randfontein area decanted to the surface. As many of the mines have closed down, the discontinuation of groundwater dewatering has allowed the water table to rise to the point of manifesting as highly polluted mining decant. Prior to this, extensive dewatering of up to 35 ML/day had groundwater pumped from the western mining basin (Fourie 2005), and discharged into the Upper Wonderfonteinsspruit, which flows south into the Vaal, and into the Tweelopiesspruit, which flows north into the Crocodile River.

The Council for Geoscience reports that minewater decant in this area has had a significant impact on the surface and groundwater quality – posing an immediate threat to downstream users, the Vaal river basin itself, Krugersdorp Game Reserve, as well as the cave systems in the Cradle of Humankind World Heritage Site (Geoscience 2009).

According to an advocacy group, the Federation for a Sustainable Environment, the cost to pump and treat the acid mine drainage could be as much as R410 400 000 per annum.

[2] A type of iron sulphide

The issue of small scale mining along the banks of the Lower Orange River was also highlighted in the discussions held with various engineers and planners. The consequences have been sedimentation of the river and a reduction in river flow, which creates conditions favourable for the proliferation of reeds. The proliferation of reeds has been exacerbated by the irrigation activities in the Lower Orange River. Return flows from these activities typically have a high nutrient load due to the use of fertilisers. Reeds pose several additional problems in that they increase the surface area available for blackfly larval attachment (WRP Consulting Engineers, Jeffares & Green et al. 2007) as well as increase riverine transmission losses caused by evaporation and evapo-transpiration (TDA).

The mining activities in the vicinity of the Orange River Mouth estuary have also been identified as contributing to the degradation of the estuary. One issue pertains to the dumping of spoil – it was stated in the interviews that current dumping practices posed significant potential for a pollution event were there to be a sizeable storm event.

Ongoing and proposed initiatives

A measure that has long been identified as being key in addressing the broad issues associated with the closure of mines is the development of regional mine closure strategies. This was echoed in discussions held with representatives of DWAF, South Africa, the Council for Scientific and Industrial Research (CSIR) and the Chamber of Mines.

Recently, the South African Department of Minerals and Energy initiated the Sustainable Development through Mining (SDM) programme which has representation from the Council for Geoscience, the CSIR and Mintek. The SDM programme has resulted in the publication of a draft regional mine closure strategy for the sub-basins[3] of the Witwatersrand goldfields mining basin, which are currently out for public comment. These strategies attempt to provide operating mines with a framework for planning their own detailed mine closure plans, whilst providing authorities some reference for reviewing individual mine closure plans. In terms of water resources management, the strategies assist stakeholders in identifying solutions to the problems discussed above (Coetzee H and Van Tonder D 2008).

The DWAF, South Africa recently issued a directive to the mines responsible for the decant instructing the mines to collect and contain the decant, treat it to standards set by the department before discharging into the upper Wonderfonteinsspruit, a tributary of the Vaal River. Recent efforts to partially treat this minewater have improved its quality although it remains outside of compliance standards set by the DWAF, South Africa Site (Geoscience 2009). The DWAF directive limits the discharge volume to 15Ml/day (Opperman I 2008).

There have been positive steps in the development of treatment facilities for mining related effluent. Recently, a plant with a treatment capacity of 20 Ml/day was commissioned in the Witbank coalfields area at a treatment cost of approximately R10/m^3. The CSIR has also developed a plant with the ability to treat water mining effluent using chemical precipitation treatment processes, which will soon be piloted. Given the significance of the World Heritage site at the Cradle of Humankind, there exists an immediate need for an intervention around the collection and treatment of mining decant which currently threatens the site. While the mitigation measures fall firmly within the ambit of the South African government and the mines, the

[3] The Witwatersrand goldfields mining basin comprises the five goldfields of the Central Rand, East Rand, West Rand, Far West Rand and Klerksdorp, Orkney, Stilfontein and Haartebeesfontein (KOSH area. Closure strategies for each of these areas have been developed as well as an overarching strategy for the Witwatersrand basin.

international status of the World Heritage site make this an important project in the conservation activities in the basin.

The Klip River is another of the Vaal River's important tributaries, with the Klip River wetlands forming an important part of the river's natural systems. Wetlands function in many ways, acting as flood agents by attenuating the flow of floodwater into river channels. Apart from providing an ideal habitat for aquatic and terrestrial ecosystems, undisturbed, wetlands are also effective in trapping sediment and nutrients. The location of the wetlands as shown in the figure below is in the southern suburbs of Johannesburg.

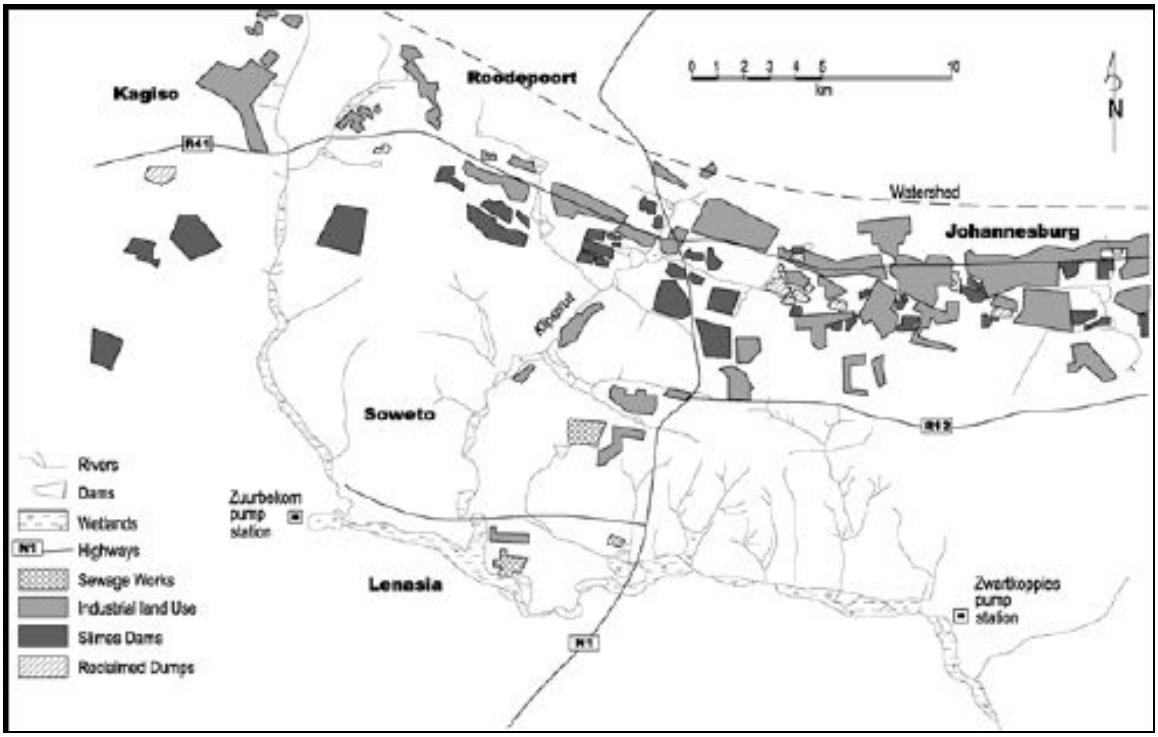


Figure 4 Klip river wetlands
Source: WRC

Pollution affecting the Klip River's catchment originates mainly from gold mines on the western Witwatersrand as well as the surrounding urban and industrial development (Working for Wetlands 2009). Several studies refer to a water quality impact assessment conducted by Stewart Scott Consulting Engineers which recorded the natural runoff of the Klip River catchment to be in the order of 111 million m^3/a. The assessment found that effluent return flows were relatively high with the average returns being in excess of 200 million m^3/a. According to Working for Wetlands these high return flows have contributed to bank erosion in parts of the wetlands. Further, high volumes of return flows also affect the time that the wetlands are inundated, thus decreasing the ability to trap pollutants (Working for Wetlands 2009).

Although the wetlands remain in reasonably good condition, the WRC reports that these factors have reduced the wetlands' ability to fulfil their water purification function and much of the heavy metal and nutrient pollution in the wetlands may be released back into the main stream with serious water quality implications for downstream users as well as the Vaal Barrage.

Current rehabilitation interventions by the Working for Wetlands programme include construction of concrete, gabion and earth structures to prevent further river bank erosion. The programme involves various stakeholders (coordinating and funding) which include amongst others the DWAF, South Africa, DEAT, the City of Johannesburg, and the South African National Biodiversity Institute (SANBI).

The DWAF, South Africa is about to commence the process of determining the Reserve requirements for the Klip River, after which measures will be developed for further rehabilitation of the wetlands.

In this regard, Working for Wetlands expressed the desire to partner with other stakeholders to access funding and expertise for the next phase of the Klip river wetlands rehabilitation.

2.4.2. Untreated municipal effluent

The consultations undertaken for this assessment indicate water quality concerns related to non-compliant effluent discharges from wastewater treatment works in the **Upper** and **Middle Vaal** areas. The Inception phase report had also addressed this and had referred to increasing nutrient concentrations in the Vaal River's tributaries. The consultations, and several studies, identify other isolated areas as having problems associated with the discharge of non-compliant effluent – the IWRM study for example noted that the South Phuthiatsana River exhibits high concentrations orthophosphate due to runoff from settlements scattered across the Lesotho lowlands catchment. However, the consensus is that the problem is most severe in the Upper and Middle Vaal areas, as evidenced by proliferation of algal blooms and water hyacinth in the Vaal Barrage and Bloemhof dam, as well as along the lower reaches of the Orange River downstream of its confluence with the Vaal Rivers.

The TDA reports that the Vaal River system receives effluent discharges of between 500 to 540 Mm^3/a, which is a significant load. Discussions held with various role-players highlight several factors as possible reasons for non-compliance of effluent discharges. Reasons are related to ageing infrastructure networks and treatment works, a shortage of experienced municipal engineers, technicians and operators as well as rapid urbanisation. In-migration into the urban centres of Gauteng has led to several treatment works either fast approaching or having already exceeded their treatment capacities.

Ongoing initiatives and proposed initiatives

Ongoing initiatives to improve the condition of wastewater infrastructure and discharge practices include:

- The Sedibeng[4] Regional Sanitation Scheme Project being undertaken by DWAF and the Sedibeng District Municipality amongst others. The R860 million project includes the replacement of three existing wastewater treatment works with a larger treatment works, the construction of new pump stations and the rehabilitation of some of the existing pipeline infrastructure.
- The DWAF, South Africa also recently took legal steps against to the Emfuleni local municipality in the Vaal region after repeated releases of non-compliant wastewater.
- The DWAF, South Africa has also completed a process in which strategic water quality monitoring points in the Vaal River catchment were identified and confirmed. The

[4] The Sedibeng area comprises a cluster of small towns along the Vaal River in the Vereeniging area.

department is also undertaking status assessments which will include the status of eutrophication in the Vaal River catchment.

An important fact which emerged during consultations is the absence of *national* guidelines[5] for phosphate in water (for domestic and recreational use) in South Africa. This is cited in a 'state of the environment' study conducted by the DEAT and a study by Momba, et al. It is unclear whether there are intentions to determine national guidelines in this regard and at the time of writing, it had not been established whether guidelines exist in the other basin states. Nonetheless, there is an apparent need for the development of phosphate guidelines which can be applied throughout the basin.

2.4.3. Agricultural return flows

Agricultural water use predominates in the Vaal-Harts area of South Africa as well as in parts of the Lower Orange River basin. Consultations revealed that the water quality impact of agricultural return flows is most significant in the Lower Orange River area. Agricultural water use in the Lower Orange River area was said to account for approximately 1 375 Million m³/a (Permanent Water Commission 2005) supporting the cultivation of maize and wheat as well as high value crops such as table grapes.

In the Lower Orange River area, salinity (measured in terms of electrical conductivity) increases in the area between Vioolsdrift and the Vaal-Orange River confluence (WRP Consulting Engineers, Jeffares & Green et al. 2007). This is attributed to irrigation return flows and evaporative losses along the river. The TDA also attributed the increase in salinity to the transfer of high quality water out of the Orange River as part of the LHWP.

Some studies propose the implementation of alternative irrigation methods as a means to curtail demand and reduce the effects of irrigation return flows, for example drip irrigation is often suggested as a replacement for flood irrigation. However discussions held with various planners and engineers revealed that a conversion from flood to drip irrigation may not always be practical or improve agricultural efficiency. The soils of Lower Orange River area have significant salt retention tendencies, and this, combined with the high degree of evaporation, means that irrigation methods will have to be appropriate to these conditions.

2.4.4. Additional proposed conservation initiatives

In addition to the water quality interventions proposed above, there is also a need for an assessment of the basin's long-term water quality requirements. The consultations indicated the need for an overall plan for the basin's development (including planned agricultural, industrial and urban/rural development etc) which could then be used to inform planning for the basin's long-term water quality requirements.

Some of the industry representatives who were consulted for this assessment expressed a need for basin water quality (TDS and nutrient) models, which could accurately analyse & predict the drivers of water quality changes. It was felt that while the overall drivers of water quality changes are known, there is an absence of models for accurately predicting and analysing these changes from a basin wide perspective. This finding supports an earlier finding by the GTZ IWRM study, which identified the need for the development of a basin wise nutrient management strategy.

[5] Most municipalities and water services providers have developed their own guidelines and typically the prescribed level of phosphate in water systems is 5µg/L

2.4.5. Summary of possible and proposed interventions

Based on the review of literature and consultations, the proposed water quality interventions as discussed above are:

- Support for the upgrading and refurbishment of various wastewater treatment works
- Collection and treatment of mining decant currently threatening the Cradle of Humankind World Heritage Site.
- Support of the (on-site) physical rehabilitation of the Klip River wetlands
- Support of the rehabilitation of the Klip River wetlands by addressing the upstream contamination of wastewater and mining effluent.
- An assessment/study of the basin's long-term water quality requirements.
- An assessment/study of basin water quality models to analyse and predict the drivers of water quality changes.
- Development of phosphate guidelines, pertaining to domestic and recreational water use, which can be applied throughout the basin.

2.5 Alteration of the flow regime

2.5.1 Major challenges associated with the flow regime

As was reported in the Inception Phase report, the main drivers behind the degraded hydrological regime are excessive water use and the lack of effective demand management in the Vaal River area of South Africa as well as reservoir operations which do not provide meaningful environmental releases. This assessment found that impacts reported as most significant are:

- The proliferation of reeds due to lower flow velocities and high nutrient loads
- An increase in the prevalence of the blackfly pest, and
- Changes in the hydraulics of the Orange River Mouth estuary.

The challenges associated with the invasion of reeds have been discussed earlier.
With regards, to the blackfly problem, one of the current challenges is that the species has not been declared a national pest in South Africa, hence the problem has not received the resources and attention required to address it in a more comprehensive manner.

Ongoing initiatives and proposed initiatives

The Lower Orange Transfrontier Conservation Area (LOTCA) shown in Appendix D was formalised in 2003. The aim was to establish large conservation and wildlife areas not only through the integration of vast landscapes and re-connected ecological systems, but also through the development of cross-border tourism linkages, ensuring sustainable benefits to local communities through socio-economic upliftment, and the promotion of peace and stability in the region (Namibia Transfrontier Project Proposed Partnership Framework 2008).

Recently, an Invasive Alien Plant Management Programme has been developed in order to address alien plant invasions (particularly Prosopis) along the river as well as in the broader LOTCA. Altogether fourteen invasive species (including reeds) have been identified for inclusion in the management programme.

According to the programme manager, its immediate objectives are to:

- Establish a joint technical working group for invasive alien plant management.
- Quantify the extent of invasive alien plants in the LOTCA.
- Conduct a livelihoods and socio-economic assessment of the LOTCA
- Control invasive alien plants in the Ai-Ais Richtersveld Transfrontier Park and expand to Spergebied National Park when appropriate.
- Develop an invasive alien plant management plan for the LOTCA.
- Develop and transfer technical capacity for the management of invasive alien plant control programmes in Namibia and
- Develop and implement a socio-economic development programme.

The programme is currently developing its business model and institutional arrangements and currently has representation from the DWAF, South Africa's National Working for Water Programme, the Namibian Ministry of Agriculture, Water & Forestry, Namibian Ministry of Environment & Tourism and Namibian Ministry of Lands & Resettlement. Other secondary stakeholders have also been identified.

During consultations, it became evident that funding is currently a constraint to the establishment of the programme. This is also driven by the multi-stakeholder nature of the initiative where resource responsibilities are not entirely clear. The initiative *is* seeking arrangements that will yield long term funding support. It would seem that there is a potential role for ORASECOM in terms of assisting to find funding for and providing support to this project.

According to the Working for Water project manager, there are intentions to undertake the same alien plant management programme in the area along the South Africa and Botswana border. Current intentions are first to rollout this programme in the Lower Orange Transfrontier Conservation Area, and then to explore a rollout in the Botswana-South Africa border area, depending on the success of the LOTCA programme.

The second issue highlighted in consultations as being of significant concern due to hydrological manipulation is the prevalence of the blackfly pest – this also has transboundary implications.

Extensive work on blackfly control has been done by the Agricultural Research Council of South Africa (ARC), the Water Research Commission (WRC) as well as the South African Department of Agriculture. There is also significant engagement between these parties and representatives from the NoordKaap Landbou Unie and AgriSA.

The Department of Agriculture has in place a Blackfly Control Programme in the areas between Hopetown and Senderlingsdrift. The indication is that the programme may be extended further upstream to the Vaal-Orange River confluence. However, there are currently some gaps in information - the department expressed the need for funding and research support in order to conduct a pilot study in this area.

The programme currently makes use of a *Bacillus Thuringiensis Israelensis* (BTI) larvicide with approximately five applications a year. The costs involved include the preliminary surveys and monitoring, the hiring of a helicopter and the larvicide itself.

There was a strong indication that direct funding support is required as the programme is almost entirely funded by the department.

It was also reported that current infrastructure for flow measurement did not meet the full requirements of the programme. Additional flow measurement stations are required along the length of the river. Such flow measurement stations will also contribute to better understanding of the flow issues in the estuary. Further work is also required around the possibility of managing the black fly through flow measures rather than through pesticide.

Box 2: Orange River Mouth Estuary

As was discussed in the Inception Report, the Orange River Mouth estuary has in recent times, undergone significant changes due to the change in flow regime as well as activities associated with localised mining. An impenetrable 1 km long road embankment alongside the river had for a long period cut off the salt marsh from freshwater resulting in a devastating increase in the salinity in the salt marsh. The most significant threat to the Orange River estuary however, is the loss of inflow of water and sediment due to the upstream damming of the river.

Working for Wetlands recently undertook several rehabilitation projects one of which was the breaking down of the impenetrable barrier between the river and the marshes. This undertaking to breach the road in four places allowed floodwaters to pour in through the breaches in 2006 bringing much-needed freshwater to the desertified 400 hectare salt marsh (Working for Wetlands, 2008). There have also been extensive efforts by the programme to clear the reeds in and around the estuary.

One key issue became evident during the consultations, which is that while there are several role players in the estuary's management, there is evidence that their individual roles and efforts needs to be co-ordinated. The Northern Cape provincial Department of Tourism, Environment & Conservation is the custodian of the estuary with the Richtersveld community and Orange River Interim Management Committee[1] also having input into management and rehabilitation of the estuary.

In addition, the provincial authority is currently engaged in efforts to secure statutory protected status for the estuary According to the RSA DEAT, a rehabilitation plan for the salt marsh has been developed by the Council for Scientific and Industrial Research, but has yet to be implemented. The plan has been incorporated into the Environmental Management Programme of Alexkor, the state-owned diamond mining company responsible for much of the degradation of the salt marsh. However, financial constraints have prevented Alexkor from implementing this component of their programme.

Box 2 Orange River Mouth Estuary

2.5.2 Summary of possible and proposed interventions

Based on the review of literature and consultations, the proposed interventions related to the altered flow regime as discussed above are:

- Support to the LOTCA Invasive Alien Plant Management Programme
- Coordination of management of the Orange River Mouth estuary
- Addressing the sand mining and specifically removal of spoil dumped in and around the estuary
- Support to the Black Fly Control programme

2.6 Summary of proposed interventions, institutional responsibility assignment and cost implications

The tables overleaf present a summary of the proposed conservation mitigation interventions and list them in terms of the assigned institutional responsibility and cost implications.

Institutional responsibility is assigned based on which body has the explicit or implicit mandate to perform functions associated with the identified mitigation intervention. Matters requiring basin wide assessments for example are clearly under the aegis of ORASECOM given its role in developing a basin-wide information base.

2.6.1. Proposed interventions related to the reduced water availability

	Conservation Issue	Possible mitigation intervention or project	Institutional responsibility	Cost implications	Once off or ongoing cost
Reduced water availability	High water demands in municipal centres compounded by poor asset management.	Water Conservation and Demand Management in the town of **Kuruman** The following are required: ➢ A survey of the current status water services infrastructure. In order to improve asset management ➢ Water audits and determination of the water balance ➢ Leak repair/retrofitting programme ➢ Pressure logging and possible pressure reduction ➢ Consumer awareness on the importance of water conservation	Kuruman municipality supported by DWAF, South Africa	<R10 million	Once off*
		Water Conservation and Demand Management in the town of **Mafikeng** ➢ Leak repair/retrofitting programme ➢ Pressure logging and possible pressure reduction ➢ Consumer awareness on the importance of water conservation ➢ Verification of existing irrigation water use in order to establish the lawfulness of water use.	Mafikeng municipality supported by DWAF, South Africa	<R10 million	Once off
		Water Conservation and Demand Management in the town of **Upington** around implementation of the existing leak reduction strategy	South Africa Local government	<R10 million	Once off
		Support of the Richtersveld COWEP programme which will require partnership with the local community, DWAF, South Africa, SANPARKS and the local municipality. The programme will entail:	SANPARKS, DWAF, South Africa, South Africa local government	<R1 million	Once off

	Conservation Issue	Possible mitigation intervention or project	Institutional responsibility	Cost implications	Once off or ongoing cost
		➢ Training of voluntary youth members for awareness raising campaigns in the Richtersveld community ➢ Training of participating households on how to read water meters and monitor consumption ➢ Monitoring of water consumption during the implementation phase of the programme ➢ Repairing of leaks and retrofitting of domestic plumbing where required and ➢ The establishment of vegetable and herb gardens			

2.6.2. Proposed interventions related to water quality

	Conservation Issue	Possible mitigation intervention or project	Institutional responsibility	Cost implications	Once off or ongoing cost
Decline in water quality	Repeated releases of non-compliant wastewater effluent across the Orange-Senqu river basin	Support the upgrading of various wastewater treatment works	SOUTH AFRICA Local government, DWAF, South Africa	>R100million	Once off*
	Extensive mining in the Witwatersrand mining basin which have led to the decant of contaminated mine water from the Vaal River system groundwater	Collection and treatment of mining decant currently threatening the Cradle of Humankind World Heritage Site, water users, and the Krugersdorp Game Reserve.	DWAF, South Africa, RSA DME, Mining companies.	>R100million	Once off*
	High return flows (containing high levels of untreated effluent) in Klip river catchment as well as (low pH) mining water pollution	Support of the (on-site) physical rehabilitation of the Klip River wetlands which includes the construction of additional gabions and earth structures to prevent river bank erosion.	Working for Wetlands, South Africa Local government	<R1million	Once off
		Support of the rehabilitation of the Klip River wetlands by addressing the upstream contamination of wastewater and mining effluent.	Working for Wetlands, RSA Local government, DWAF, South Africa, South Africa DME, Mining companies.	R10million-R100million	Once off*

2.6.3. Proposed interventions related to flow regime

	Conservation Issue	Possible mitigation intervention or project	Institutional responsibility	Cost implications	Once off or ongoing cost
Flow regime	Degradation of the Orange River Mouth estuary and Lower Orange River area	Addressing the sand mining and specifically removal of spoil dumped in and around the estuary	Local mining companies, DWAF, South Africa, Northern Cape provincial Department of Environment & Conservation, the Orange River Interim Management Committee	<R1million	Once off
	Flow reductions which have created conditions favourable for the proliferation of reeds and other invasive alien species.	Support to the Lower Orange Transfrontier Conservation Area (LOTCA) Invasive Alien Plant Management Programme. Support required is for: ➢ Funding and for the programme's activities which will involve: • Establishing a joint technical working group for invasive alien plant management. • Quantification of the extent of invasive alien plants in the LOTCA. • Carrying out a livelihoods and socio-economic assessment of the LOTCA • Developing an invasive alien plant management plan for the LOTCA. • Developing and transferring technical capacity for the management of invasive alien plant control programmes in Namibia	DWAF, South Africa, Working for Water, Namibian Ministry of Agriculture, Water & Forestry, Namibian Ministry of Environment & Tourism and Namibian Ministry of Lands & Resettlement.	<R1million	Per annum
	Collapse of the Orange River	Coordination of management of the Orange River	Local mining	<R1million	Per

	Conservation Issue	Possible mitigation intervention or project	Institutional responsibility	Cost implications	Once off or ongoing cost
	mouth estuary due to the absence of natural seasonal flow patterns as well as localised mining activities	Mouth estuary with involvement from the Northern Cape provincial Department of Environment & Conservation, the Orange River Interim Management Committee and Richtersveld community.	companies, DWAF, South Africa, Northern Cape provincial Department of Environment & Conservation, the Orange River Interim Management Committee		annum
	Blackfly prevalence due to low flow conditions, the absence of natural seasonal flow patterns as well as the reed encroachment.	Support to the Black Fly Control programme. The following are currently required: ➢ Funding and research support in order to pilot the control programme upstream towards the Vaal-Orange River confluence. ➢ Direct funding support for surveys and monitoring, the hiring of helicopters employed during applications and purchase of larvicide. ➢ The installation of additional flow measurement stations along the length of the river.	DWAF, South Africa, WRC, South Africa Department of Agriculture, RSA Agricultural Research Council	<R1million	Per annum

2.6.4. Proposed studies and assessments

	Conservation Issue	Possible study or assessments required	Institutional responsibility	Cost implications	Once off or ongoing cost
Resource availability	High agricultural demands in the Lower Orange river area	Study on the potential for increased efficiency of water use in agriculture, taking into account issues pertaining to soil type, technological options, and crop type.	DWAF, South Africa, WRC, Namibian Ministry of Agriculture, Water & Forestry, South Africa Agricultural Research Council	<R1million	Once off
	Under-utilisation of Taung Dam in the Lower Vaal River area.	Study on the long term yield of the Taung dam and the potential for it to supply other uses.	DWAF	<R1million	Once off
Water quality	The combination of mining, urban and industrial pollution	An assessment/study of the basin's long term water quality requirements.	ORASECOM	<R10million	Once off
		An assessment/study of basin water quality models to analyse and predict the drivers of water quality changes.	ORASECOM	<R10million	Once off
		The development of phosphate guidelines, pertaining to domestic and recreational water use, which can be applied throughout the basin.	ORASECOM	<R10million	Once off

Indicative ranges: <R1million = Less than R1million, >R1million=Greater than R1million
* Quoted in terms of estimated once-off costs but may have ongoing costs as well.

3 Proposed priority status of identified conservation initiatives

3.1. Criteria for prioritisation

Criteria for prioritising identified conservation issues and measures were developed during the Inception phase and were presented at the Inception workshop for refinement. The criteria were grouped according to:

- Recognition of the issue as a significant transboundary concern.
  - for two or more of the riparian states
  - having significant impact across national borders
- Significance / importance of the conservation issue.
  - ecological impact of the issue on aquatic systems and catchment functioning
  - social impact on people in the basin, particularly the poor
  - economic impact within the region, a country or local area
- Relevance of the issue for strengthening ORASECOM.
  - flagship project requiring joint action across national boundaries
  - solution within the financial constraints of ORASECOM
  - piloting or initiation focus, rather than routine operational implementation

The refined criteria are presented below:

Criteria for selection of conservation projects by Orasecom		
Criterion	**Explanation**	**Rating (1=low, 2=medium, 3=high)**
Transboundary impact:	The conservation issue requiring attention has an impact on at least one other country in the basin	3 = Impact in 3 riparian states 2 = Impact in 2 riparian states 1 = Potential for impact on 2 riparian states
Significance of impact:	The conservation issue requiring attention has significant transboundary impact	3 = Transboundary impact is extremely significant 2 = Transboundary impact is significant 1 = Transboundary impact is moderate
Range of benefits:	The conservation issue requiring attention has ecological, social and economic impacts	3 = Issue has ecological, social and economic impacts 2 = Issue has impacts in two of ecological, social and economic areas 1 = Issue has impacts in one of ecological, social and economic areas
Benefits to the poor:	The conservation issue requiring attention has specific impacts on poor communities in the basin and poor women in particular	3 = Mitigation will have high benefits for poor communities 2 = Mitigation will have moderate benefits for poor communities 1 = Mitigation will have little benefit for poor communities

Criteria for selection of conservation projects by Orasecom		
Criterion	**Explanation**	**Rating (1=low, 2=medium, 3=high)**
Credibility:	Resolving the challenge will boost the credibility and profile of Orasecom in the basin	3 = High boost to the credibility and profile of Orasecom in the basin 2 = Moderate boost to the credibility and profile of Orasecom in the basin 1 = Low boost to the credibility and profile of Orasecom in the basin
Availability of information:	If studies have already been conducted regarding addressing the challenge, Orasecom will be better placed to take speedy action than if initial studies are still required.	3 = Considerable work has already been done regarding what is needed to address the challenge 2 = Moderate work has already been done regarding what is needed to address the challenge 3 = Little work has been done regarding what is needed to address the challenge
Lack of clarity of responsibility, i.e. is there a clear role for Orasecom	Where it is unclear with whom the accountability/responsibility of the issue lies	3 = Very difficult to assign resp. 2 = Difficult to assign resp. 1 = Possible to assign resp.

Table 3 Criteria for selection of conservation projects by ORASECOM

3.2. Proposed priority status of interventions

The above criteria were applied to the proposed conservation interventions listed in the preceding section in order to establish a *preliminary* priority status of these interventions. The Consultation Phase workshop was then used to review this priority status. In prioritising the proposed studies, the criterion relating to sufficient information availability was not applied, since the studies are required to address this issue.

The preliminary proposed priority status of the interventions is given in the table 4 overleaf. This lists each of the proposed conservation initiatives and scores each one in terms of the criteria developed during the Inception Phase. As stated above, with the exception of the last criterion, a score of 1 implies a low rating, 2 implies medium rating and 3 implies a high rating.
During the Inception Phase workshop, it was agreed that a criterion reflecting the lack of clarity of responsibility was an important consideration in prioritising conservation initiatives. This criterion considers both whether it is unclear with whom the accountability/responsibility for the issue lies as well as whether there is a clear role for ORASECOM. In this regard, a score of 1 implies a low level of difficulty to assign responsibility, 2 implies moderate difficulty and 3 implies high difficulty in assigning responsibility for the issue and proposed intervention.

The initiatives have been grouped according to implementation-or project-type interventions and studies/assessments. Naturally because the latter have been proposed due to a lack of information, the proposed studies have not been assessed in terms of the 'Availability of information' criterion.

	Ranked Criteria							
Possible water-related conservation projects	**Transboundary impact**	**Significance of impact**	**Range of benefits**	**Benefits to poor**	**Credibility**	**Availability of information**	**Clear role for Orasecom**	**Points (max 21)**
Support to the Lower Orange Transfrontier Conservation Area (LOTCA) Invasive Alien Plant Management Programme	2	2	2	2	3	3	3	17
Coordination of management of the Orange River Mouth estuary	2	2	2	1	3	2	3	15
Collection and treatment of mining decant currently threatening the Cradle of Humankind World Heritage Site, water users, and the Krugersdorp Game Reserve,	1	3	3	1	3	3	1	15
Support to the Black Fly Control programme.	2	2	2	1	2	3	2	14
Support of the Richtersveld COWEP programme	1	1	2	3	2	3	2	14
Support the upgrading of various wastewater treatment works	2	2	2	2	2	3	1	14
Addressing the sand mining and specifically removal of spoil dumped in and around the estuary	2	2	1	1	2	2	3	13
Support of the (on-site) physical rehabilitation of the Klip River wetlands	1	1	2	2	2	3	2	13

	Ranked Criteria							
Possible water-related conservation projects	**Transboundary impact**	**Significance of impact**	**Range of benefits**	**Benefits to poor**	**Credibility**	**Availability of information**	**Clear role for Oraseco m**	**Points (max 21)**
Support of the rehabilitation of the Klip River wetlands by addressing the upstream contamination of wastewater and mining effluent.	1	1	2	1	2	3	2	12
WC/WDM Kuruman	1	1	2	2	2	3	1	12
WC/WDM Mafikeng	1	1	2	2	2	3	1	12
WC/WDM Upington	1	1	2	2	2	3	1	12

Possible water-related conservation studies								Points (max 18)
An assessment/study of the basin's long-term water quality requirements.	3	3	3	2	3	N/A	3	17
The development of phosphate guidelines, pertaining to domestic and recreational water use, which can be applied throughout the basin.	3	3	2	1	3	N/A	3	15
An assessment/study of basin water quality models to analyse and predict the drivers of water quality changes.	3	3	2	1	3	N/A	3	15
Study on the potential for increased efficiency of water use in agriculture	2	2	2	2	3	N/A	3	14

	Ranked Criteria							
Possible water-related conservation projects	**Transboundary impact**	**Significance of impact**	**Range of benefits**	**Benefits to poor**	**Credibility**	**Availability of information**	**Clear role for Oraseco m**	**Points (max 21)**
Study on the long term yield of the Taung dam and the potential for it to supply other uses.	2	1	2	2	1	N/A	1	9

Table 4 Preliminary priority status of proposed interventions

As shown in the table above the interventions which ranked highest were typically those involving basin-wide studies and transboundary initiatives where a clear mandated body was absent. These initiatives consistently ranked high in the extent of their transboundary impact, the significance of their impact and the range of (ecological, social and economic) benefits. In contrast, localised implementation-type initiatives the Klip river wetlands rehabilitation and the three water conservation and demand management initiatives) ranked lower in this exercise.

These initiatives and their preliminary scoring were presented for discussion and refinement to the PSC and various stakeholders at the Consultation Workshop. The exercise confirmed the approach that localized issues and issues which have a clearly assigned responsible party should not be a central element of ORASECOM's conservation strategy. In addition, it was agreed that basin wide issues should receive greater priority than most other issues. The workshop deliberations confirmed that the Fund should serve the interests of a basin-wide plan. Lastly, it was also agreed that ORASECOM has a role to play in filling certain gaps, specifically in establishing pilot projects in order to demonstrate untested technologies or approaches.

4 Concluding remarks

Following the Inception Phase, the following areas were identified as being key considerations in conservation of the Orange-Senqu River basin's resources:

- The threat to water **resource availability**
- The decline in **water quality**
- Alteration of the **flow regime/hydrology**
- Soil erosion and wetland **degradation**
- The invasion of **alien species**

These issues were presented to the ORASECOM steering committee and basin stakeholders at the Inception Phase workshop where the priority issues were identified to be those relating to:

- The threat to water **resource availability**
- The decline in **water quality**
- Alteration of the **flow regime/hydrology**

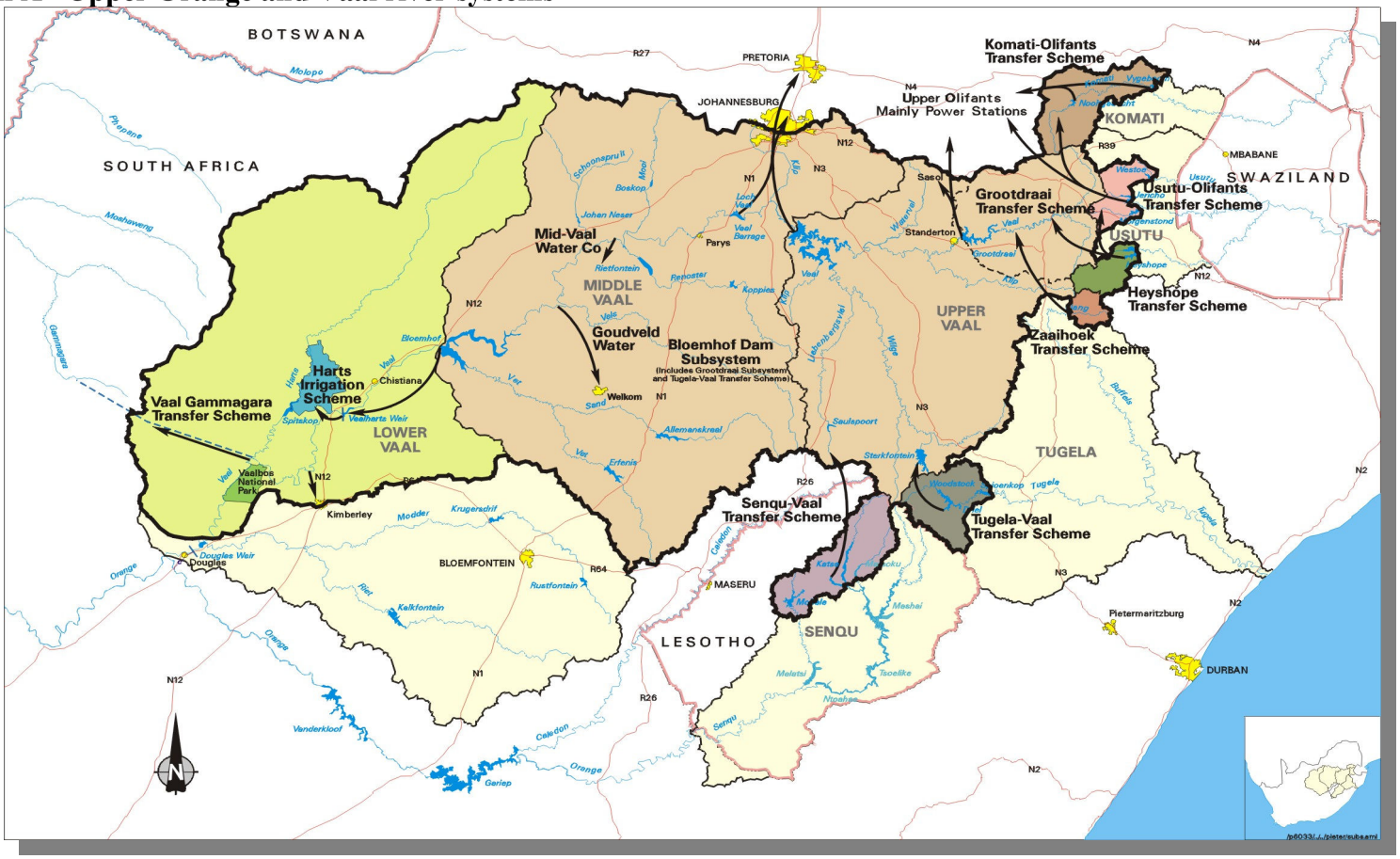
The Consultation phase assessment unpacked these three areas in order to examine their status, to examine whether there are current activities to address them, whether there have been or are studies conducted in terms of addressing them, and to identify possible mitigation interventions that may be suitable for ORASECOM to undertake.

The assessment involved review of the available literature as well as consultations with sector specialists and stakeholders. During consultations, the various stakeholders and sector specialists were asked to give indication of the associated cost implications for the various interventions. Given the broad definition of the initiatives, the funding requirements were expressed in terms of possible, but realistic cost ranges.

This document forms part of the final deliverable for this project and must be read in conjunction with the Business Case report. This document sets out how the key water-related conservation mitigation measures/projects were identified and subsequently prioritised according to the criteria approved in the first phase of the project. The accompanying Business Case report combines the recommended conservation measures and performance indicators discussed herein, into a business case for funding mechanisms.

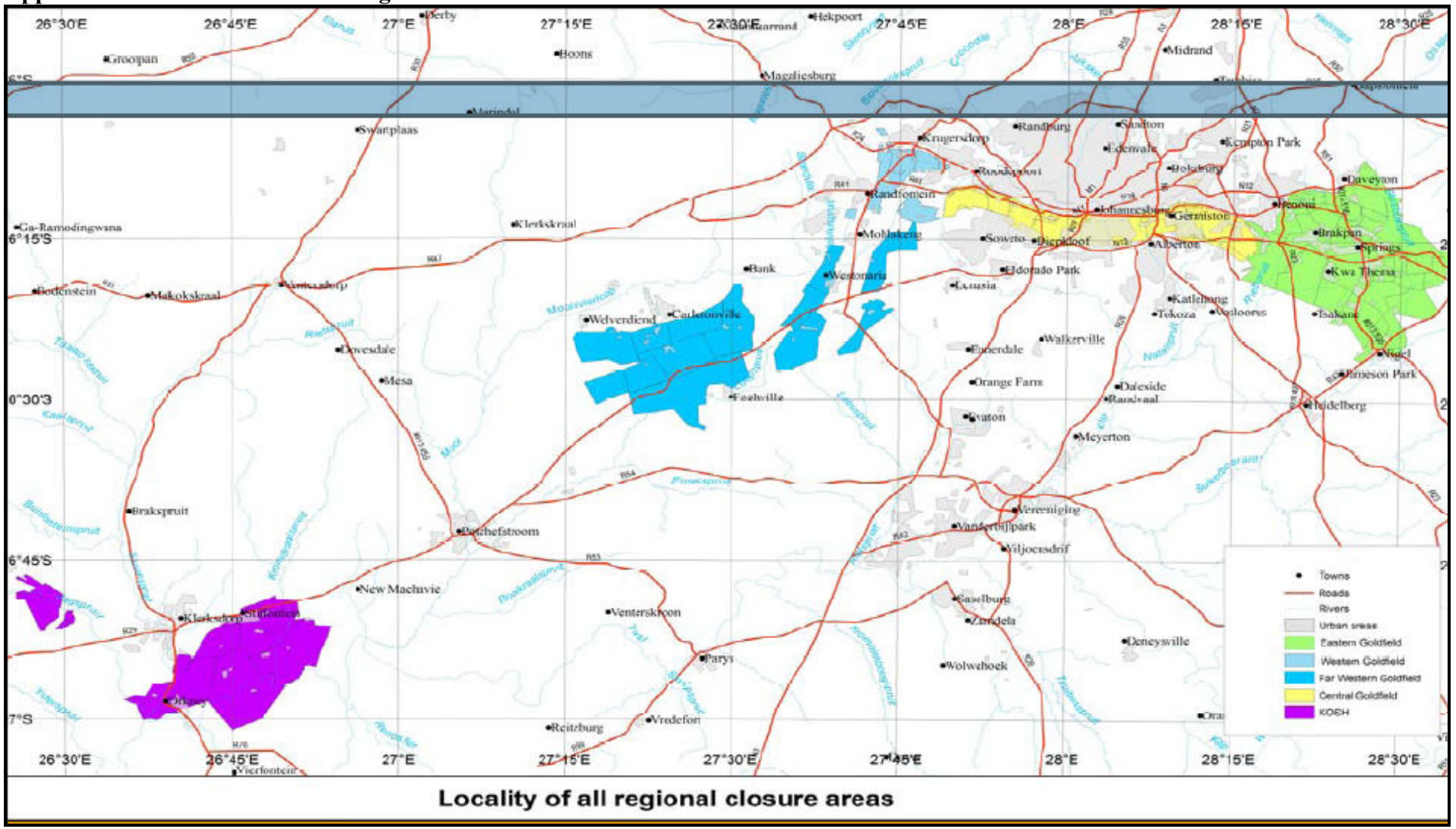
Appendices

Appendix A - Upper Orange and Vaal river systems



'**Source: DWAF, South Africa 2008**

Appendix B – Witwatersrand mining basin

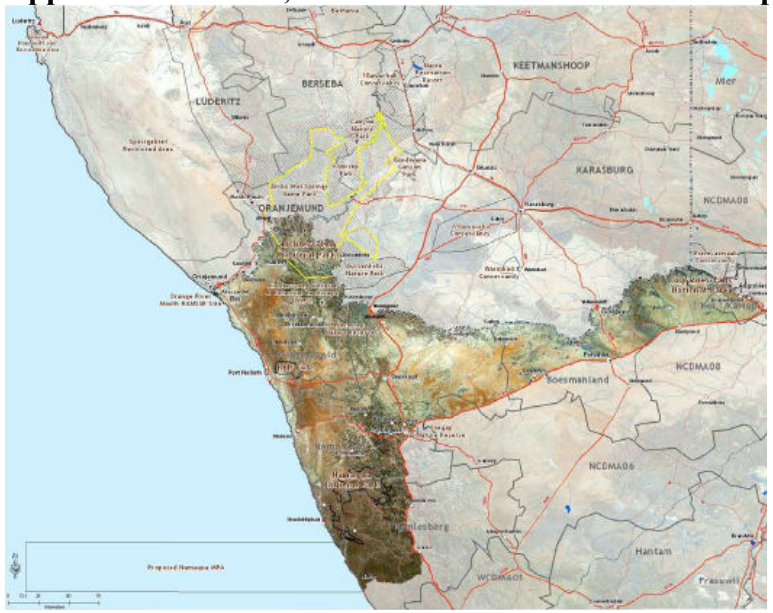


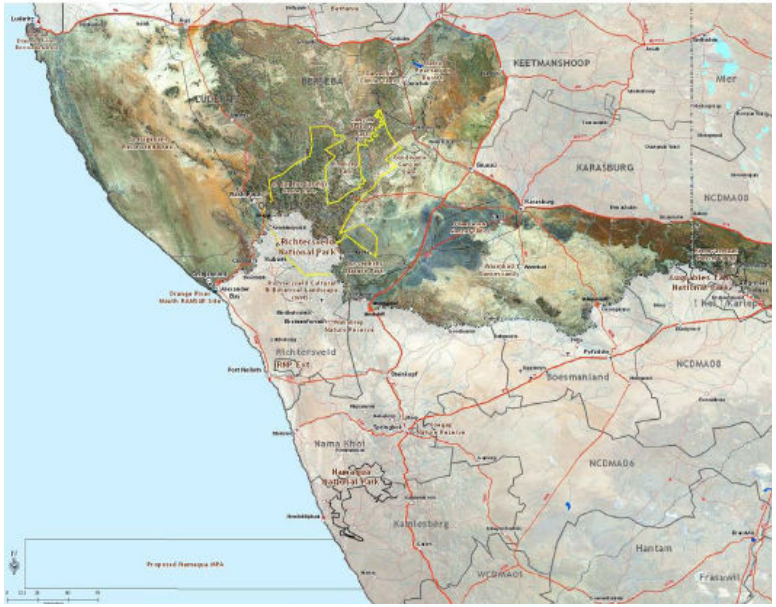
Source: Council for Geoscience, 2009

Appendix C - Indication of National Parks/Reserves including Richtersveld National Park area

Source: www.sa-venues.com

Appendix D - TFCA, Namibian and South African components





Source: www.dwaf.gov.za

Appendix E Consultations undertaken

Name	Organisation
Peter Ashton	CSIR
Kevin Scott	ARC
Johan van Rooyen	DWAF, South Africa
Seef Rademeyer	DWAF, South Africa
Barbara Weston	DWAF, South Africa
Martin Ginster	SASOL
Andries Meyer	SASOL
Nikisi Lesufi	Chamber of Mines
Gerhard	WRC
Dr Rob Palmer	Nepid Consultants
Debbie Sharpe	Working for Water
Alexis Symonds	SANPARKS
Paul Bewhser	Ecotourism Afrika Trust
Stephan de Wet	DWA, Namibia
Maria Amakali	DWA, Namibia
Smart Moalosi	DWA, Botswana
Winston Coe	Working for Wetlands (Orange River)
Thomani Manungufala	Working for Wetlands (Klip River)
Gert Greyvenstein	Department of Agriculture (RSA)
Ronnie McKenzie	WRP
Willem Wegelin	WRP
Nigel Adams	DWAF, South Africa
Marius Keet	DWAF, South Africa
Pieter van Niekerk	DWAF, South Africa
John Dini	Working for Wetlands
Lazarus Karaibeb	Karas Investment/Greater Fish River Canon Complex Ventures (Namibia)
Piet Heyns	Ex-DWA, Namibia
Dudley Biggs	Ex-DWA, Namibia

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