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

FINAL RECONCILIATION STRATEGY - EXECUTIVE SUMMARY

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ORANGE RIVER

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FINAL RECONCILIATION STRATEGY

EXECUTIVE SUMMARY

Prepared by:

WRP Consulting Engineers, Aurecon, Golder Associates Africa, and Zitholele Consulting.

Title:	***Final Reconciliation Strategy – Executive Summary***
Authors:	*Study Team*
Project Name:	***Development of Water of Reconciliation Strategies for Large Bulk Water Supply Systems: Orange River***
DWA Report No:	*P RSA D000/00/18312/12*
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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	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

List of Abbreviations & Acronyms

amsl	above mean sea level
BHN	Basic Human Needs
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
DWA	Department of Water Affairs
EWR	Ecological Water Requirements (Ecological Component of the Reserve)
FSL	Full Supply Level
IAP	Invasive Alien Plants
IBs	Irrigation Boards
ISP	Internal Strategic Perspective
IWQMP	Integrated Water Quality Management Plan
IWRM	Integrated Water Resource Management
LHWP	Lesotho Highlands Water Project
m^3/a	Cubic metre per annum
MOL	Minimum Operating Level
NWRS	National Water Resource Strategy
ORASECOM	Orange-Senqu River Commission
ORP	Orange River Project
PES	Present Ecological State
RWQOs	Resource Water Quality Objectives
URV	Unit Reference Value
WC/WDM	Water Conservation /Water Demand Management
WDM	Water Demand Management
WMA	Water Management Area
WRPM	Water Resource Planning Model
WRYM	Water Resource Yield Model
WUAs	Water User Associations

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

Final Reconciliation Strategy

EXECUTIVE SUMMARY

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1 PURPOSE OF THIS REPORT

The purpose of the Executive summary is to provide an abridged description of the Reconciliation Strategy developed for the Large Bulk Water Supply Systems of the Orange River. An overview of the strategy will be given highlighting the most important components and actions to be taken over time to ensure that sufficient water is made available for the growing water requirements of user's dependant on the system as well as for the ecological requirements over the planning period.

2 INTRODUCTION

The Department of Water Affairs (DWA) has identified the need for detail 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 for the Large Bulk Water Supply Systems of the Orange River was 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 have formed an integral part of the strategy development process.

Since 1996, 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 Ash 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 in its planning stages and is expected to be in place by 2022. This will reduce the yield of the Orange River System and result in a negative water balance in the Orange River, requiring a yield replacement option in the Orange River.

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 2050. 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.

3 CONTEXT OF STUDY

Water resources allocation must be based on the equitable and reasonable utilisation of the water sources in the shared watercourse by each watercourse state.

Specified factors/criteria including social, economic and environmental needs; the population dependent on the shared watercourse; the effects of the use or uses of a shared watercourse in one Watercourse State on other Watercourse States; as well as existing and potential uses must be taken into account when agreeing what is equitable and reasonable. All relevant factors are to be considered together and a conclusion reached on the basis of the whole.

This water reconciliation strategy by DWA will be an input to the future Catchment Management Strategy (CMS) once the Catchment Management Agency (CMA) gets established. It is important that this reconciliation strategy is also in harmony with the to-be-established National WWater Resource Strategy (2nd Edition).

4 STUDY PROCEDURE AND STAKEHOLDER ENGAGEMENT

The study is anchored by technical investigations and stakeholder engagement processes that are intertwined. **Figure 4 1** illustrates the flow of the processes.

The technical process started with a literature survey and review of current information with the Summary Report of previous and current studies as deliverable.

The Preliminary Screening of Options was undertaken at a screening workshop which was held on 7 February 2013 where a list of possible reconciliation options were evaluated by the Study Steering Committee to define the shortlist of options that was investigated further.

The next three steps of the technical process, i.e. baseline evaluation, investigation of reconciliation options and assessment of environmental impacts all led to the development of the preliminary reconciliation strategy. The gaps in the preliminary reconciliation strategy were then investigated and the reconciliation options were refined.

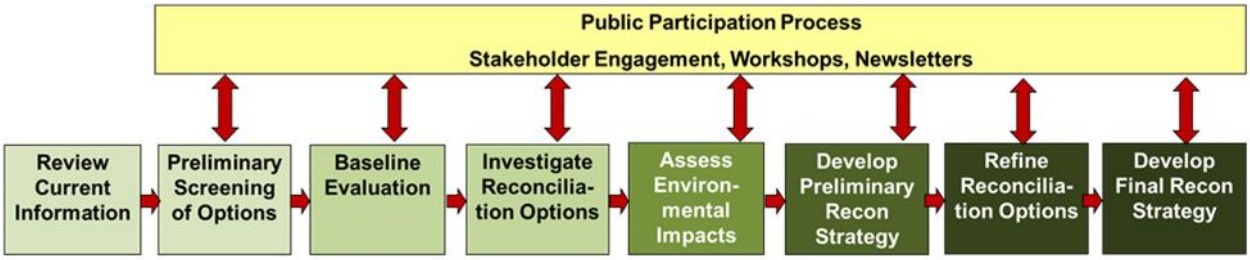


Figure 4-1: Technical Studies and Public Participation Process

The development of this Final Reconciliation Strategy is the last step in the technical process.

5 SYSTEM DESCRIPTION

The Senqu River in Lesotho, with its tributaries, drains most of the Lesotho Highlands. After this river has crossed the Lesotho/South Africa border, it becomes the Orange River which then has its confluence with the Caledon River in the RSA in the upper reaches of the Gariep Dam.

Most of the tributaries within Lesotho will be controlled by the Lesotho Highlands Water Project (LHWP) once all the proposed phases have been developed. Phase I of LHWP, i.e. the Katse and Mohale Dams, Matsoku Weir and transfer tunnels is complete and 780 million m³/ water is transferred from these dams to the Vaal Dam in the Vaal River Catchment.

The two major dams within the Caledon catchment are the Welbedacht Dam and the Knellpoort Dam which are sources for the water supply to Bloemfontein.

The Kraai River drains from the North Eastern Cape into the Orange River, downstream of Lesotho and upstream of Gariep Dam.

The Gariep Dam, Vanderkloof Dam, Orange-Fish Tunnel, Orange Vaal transfer canal and Orange-Riet Canal system are all part of the Orange River Project (ORP).

Tributaries downstream of the Orange/Vaal confluence such as the Ongers, Sak and Fish (Namibia) Rivers are draining arid and semi-arid regions. The flows in these rivers are very infrequent and it is expected that their flows will only contribute to the Orange River's flow during periods of relative high flows in the Orange River. The individual yield contribution of these rivers to the Orange River is relatively small.

6 THE RESERVE

The Reserve is that portion of the natural flow that has to be available in a river or stream in order to sustain the aquatic ecology, and also to provide for basic human needs.

Currently a total of 288 million m³/annum is released to supply the river mouth EWR. Riverine EWRs were recently assessed at an Intermediate Level in a study by ORASECOM at selected key areas of the Orange River Basin. The implications of these EWRs on the yield of the system, including releases to the estuary will be a total reduction in the yield available for consumptive use of 722 million m³/a. It is foreseen that the Ecological Preferred EWR can only be met once a new dam on the system comes into operation.

Current and projected water requirements

The projected total high and low growth water requirement figures for 2040 are shown in **Table 6.1.**

Table 6-1: Total high and low growth water requirements

Sector	Requirement in 2012 (million m^3/a)	Future requirement (2050)	
		High growth [4] (million m^3/a)	Low growth (million m^3/a)
Irrigation	2 370	2 621	2 489
Urban/Industrial	252	570	564
Mining	16	34	34
Riverine and Operational requirements	846	795	715
Transfers not included in above given demands[2]	780	1 217	1 105
TOTAL [3]	**4 264**	**5 237**	**4 907**

Notes [1] The EWRs were excluded from the water users listed above and incorporated in the determination of the water availability (yield analysis) – see **Section 5.2**

[2] Transfers from Phases 1 and 2 of Lesotho Highlands Water Project to the Vaal system. High growth assumes full Phase ll transfer in place

[3] The demands exclude non-consumptive power generation water use. Transfers to meet water requirements in the Eastern Cape (638 million m^3/a in 2012) are included.

[4] WC/WDM for Bloemfontein already included in high demand projection

7 WATER AVAILABILITY

Generally groundwater can be used for domestic and stock watering and supply for smaller towns supplied by well fields within the Orange River basin. The harvest potential estimates for the Upper and Lower Orange areas provide an estimate of the maximum volume of water available per surface area for sustained abstraction. It is assumed that there is adequate groundwater resources available in the basin to supply towns and communities not connected to the main surface water supply schemes. However, borehole siting should be based on scientific principles, and sound management practices need to be applied to ensure sustainability of the resource.

As far as surface water is concerned, the two large sub-systems within the study basin, the LHWP and the ORP (Gariep & Vanderkloof dams), are providing most of the available yield within the Orange/Senqu system. The historic firm yields which are available from the current systems at 2012 development level are summarised in **Table 6.1** below.

Table 7-1: Historic Firm Yield from large dams in the system

Sub-system	Dams	Live Storage (million m^3)	Yield * (million m^3)
LHWP Phase I	Katse	**1 517**	780
	Mohale	**851**	
Orange River Project	Gariep	4 576	3 323
	Vanderkloof	2 173	
Caledon/Modder sub-system	Knellpoort	131	84
	Rustfontein	72	
	Welbedacht	6.6	
	Mockes	3.3	

Notes: * - The yield for each of the sub-systems refer to the total sub-system yield as obtained from the combination of dams applicable to each individual sub-system

8 WATER QUALITY

The quality of surface water at any point in a catchment reflects the combined effect of many physical, chemical, and biological processes that affect water as it moves along hydrologic pathways over, under, and through the land. An assessment of the water quality of the Orange River was undertaken in order to identify water quality issues/aspects that may have an influence on the overarching planning and management of the system. The available water quality data in the study area was sourced from the Department of Water Affair's (DWA) Water Management System (WMS) database. The available Resource Water Quality Objectives (RWQOs) for the Upper and Lower Orange WMAs were collated and used to compare the instream water quality against. The results of the analysis were assessed and discussed and based on this, management actions for the water quality of the Orange River System are recommended. In addition based on an understanding of the water quality of the system, a high level qualitative assessment of the implications of the reconciliation options is presented

In terms of the water quality analysis and assessment of water quality issues undertaken, the following can be summarised in terms of the task conclusions and recommendations:

- The water quality present state analysis indicates increasing salinity in the Orange River (temporal and spatial) and high nutrient concentrations that indicate the potential for eutrophic conditions throughout the catchment and a possibility of hypertrophic conditions. The evidence suggests that the high turbidity in the system is the limiting factor for algal growth.

- The high concentration of turbidity that is evident in the system specifically in the Upper Orange WMA does not appear to be a significant threat to the aquatic ecosystem based on ecological assessments that have been undertaken. However it is apparent that it must be taken into consideration in the design and management of water supply infrastructure.

- The development of an integrated water quality management strategy is required that addresses the nutrient and salinity management of the system, the refinement and adoption of the RWQOs, the quantification of the extent of the actual and emerging problems of water pollution/water quality deterioration and the actions required for land use management.

- It is recommended that:
    - Nutrient modelling of the system be undertaken, and
    - Irrigation return flows be assessed.

- Improved and consolidated water quality monitoring of the Orange River System (surface and groundwater) is required to support effective water resource management.

- The qualitative high level assessment undertaken of the water quality implications of the reconciliation options indicates that there will be no significant impacts on the current water quality of the Orange River System. However the potential for Vioolsdrift Dam to act as a sink for nutrients and sediment and for Verbeeldingskraal Dam to capture sediments does exist. These impacts must be investigated further should these options be implemented.

- A desktop study was undertaken to identify the opportunities for re-use of treated sewage effluent from the urban areas. The current and future discharge volumes were obtained from the literature and from the municipalities. The water quality requirements for the re-use for irrigation, indirect re-use and direct re-use options are discussed. The water treatment requirements for the different re-use options are presented and the capital costs for the treatment determined. The assessment of the opportunities for re-use of treated effluent showed that currently the potential is limited. However effluent re-use could contribute to the suite reconciliation options in the future with the expected growth in the effluent volumes.

9 THE CURRENT AND FUTURE WATER BALANCE

9.1 WATER BALANCE WITHOUT INTERVENTION OPTIONS

Currently there is a slight surplus in the system but the growth in water demand over the next 37 years up to 2050 will cause water shortages over time.

Polihali Dam will increase the yield of the Orange River System but the transfer to the Vaal River System will be greater than the increase in system yield, thus reducing the yield of the Orange

River system. The yield created by Polihali Dam can be shared by the Orange and Vaal users for as long as the Vaal users do not need the full yield of the dam. The long term effect will be a growing water shortage as illustrated in **Figure 9.1.**

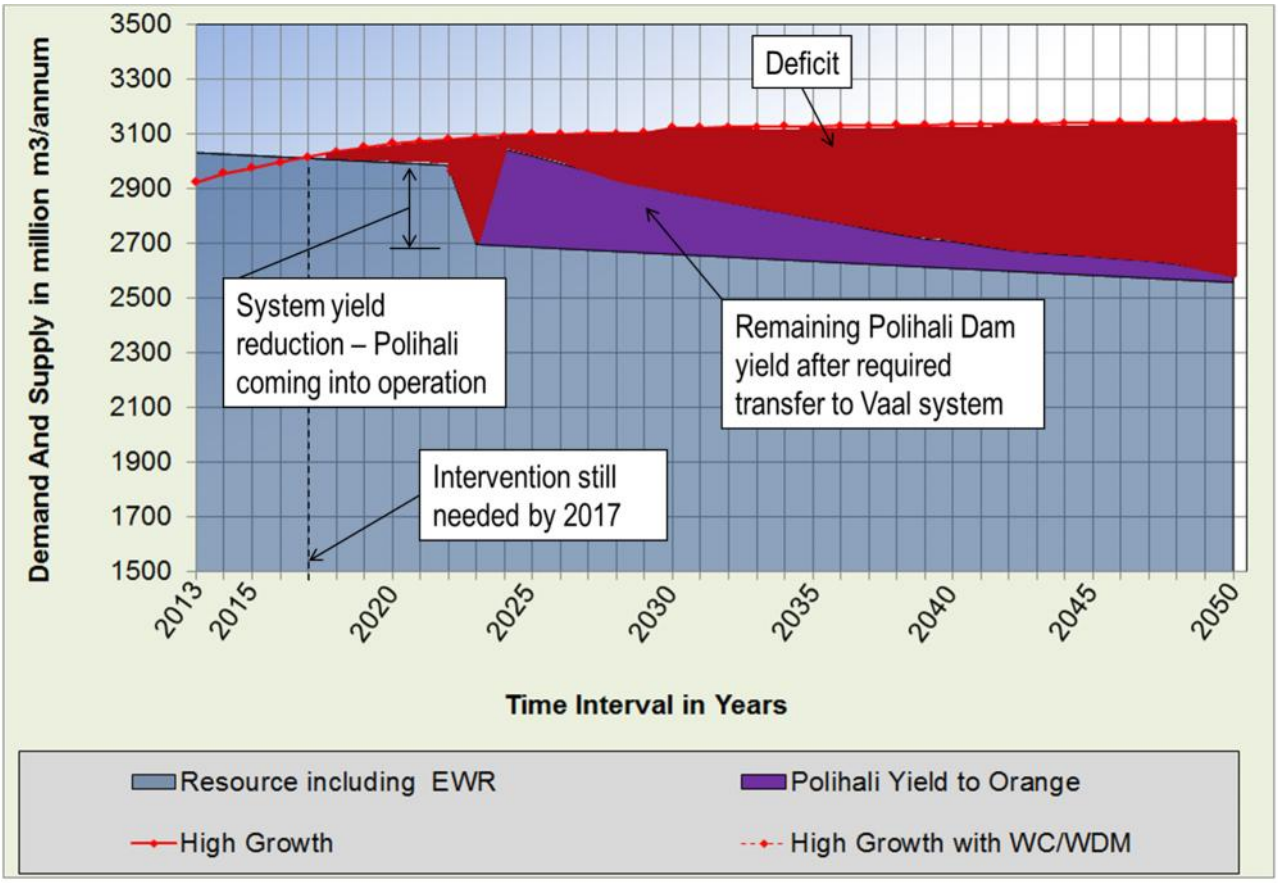


Figure 9-1: Future water balance of Orange River Project (ORP – with LHWP Phase II and no further possible intervention scenarios

Intervention scenarios comprise the introductions over time of various combinations of reconciliation options, which can be divided into two main categories:

- Reconciliation Options that reduce the water requirements.
- Reconciliation Options that increase the water supply.

Reconciliation Options considered that reduce the water use or water requirements are:

- Water conservation and water demand management,
- Mechanism to re-allocate saved irrigation water,
- Reducing assurances of supply,
- Compulsory licensing.

Reconciliation Options considered that increase the water supply are:

- Groundwater development,
- Transfers in,
- New dams,
- Re-using sewage effluent,
- System operating rules,
- Rainfall enhancement,
- Removal of invasive alien plants,
- Desalination of sea water.

Options were screened at a Screening Workshop held in Kimberley on 7 February 2013 in accordance with agreed criteria.

9.2 RECONCILING THE WATER REQUIREMENTS WITH THE WATER RESOURCE

9.2.1 Reconciled water balance assuming current EWR releases are maintained

A recommended reconciliation scenario, comprising a combination of options, has been selected in accordance with the selection criteria and a future water balance for this scenario was analysed. This scenario assumed that the current EWR releases are maintained throughout the planning period. The future water balance of the selected scenario is shown in **Figure 9.2.**

The scenario comprises:

- Groundwater Development

  Groundwater is highly suited for small town domestic supply and in this basin should always be one of the first options to be considered before turning to a surface water option. No regional groundwater supply schemes are foreseen. It was therefore assumed that the future water deficits in the small towns will be satisfied with groundwater and therefore only surface water is shown on the water balance graphs.

- Real time monitoring at the Orange/Vaal confluence to optimise the releases from Vanderkloof Dam.

  The estimated saving in operations losses is 80 million m^3/a. This intervention will be relatively inexpensive to implement and can be done quickly as it is not a labour intensive exercise. It was assumed that all telemetry will be installed and that the intervention will be operational by 2016.

- Water Conservation and Water Demand Management

  The two water use sectors where WC/WDM can be successfully applied are the domestic water use sector and the irrigation sector. The contribution of water savings in the domestic water use sector will be very small relative to the total water use from the ORP, i.e. approximately 6 million m^3/a. The current irrigation water use is approximately 2 000 million

m^3/a. A conservative 5% of the total irrigation water demand was taken as a possible water saving. It was assumed that the WC/WDM plan will be rolled out in 2015 and that it will take the irrigators 5 years to achieve the full water saving of 100 million m^3/a, that can be made available.

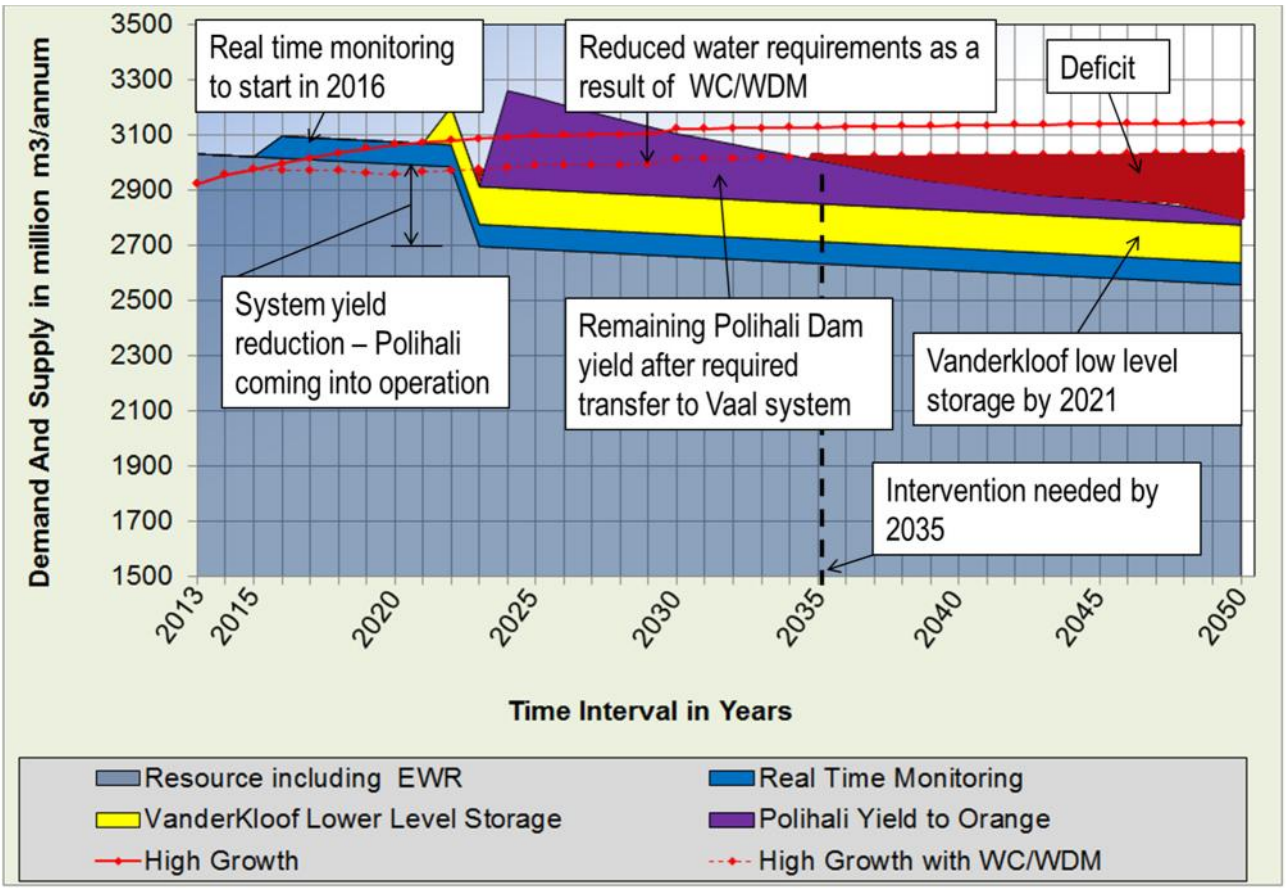


Figure 9-2: Water balance with WC/WDM, real time monitoring and Vanderkloof Dam low level storage

- Minimum Operating Level – Vanderkloof Dam

  The Vanderkloof Dam could be operated at a lowering Minimum Operating Level (MOL) and the yield of the system could increase by approximately 137 million m^3/a. The current minimum operation level is 1 147.8 m amsl and it is proposed to lower it to 1 111.0 level. The new proposed minimum operating level is below the irrigation outlets and to continue to supply for irrigation, water would be abstracted from the right bank silt outlet. A pump station will be required to pump the water into the irrigation canal which supplies water to Ramah and Orange-Riet canals. Lowering the MOL would mean that ESKOM would not be able to generate hydropower for some limited periods.

9.2.2 Reconciled water balance assuming updated EWR releases will be phased in over time

Initial preliminary results from EWR studies commissioned by ORASECOM indicated that the Ecological Preferred EWR requires additional releases from the ORP, reducing the available water by 434 million m^3/a, i.e. a total of 722 million m^3/a. A further reconciliation scenario was formulated where the Ecological Preferred EWR is implemented and it was shown the following two additional interventions are needed:

- Vioolsdrift Dam

  The dam at Vioolsdrift is needed for two purposes, i.e. to regulate the river flow and to increase the yield. The water loss that can be saved if Vioolsdrift is used as a regulating dam is 120 million m^3/a, and this is then available from Vanderkloof Dam. By utilising the remaining storage capacity in the dam, a further yield increase of 192 million m^3/a can be achieved. The additional total benefit of Vioolsdrift Dam will therefore be 312 million m^3/a. A dam with a full supply level of 210 mamsl and 510 million m^3 storage was found to be the optimum size. Any larger dam would not help meet additional growth in the water requirements because the downstream demands would all have been met.

- Gariep Dam Raising

  Among all the dam development options in the Upper Orange WMA, raising Gariep Dam by 10m and Verbeeldingskraal Dam was found to be economically the preferred two options. The Unit Reference Value (URV), an economic index, for the combination of options that includes the raising of Gariep is of R0.31 m^3, at 8% discount rate for a yield increase of 350 million m^3/a. The combination of options that includes Verbeeldingskraal Dam as an alternative to the raising of Gariep produced a URV of R0.29 at 8% discount rate and relates to a yield increase of 230 million m^3/a in the context of the combined system.

  The envisaged 10m raising of Gariep Dam would have social impacts since the town of Bethulie will have to be substantially rebuilt above the area that would be at risk of flooding. People in Bethulie will have to be relocated. Despite the associated mitigation costs, the raising of Gariep Dam was still one of the most economical options. The scenario where the Ecological Preferred EWR is implemented in 2025 is shown in **Figure 9.3.**

  The water balance for the combination of options that includes Verbeeldingskraal Dam is given in **Figure 9.4**. Due to the lower yield produced by Verbeeldingskraal Dam, this option will not be able to maintain a positive water balance over the entire planning period, and deficits are expected to occur from 2037 onwards. The Verbeeldingskraal combination of options however significantly reduce the total evaporation losses from the Orange System in comparison with the raised Gariep combination of options, and resulted in significantly higher spills from Vanderkloof Dam, which will be to the advantage of the environment and the yield generated from Vioolsdrift Dam

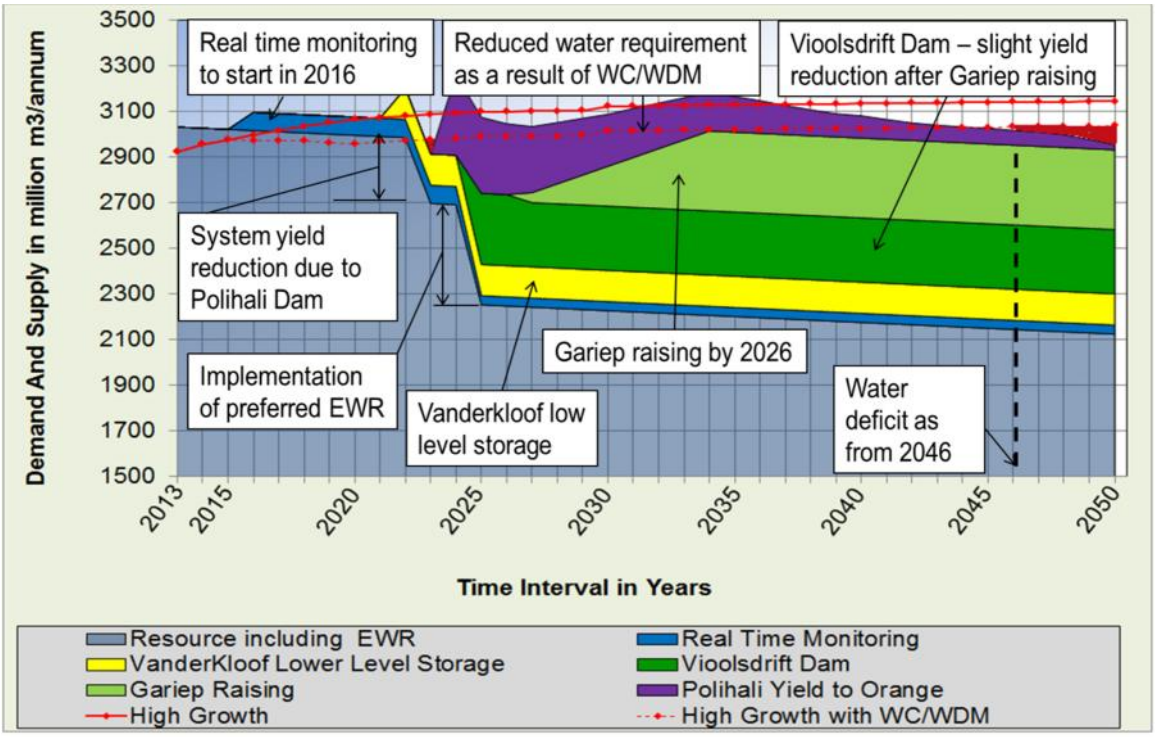


Figure 9-3: Vioolsdrift Dam and the raising of Gariep Dam are needed if the ecological preferred EWR needs to be operationalised

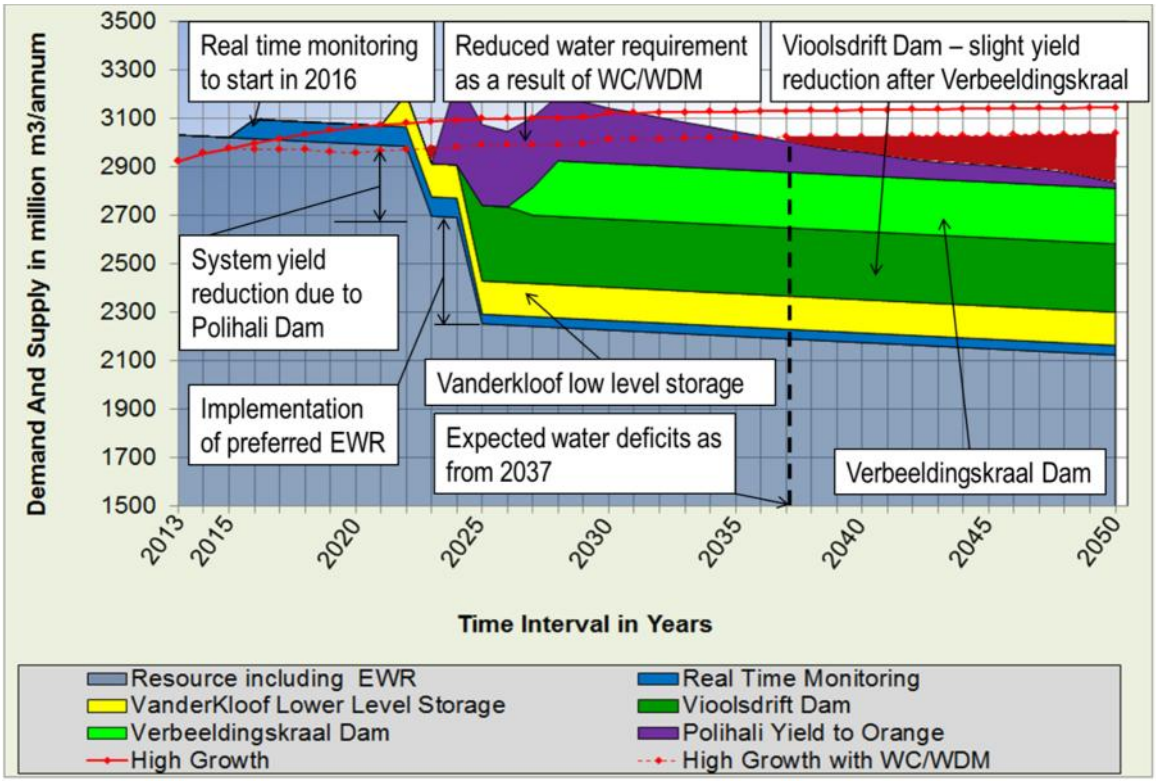


Figure 9-4: Vioolsdrift Dam and Verbeeldingskraal Dam are needed if the ecological preferred EWR needs to be operationalised

10 THE ORANGE RECONCILIATION STRATEGY IN A NUTSHELL

The following measures are envisaged for the Orange River system (South African portion) to maintain a water balance between the water needs and availability up to the year 2050:

(i) Water required to supply the current and future social and economic activities as well as supporting the transfer to the Vaal River system, will have to come from within the Orange/Senqu basin. It was found that transferring water from a neighbouring basin (e.g. Mzimvubu measures) will be too expensive.

(ii) The existing EWR needs to be maintained and to avoid immediate large negative socio-economic implications additional releases towards an alternative EWR can only be implemented as soon as a new dam is commissioned. Further optimisation of the EWR in combination with the proposed augmentation options is recommended. That is to achieve an acceptable balance between protection of the ecology and use of water for socio-economic purposes.

(iii) Groundwater, if available, should be prioritised as the first choice to augment the water resources of towns and communities located far from the Orange River.

(iv) All water requirements can be balanced by availability through the implementation of the following measures:

(v) Shared utilisation of LHWP Phase II between the Vaal River and Orange River systems is an essential measure to postpone large capital expenditure that would otherwise be required at the same time Polihali Dam become operational;

(vi) Plan and implement WC/WDM in the domestic and irrigation water use sectors. Targeted savings of 6 million m3/a for the domestic/industrial water use sector (excluding Bloemfontein) and 5% of total water use in the irrigation water use sector need to be achieved not later than 2020;

(vii) The introduction of a mechanism whereby water, saved through water use efficiency, especially in agriculture, can be made available to other water users in the system;

(viii) Limit operational losses through real time monitoring of river flows in the Orange and Vaal rivers to maximise the beneficial use of the spillages from the Vaal River System – target implementation date 2016, and

(ix) Utilising a greater portion of Vanderkloof Dam's storage capacity by lowering the minimum operating level in the dam. This measure will require pumping infrastructure which has to be in place by 2022.

(x) If a decision is taken to implement the Ecological Preferred EWR during this planning horizon, the following actions are also required sooner:

(xi) Commission Vioolsdrift Dam at the decided date for alternative EWR implementation, and

(xii) Creating additional yield in the system by raising Gariep Dam by 10m or by building the Verbeeldingskraal Dam. The implementation date of either of these options will be dependent on the implementation date of the Ecological Preferred EWR, by approximately 2026.

(xiii) Investigating further management measures, such as lowering the assurances of supply, eliminating unlawful water use and eradicating invasive alien plants in the Kraai River catchment.

(xiv) Hold negotiations with WUA and Irrigation Boards to agree on appropriate assurances of supply for irrigated agriculture.

(xv) Initiate a process to decide what the desirable EWR should be for the river system.

11 ACTIONS REQUIRED

A number of short term actions are required. They are:

- Complete the verification process in the Upper Orange and start the validation and verification process in the Lower Orange. Determine the increase in lawful and unlawful irrigation.
- Obtain confirmation that Polihali Dam will be utilised as a shared resource between the Vaal and Orange River systems.
- Conduct a study on the level of environmental protection weighed up against the socio-economic implications to establish whether a reduced EWR compared to the preferred ecological EWR, 2013 will suffice.
- Develop an Integrated Water Quality Management Strategy to ensure that available water resources remain fit for use.
- Interact with Water User Associations and Irrigation Boards, not yet transformed into WUA re lowering the assurances of supply.
- Develop a WC/WDM plan for each scheme under the ORP. These plans need to be ready for implementation by 2015.
- Determine the extent of water savings which can be made available through WC/WDM. Also develop a mechanism to re-allocate the saved water.

- Implement the real time monitoring of the Vaal River and Orange River flows downstream of Bloemhof and Vanderkloof dams as soon as possible, as this option is regarded as a quick win.
- Notify the co-basin states of the possible interventions.
- Initiate negotiations with Namibia on Vioolsdrift Dam.
- Develop an Integrated Water Quality Management Strategy to ensure that available water resources remain fit for use.

The following medium to long-term actions is required:

- Commission a bridging study on the utilisation of the Vanderkloof Dam lower level storage. Negotiate with all affected stakeholders to define and agree on the appropriate institutional arrangement. Then proceed with the design and implementation of the pumping station and pipelines for pumping water from the reduced minimum operating level of Vanderkloof Dam into the existing Oranje Riet canal.
- Initiate a feasibility study for Vioolsdrift Dam.
- Commission a pre-feasibility study for choosing between the raising of Gariep Dam and the Verbeeldingskraal Dam
- The feasibility study for the raising of Gariep Dam or Verbeeldingskraal Dam should commence, after the completion of the pre-feasibility study mention above, assuming that the option is still needed when the final decision on the desirable EWR was taken.

The timelines and responsibilities for the required actions are summarised in **Table 10.1**

Table 11-1 : Summary of short term and medium to long term actions

Action	Responsibility	Timeline
Verification of Water Entitlements – Upper Orange	DWA Regional Office, Bloemfontein	Process started already. Complete within 3 years, i.e. 2016.
Validation & Verification – Lower Orange	DWA Regional Office, Kimberley	Complete Validation by 2015 and Verification by 2019.
Confirm Polihali Dam to be operated as a shared resource and develop optimal operating rules.	DWA Head Office, International relations. Through ORASECOM & DWA National Water Resource Planning	Immediately.

Action	Responsibility	Timeline
Do a study on the impacts if the ecological preferred EWRs, 2013 are reduced	DWA Head Office, RDM	Start Immediately
Develop an Integrated Water Quality Management Strategy	DWA Head Office Water Quality Planning	Start immediately.
Negotiate reduced assurances of supply with water users.	DWA Regional Offices, Bloemfontein & Kimberley.	Start immediately. To be concluded in 2015.
Develop WC/WDM plans for municipalities, WUAs and IBs not yet transformed into WUAs.	Municipalities and WUAs, with support from Directorate Water Use Efficiency DWA Head Office.	Start immediately. Plans must be in place and ready for implementation in 2015.
Install telemetry for real time monitoring – Design of system.	DWA Head Office Mechanical and Electrical	Start immediately. System must be installed by 2015.
Negotiate with Namibia about Vioolsdrift Dam.	DWA Head Office, International Relations through ORASECOM	As soon as possible. Try to reach agreement before **2015**
Commission a bridging study to proceed with the implementation of the option to utilise the Vanderkloof LLS. To be followed by design of pumping station and piping for pumping from reduced m.o.l in Vanderkloof Dam into the Oranje Riet Canal	DWA; Options Analyses in Head office (Bridging Study) & DWA Mechanical & Electrical to prepare tender documents.	2017.
Feasibility Study for the Vioolsdrift Dam. Other dam building processes to follow.	DWA; Options Analyses in Head Office.	Start at the latest in 2016.
Pre-feasibility study for choosing between Gariep Dam Raising and Verbeeldingskraal Dam.	DWA Options Analyses in Head Office.	After Vioolsdrift Feasibility Study.
Delay feasibility Study for the raising of Gariep Dam or Verbeeldingskraal Dam until EWR is selected. Other dam building processes to follow.	DWA: Options Analyses in Head Office.	Pending decision on EWR.

12 IMPLEMENTATION ARRANGEMENTS

It is DWA's intention to form a Strategy Steering Committee that will oversee the implementation of the strategy as well as recommend adaptive measures to accommodate any changes that may affect the reconciliation scenarios.

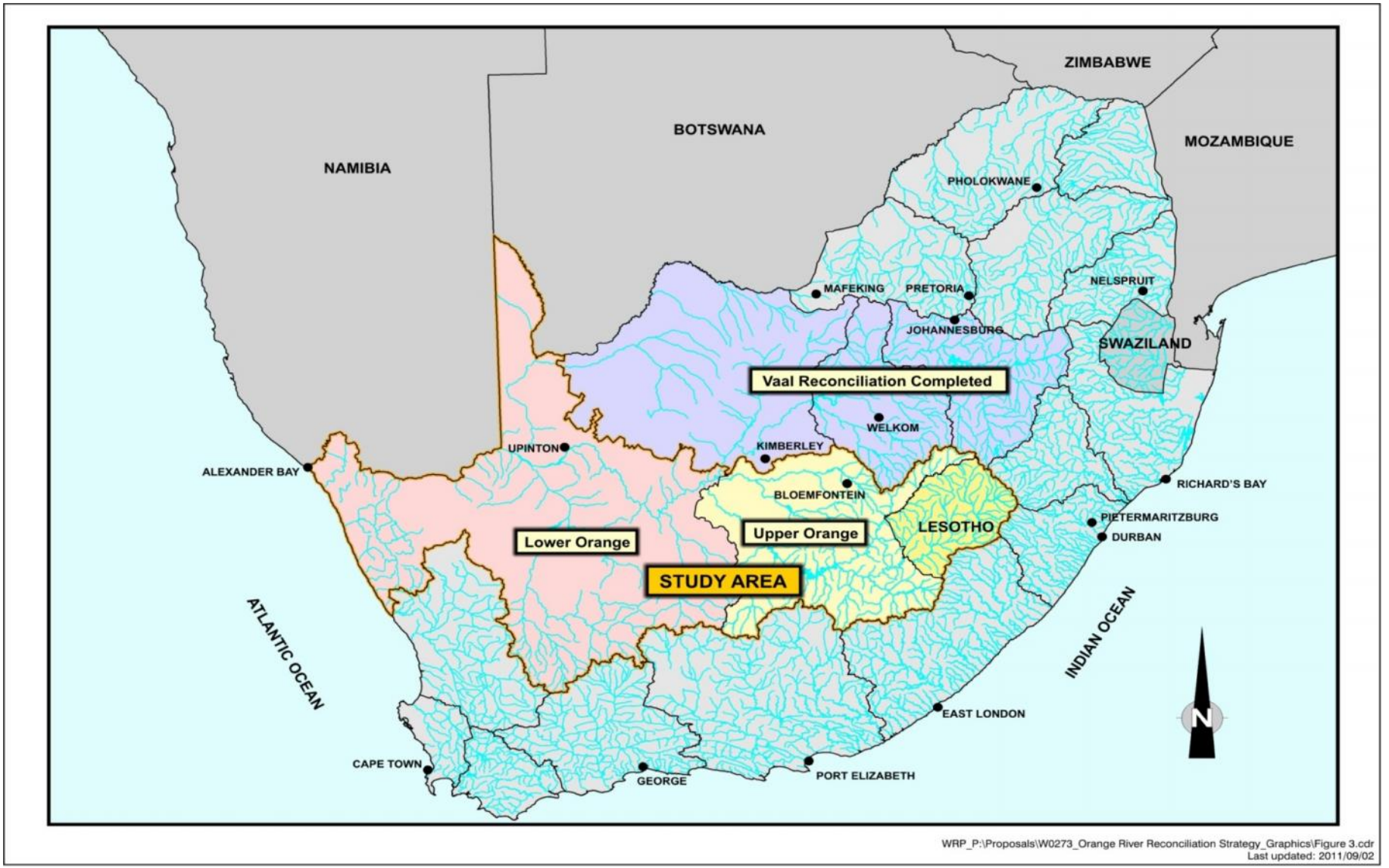
The strategy actions will be the responsibility of the respective institutions listed in **Table 10.1**. Detail project plans need to be compiled in which the actions will have to be broken down further with time lines and budgetary requirements for each organisation.

The SSC members will convene twice a year where each organisation will be requested to present progress on implementation of their respective activities.

Particular attention needs to be given to strategy recommendations requiring negotiations with the Shared Basin States. DWA International Liaisons will have to take the lead, most likely through the structures provided by ORACECOM. Integration of the Reconciliation Strategy with the Integrated Water Resource Management Plan currently been developed by ORACECOM need to be coordinated.

Appendix A

MAPS



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

Study area locality map

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

Location of Key Intervention Options