DWA REPORT NUMBER: P RSA D000/00/18312/14

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA
Directorate: National Water Resource Planning

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

PRELIMINARY SCREENING OPTIONS IDENTIFIED AND AGREED ON DURING THE WORKSHOP OF 7 FEBRUARY 2013

NOVEMBER 2014

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ORANGE RIVER

REFERENCE

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PRELIMINARY SCREENING OPTIONS AGREED: WORKSHOP OF FEBRUARY 2013

Prepared by:

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

Report No. P RSA D000/00/18312/14

Title:	***Preliminary Screening Options Agreed: Workshop of February 2013***
Authors:	*Study Team*
Project Name:	***Development of Water of Reconciliation Strategies for Large Bulk Water Supply Systems: Orange River***
DWA Report No:	*P RSA D000/00/18312/14*
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Consultants: WRP Consulting Engineers (Pty) Ltd in association with Aurecon, Golder Associates Africa and Zitholele Consulting

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(Study Manager)

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Acting Director: National Water Resource Planning

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

CMA	Catchment Management Agency
DWA	Department of Water Affairs
EWR	Ecological Water Requirements (Ecological Component of the Reserve)
IAP	Invasive Alien Plants
IWQMP	Integrated Water Quality Management Plan
LORMS	Lower Orange River Management Study
m^3/a	Cubic metre per annum
NWA	National Water Act (Act 36 of 1998)
PSP	Professional Service Provider
RO	Regional Office
SMC	Study Management Committee
SSC	Study Steering Committee
URV	Unit Reference Value
WC/WDM	Water Conservation /Water Demand Management
WMA	Water Management Area
WRYM	Water Resource Yield Model

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

Preliminary Screening Options Agreed: Workshop of February 2013

EXECUTIVE SUMMARY

The Department of Water Affairs commenced on a study called "Development of Reconciliation Strategies for Large Bulk Water Supply Systems; Orange River."

The preliminary screening of water reconciliation options was done during a workshop with the Study Steering Committee held in Kimberley on 7 February 2013.

The overall objective of the Preliminary Screening Workshop was to understand the water resource status in the basin, agree on which of the numerous possible reconciliation options must be further investigated.

A multi-criteria decision support tool was used to compare the economics, social and environmental and implementation characteristics of all the options.

The outcome of the meeting was that the following water reconciliation options should be taken forward for further investigation.

Options to reduce the water requirements

- *WC/WDM for Domestic, Irrigation and Industrial Water Use Sectors.*
- *Reducing assurances of supply.*
- *Water trading.*

Options to increase water availability

- *System operating rules*
  - *Real time monitoring of flows at the Vaal/Orange confluence.*
  - *Lower minimum operating level in Vanderkloof Dam.*
- *Removal of invasive alien plants in the Kraai catchment.*
- *Prevention of soil erosion.*
- *Dams:*
  - *Ntoahae Dam*
  - *Malatsi Dam*

  } Senqu-Catchment

  - *Bosberg Dam*
  - *Boskraai Dam*
  - *Gariep Dam Raising*
  - *Knoffelfontein Dam*

  } Upper Orange

  - *New Boegoeberg Dam*
  - *Vioolsdrift Dam*

  } Lower Orange

In addition the workshop took note of and supported the DWA position that unlawful water use, the scale of which is being determined through the Validation and Verification process must eliminated

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1.1 INTRODUCTION

1.2 Background

The Orange River Basin is shared between four countries, i.e. Botswana, Lesotho, Namibia and South Africa. The Orange River drains a catchment area of 973 000 km^2 and runs generally in a westerly direction from its headwaters in Lesotho and the Free State Province of South Africa and finally discharges into the Atlantic Ocean at Alexander Bay. It forms the Southern border between South Africa and Namibia. The South African portion of the basin (607 000 km^2) covers almost 50% of South Africa's total area.

Increases in water demands in all water use sectors over the last number of years have resulted in a river system, which is currently in balance but which will experience water deficits in the near future.

In order to provide for these anticipated water deficits, the Department of Water Affairs embarked on this study, i.e. "Development of Reconciliation Strategies for Large Bulk Water Supply Systems; Orange River".

Furthermore, Phase II of the Lesotho Highlands Water Project (LHWP) which includes the new Polihali Dam in Lesotho is being planned. The transfer of water from this dam to the Vaal System will reduce the water availability in the Orange River In order to maintain the assurance of supply to existing users in the Orange River system a "yield replacement" intervention must therefore be implemented before the full LHWP Phase II yield is diverted.

The objective of this study is to develop a reconciliation strategy for the bulk water resources of the Orange River System to ensure sufficient water can be made available to supply the current and future lawful water needs of all the users up to the year 2040.

In determining the yield of the Orange River system, which will be available to meet the consumptive water requirements, the effects of the ecological water requirements of the Orange River, its tributaries and the estuary and the impacts of climate change, must considered.

The study comprises the identification of all possible options for achieving and maintaining a water balance in the future, screening those that are feasible and combing the most appropriate options into preliminary and final water reconciliation strategies. The preliminary strategy will be a first order strategy in which the gaps requiring further investigation are clearly identified. In the final water reconciliation strategy will include the results of the further investigations and refine the preliminary strategy.

The Preliminary Screening Meeting held on 7 February 2013 in Kimberley with the key stakeholders of the river system was a step in the process of developing the Preliminary Water Reconciliation Strategy.

A Final Screening Meeting will consider the characteristics of the reconciliation options agreed for further study at the Preliminary Screening Meeting and select a water

reconciliation scenario, comprising a combination of options, on which the final strategy will be based.

This report describes the deliberations at the Preliminary Screening Meeting and summarises the outcomes.

1.3 Objectives of the Preliminary Screening Meeting

The primary objectives of the Preliminary Screening Meeting were to understand the water resource status in the basin, agree on the possible reconciliation options and to decide which options must be further investigated.

The secondary -objectives were as follows:

- Review water resource and water use information as part of the process of producing an updated water balance for the study area,
- Provide stakeholders the opportunity to supplement information where gaps exist.
- Agree on the list of main concerns,
- Present information on possible reconciliation options,
- Agree on the criteria and methodology to be used in screening the options.
- Decide which options must be taken forward for further investigation.

1.4 Report Layout

This report provides a brief description of the preparation towards the Preliminary Screening Workshop, the workshop proceedings, the options considered, the evaluation process and the workshop findings.

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

2. THE WORKSHOP PROCESS

2.1 Invitations

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

The SSC comprises representatives of the water related institutions/organisations as well as district municipalities and provincial government departments in the orange River basin in South Africa

Invitations to the workshop were sent out three weeks before the meeting. A Starter Document was attached to the invitation to provide each stakeholder with the necessary background and the identified reconciliation options. An example of the e-mail invitation is attached as **Appendix A**.

2.2 Starter Document

The 39 page Starter Document contained the following information:

- Objectives of the study.
- Description of the study area.
- Overview of the current water resource status in the Orange River Basin.
- The need for water reconciliation in the basin.
- Summary of the identified reconciliation options.
- Description of the proposed screening process.
- Description of the envisaged way forward.

Hard copies of the Starter Document were made available at the workshop. The Starter Document is appended as **Appendix B.**

2.3 Workshop AGENDA

The agenda of the workshop is attached as **Appendix C**. Since the meeting was a combined SSC meeting and stakeholder workshop, the matter arising out of the previous SSC meeting were dealt with first, whereafter the workshop on reconciliation options continued.

2.4 Evaluation of Reconciliation Options

A multi-criteria decision support tool was proposed and accepted by the workshop, to evaluate the identified reconciliation options. The tool was populated by the stakeholders, assisted by the facilitator. Consensus was reached on the options which could be discarded and those options which will be taken forward for further investigation.

3. THE WORKSHOP PROCEEDINGS

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

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

The workshop commenced with a recap of the study objectives and the progress made thus far. A brief explanation of each of the 20 project tasks was also provided.

The process to be followed for the day was then explained.

The process continued with a Study Area Overview and a water balance perspective. It was pointed out that, after balancing the current and future Orange River system yield and water requirements, a water shortage of approximately 1 000 million m^3/a will soon be experienced if no interventions are implemented.

The stakeholders were then offered the opportunity to raise issues and challenges in the Orange Catchment of which they were aware and which should be taken into consideration for the study. These are listed in section 4 of this report.

The proposed criteria for selection of options and the multi-criteria decision support matrix were then explained and agreed. The criteria and matrix are dealt with in Section 6 of this report.

The possible reconciliation options were then presented and these were jointly assessed using the multi-criteria decision support matrix.

Finally, the findings were summarised and agreed and the way forward was decided.

4. ISSUES/CHALLENGES IN THE ORANGE RIVER BASIN RAISED BY STAKEHOLDERS

The stakeholders were offered an opportunity to raise issues or identify challenges of which they were aware and which should be taken into account in the study. The following issues were raised:

4.1 Water Quality Problems

There is an overall water quality problem in the catchment area. The Department intended to proceed with a separate study to address such problems, namely the Integrated Water Quality Management Plan (IWQMP). Procurement of the PSP has unfortunately been delayed. The workshop members expressed their concern at the delay and agreed that it would have been better if this Water Reconciliation Strategy and the IWQMP could run in parallel. They requested that it be expedited.

4.2 Sewerage Works

The sewerage works of many of the Municipalities are not adequately treating all the sewage effluent in their catchments and should be upgraded. This is typical of an issue which needs to be assessed in the IWQMP referred to above and addressed by the Municipalities.

4.3 Water Requirements of the Eastern Cape

The water requirements of the Eastern Cape including the requirements for dilution to maintain acceptable salinity levels in the water supplied need to be considered. The possibility of higher allocations from Gariep Dam was suggested. However, the study will only take into account the Eastern Cape's bulk water requirement and does not include water yield and quality modelling within the Eastern Cape.

4.4 Legal Requirements for hydro power generation

The legal requirements for hydro power generation for farmer's own use were queried. There are a number of water users along the Orange River who would like to generate hydro power for their own purposes, increasing the benefits from the water. The study should look at the allocation of water for this purpose, noting that it is effectively non consumptive

4.5 Possible Olive Production at Aggenys

The water requirements and source for proposed substantial expansion of olive production in the Aggenys vicinity need to be understood and considered.

4.6 Boegoeberg Dam

The existing Boegoeberg Dam was reported to be in need of being rebuilt to enable it to continue to serve the irrigators. The New Boegoeberg Dam, to replace the current structure, will be a saving as it will replace the current Boegoeberg structure and render the benefits of water storage. This factor needs to be taken into consideration when New Boegoeberg Dam and Vioolsdrift Dam options are compared. If Vioolsdrift Dam is

selected instead, the cost of the replacement of the existing Boegoeberg Dam will still be incurred.

4.7 Water Demand for New Developments

The water demand of the growing number of wind and solar power generation stations should be investigated. The same applies for the water requirement of the Square Kilometre Array Radio Telescope and developments such as fracking.

4.8 Invasive Alien Vegetation along the Kraai River

The river banks of the Kraai River are heavily infested with Willow Trees and an Invasive Alien Plant removal programme for the Kraai River should be considered.

4.9 Knoffelfontein Dam

The De Krans Dam, now known as Knoffelfontein Dam should be considered for supplying irrigation water to emerging farmers in the vicinity of Richie. This dam site is situated just downstream of the confluence of the Riet and Modder Rivers and the earlier rejection of this site should be reconsidered.

5. THE WATER RECONCILIATION OPTIONS CONSIDERED

Possible reconciliation options can be divided into two groups, i.e.:

- Options to reduce water requirements.
- Options to increase the water availability.

The full list of possible reconciliation options that had been identified were presented to the meeting and it was explained why the majority of the options were discarded.

A description of the most promising options can be found in **Section** 4 of the Starter Document **Appendix B.** The following options were considered:

5.1 Options to reduce water requirements

DWA stated that elimination of unlawful water use has to be carried out, it is not optional. The quantum will be known when the verification and validation processes are complete.

- Water Conservation and Water Demand Management (WC/WDM) in the Irrigation, Urban/Domestic and Industrial Water Use Sectors.
- Promoting rainwater harvesting.
- Reducing assurances of supply.
- Water trading.
- Compulsory licensing.

5.2 Options to increase the water availability

- System operating rules.
  - Real time monitoring of flows at the Orange/Vaal confluence to optimise water releases from Vanderkloof Dam.
  - Lower the minimum operating water level in Vanderkloof Dam.
  - Lower the minimum operating level in Gariep Dam.
- Removal of invasive alien plants.
- Preventing soil erosion.
- Possible new dams
  - Ntoahae Dam
  - Tsoelike Dam
  - Lebelo Dam
  - Malatsi Dam

  } Senqu-Catchment, Lesotho

  - Bosberg Dam
  - Boskraai Dam
  - Gariep Dam Raising
  - Kloksfontein Dam

  } Upper Orange

  - New Boegoeberg Dam
  - Vioolsdrift Dam

  } Lower Orange

6. EVALUATION CRITERIA AND THE MULTI-CRITERIA DECISION SUPPORT TOOL

The evaluation criteria and scoring thresholds, where 1 indicates a negative assessment and 3 indicates a positive assessment against the criterion, are shown in **Table 6.1**. They were presented to the meeting and after a few minor amendments, agreed.

Table 6.1: Evaluation criteria and scoring thresholds

Criteria	Score Thresholds		
Politically Acceptability & Alignment with National Planning	**Very difficult to convince = 1**	**Political view can be swayed = 2**	**In line with political vision = 3**
Unit Reference Value	**>R 1.00/m^3 = 1**	**R0.51/m^3 to R1.00/m^3 = 2**	**0 – R0.5/m^3 = 3**
Environmental consequences	**High impact = 1**	**Moderate impact = 2**	**Low impact = 3**
Social consequences	**Huge disruption = 1**	**Some disruption = 2**	**Minor disruption = 3**
Management Intensity	**High = 1**	**Medium= 2**	**Low = 3**
Implementing Time	**>10 y = 1**	**5 y to 10 y = 2**	**5 y = 3**
Water quality impact	**Detrimental = 1**	**Neutral = 2**	**Beneficial = 3**
Hydro power potential	**Low = 1**	**Medium = 2**	**High = 3**

Each criterion was allocated a certain weight for the multi-criteria decision matrix. It was decided to allocate a weight of 6 to the Unit Reference Value criterion (present value of costs/ present volume of annual yields over 50 years) and a weight of 1 each to the remaining seven criteria. This then means that the URV criterion is almost as important as the remaining criteria put together.

The matrix with the eventual scores is shown in **Figure 6.1.**

The scores of the four Lesotho dams, i.e., Malatsi, Lebelo, Ntoahae and Tsoelike were very close to each other, and Malatsi and Lebelo as well as Ntoahae and Tsoelike are mutually exclusive. It was therefore agreed that the Study Management Committee would do a re-assessment of these four dams and that they then take a decision which two of the four Lesotho Dam sites must be taken forward for further investigation. This Re-assessment took place at the SMC's meeting held on 13 March 2013 and it was decided that Malatsi and Ntoahae were the two preferred options. The matrix in Figure 6.1 represents the evaluation of the SSC as fine-tuned by the SMC on 13 March.

Criteria↓ / Options →	Weight	Tsoelike Dam to augment the Orange	Ntoahae Dam to augment the Orange	Malatsi Dam to augment the Orange	Lebelo Dam to augment the Orange	Mzimvubu - Kraai Transfer	New Bosberg Dam	New Boskraai Dam	Raising of Gariep Dam	Improved Operating Rules for Van Der Kloof Dam - Changing m.o.l.	Improved Operating Rules for Vanderkloof Dam - real time monitoring of Vaal and Orange	Improved Operating Rules for Gariep Dam changing m.o.l.	Kloksfontein Dam	Vioolsdrift Regulating	Vioolsdrift Yield Dam	Mzimvubu - Kraai Transfer
Political Acceptability **Very difficult to convince = 1** **Political view can be swayed = 2** **In line with political vision = 3**	1	1	1	1	1	2	2	2	2	3	3	2	0	3	3	2
Additional Yield **0 - 50 million m3/a = 1** **51 - 300 million m3/a = 2** **> 300 million m3/a = 3**	0	3	3	2	2	2	3	3	3	2	2	1	0	2	3	2
Capital Costs **> R 3 billion = 1** **R 1 billion - R 3 billion = 2** **0 - R 1 billion = 3**	0	2	2	2	2	1	2	1	3	3	3	2	0	3	2	1
Operational Costs **> R 10 million/a = 1** **R 5 million/a - R 10 million/a = 2** **0 - R 5 million/a = 3**	0	2	2	2	3	1	2	1	3	3	3	2	0	3	2	1
URV **> R 1.00/m3 = 1** **R 0.31/m3 - R 1.00/m3 = 2** **0 - R 0.30/m3 = 3**	6	2	2	2	2	1	2	2	3	2	2	1	0	2	2	1
Environmental Consequences **High Impact = 1** **Meduim Impact = 2** **Moderatre Impact = 3**	1	2	3	1	1	1	3	2	2	3	3	3	0	3	3	2
Social Consequences **Huge disruption = 1** **Some disruption = 2** **Minor disruption = 3**	1	2	1	1	2	2	3	2	1	3	3	3	0	3	3	2
Management Intensity **High = 1** **Medium = 2** **Low = 3**	1	2	2	2	2	2	2	2	2	3	3	2	0	3	3	2
Time to Commissioning **> 10 years = 1** **5 y - 10 y = 2** **< 5 y = 3**	1	1	1	1	1	1	1	1	2	3	3	3	0	2	2	1
Water Quality Impacts **Detrimental = 1** **Neutral = 2** **Beneficial = 3**	1	2	2	2	2	2	2	2	1	2	2	1	0	2	2	2
Hydropower Potential **Low = 1** **Medium = 2** **High = 3**	1	2	2	2	2	1	1	2	2	1	1	1	0	1	1	1
Totals		24	24	22	23	17	26	25	30	30	30	21	0	29	29	18
Fatal Flaw? Yes - red No - green		N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	Y

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Figure 6-1: Outcome of Preliminary Screening on Multi-Criteria Decision Matrix

7. FINDINGS OF THE WORKSHOP

The options with the highest scores, each receiving a score of 30 were the following:

- Operating rules: Real time monitoring at the Orange/Vaal confluence to optimise water releases from Vanderkloof Dam.
- Operating rules: Lowering the minimum operating water level in Vanderkloof Dam.
- Raising Gariep Dam.

It was agreed that Tsoelike Dam and Ntoahae Dam are mutually exclusive and that Malatsi Dam and Lebelo Dam are mutually exclusive. All four dams ended with similar scores and the SMC decided that Ntoahae and Malatsi Dams were the preferred options and should be forward for further investigation.

Although the Bosberg and Boskraai options scored lower than the Gariep Dam, the scores of these two dams were higher than the dams in Lesotho and it was agreed that, given the accuracy of the information on which the evaluation was based, and the fact that they are in South Africa, they should be retained

The Mzimvubu-Kraai Transfer option was rewarded the lowest score of 17. It was felt that this possible scheme should be marked as a fatal flaw because of the high capital and operational costs which are prohibitive.

The Kloksfontein Dam was not evaluated since no data on the dam site could be found before the workshop. It was also mentioned by one of the stakeholders that the envisaged Kloksfontein Dam poses a flood hazard and will inundate existing land. It was therefore agreed that this option should be discarded.

One of the stakeholders raised a point that the Knoffelfontein Dam site, just downstream of the Riet and Modder Rivers, is a good site, and that this dam would enable the establishment of emerging farmers, it was decided to include Knoffelfontein Dam in the list of dams taken forward for further investigation.

The comment by one of the stakeholders, that the current Boegoeberg Dam needs to be replaced, should the Vioolsdrift Dam option be selected implied that the New Boegoeberg Dam needed to be reconsidered as a possible option. It was previously discarded in favour of the Vioolsdrift option in the LORMS Study, but the replacement of the current Boegoeberg Dam was not taken into account as a cost.

The sites for new dams which was agreed should be investigated further are listed in **Table 7.1.:**

Management options such as WC/WDM, Eliminating unlawful water use, promoting rainwater harvesting, reducing assurances of supply, water trading and compulsory licensing were also considered. Some of these management options imply simply good practice. It was decided to take each of them forward except for compulsory licensing which was included in the National Water Act for the purpose of correcting imbalances.

Figure 7-1: New dam sites to be considered

Dam	Score
Malatsi	22
Ntoahae	24
New Boskraai Dam	25
New Bosberg Dam	26
Knoffelfontein	
New Boegoeberg	
Vioolsdrift Regulating Dam	29
Vioolsdrift Yield Dam	29

It was also agreed that rainwater harvesting will have an insignificant effect on the total water balance but it could be promoted for small scale users.

8. SUMMARY OF THE INTERVENTION OPTIONS TO BE FURTHER INVESTIGATED

8.1 Options to reduce the water requirements

- WC/WDM for Domestic, Irrigation and Industrial Water Use Sectors.
- Reducing assurances of supply.
- Water trading.

8.2 Options to increase water availability

- System operating rules
  - Real time monitoring of flows at the Vaal/Orange confluence.
  - Lower minimum operating level in Vanderkloof Dam.
- Removal of invasive alien plants in the Kraai catchment.
- Prevention of soil erosion.
- Dams:
  - Ntoahae Dam
  - Malatsi Dam

  } Senqu-Catchment

  - Bosberg Dam
  - Boskraai Dam
  - Gariep Dam Raising
  - Knoffelfontein Dam

  } Upper Orange

  - New Boegoeberg Dam
  - Vioolsdrift Dam

  } Lower Orange

APPENDIX A
(Example of Invitation Letter)

APPENDIX B

Starter Document

APPENDIX C
Workshop Agenda

APPENDIX D

Minutes of SSC Meeting and Workshop

APPENDIX E
Presentation Slides

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28 November 2012

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Lesotho Head of Delegation
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Dear Ms Shiweda

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

- **AN INVITATION TO ATTEND THE SECOND STUDY STEERING COMMITTEE MEETING ON 7 FEBRUARY 2013 IN KIMBERLEY, SOUTH AFRICA**

Introduction

The South African Department of Water Affairs has commissioned a study to develop a reconciliation strategy for the bulk water resources of the Orange River System.

As the Department wishes to follow a transparent process and include stakeholders as prescribed by the National Water Act of 1998, an extensive public engagement process is being followed which also include extending an invitation to ORASECOM members to be involved in this process.

You are invited to nominate an official from your country to attend the next meeting of the Study Steering Committee (SSC), a voluntary body operating at a strategic level which ensures that the technical aspect of the study is transparent and consultative and that cooperative governance is embraced. Membership of the SSC includes representatives of government (local, regional and national), agriculture, water service providers, industry and civil society representing a wide variety of stakeholder groups in the study area. It is anticipated that the SSC would meet every six months.

The second SSC meeting will be held on **Thursday, 7 February 2013** in **Kimberley** and will start at **10:00** (coffee and tea will be provided from 09:30). Lunch will also be provided. The venue and directions to the venue will be sent to you at a later stage.

Study Background

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

Major water resource infrastructure in the study area are the Gariep and Vanderkloof Dams with associated conveyance conduits supporting large irrigation farming in the provinces of the Free State, Northern Cape and the Eastern Cape – through the Orange-Fish Tunnel.

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

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

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

Scope of work

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

Appropriate integration with other planning and management processes as well as cooperation among stakeholder will be key success factors in formulating coherent recommendations and action plans. The outcomes of the Strategy will be specific interventions with particular actions needed to balance the water needs with the availability through the implementation of regulations, demand management measures as well as infrastructure development options.

Contacts

The Department has appointed a team of Professional Services Providers to assist in the development of this Strategy. For any enquiries regarding your involvement or logistics with regards to the SCC meeting, contact the Public Participation Office (André Joubert or Patiswa Mnqokoyi).

An agenda will be sent to you before the meeting.

We look forward to welcoming you at this meeting.

Best regards,

For DIRECTOR–GENERAL
Letter signed by: Mr S Rademeyer
Designation: Chief Engineer, National Water Resource Planning (Central)
Date: 28/11/2012

Attendance Record: ORESCOM - SSC Meeting held on 7 February 2013 at Flamingo Casino, Kimberley

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

STARTER DOCUMENT FOR

PRELIMINARY SCREENING OF AUGMENTATION AND INTERVENTION OPTIONS

FIRST DRAFT

January 2013

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PRELIMINARY SCREENING WORKSHOP STARTER DOCUMENT

1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

This Starter Document gives a brief background on the study area, the status quo in the area and it then presents status information on the possible interventions that have been identified so far to reconcile the water requirements with the available water resources in the study area. These intervention possibilities will be presented and discussed as options at the Screening Workshop on 7 February 2013 with the aim to obtain comments as well as to add additional or exclude options where appropriate.

1.2 OBJECTIVES OF THE STUDY

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

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

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

1.3 STUDY AREA

The entire Orange River Basin is shown in **Figure 1.1** including the portions in Botswana, Lesotho and Namibia and including the Vaal River catchment. The study area comprises only the South African portion of the Orange River Basin, excluding the Vaal River Catchment.

Figure 1.1: The Orange River Basin

The Vaal River is an important tributary of the Orange River, but since the Vaal River Reconciliation Strategy has already been developed, the Vaal River Catchment will not form part of the study area. However, strategies developed for the Vaal River System that will have an impact on the Orange River, will be taken into account.

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

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

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

Other major tributaries into the Orange River are:

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

A separate study was also done for the Greater Bloemfontein Area i.e. Water Reconciliation Strategy Study for Large Bulk Water Supply Systems: Greater Bloemfontein Area. The recommendations of this strategy will also be taken into account in this study.

For the purpose of describing the current status of the Orange River Basin, the basin has been divided into four sub-areas, i.e.:

- The Senqu River catchment in Lesotho
- The Upper Orange Water Management Area (WMA)
- The Lower Orange WMA
- The Eastern Cape Rivers supported by the Orange

Although the Senqu River Catchment in Lesotho does not form part of the study area, the development in this catchment impacts directly on the water availability in the study area and this area is therefore separately described despite of the fact that it is situated in another country.

The South African portion of the Orange River Basin is currently divided in two Water Management Areas, i.e. the Upper and Lower Orange WMAs. The Upper WMA stretches from the headwaters of the Caledon River and Lesotho boundary down to the confluence of the Vaal River and the Lower Orange WMA from this point to the sea. (See **Figure 1.2**). It should be noted that the DWA recently proposed that the two WMAs are managed as a unit.

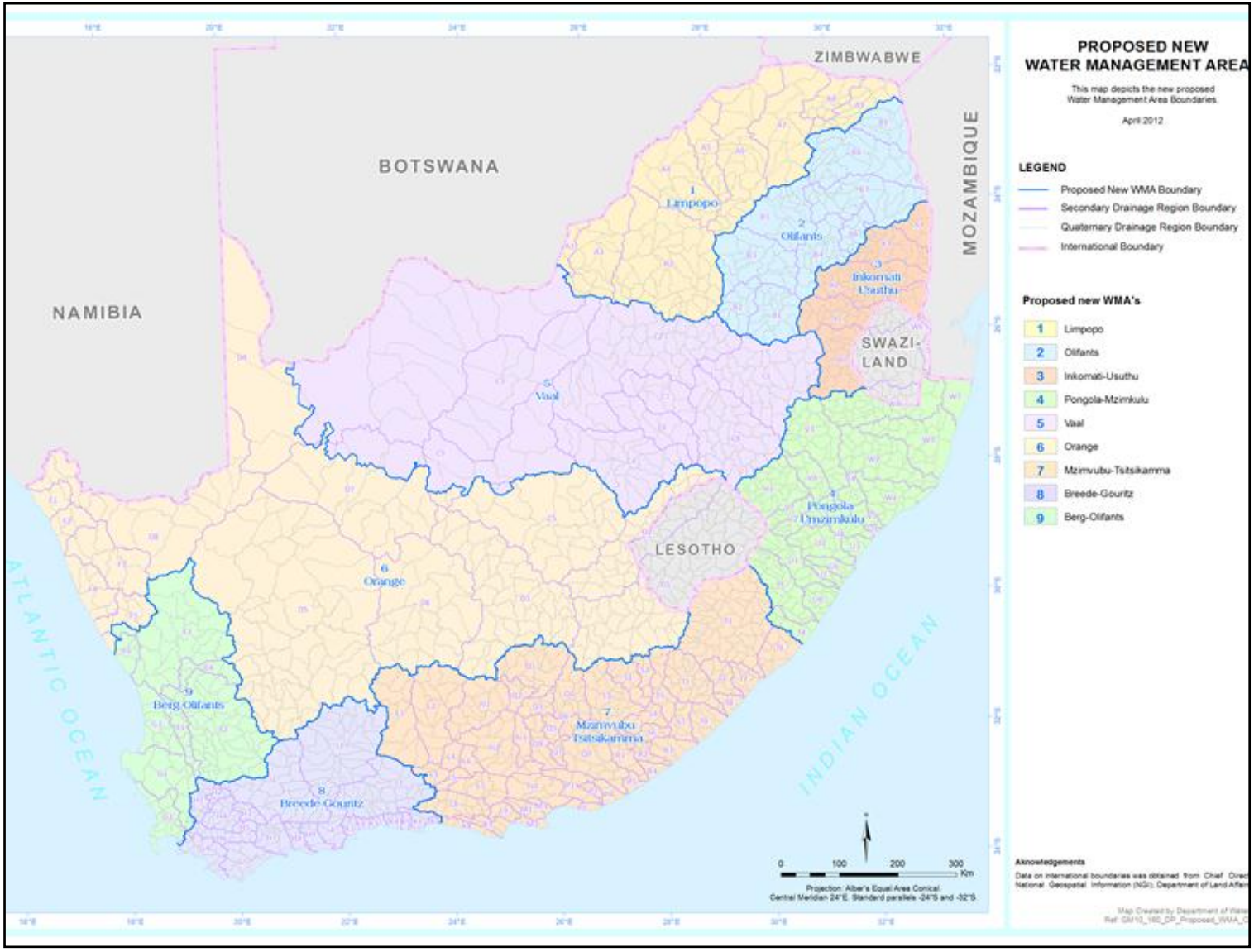


Figure 1.2: Upper and Lower Orange Water Management Areas (Area 6)

The water supply from the two rivers in the Eastern Cape, the Great Fish and Sundays Rivers, as well as the water supply to Port Elizabeth are supplemented with water transferred from the Orange River via the Orange-Fish Tunnel. This area will also be separately described.

2 OVERVIEW OF THE CURRENT STATUS IN THE ORANGE RIVER BASIN

2.1 CURRENT STATUS OF THE SENQU RIVER CATCHMENT

The Lesotho Highlands Water Project, Phase 1A (Katse Dam) and Phase 1B (Mohale Dam), were completed in 1998 and 2002 respectively and comprise the following:

Phase 1A: The 185 m high double curvature arch Katse Dam on the Malibamatso tributary from which a 45 km transfer tunnel runs to Muela Power Station from where a further 38 km delivery tunnel runs to the Ash River in the Vaal River catchment from where this transfer water is flowing to the Vaal Dam.

Phase 1B: The 145 m high Mohale Dam (a concrete faced rockfill dam) on the Senqunyane tributary from where the 32 km Mohale tunnel runs to Katse Dam and the Matsoku Diversion Weir from where additional water is diverted through the 6 km Matsoku tunnel into Katse Dam.

The Katse and Mohale Dams are shown on **Figure 2.1**.

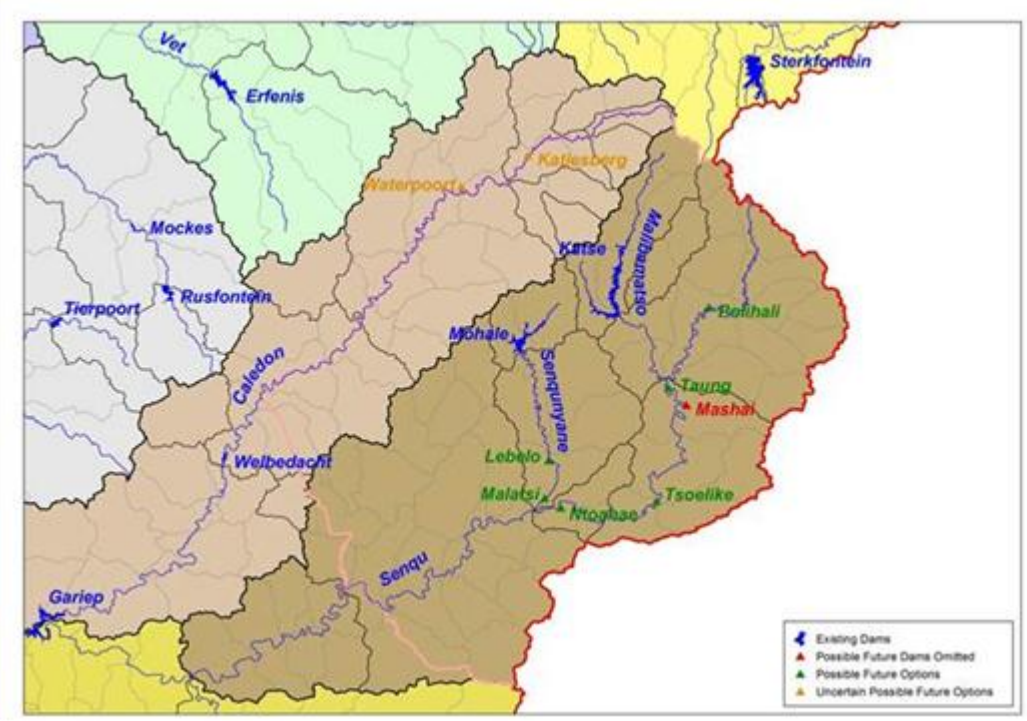


Figure 2.1: Katse and Mohale Dams on tributaries of the Senqu River

Currently 780 million m^3/a is transferred from the Mohale and Katse Dams to the Vaal Dam in the Vaal River Catchment.

2.2 CURRENT STATUS OF THE UPPER ORANGE RIVER

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.

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

The two major dams within the Caledon catchment are the Welbedacht Dam (see **Figure 2.2**) and the Knellpoort Dam. The Welbedacht Dam is situated on the Caledon River while the Knellpoort Dam is situated on the Rietspruit, a tributary of the Caledon River. The Knellpoort Dam is operated as an off-channel storage dam by pumping water from the Caledon River into the dam.

The Knellpoort Dam was built to augment the storage capacity of Welbedacht Dam and to transfer water to the upper reaches of the Modder River. The storage capacity of Welbedacht Dam has reduced significantly due to siltation.

Water from the Welbedacht Dam is pumped to the Welbedacht water purification works from where potable water is pumped to supplement the water supply from the Modder River (Vaal River tributary) to Bloemfontein. Water is also supplied from this system to Botshabelo, Thaba Nchu, as well as the smaller towns of Wepener, Dewetsdorp, Reddersburg, Edenburg and Excelsior, which are also dependent to varying degrees on local water resources.

The two largest dams in the RSA, i.e. the Gariep and Van Der Kloof Dams are situated on the main stem of the Orange River, downstream of the confluence of the Caledon River with the Orange River (see **Figure 2.2**). These two dams are utilized for river flow control, flood control, hydro power generation and storage of water for urban and irrigation use.

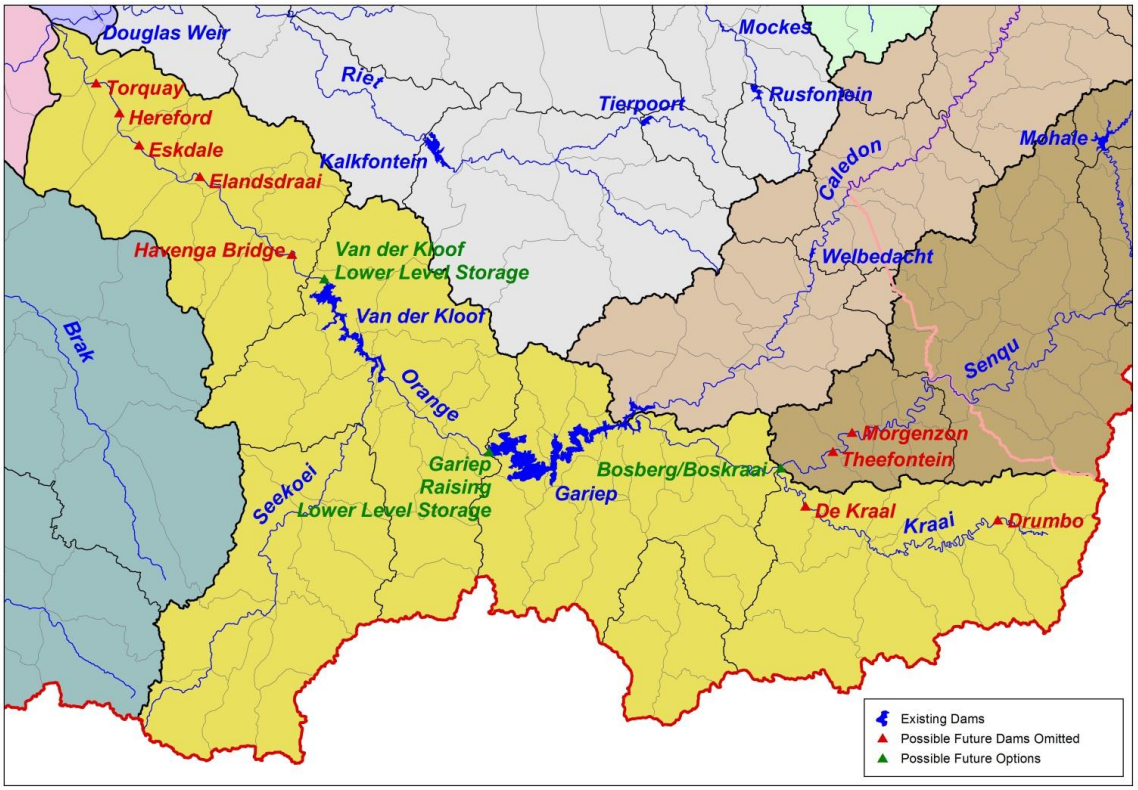


Figure 2.2: Gariep and Van Der Kloof Dams in the Upper Orange WMA

Water is transferred from the Gariep Dam via the Orange-Fish Tunnel to supplement to irrigation and urban water demands along the Great Fish and Sundays Rivers, as well as in Port Elizabeth. Water is also transferred from Van Der Kloof Dam to supplement the irrigation demands along the Riet River, which is a tributary of the Vaal River. The third transfer scheme comprises the transfer of water from the Orange River at Marksdrift into the Douglas Weir on the downstream end of the Vaal River.

2.3 CURRENT STATUS OF THE LOWER ORANGE RIVER

The Lower Orange River comprises the Orange River from the confluence with the Vaal River to the Atlantic Ocean. The major tributaries draining into this section of the Orange River are:

- The Vaal River;
- The Ongers and Sak Rivers from the northern Karoo;
- The Molopo and Nossob Rivers from Namibia, Botswana and the Northern Cape Province north of the Orange do not contribute to the Orange River as these river beds are impeded with sand dunes; and
- The Fish River from the southern part of Namibia.

Tributaries 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 contribute to the Orange River's flow only during periods of relative high flows in the Orange River. The individual yield contribution of these rivers to the Orange River is regarded as relatively low.

Water is abstracted for irrigation along the main stem of the Orange River at various points, for urban use and for stock watering in the Kalahari. Water is also transferred via pipelines to the Aggenys mines and to the town of Springbok.

2.4 THE EASTERN CAPE RIVERS SUPPORTED BY THE ORANGE

Water is transferred from Gariep Dam on the Orange River through the 83 km long Orange/Fish tunnel to a tributary of the Great Brak River (tributary of the Great Fish River) in the Eastern Cape Province where it runs into the Grassridge Balancing Dam. Water is supplied along the Great Fish River for irrigation and urban use to towns such as Cradock and Cookhouse.

From the Elandsdrift weir on the Great Fish River, Orange River water is diverted through the 46 km Cookhouse tunnel, a series of canals and diversion weirs and the Darlington Dam to the water users along the Little Fish River and Sundays River, mostly for irrigation purposes, but towns such as Somerset East, Kirkwood and the Nelson Mandela Metro also receives water for urban use.

From Elandsdrift weir on the Great Fish River, water is released to the Lower Fish Government Water Scheme from where the town of Grahamstown and further irrigation land are supplied with water.

3 THE NEED FOR WATER RECONCILIATION FOR THE ORANGE RIVER BASIN

As part of this study the current and projected future water demands will be compared with the current and projected water availability in the system to determine whether a water balance will be achieved. In the situation where water deficits exist or are foreseen in the future, water reconciliation interventions need to be introduced. There are two types of reconciliation interventions, namely:

- Interventions that will reduce the water requirements.
- Interventions that will increase the water availability.

The latter intervention type can be either management measures (e.g. changing system operating rules) or development interventions (e.g. new dams, new transfer schemes, etc.).

During the course of the study the water balance will be reviewed through water yield modelling exercises.

The probability that reconciliation interventions will be needed for the Orange in future is high for the following reasons:

- Increasing water demands in all water use sectors.
- Phase 2 of the Lesotho Highlands Water Project (LHWP) has already been announced and it is known that the new Polihali Dam and the transfer of this dam's water to the Vaal System will reduce the water availability lower down in the Orange River. A yield replacement intervention must therefore be implemented before the full LHWP Phase 2 yield is diverted to maintain assurance of supply to existing users.
- The ecological water requirements of the Orange River and its tributaries as well as the ecological water requirements for the Orange River Estuary are being determined and it must be ensured that after these requirements are met, enough water will still be available for all the existing and future water users. The system is not currently operated to meet these.
- The impact of climate change could be such that water availability is affected and measures to counteract this impact must be identified.

It is therefore prudent to identify the possible water reconciliation options even before the modelling has been done and before the final water balance has been drawn up.

4 SUMMARY OF IDENTIFIED RECONCILIATION OPTIONS

4.1 BACKGROUND TO IDENTIFIED OPTIONS

The Orange River system has been the subject of many studies from different perspectives and it was essential to collate relevant information on all intervention options, understand the approaches as well as the assumptions leading to option selections or exclusions and prepare a concise summary document for discussion purposes. This was necessary to be in a position to undertake a synthesis of all available information and decide whether the previously identified interventions are suitable for further consideration and assessment in this study.

A report on the Literature Review has been prepared containing information from all known previous water resource studies. It serves as the source of information for this Starter Document and preparation for the Screening Workshop.

4.2 APPROACH

Reconciliation options have been investigated and assessed in several previous studies. Numerous intervention options have previously been screened and it is not the intention to redo all this previous work but to review these options and determine which options previously looked attractive and why certain options have previously been discarded and to check whether those reasons are still valid today. The following sections therefore summarise those reconciliation options that survived the current screening processes and should remain on the list of options for this study. If any doubt exists about discarding or retaining a certain option that was previously discarded or accepted, it could be placed back on this study's list. This summary must however be read together with the list of options screened previously as in **APPENDIX A.**

4.3 MANAGEMENT OPTIONS THAT WILL REDUCE WATER REQUIREMENTS

The following intervention options can be considered for the Orange River Basin:

- **Water Conservation and Water Demand Management (WC/WDM)**
  WC/WDM is about the more efficient use of water and reduction of water losses. Implementation of WC/WDM has the potential to fairly quickly reduce water use significantly and alleviate some of the pressures on the available water resources.

  WC/WDM can be applied in all water sectors. In the study area the focus could be on three water use sectors, i.e.:
  - Irrigation
  - Urban / Domestic
  - Industrial

  If all three sectors can start applying WC/WDM measures immediately, it will take approximately 5 years to phase in the full benefits of the water saving.

WC/WDM in the irrigation sector could lead to the horizontal expansion of irrigation lands which would not necessarily mean a reduction in water demand. Irrigation farmers who would like to expand their enterprise by using water more efficiently are encouraged to do so. There might however be irrigation farmers who cannot further expand horizontally owing to limited irrigable land and these farmers might want to surrender their saved water for re-allocation. An incentive could possibly be created by creating a market for such water savings.

- **Eliminating Unlawful Water Use**

  The Department of Water Affairs is legally bound, in terms of the National Water Act (Act 36 of 1998) to address all unauthorised water use and direct such users, where required, to stop this practice. The Department is currently busy with a process of validation and verification in the Upper Orange WMA which will identify the unauthorised water users. To date letters have been sent to existing users and it is the intention to finish the validation exercise by July 2013.

  Once this intervention is complete and all unlawful water use has been eliminated, the water requirements will have been restored to what it was supposed to be. This intervention will therefore reduce the water requirements from its current level (including unlawful water use), but not from its previously planned level.

- **Promoting rainwater harvesting**

  This type of intervention can reduce urban water demands. House owners can be encouraged to connect a water tank to the gutters of their houses and harvest the rainwater for domestic or garden use. In some municipalities the erection of a water tank is compulsory for any new developments. It must however be determined whether the rainfall in the study area is frequent enough to justify this measure as an option in the light of the fact that the annual rainfall reduces significantly along the Orange River from east to west.

- **Reducing Assurances of Supply**

  Water users along the Orange River had the privilege of receiving their water at an assurance of supply of at least 95%. This means that once in 20 years there is a chance of not receiving the full water quota. For irrigation water use, this is a luxury. If water can be made available at a lower assurance of supply, more water can be allocated.

  The generally accepted assurances of supply for the different sectors are as follows:

  Power generation - 99.5% (1 in 200 years risk of failure)
  Domestic Water Use - 98% (1 in 50 years risk of failure)
  Industrial Water Use - 98% (1 in 50 years risk of failure)
  Mining Water Use - 98% (1 in 50 years risk of failure)
  Irrigation Water Use - 80% (1 in 5 years risk of failure)

- **Compulsory Licensing**

  The NWA allows the Minister to require licensing of all water use. The procedure

means that nearly all existing users in a targeted area would have to apply for a licence. The Minister considers all the licence applications, taking cognisance of the water availability, and may license or where required reduce the existing uses. The Minister may also reallocate the available water in a fair and equitable manner.

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

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

- **Water Trading**

  As described under WC/WDM there is the possibility of creating a selling opportunity of the WC/WDM savings as a possible measure. Such a measure will not necessarily cause economic prejudice and social hardships. It means that a water user, after applying WC/WDM can offer a portion of his/her entitlement representing the amount of water saved, to the water resource authority at an agreed price. This option is attractive in the sense that it can be implemented almost immediately and is not dependent on completion of the entire validation and verification processes. It is only those water users who offer a portion of their water use entitlements for sale whose entitlements must be validated and verified and this can be done on an ad hoc basis.

  The process is relatively inexpensive, and it is easy to implement. However an appropriate policy within the Department of Water Affairs needs to be developed and user guidelines need to be prepared.

  Another form of water trading is where the full water entitlement is offered for sale.

  Such water trading should be regulated as it could lead to severe social impacts and job losses if a commercial farming enterprise closes down. *Only if there is no other way out and water is urgently needed in the short term, should the transfer of complete water entitlements be considered.* The partial purchase of water entitlements is preferred.

  The option to transfer water entitlements is dependent on the administrative processes in terms of Section 25 of the NWA and the compiling of the contract between the buyer and seller and the issuing of the new water use licence.

4.4 MANAGEMENT OPTIONS THAT WILL INCREASE WATER AVAILABILITY

- **System Operating Rules**
  System operating rules can possibly be adapted so that more yield can be obtained from the system. An example is to reduce the minimum operating level of Van Der Kloof Dam. Such a change will of course reduce the power generation opportunities which will not be beneficial to ESKOM and will then need to be weighed up against the higher yield which one can gain from the system.

- **Removal of Invasive Alien Plants**
  It is well known that invasive alien plants use more water than indigenous plants and by removing the aliens and rehabilitating the areas with indigenous plants can free up water. However, it is not anticipated that this specific option will, in the case of the Orange River basin, offer significant opportunities for major yield increases.

- **Preventing Soil Erosion**
  Preventing soil erosion will not increase the water availability but will ensure that the current availability, and the water quality (in terms of sediment load), is maintained.

  Farmers must be encouraged to maintain acceptable farming and grazing practices.

4.5 DEVELOPMENT OPTIONS THAT WILL INCREASE THE WATER AVAILABILITY

4.5.1 Development Options in the Senqu River Catchment

The Lesotho Highlands Further Phases (LHFP) which will follow the completed Phase I of the Lesotho Highlands Water Project (LHWP) have been studied at Pre-Feasibility Level (LHWC 2008 – Stage 1 Study) and layouts for possible future Phases II, III and IV were identified and ranked. The recommended layout for further phases comprised:

Phase II The new Polihali Dam transferring water to Katse Dam with water transfers through the existing Transfer and Delivery Tunnels.

Phase III The new Tsoelike Dam pumping to the new Taung Dam pumping to Katse Dam with a new Transfer Tunnel to Muela HP plant and a new Delivery Tunnel from Muela to the Ash River.

Phase IV New dams at Malatsi and Ntoahae Dam with pumped transfer from Ntoahae to Tsoelike and then, via the Phase III infrastructure to Taung, Katse, Muela and the Ash River.

The layout of Phases II and III are shown in **Figure 4.1.**

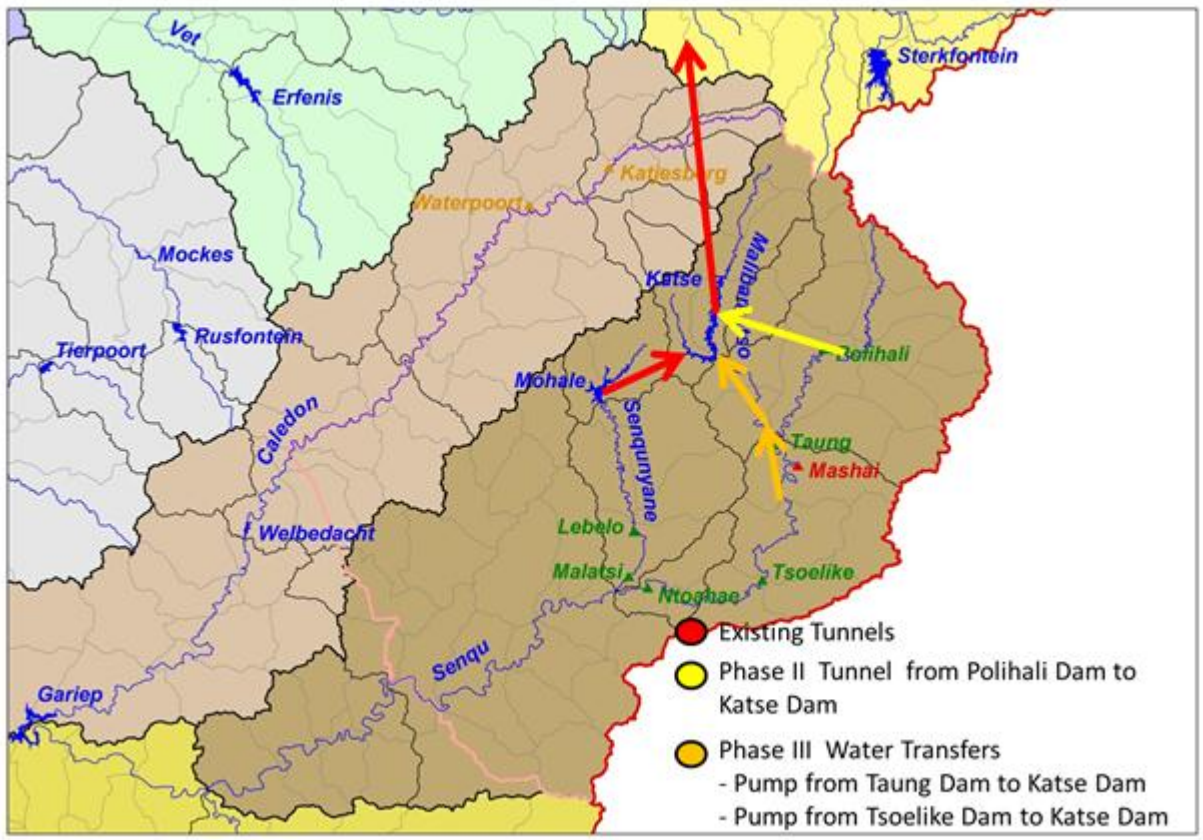


Figure 4.1: Position of Dams and Water Transfers for Phases II and III (need to improve the image).

Although this was the recommended layout for three further phases only Phase II was studied further and accepted for implementation by South Africa and Lesotho. An alternative layout with the same Phases II and III but an alternative layout for Phase IV, with a dam at Lebelo was also considered. That layout, or possibly others, could be recommended in further studies which will be required prior to any decision to proceed with Phase III or IV of the LHWP.

The Phase II layout was studied at Feasibility Level and that Phase is now moving to implementation. In the Feasibility Study it was estimated that it will increase the total Orange River System yield by an estimated 182 million m^3/annum (LHWC 2009) and have a transferable yield of 460 million m^3/annum.

The Polihali Dam can initially be used to support both the Vaal and the Orange River Systems until the Vaal water demand increases to a point where no further support can be given to the Orange.

Although each new phase will thus initially be able to support the Orange, until transfers from that phase to the Vaal exceed the incremental Orange River System yield, they will ultimately reduce the Orange System Yield.

This reduction in system yield will have to be replaced in order to place downstream users in the same position as before.

Tsoelike, Malatsi or Lebelo Dam can serve as interventions to provide the replacement yield instead of being a feeder dam for Katse. If, however, Phases III and IV go ahead as planned, the replacement yield must be created somewhere else in the basin.

4.5.2 Upper Orange WMA

Interventions have been investigated in previous studies with the following three objectives:

- Finding a replacement yield for the reduction in yield caused by Phases II to IV of the LHWP.
- Augmenting Bloemfontein and other towns with a secured water supply as recommended in the report of the Water Reconciliation Strategy Study For Large Bulk Water Supply Systems: Greater Bloemfontein Area.
- Identifying an irrigation scheme for small scale emerging and currently resource poor farmers.

4.5.2.1. Replacement yield as compensation for impacts of LHWP

Five options could possibly be considered for this study, i.e.:

- Water transfer from the Mzimvubu Basin.
- New Bosberg Dam.
- New Boskraai Dam.
- Raised Gariep Dam.
- Lower Level Storage for Van Der Kloof Dam.

These five options are shown in **Figure 4.2.** Please note that the options shown in green are the options that are suggested to be taken forward for assessment in this study. The options shown in red are the options suggested to be discarded.

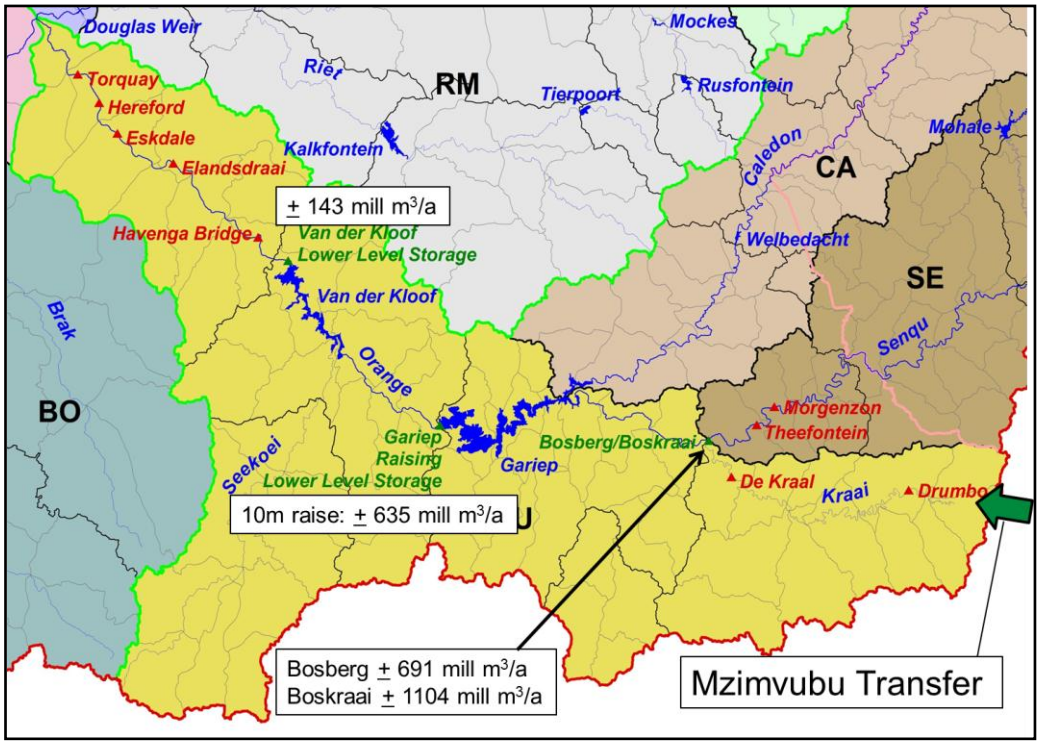


Figure 4.2: Options to be considered in the Upper Orange WMA (Options in red have been discarded at some stage and options in green are still possible future options)

- Transfer from the Mzimvubu River Basin
  Possible water transfers from the Mzimvubu River Basin have been described in various previous study reports. The Orange River System Analysis Phase 2 and the Vaal Augmentation Planning Study both describe three possible water transfer schemes from the Mzimvubu River basin, i.e.
  - Water transfer into the Kraai River, a tributary of the Orange River.
  - Water transfer into Tsoelike Dam of LHWP.
  - Water transfer to the Tugela River.

  All three these options had the objective to augment the Vaal River system, therefore a water transfer in a northern direction from the Goedemoed Weir in the Orange and the so-called Caledon River cascade option were considered part of the Kraai River transfer option.

  The preferred option was somewhat inconclusive, but favoured the Tugela option.

  It is now suggested to look at the Kraai River option as yield replacement option for the Orange River, i.e. without the Caledon cascades or the Goedemoed transfers to the Vaal catchment.

- Bosberg and Boskraai Options
  Two dam sites on the main stem of the Orange River have been investigated, namely Bosberg and Boskraai.

The two sites are close to each other and are mutually exclusive. The Boskraai site, however, is situated on the confluence of the Orange and Kraai rivers and therefore will produce a higher yield than upstream of the confluence of these two rivers.

The new Bosberg Dam can increase the yield of the Orange River System by ± 691 million m^3/a and the Boskraai Dam by ± 1 104 million m^3/a.

- Raising Gariep Dam
  Gariep Dam can be raised. Two levels have been investigated, i.e. a raising by 5m and a raising by 10m. Very high evaporation losses can be expected if this option is pursued.

  A 10 m high raise could increase the Orange River system yield by ± 635 million m^3/a.

- Amended Operating Rules for Van Der Kloof Dam
  A lower minimum storage level for Van Der Kloof Dam has been considered which could increase the system yield by ± 143 million m^3/a.

  The disadvantage of this option is that it would limit Eskom's power generation opportunities.

4.5.2.2. Augmenting Bloemfontein and other Towns with a Secured Water Supply

A water reconciliation strategy study for large bulk water supply systems for the Greater Bloemfontein Area was recently done. The interventions for this area were identified as the following in order of priority:

- Urban WC/WDM;
- Groundwater Interventions for small towns;
- Solving siltation problems at Welbedacht Dam;
- Developing additional yield in the Caledon River;
- Water reuse, and
- Augmenting from the Orange.

- **Urban WC/WDM for Bloemfontein**
  The implementation of this intervention under the "Best Case Scenario" has the potential to save approximately 25 million m^3/a of water and the "Most Probable Scenario" the potential to save approximately 12 million m^3/a of water.

- **Groundwater Interventions**
  The development of boreholes to supply the smaller towns of Reddersburg, Edenburg, De Wetsdorp and Wepener are viable options which should be further considered.

- **Developing Additional Yield in the Caledon River**
  A yield analysis of the Caledon system has shown that there is still significant water available in the Caledon River to reconcile water supply and requirements for the Greater Bloemfontein area. The development of the additional yield (which could be as much as 60 million m^3/a) would depend on the capacity of the infrastructure that is constructed to abstract water (and the feasibility thereof given the sediment related problems being experienced) from the Caledon River/Welbedacht Dam. The yield of the existing system is currently being negatively impacted by the problems associated with the on-going high siltation experienced at Welbedacht Dam, Welbedacht WTP and Tienfontein Pump Station. It is important to address the scouring of Welbedacht Dam and the associated sediment related issues prior to the development of additional water resource capacity/infrastructure (especially increasing the capacity of Tienfontein Pump Station).

  Given the close proximity of the Caledon River to Bloemfontein and the existing infrastructure, it would be considerably less costly to further develop this source than to obtain additional water from the Gariep Dam or from the Van Der Kloof Dam (the current cost estimates indicate that it would be in excess of 3 times more expensive to obtain water from the Gariep Dam than from the Caledon River). However, the cost of the water from the LHWP must be checked before this option is assessed.

- **Water Reuse for Bloemfontein**
  Water reuse could be a next intervention for Bloemfontein. Public resistance may be encountered, but this option was pursued with great success in Windhoek, Namibia. It must, however, be realised that water reuse will not increase the yield of the Orange River System, but it might solve Bloemfontein's water supply problem for a number of years. It must, also be investigated if other users (e.g. irrigators) won't be deprived from their water if Bloemfontein is starting to reuse its own water which will result in less waste water being discharged into the stream.

- **Transferring LHWP water to the Caledon River**
  For the intervention identified as part of the Greater Bloemfontein Reconciliation Strategy Study, it is proposed that water from the LHWP would be released into one of the tributaries of the Caledon River, probably at the existing release structure on the Little Caledon River. Water released into the Caledon River would be abstracted at Tienfontein Pump Station and delivered to Knellpoort Dam, from where it would be transferred via the Novo Transfer Scheme and Modder River to the Rustfontein Dam to augment the supply to Bloemfontein and the surrounding towns.

4.5.2.3. Irrigation Schemes for Small Scale Emerging Farmers

The Kloksfontein Dam is an off-channel Storage Dam site and is located ± 12 km south of Ritchie. This dam was considered during the Orange River Development

Replanning Study (1998) for providing off-channel storage for balancing water for the Orange Riet Canal. The dam option was discarded at that stage since the downstream demands of the dam were too small to justify such development. This project could possibly be reconsidered when supply to Douglas and irrigation to resource poor farmers are included.

4.5.3 Lower Orange WMA

Although a number of dam sites have been identified on the Lower Orange River, the Lower Orange River Management Study concluded that the only appropriate site for further consideration was at Vioolsdrift. Two possible dams were considered. A regulating dam and a yield dam.

i. Vioolsdrift Re-regulating Dam:

Full Supply Level	201,5 masℓ
Yield (million m^3/a)	170
Active Storage (million m^3)	110
Dam Height to NOC	25
Dam Type	Concrete gravity
Spillway	Central

ii. Vioolsdrift Yield Dam:

Full Supply Level	220,5
Yield (million m^3/a)	297
Total Storage (million m^3)	2 100
Active Storage (million m^3)	1 500
Dam Height to FSL	54.6
Dam Type	Concrete gravity
Spillway	Central

The position of the Vioolsdrift Dam is shown on the map in **Figure 4.3.**

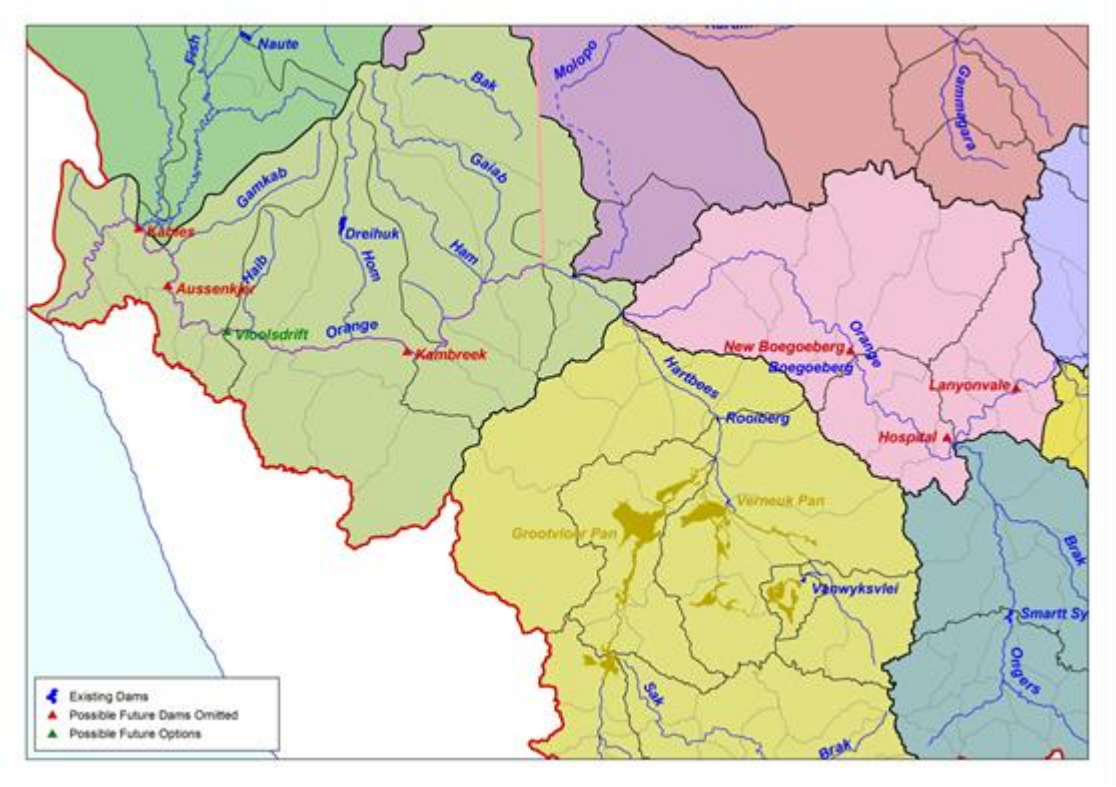


Figure 4.3: The Lower Orange WMA and the position of the Vioolsdrift Dam Option

4.5.4 Development Options in the Eastern Cape

There are a few development options in the Eastern Cape, but the objective here is to only focus on the options that will have an impact on the dependency of the Eastern Cape on Orange River Water.

In 2005 a report was prepared for the Eastern Cape Provincial Government named Mzimvubu River Basin: Water Utilisation Opportunities. In this report three possible options to transfer Mzimvubu water to the Fish and Sundays Rivers were described. (See **Figure 4.4**)

The Internal Strategic Perspective for the Fish to Tsitsikamma WMA (2005) states that the development opportunities for surface water in the Fish to Tsitsikamma WMA are limited and that the focus should fall on water trading, WC/WDM, more effective use of existing infrastructure and groundwater development.

The Algoa Water Supply System Reconciliation Strategy (2011) also does not mention any development options that will have an impact on the dependency of the Eastern Cape on Orange River Water. The development options described in the report will address the growing water requirements of Nelson Mandela Bay Municipality but will not necessarily reduce or increase the annual transfer volume from the Orange River.

4.5.4.1. The Northern Transfer Option to the Kraai

This consists of a number of dams in the Mzimvubu River Basin together with a system of canals, pump stations, pipelines and tunnels that transfer the water into a small tributary of the Orange River near Rhodes. From here the water flows to the Orange River from where it can be released through the Orange Fish Tunnel into the headwaters of the Fish River at Teebus, for further distribution.

4.5.4.2. The Southern Piped Transfer Option

This consists of a large dam in the lower reaches of the Mzimvubu River and pump stations and pipelines that transfer the water into another small tributary of the Orange River near Dordrecht. From here the water can flow to the headwaters of the Fish River as in the case of the Northern transfer option.

4.5.4.3. The Southern Canal Transfer Option

This consists of a large dam in the lower reaches of the Mzimvubu River and pump stations, pipelines and canals that transfer the water as far as the Little Fish River at the outlet of the Cookhouse Tunnel near Somerset East. Through an exchange of water with that which is being supplied by the Orange River Project at present, it would also be possible to abstract water further upstream in the Fish River.

Of these three options only the Southern Canal transfer option would transfer water directly to the Fish Tsitsikamma WMA, the first two via the Upper Orange WMA and existing Orange Fish Tunnel.

Whilst the above three options had the objective to expand the water use along the Fish and Sundays Rivers while still receiving the full transfer quota from the Orange River, **Options 4.4.4.1 to 4.4.4.3** could also serve to reduce the dependency of the Eastern Cape on Orange River water. This means that the Mzimvubu water could possibly replace the existing Orange River water supply to Fish and Sundays River valleys. Such an option could make more water available in the Orange River Basin.

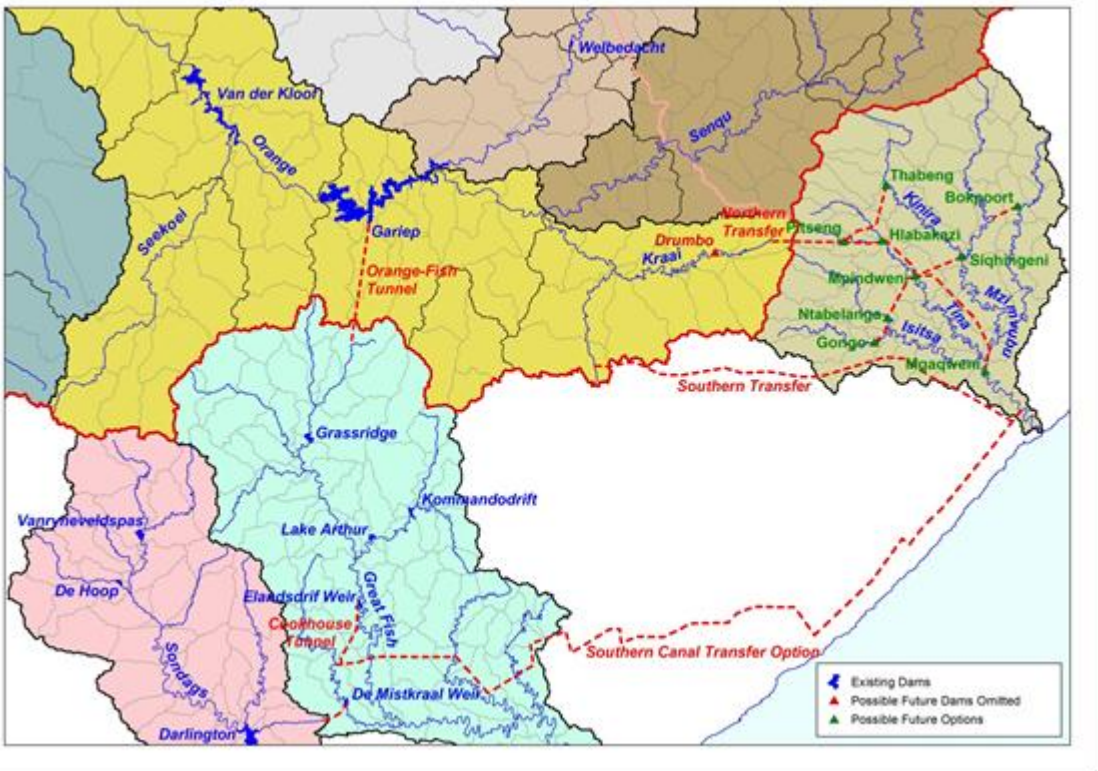


Figure 4.4: Transfer options to support the Eastern Cape System

5 SCREENING PROCESS

The screening of options will be done in collaboration with the study stakeholders and two screening workshops are envisaged, i.e. the Preliminary Screening Meeting reasonably early in the study and the Final Screening Meeting towards the end of the study.

The objectives of the Preliminary Screening Workshop are to agree with the stakeholders in the study area on what the main issues and concerns are to identify possible options to solve the concerns and to eliminate those options which should not be given further consideration under this study. Concerns in this context are related to water deficit or water quality problems.

This Starter Document only serves the purpose of guiding the stakeholders to identify options. It may well be that certain options have not previously been investigated and need to be added to the list for which the opportunity will be granted.

All identified options have been subjected to an initial screening. It will be assessed whether any one of the options contains a fatal flaw. Such a flaw could be, for example, unacceptable environmental consequences, major political implications and public health and safety issues.

A multi-criteria decision matrix will then be used to distinguish between the remaining options that have to be screened out and those that need further investigation. An example of such a matrix with the suggested criteria is shown in **APPENDIX B.** First order estimates of the additional yield / water savings, capital and operational costs and conceptual unit reference values (URVs) will be used in the matrix as well as other criteria such as biophysical and social impacts, implementing time and management intensity.

The proceedings of the workshop will be accurately recorded together with comments and questions raised, and possible management and infrastructure options to be taken forward will be listed. The reasons for discarding any options will be recorded. The document will outline the focus for the remainder of the study.

6 THE WAY FORWARD

After the preliminary screening meeting, the agreed list of reconciliation options will be analysed and scenarios for different development combinations will be modelled so that a water balance for each scenario can be drawn up. A final decision on the selection of interventions will then be taken by the Study Steering Committee on which the preliminary reconciliation strategy will be based.

The preliminary strategy will then be assessed by the stakeholders at the final screening meeting at which occasion the selected scenario must be confirmed. The preliminary strategy will then be refined in the final reconciliation strategy.

APPENDIX A: LIST OF INTERVENTION OPTIONS

Table A 1: Augmentation options identified from the literature – Senqu catchment Area **(**See **Figure 4.1.**)

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
1	Polihali Dam	LHWP Feasibility Study Phase II Stage 2	2008/09	• Polihali Dam (2 322 million m^3 storage) and tunnel (max capacity 35 m^3/s) to transfer water to Katse Dam from where water is transferred to Vaal Dam. • Increase transfer volume to Vaal by 460 million m^3/a. • Purpose is to primarily support the Vaal System. • Can initially be used to support both the Vaal and the Orange until the Vaal demand increased to a point that no support can be given to the Orange system. • The increase in the overall system yield with Gariep & Vanderkloof included is only 182 million m^3/a. • When the total yield from Polihali dam is utilized by the Vaal System it is expected that the yield of Gariep and Vanderkloof dams will reduce by almost 290 million m^3/a.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Need to determine the effect on the Orange with Polihali Dam fully utilised by the Vaal System. • Determine when the Orange will require an intervention option to cancel the effect of Polihali Dam. • Identify possible intervention options to be used for this purpose.			• The operating rule used for Polihali Dam will have a significant effect on its impact on the Orange, in particular until the time when the dam is fully utilised. • There is a possibility of a separate operating rule study to address this issue. Results from this study should be used if available in time.
2	Mashai Dam	LHWP Feasibility Study Phase II Stage 1 and Vaal Augmentation Planning (VAPS)	2008	• Mashai Dam was identified in the VAPS as the best option for Phase ll of the LHWP. • In the Feasibility Study this dam was an option for Phase ll or Phase III of LHWP conveying water North, via Katse dam towards the Vaal system. • In the Phase 1 of the Feasibility Study, Taung dam was the preferred alternative and Mashai was not considered further.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None, as it is no longer an option for augmenting the Orange, after Polihali Dam			• Polihali was proposed and has been agreed as Phase ll of the LHWP and Taung in combination with Tsoelike as the best option for LHWP Phase lll. • With Polihali Dam in place the yield from Mashai Dam will be reduced to almost zero and it is therefore no longer regarded as an option for augmenting the Orange.
3	Taung Dam	LHWP Feasibility Study Phase II Stage 1	2008	• This dam would constitute Phase llla of LHWP, acting as a conveyance to transfer water almost to Katse and then through new conveyances northwards to the Vaal system.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None, as it is no longer an option for augmenting the Orange, after Polihali Dam			• With Polihali Dam in place the yield from Taung Dam will be reduced to less than 70 million m^3 / annum and it is therefore no longer regarded as an option for augmenting the Orange.
4	Tsoelike Dam	LHWP Feasibility Study Phase II Stage I	2007	• This dam would constitute Phase lllb of LHWP with its yield being transferred to Taung dam and then Katse dam with conveyances northwards to the Vaal system. • Tsoelike Dam could also be used to support the Orange or partly support the Orange, even if Phase III of LHWP does not proceed. • Dam sizes between 135 m and 165 m and storages respectively of 1 400 & 2 942 million m^3, were evaluated. • The yield with Taung and Polihali dams in place was estimated at 143 million m^3/annum.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Determine if Tsoelike dam could be used to replace the yield in the Orange, if Phase III does not proceed, or if it was constructed ahead of Phase III and used			• This dam can be used as an intervention option for the Orange to replace the yield taken out by Polihali Dam.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
	for augmenting the Orange in the interim.			• This dam could be used as part of phase lll of the LHWP. • It is very unlikely that the dam when fully utilized for Vaal augmentation, could form part of Phase III of LHWP and also create enough replacement yield to cancel the impact of Polihali Dam on the Orange.
5	Ntoahae Dam	LHWP Feasibility Study Phase II Stage 1 and Vaal Augmentation planning (VAPS)	2007	• This dam would constitute Phase lVa of LHWP, acting as a conveyance to transfer the yield of Malatsi almost to Tsoelike and then to Taung and Katse dams and then through conveyances northwards to the Vaal system.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Consider as an option for augmenting the Orange if built before Phase III and until Tsoelike Dam is constructed. Also an option if Phase III does not proceed.			• Was identified in the VAPS to form part of phase IV of the LHWP. • As part of the LHWP Feasibility Study Phase ll Stage 2 this dam was again recommended to form Phase IVa of LHWP. • With Tsoelike Dam in place the yield from Ntoahae Dam will be virtually zero and will therefore no longer be an option for augmenting the Orange after Tsoelike Dam.
6	Malatsi Dam	LHWP Feasibility Study Phase II Stage 1	2007 & 1994	• Was identified in the VAPS to form part of phase IV of the LHWP. • As part of the LHWP Feasibility Study Phase ll Stage 1 this dam was again recommended to form phase IVb of LHWP. • It has a yield of 254 million m^3/annum.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Determine if Malatsi dam could be used to replace the yield in the Orange, if Phase IV of LHWP does not proceed, or if it was constructed ahead of Phase IV and used for augmenting the Orange in the interim.			• This can be used as an intervention option for the Orange to replace the yield taken out by Polihali, Taung, & Tsoelike Dams.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
7	Lebelo Dam	LHWP Feasibility Study Phase ll Stage 1	2007	• This was a new dam site identified as part of the LHWP Feasibility Study Phase ll Stage 1. It was considered as an alternative Phase IV to Malatsi and Ntoahae. It would have transferred water to Mohale dam, but it was not the preferred phase IV of LHWP at that time. • Lebelo and Malatsi are mutually exclusive. • The yield was estimated at 213 million m^3 /annum.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Determine if Lebelo dam could be used to replace the yield in the Orange. • If Phase IV does not proceed, or if it was constructed ahead of Phase III and used for augmenting the Orange in the interim.			• To replace yield in the Main Orange due to upstream developments.

Table A 2: Augmentation options identified from the literature – Upper Orange River Catchment Area (See **Figure 4.2**)

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
1	Bosberg Dam	Planning (ORRS)	1998	• Dams up to 57 m high were considered feasible at this site. • Higher dams would start to spill through a saddle to the Kraai River, requiring an expensive saddle dam. • Large Bosberg 5 768 million m^3 storage plus 1 500 million m^3 storage at Vioolsdrift provide yield of 979 million m^3/a. Vioolsdrift contribution approximately 288 million m^3/a.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Determine if Bosberg Dam can be used to replace the yield in the Orange as result of Polihali Dam • Which is the best option to use? Bosberg or Lebelo/Malatsi or Ntoahae.			• This can be used as an intervention option for the Orange to replace the yield taken out by Polihali Dam. • The operating rule for this dam is important as it keeps the water in Bosberg until Gariep reaches its m.o.l. and therefore significantly reduces evaporation losses from Gariep.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
				• Reduced hydro-power at Gariep and Vanderkloof, but additional hydro-power from Bosberg because of operating regime.
2	Boskraai Dam	Planning (ORRS)	1998	• The Boskraai Dam actually consists of a Bosberg Dam of higher than 57m together with a dam of similar height on the Kraai River. • Although the dam site allows for higher dams to be built a maximum water depth of 75m was assumed to prevent the FSL to extend into Lesotho. • Large Boskraai Dam of 10 605 million m^3 in combination with a 1 500 million m^3 storage Vioolsdrift provide yield of 1 392 million m^3/a. Vioolsdrift contribution approximately 288 million m^3/a.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Determine if Boskraai Dam can be used to replace the yield in the Orange as result of Polihali Dam and possible future phase of LHWP.			• This can be used as an intervention option for the Orange to replace the yield taken out by Polihali Dam as well as to transfer water to the Vaal System. • The operating rule for this dam is important as it keeps the water in Boskraai until Gariep reaches its m.o.l. and therefore significantly reduces evaporation losses from Gariep. • Reduced hydro-power at Gariep and Vanderkloof, but additional hydro-power from Boskraai Dam.
3	Mzimvubu Transfer to the Orange	Orange River System Analysis Phase 2 and VAPS	1993 & 1994	• Assessed 3 options, i.e. Mzimvubu/Kraai, Mzimvubu/ Tugela and Mzimvubu/LHWP transfers. • Mzimvubu/Kraai came out as the option with lowest URV for water to Vaal. • Recommended further in detail investigations.
		Mzimvubu River Basin: Water Utilisation Opportunities	2005	• Report prepared for the Eastern Cape Province: Focus was on the Eastern Cape. • Assessed 3 Options: Northern Transfer, Southern Transfer and Southern Canal Transfer options.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Compare Mzimvubu to Orange/Great Fish options and select one of the two.			• Mzimvubu/Kraai of VAPS could be a possible option to augment the Orange River but without the transfer infrastructure to the Vaal. • Mzimvubu/Kraai of 2005 study could also be a possible option to augment the Orange River. •
4	Raised Gariep Dam	Planning (ORRS) Pre-feasibility	1998	• Increase in yield for a 5m raising is 316 million m^3/a. • Increase in yield for a 10 m raising 635 million m^3/a.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Consider as an option for augmenting the Orange.			• This can be used as an intervention option for the Orange to replace the yield taken out by Polihali Dam. • When raising Gariep higher than 10m a significant decrease in the rate of yield increase is experienced. • Results in very high evaporation losses.
5	Vanderkloof Dam reduced m.o.l.	Pre-feasibility (LORMS)	2005	• 143 million m^3/a yield increase for storage between canal outlets and existing bottom outlets at Vanderkloof Dam.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Consider as intervention option for the Orange. • Weigh up benefits, i.e. reduced hydro power generation opportunities.			• This can be used as an intervention option for the Orange to replace the yield taken out by Polihali Dam. • Disbenefit: Due to periods when no hydro-power can be generated.
6	Torquay Dam	Planning (ORRS) Pre-feasibility	1998	• The main purpose of Torquay Dam is to re-regulate the water released through the hydro-power turbines at Vanderkloof Dam for later release to the irrigation farmers downstream. • This will enable the generation of more hydro-power during the winter periods. • Depending on the size of Torquay dam an additional

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
				yield of 253 million m^3/a for a 1 500 million m^3 storage dam.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. This option appeared to be less beneficial than a dam at Vioolsdrift.			• This can be used as an intervention option for the The Valley at the dam site is 60 m high. Higher dams will require extensive walls on the left flank. • Discarded by Pre-feasibility study as either Boegoeberg and Vioolsdrift dams provided more cost effective and practical options. • Benefit of hydro-power generation was however not included.
7	Drumbo dam	Reconnaissance Phase (ORRS)	**1998**	• Located in the Kraai River ± 25 km north east of Barkley East. • To provide balancing storage for the proposed interbasin transfer from the Mzimvubu River. • Increase the Orange River's yield.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Can still be considered as part of the Mzimvubu/Kraai transfer options.			• Was omitted since it is part of the Mzimvubu transfer scheme which was not included as part of the ORRS.
8	De Kraal / Upper Kraai Dam	Reconnaissance Phase (ORRS)	**1998**	• Located in the Kraai River ± 10 km south east of Aliwal North. • Storage of water for hydro-power generation.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. The arguments in the ORRS for discarding the project are still valid today.			• Was discarded since irrigation areas will be inundated. • People in the dam basin will have to be relocated.
9	Theefontein / Oranjedraai dam	Reconnaissance Phase (ORRS)	**1998**	• Located in the Orange River ± 25 km upstream of Aliwal North. • Storage of water for Hydro-power generation.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Option discarded in ORRS, and same conditions are present today.			• Was omitted since it is part of the Mzimvubu transfer scheme.
10	Morgenson Dam	Reconnaissance Phase (ORRS)	**1998**	• Located in the Orange River ±35 km upstream of Aliwal North. • Storage of water for Hydro-power generation.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Option discarded in ORRS, and same conditions are present today.			• Was discarded since it will inundate land in Lesotho. • And it is less attractive than the Bosberg Dam option.
11	Raising of Vanderkloof Dam	Reconnaissance Phase (ORRS)	**1998**	• Located in the Orange River ±8 km North of Petrusville. • Increase water yield. • Increase hydro-power generation.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Option discarded in ORRS, and same conditions are present today.			• Was discarded since the dam was not designed to be raised. • And consequently any raising will be prohibitively expensive.
12	Utilise dead storage in Gariep Dam	Planning (ORRS) Pre-feasibility	1998	• Increase water yield.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• This is an option in combination with Bosberg or Boskraai options.			• Would reduce hydropower generation • Might be a good option in combination with an upstream dam such as Bosberg that can make up for hydropower losses at Gariep Dam.
13	Havenga Bridge Dam	Planning (ORRS)	1998	• Alleviation of abstraction problems experienced by irrigators between Vanderkloof Dam and Prieska.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Discarded option in ORRS and same conditions are present today.			• Was discarded in Pre-feasibility phase as it was only for hydro-power purposes and not for yield increase.
14	Eskdale Weir	Reconnaissance Phase (ORRS) and LORMS	1998 & 2005	• 15km downstream of Hopetown. • Increase hydro-power. • Increase irrigation development in the Plooysburg area.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Discarded option in ORRS and LORMS, and same conditions are present today.			• Discarded since Torquay Dam provides similar benefits and was found to be a more cost effective and practical option. • Vioolsdrift was a better option than Torquay.
15	Hereford Weir	Reconnaissance Phase (ORRS) and LORMS	1998 & 2005	• 35km downstream of Hopetown. • Increase hydro-power. • Increase irrigation development in the Douglas area.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Discarded option in ORRS and LORMS, and same conditions are present today.			• Discarded since Torquay Dam provides similar benefits and was found to be a more cost effective and practical option.
16	De Krans Dam	Reconnaissance Phase (ORRS)	1998	• Located ±15km downstream of Ritchie. • Regulation and balancing of water supply from the Orange-Riet canal and Riet River flow. • Storage capacity for irrigation supply.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Option discarded in ORRS and LORMS, and same conditions are present today.			• Discarded since the sedimentation forecast for this dam is very high. • Demands below the dam are relatively low.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
17	Kloksfonten Dam	Reconnaissance Phase (ORRS)	1998	• Off-channel Storage located ±12km south of Ritchie. • Off channel storage for balancing of water from Orange Riet canal. • Storage capacity for irrigation supply.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Reconsider when supply to Douglas and irrigation for resource poor farmers are considered.			• Omitted from ORRS since the demands downstream of the dam are too small to justify such a development.
18	Elandsdraai Dam	Reconnaissance Phase (ORRS) and LORMS	1998 & 2005	• Minimisation of abstraction problems by providing more constant base flow, by re-regulating hydro power releases from Van der Kloof Dam.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. Option discarded in ORRS and LORMS, and same conditions are present today.			• Was discarded in LORMS Pre-feasibility phase as it was only for re-regulating hydro-power releases and not for yield increase.
19	Groundwater Development Options	Planning (Water Reconciliation Strategy Study for large Bulk Water Supply Systems: Greater Bloemfontein Area)	2009	• No major groundwater schemes. • Development of boreholes for smaller towns e.g. Reddersburg, Edenburg, De Wetsdorp and Wepener.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Consider groundwater for smaller towns e.g. Reddersburg, Edenburg, De Wetsdorp, Wepener.			• Tendency has been to neglect the groundwater resource. • Could be a good solution for towns far from surface water resource.
20	Reuse of treated effluent	Planning (Water reconciliation Strategy Study for large Bulk Water Supply Systems: Greater	2009	• Treated sewage water from Bloemfontein a possibility. • Considered in strategy study.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
		Bloemfontein Area)		
	Proposed assessments in the Reconciliation Study			**Comments:**
	• None. This option is fifth on the priority list of the Greater Bloemfontein Strategy. Will probably become an option in the next 20 year planning timespan. • Has local benefits but does not increase system yield, some return flows are reduced.			• Negative perceptions associated with the use of treated sewage effluent for domestic purposes must first be broken down. • Only local benefit – will not increase the total system yield.

Table A3: Augmentation options identified from the literature – Lower Orange Catchment Area (See **Figure 4.3**)

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
1	Vioolsdrift Dam	Pre-feasibility (LORMS)	2005	• Three different Vioolsdrift Dam options are considered: ○ Yield dam ○ Re-regulating dam ○ Yield in combination with re-regulation
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Consider as a possible option.			• These can be used as intervention options for the Orange to replace the yield taken out by Polihali Dam. • Dam will be on the border of Namibia and South Africa.
2	Lanyonvale Dam	Reconnaissance Phase (ORRS) and LORMS	1998 & 2005	• Orange River ± 60km downstream of Douglas. • Flood absorption and attenuation. • Regulation of seasonal irrigation supply from Vanderkloof Dam to increase hydro-power generation.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• None. Option discarded in ORRS and LORMS, and same conditions are present today.			• Discarded since a new Bosberg Dam is considered to be a more cost effective and practical dam.
3	New Boegoeberg Dam	Reconnaissance Phase (ORRS) and LORMS	1998 & 2005	• Orange River ± 1km downstream of existing Boegoeberg.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
				• Regulation of river flow to improve supply of lower Orange River water. • Reduction in water losses due to excessive releases poorly timed at Vanderkloof. • Increase in Water Yield. • Increase in hydro-power. • Better utilization of spills from the Vaal River System.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• None. Option discarded in LORMS, and same conditions are present today.			• Parts of Prieska will be inundated for a dam with a capacity in excess of 2000 million m^3. • Discarded in LORMS since Vioolsdrift Dam offers a more cost effective and practical solution.
4	Kambreek Dam	Reconnaissance Phase (ORRS) and LORMS	1998 & 2005	• Orange River ± 15km downstream of Pelladrift. • Regulation of river flow to improve supply of far lower Orange River. • Reduction in water losses due to excessive releases at Vanderkloof. • Increase in Water Yield. • Better utilization of spills from the Vaal River System.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• None. Option discarded in ORRS and LORMS, and same conditions are present today.			• Discarded since Vioolsdrift Dam offers a more cost effective and practical solution.
5	Aussenkjer Dam	Reconnaissance Phase (ORRS)	1998	• Orange River ± 65km downstream of Vioolsdrift. • Regulation of river flow to the Orange River mouth. • Increase in Water Yield. • Better utilization of spills from the Vaal River System.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• None. Discarded in ORRS, and same conditions are present today.			• Discarded since the dam is located too far downstream to accommodate certain water demands and too far

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
				upstream to capture the Fish River water.
6	Kabies Dam	Reconnaissance Phase (ORRS) and LORMS1	1998 & 2005	• Orange River ± 2 km downstream of Orange/Fish confluence. • Regulation of river flow to the Orange River mouth. • Increase in Water Yield.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• None. Option discarded in ORRS in LORMS, and same conditions are present today.			• Discarded since the cost/yield ratio is very high and downstream demands are low.
7	Hospital Dam	Reconnaissance Phase (ORRS) and LORMS	1998 & 2005	• Flood absorption and attenuation. • Regulation of seasonal irrigation supply from Vanderkloof Dam to increase hydro-power generation.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• None. Option discarded in ORRS and LORMS, and same conditions are present today.			• Discarded since Boegoeberg Dam is considered to be a more cost effective and practical option.

Table A 4: Augmentation options identified from the literature – Eastern Cape Area supplied from the Orange **(**See **Figure 4.4)**

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
1	Transfer from Mzimvubu	Mzimvubu River basin: Water utilisation opportunities	2005	• Three options were considered - **The Northern transfer option**. Number of additional dams in the Mzimvubu River Basin together with a system of canals, pump stations, pipelines and tunnels that transfer the water into a small tributary of the Orange River near Rhodes. From there the water flows to the Orange River from where it can be released through the Orange Fish Tunnel into the headwaters of the Fish River at Teebus, for further distribution.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features of the Option
				- **The Southern Piped transfer option**. This consists of a large dam in the lower reaches of the Mzimvubu River and pump stations and pipelines that transfer the water into another small tributary of the Orange River near Dordrecht. From here the water can flow to the headwaters of the Fish River. - **The Southern Canal transfer option**. This consists of a large dam in the lower reaches of the Mzimvubu River and pump stations, pipelines and canals that transfer the water as far as the Little Fish River at the outlet of the Cookhouse Tunnel near Somerset East.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Compare the options and consider the preferred option to augment the Orange. Could replace the yield lost as a result of the LHWP dams.			• These options were considered to support the Eastern Cape with water from the Mzimvubu • The Southern Canal Transfer Option could reduce the dependency of the Eastern Cape on Orange River Water

Table A5: Possible Management Options that will reduce water requirements

No:	Name of option	Sector	Key Features of the Option
1	Water Conservation and Water Demand Management	Irrigation	• Improved efficiency in conveyance of water to field edge. • Improved efficiency beyond field edge.
		Urban Domestic	• Various actions by Municipalities, e.g. pressure control, improved metering, etc. • Cooperation of the public. Improved water user efficiency at household level.
		Industrial	• Improved water use efficiency through review of existing processes.
2	Eliminating Unlawful	Mainly in the Irrigation	• Extent of unlawful water use will become known after the validation and verification

No:	Name of option	Sector	Key Features of the Option
	water use	Sector	process. • Directives to unlawful water users to cut back on their water use.
3	Promoting Rainwater harvesting	Domestic	• Water tanks with guttering for households. • Only efficient in areas with regular rainfall. • System yield increase is significant.
4	Reducing assurances of supply	Mainly Irrigation Sector	• More water can be allocated if lower assurance of supply is accepted.
5	Compulsory licensing	All sectors	• Licensing of all water use. • Dependent on the completion of the Validation and Verification process. • Labour intensive process.
6	Water Trading	Mainly Irrigation Sector	• Trading of partional water entitlements if linked to WC/WDM. • Trading of full entitlement. • Social consequences must be considered. • Clear policy and rules needed.
	Proposed assessments in the Reconciliation Strategy		**Comments:**
	• All options except rainwater harvesting to be considered. • Rain water harvesting can be promoted to alleviate local water supply shortages.		• WC/WDM could possibly be linked to Compulsory Licensing or Water Trading

Table A 6: Possible Management Options that will increase water availability

No:	Name of option	Sector	Key Features of the Option
1	Improved system operating rules	All sectors	• By operating a water supply system more efficiently, more water can be freed up – reduced losses.
2	Removal of invasive alien plants	All sectors	• Limited opportunity for the Orange River basin.
3	Preventing Soil erosion	Agricultural	• Will not increase water availability but will ensure that the current water availability is maintained.
	Proposed assessments in the Reconciliation Strategy • Improved system operating rules and preventing soil erosion will be considered.		**Comments:** • Anticipated benefit from removing alien invasive plants is small • Removing invasive alien plants is still important and although not analyzed as an option, the practice of removing these plants in the basin should be continued

APPENDIX B: MULTI-CRITERIA MATRIX

Hypothetical Example Of The Multi-Criteria Matrix

A score out of 3 must be given to each option for each criterion, where 1 = low/least benefit; 2 = reasonable/middle benefit and 3 = high/best benefit

Criteria↓ / Options →	A	B	C	D	E	F	G	H	J	K	L	Etc.	Weight
Political Acceptability	3	3	2	2	2	2	2	3	3	3	1	2	1
Additional Yield	3	3	3	3	3	3	2	2	2	3	3	3	0
Capital Costs	3	3	1	1	1	1	3	3	2	2	1	1	0
Operational Costs	3	3	1	3	3	3	3	3	3	3	1	1	0
URV	3	3	1	2	2	2	3	3	3	3	1	1	6
Environmental Consequences	3	3	2	2	2	3	3	3	3	3	2	2	1
Social Consequences	2	2	2	2	2	2	3	2	2	2	2	2	1
Management Intensity	3	3	1	3	3	3	3	3	3	3	1	1	1
Implementing Time	1	1	1	2	2	2	3	3	2	2	1	1	1
Water Quality Impacts	2	2	2	2	2	2	2	2	2	2	3	3	1
Hydropower Potential	3	3	3	3	3	1	1	1	2	2	3	3	1
Totals	35	35	19	30	28	26	35	35	35	35	19	20	13
Fatal Flaw?	N	N	N	N	N	N	N	N	N	N	N	N	

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Directorate: National Water Resource Planning

Development of Reconciliation Strategies for Large Bulk Water Supply Systems: Orange River (ORECONS)

Study Steering Committee (SSC) Meeting No. 2
and
Preliminary Screening Workshop

DRAFT PROGRAMME

Time	10h15 (Registration at **09h45** with tea & coffee)
Date	7 February 2013
Venue	Flamingo Casino, Kimberley

Study Objectives

1. *To address growing water demands.*
2. *To identify serious water quality problems.*
3. *To identify resource development options.*
4. *To provide reconciliation interventions.*
   a) *Infrastructural interventions.*
   b) *Management interventions.*
5. *To facilitate communication and strengthen the partnership between the DWA and key stakeholders.*

Meeting Objectives

1. *To strengthen the partnership between DWA and key stakeholders.*
2. *To identify main concerns of the key stakeholders.*
3. *To identify the reconciliation options.*
4. *To screen options and agree options for further evaluation.*

		ACTION
1.	**Welcome and Introduction**	Seef Rademeyer
1.1.	Attendance	
1.2.	Apologies	
2.	**Acceptance of Agenda**	Seef Rademeyer
3.	**Minutes of the previous meeting**	Seef Rademeyer
3.1.	Approval	

		ACTION
3.2.	Matters arising	
3.2.1.	Transfer of water entitlements – Eastern Cape to Orange River Basin.	
3.2.2.	Modelling of the Orange-Fish water transfer.	
3.2.3.	Integrated system for the Vaal and Orange Rivers. (ORASECOM project)	
3.2.4.	Water demand by the solar energy generation industry.	
3.2.5.	Towns dependant on Orange River Water and part of All Towns Study – should also form part of this study.	
3.2.6.	Assurances of supply (water supply criteria)	
3.2.7.	Stakeholders to be invited to SSC meetings.	
4.	**Status and recap since the previous meeting**	Pieter Van Rooyen
5.	**Overview on Progress on Study Tasks**	Pieter Van Rooyen
6.	**Screening Workshop: Process to be followed – Workshop objectives**	Andrew Tanner
7.	**Catchment overview**	Johnny Beumer
8.	**Water balance perspective and risk criteria**	Manie Mare
9.	**Identification of issues/challenges in the Orange catchment (two-way discussion between the audience and presenters)**	Andrew Tanner
10.	**Explanation of the selection criteria (including the concepts Yield, Capital Costs, Operational Costs and URV)**	Andrew Tanner
11.	**Explanation of the multi-criteria decision support matrix**	Andrew Tanner
12.	**Presentation of possible reconciliation options**	Johnny Beumer
12.1.	Management and regulating options	
12.2.	Increasing Supply - Transfer in	
12.3.	Increasing supply - Possible new dams	
12.4.	Groundwater developments and rainwater options	
12.5.	Water quality improvement options	
13.	**Possible additions from the audience**	Andrew Tanner
14.	**Assessment of options**	Andrew Tanner

		ACTION
15.	**Agreement of options for further study**	Andrew Tanner
16.	**Way Forward**	Andrew Tanner
17.	**Date of next meeting**	Seef Rademeyer
18.	**Closure**	Seef Rademeyer

water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Development of Reconciliation Strategies for Large Bulk Water Supply Systems: Orange River

Study Steering Committee Meeting 2 and Preliminary Screening Workshop

Draft Minutes

DATE: **Thursday, 7 February 2013**
TIME: **10:15 – 13:00**
VENUE: **Flamingo Casino, Kimberley**

Item	Description	Action
1	**WELCOME AND INTRODUCTIONS**	**ACTION**
	The Chairperson, Mr Seef Rademeyer, (Department of Water Affairs – DWA) welcomed all to the second meeting of the Study Steering Committee and the Preliminary Screening Workshop of the Reconciliation Strategy Study for the Orange River Bulk Water Supply System. The Study and Meeting Objectives were : • *Study Objectives are to:* o address growing water demand; o identify serious water quality problems; o identify resource development options; o provide reconciliation interventions such as: o *infrastructural interventions; and* o *management interventions* o Facilitate communication and strengthen the partnership between DWA and key stakeholders. • *Meeting Objectives:* o to strengthen the partnership between DWA and key stakeholders; o to identify main concerns of the key stakeholders; o to identify the reconciliation options; and o to screen options and agree on options for further evaluation.	
1.1	***Attendance*** An attendance register is attached as **Appendix A**.	
1.2	***Apologies*** The following apologies were received:	

Item	Description	Action
	Mr Hanke du Toit, Oranje Riet Water Users Association Mr Stanley Chamberlain, Upington Eilande Besproeïngsraad Ms Lizelle Beukes, Oranje Vaal Water Users Association Mr Andre Smith, Boegoeberg Water Users Association	
2	**ACCEPTANCE OF AGENDA**	
	The Agenda was presented and accepted as tabled.	
3	**MINUTES OF THE PREVIOUS MEETING**	
3.1	*Approval* The Minutes of the SSC Meeting #1 were tabled and accepted. Mr Rademeyer requested that should the attendees have any comments / issues related to the Minutes, to please submit them to the Secretariat.	
3.2	*Matters arising*	
3.2.1	*Transfer of water entitlements – Eastern Cape to Orange River Basin* Mr Rademeyer informed the attendees that the study team is aware of this matter and it will be accounted for.	
3.2.2	*Modelling of the Orange-Fish water transfer.* Mr Rademeyer stated that an assessment will be done to identify how to link the Orange River Model with the Eastern Cape system model. The study team realised that the hydrology for the two River Systems are not covering the same record period. The Eastern Cape Side is 15 years shorter than the records available for the Orange and Integrated Vaal systems.	
3.2.3	*Integrated system for the Vaal and Orange Rivers. (ORASECOM project)* The integrated Vaal and Orange system that was developed as part of the ORASECOM project, was used as the base input data sets for the further development and improvement of the models, for the purpose of this study.	
3.2.4	*Water demand by the solar energy generation industry* These demands are currently being sourced and will be included in the study.	
3.2.5	*Towns dependant on Orange River Water and part of the All Towns Study – should also form part of this study* All the towns covered in the All Towns Study receiving water from the Orange are captured in the data base prepared for this study. These demands and related projections are used as the basis for the urban/domestic water use and will be improved where possible.	
3.2.6	*Assurances of supply (water supply criteria)* This item will be addressed under Item 8 of the agenda.	
3.2.7	*Stakeholders to be invited to SSC meetings* There was appreciation for the fact that the identified stakeholders had been invited and that the meeting was more representative. These include representatives of (other than Government Departments):	

Item	Description	Action
	• Orange-Senqu River Commission (ORASECOM – Lesotho representatives); • ESKOM; • Sundays River Water User's Association; • Great Fish River Water User's Association; • Orange River Agricultural Union; • Northern Cape Agricultural Union; • Oranje Vaal Water User's Association; • Boegoeberg Water User's Association; • South Africa Association for Water User's Associations (SAAFWUA); • Black Mountain Mines; and • Van Der Kloof Water User's Association.	
4	**STATUS AND RECAP SINCE THE PREVIOUS MEETING**	
	Mr Pieter van Rooyen (WRP) provided a summary of the Orange River Reconciliation Strategy Development. He presented the organogram of the various Role Players and their roles and responsibilities within the 18 study tasks as well as the Status of the ORECONS to date. He informed the attendees that the Preliminary Reconciliation Strategy needs to be in place by July 2013. The progress on the task was briefly explained. And included: **Tasks completed:** • Inception report. • Summary of previous and current studies. **Tasks that still needs to be completed:** • Preliminary Screening workshop. • Water Conservation & Demand Management. • Water Quality & Re-use. • Surface water hydrology (surface hydrology will not be redone and will only be reviewed internally). • Reserve requirements Scenarios and Scheme yields. • International Obligations. • Water Requirement Scenarios. • Irrigation demands and WC/WDM. • Groundwater. • Review Schemes and update cost estimates. • Assess Environmental & Social Implications. • Assembly of information and Formulation of Scenarios. It was noted that the recent reconciliation strategy study on the Greater Bloemfontein Area will also be incorporated in this strategy. A copy of the presentation is attached as **Appendix B**.	
5	**OVERVIEW ON PROGRESS ON STUDY TASKS**	
	Mr Van Rooyen presented an overview on the progress of the Study Tasks and briefly discussed the Stakeholder Engagement Programme (inclusive of the SSC Meetings and public engagement).	

Item	Description	Action
	Attendees were also informed that the public meeting which was scheduled to take place in February 2013 is believed to be premature and the decision was taken to rather distribute a newsletter with the relevant information regarding the ORECONS study and a brief summary and outcome of today's meeting. The draft Final Reconciliation Strategy document is scheduled for completion in April 2014 and the document is envisaged to be ready for distribution in July 2014.	
6	**SCREENING WORKSHOP: PROCESS TO BE FOLLOWED – WORKSHOP OBJECTIVES**	
	Mr Andrew Tanner (of the study team) explained the housekeeping arrangements, cell phones to be switched off, lunch arrangements, stakeholder identification when making inputs, breaks etc. He also asked that any notes or ideas that the attendee(s) did not raise at the workshop should be submitted in writing to the Secretariat. Mr Tanner stated that he believed that there is collective knowledge in the room and the Task Team is looking forward to receive this knowledge during the Workshop. It is local knowledge that is of the utmost importance and by sharing this knowledge it will contribute to a well-documented and comprehensive Strategy Document at the end of the day. The Workshop Objectives were presented and the attendees were requested to think about and make notes of issues to be raised. One of the key discussions points for the SSC Meeting was the contributions from the attendees' in the selection of intervention options for further investigation. The Workshop Objectives and Items presented are included in the presentation and are attached as **Appendix C**.	
7	**STUDY AREA OVERVIEW**	
	Mr Johnny Beumer (of the study team) informed the attendees that the stakeholders need to know which areas fall within the Orange-Senqu River Basin and where the main infrastructure are located. The Basin is shared with South Africa's neighbouring countries i.e. Lesotho, Botswana and Namibia. It is therefore important to note that the decisions taken by these countries, which may have an impact on the water quality and volumes, need to be captured in this study. It is also important to note that the decisions taken and planning done by South Africa, which could have an impact on the water resources of the neighbouring countries, must be conveyed to those sharing countries in terms of the SADC Protocol on Shared Watercourses. This type of communication can be disseminated through the existing Orange Senqu Water Commission (ORASECOM). The study area consists of two Water Management areas (WMAs) the, Upper Orange (WMA 13) and the Lower Orange (WMA 14). The second edition of the National Water Resource Strategy proposes that the two WMAs are managed by a single Catchment Management Agency. The Vaal River Reconciliation Study has already been completed and would therefore not be repeated in this study. The strategies developed for the Vaal River will however be taken into account in this strategy. The Vaal River is therefore not directly included in the study. In terms of the Eastern Cape, water is being transferred from the Orange River to the Fish and	

Item	Description	Action
	Sundays rivers and therefore WMA15 (Fish to Tsitsikamma) also needs to be taken into account. Mr Beumer also covered the following important aspects in his presentation: (see **Appendix C**), • Overview of the current status of the study area; • The Senqu River Catchment existing major infrastructures i.e. Katse Dam on the Malibamatso Tributary and Mohale Dam on the Senqunyane Tributary; • The Eastern Cape receiving water from the Orange River; • The Upper Orange WMA – existing major infrastructures i.e. Welbedacht Dam on the Caledon Tributary, Gariep and Vanderkloof dams on the main stem. • The Lower Orange WMA – existing major infrastructure i.e. Boegoeberg Dam and the irrigation canals of various Water User Associations / Irrigation Boards including the Vioolsdrift irrigation canals further downstream.	
	Discussions and Questions Raised:	
7.1	Mr Nic Knoetze pointed out that the Orange-Riet canals downstream of VanderKloof Dam were not mentioned. It was agreed that this was an oversight and that these canals form part of the main infrastructure in the Upper Orange WMA.	
7.2	Mr Pieter Venter (Black Mountain Mines) stated that most of the canals at Onseepkans are defunct.	Noted
8	**WATER BALANCE PERSPECTIVE AND RISK CRITERIA**	
	Mr Manie Mare started off by explaining that the main study area comprising of the Upper and Lower Orange WMAs is directly and indirectly affected by the Vaal and Senqu catchments as they form part of the same river basin. Transfers to and from the Vaal are also taking place from the Thukela, Olifants, Usuthu and Komati catchments, which form part of the overall integrated system, and therefore need to be taken into account in the system modelling. The Fish River in Namibia enters the main Orange not far upstream of the river mouth and might have an effect on the environmental requirements at the estuary. Although river flows from the Nossob, Auob and Molopo rivers do not enter the main Orange, they are part of the basin and will be of local importance in some areas. All these areas need to be taken into account to ensure that the Study Team has an overall picture, but the focus will however be on the Upper and Lower Orange WMAs, which is defined as study area for the Orange Reconciliation Study. In summary, Mr Mare presented the current and possible future water balances and stated that currently there is a small surplus available. In the context of the total system demand of 3 140 million m^3/a the surplus is about 5% of the demand, which is less than the general excepted accuracy of good hydrology which is in the order of 10%. For practical purposes one can therefore say the system is currently in balance. The presentation also highlighted the following aspects: • The Mean Annual Runoff Total Basin (Gross MAR of 11 900 million m^3/a); • Along the Lower Orange the evaporation and evapotranspiration from the main Orange River is much higher than the incremental flows entering the Orange River, so that the flow even under natural conditions reduces as it flows towards	

Item	Description	Action
	the river mouth; • The Orange Basin total demand is 6 820 million m^3/a; • Gariep and Vanderkloof dams are the largest storage dams on the Orange and together forms the Orange River Project (ORP). These dams are also utilised for the generation of hydro power; • The ORP Demand (Total demand of 3 140 million m^3/a); • It is difficult to release the exact volume required from Vanderkloof Dam to satisfy all the downstream requirements along the Orange, as a distance of approximately 1 300 km must be covered from Vanderkloof Dam to the river mouth. It takes about 1 month for the water to reach the river mouth; heat waves are sometimes experienced that increases the water requirements significantly and there might be some un-lawful abstractions taken place, which all impact on the water use. Some allowance was therefore made for operational requirements. This was initially estimated at 270 million m^3/a, but has due to improved operation and monitoring, already reduced to 180 million m^3/a. • Historic Firm Yield. The definition of the historic firm yield was clearly explained and illustrated graphically; • ORP system yield & future water requirements, indicate a possible future shortage of approximately 1000 million m^3/a when Polihali Dam and updated EWRs are in place; • Yield and Supply Assurance: o ORP long-term stochastic yield and related assurances were explained; o User supply assurance requirements (priority classification table) as currently used in the annual operating analyses for the Orange River system were presented. A copy of the presentation with additional information is attached to the Minutes as **Appendix D**. The assurance of supply to users is a very important aspect and will be discussed in more detail at the next SSC meeting, due to current time limitations. It was proposed and accepted that a task group be selected from main stakeholders to discuss this, and to come up with proposals.	HGM/PvR
	Discussions and Questions Raised:	
8.1	Mr Peter Pyke, DWA, emphasised that the current surplus is very small and suggested that the system should rather be seen as in balance. *Mr Mare* agreed and stated that the calculated surplus is only in the order of 5% of the total ORP yield.	
8.2	Mr Mpho Mofokeng, Greater Taung Local Municipality, asked whether the criteria took climate change into account. He also asked whether the system should not also improve the management of the dams in terms of flood control. He stated that	

Item	Description	Action
	the release of water in the 2011 flood was not properly synchronised and as a result washed away large areas of productive agricultural land. It was further mentioned that the agricultural sector are still recovering from those flood incidents. *Mr J van Rooyen* responded that there are limited opportunities as to what can be done to prevent flooding. *Mr Mare* responded that the dams are not big enough to control / avoid large flood occurrence. In terms of whether climate change has been taken into account, on-going studies by several institutions are investigating the impact of climate change. These indicate an increase in rainfall on the eastern high rainfall side of the basin and a decrease on the western low rainfall side of the basin. This should rather result in an increase in the system yield. To be conservative, this was not yet taken in into account in the analyses.	
8.3	Mr Pyke said in terms of Mr Van Rooyen's response on floods, that floods can be influenced on a smaller scale, when lower flood volumes are experienced with resulting lower and more controlled releases. It was also pointed out that the encroachment of agriculture and housing developments on the river banks could be as result of these sectors believing or are wrongly under the impression that the dam will protect them.	
8.4	Mr Du Plessis, Sunday's River WUA asked whether the figures presented are factual and whether the future development of 3 000 ha in the Eastern Cape has been included in the calculations. *Mr Mare* replied that the scheduled areas currently irrigated was supplied by DWA Eastern Cape and should be close to the actual development. The 3 000 ha for resource poor farmers is only included in the future scenario, as none of it has yet been developed. The final analysis will however be done with the latest updated figures, still to be received.	
8.5	Mr Johan van Rooyen, DWA, said that water for the 12 000 ha had been allocated for the development of emerging farmers. The latest increased allocation to the Nelson Mandela Bay Municipality (NMBM) needs to be included in the total volume transferred to the Eastern Cape. It was also commented that the SSC must ensure that they do not create the impression among users that there is a surplus in the Orange System, as there is currently no surplus.	
8.6	Mr Nic Knoetze, South African Water User Association, commented that the figure of 62% being used by irrigation is an assumption from DWA side, and it was stated that to manage the Orange River more effectively, actual figures are required. *Mr Johan van Rooyen* responded to say that it is also important to utilise the information from the current Upper Orange Validation & Verification study. The results from the validation component of the study only reflect the total area irrigated and is not stating whether it is lawful irrigation or not. Only once the verification component is completed, will we know which part of the existing irrigation is lawful. It is then very important to put processes in place to remove unlawful users. Mr Maré added that the information from the Upper Orange Validation & Verification	

Item	Description	Action
	study was obtained and will be used for the purpose of this study. Work was done as part of the ORASECOM Phase 2 study to identify irrigation areas in the Upper and Lower Orange WMAs, using satellite imagery. This information will be used to confirm scheduled irrigation areas as obtained from DWA for the Lower Orange WMA. Anomalies will be followed up with the DWA regional offices.	
8.7	Mr Johan van Rooyen pointed out that the jump from explaining the historic firm yield to using the long-term stochastic yield in the presentation is too big and need to be explained in more detail to the SSC members. *Mr Mare* agreed and replied that the information given until now in the presentation only made use of the historic firm yield. There is however a need to know at what assurance the yield can be supplied. We currently only have natural flow records of between 80 to 90 years available and when we want to determine the yield at a 1 in 100 year (99%) and 1 in 200 year (99.5%) assurance, it is just not possible to determine that from the historic natural flow records due to the limited record length. To be able to determine the yield at these high assurance levels, stochastic flow sequences are generated with the same length as the historic flow sequence. Instead of only analysing one historic flow sequence, it is now possible to analyse 500 or even a 1000 stochastic flow sequences for each of the sub-catchments within the study area. To be able to generate these stochastic flow sequences, the statistical properties or parameters of each of the historic flow records are first determined. These statistical parameters are then in turn used to generate stochastic flow sequences for each of the sub-catchments. The stochastic flow sequences will not look exactly the same as the historic flow sequence, but will have the same statistical parameters. By using this approach it is possible to determine the long-term stochastic yield of a system or sub-system at various assurance levels.	
8.8	An attendee enquired whether Eskom, as an industry, was included in the ORP Priority Classification. *Mr Johan van Rooyen* responded that the term “urban” include all industries within a town. A discussion took place regarding the level off assurance allocated to some of the water user sectors.	
8.9	*Mr Andrew Tanner* commented that this point will need to be discussed in detail. The question of whether “industry” for example needs to be broken down into different categories will be considered and taken forward by the Study Team. Mr Rademeyer confirmed that more information is needed on this matter and this need to be addressed before the next SSC meeting.	**Task Team**
8.10	Mr Wilco Fourie, from the Orange River Agricultural Union & Northern Cape Agricultural Union, commented on the flooding issue, already addressed under item 8.2. He does not agree with the previous comment, as the Agricultural Sector requested DWA early enough to release water to prevent flooding. It is in situations such as these that all role players must try to establish better communication between them, especially agriculture and DWA. The flood of 1988 was properly	

Item	Description	Action
	managed but not the 2011 flood. *Mr Tanner* acknowledges the request and noted the concern and confirmed that this matter will be looked at.	**AT**
8.11	Mr Dries Visser, DWA, commented that DWA had at previous occasions explained the flood management control system. DWA makes use of the flood management system when the dams, especially Van Der Kloof Dam, are nearing full capacity.	
9	**IDENTIFICATION OF ISSUES/CHALLENGES IN THE ORANGE CATCHMENT (TWO-WAY DISCUSSION BETWEEN THE AUDIENCE AND PRESENTERS)**	
	Mr Andrew Tanner presented the typical issues and/or challenges faced with in the Orange River Catchment Area and requested a two-way discussion between the audience and the presenters. The typical issues/challenges were presented as: • Areas with water shortages; • Planning by other entities that must be taken into consideration; • Water quality problems; • Illegal water use; • Current disputes between parties on water issues; • Over abstraction negatively impacting on water for basic human needs and the environment; • Water management problems; and • Etc. A copy of the presentation covering this section of the presentation is attached as **Appendix C**.	
	Discussions and Questions Raised:	
9.1	Mr Jurgo van Wyk, DWA, stated that there is an overall water quality problem in the catchment area. At the previous SSC meeting the water quality calibration study currently in process as well as the proposed Integrated Water Quality management plan studies were mentioned and briefly explained. The SSC was informed that the Terms of Reference for the Integrated Water Quality Management Plan had been finalized a year ago, but the process for procurement of a PSP has not yet been started by DWA. Mr J van Wyk also requested the SCC to please provide support for the approval of this study and to highlight the importance that the Water Quality Management Plan study needs to run in parallel with the Orange Reconciliation Study. The SSC members agreed that the Water Quality Strategy is important and that the studies should run parallel.	**SSC Members**
9.2	Mr Andreas Engelbrecht (Great Fish River WUA) tabled a request that municipalities upgrade their sewage works by taking various options into consideration. This request was noted, but it will be of more significance in the water quality strategy.	

Item	Description	Action
9.3	A discussion ensued between Mr Johan van Rooyen, Mr Andreas Engelbrecht and Ms Magda Lichthelm regarding the operating model that is used in the Fish and Sundays Rivers, which also relates to the salinity levels originating from the catchment. This model is required to ensure that DWA knows exactly what needs to be released from the Orange River through the Orange/Fish tunnel. Water demand management needs a closer look and the possibility of water being supplied to the Fish River from another water resource. The possibility of receiving higher allocations from the Gariep Dam to the Eastern Cape was also mentioned. *Mr Tanner* confirmed that the study will take a closer look at the Eastern Cape's requirements and will discuss it with the SSC. However, the reconciliation strategy required to address the Eastern Cape's shortfall is not part of the study scope.	**Task team**
9.4	Mr Dries Visser enquired whether there is some form of legal requirements from DWA, should a farmer want to generate hydro power from the river – would it be allowed or not. The electricity generated would be for own consumption. *Mr Tanner* said that this point will be flagged for discussion later. Post meeting note: The point was not discussed later and the matter will stand over to the next meeting.	**AT**
9.5	Mr Gradus Teseling, Vanderkloof WUA, mentioned that a study was conducted by the Oranje Riet WUA at the time when Mr Nic Knoetse was still CEO. The intention of that study was to generate hydro-electricity where the water entered the Vanderkloof canals from the dam. The potential power is 1.2 MW. Another study is an estimate of the energy potential in the flow of the Orange River, between Vanderkloof Dam and Hopetown, estimated to be 50MW. There are currently investigations under way for individual water users to generate power from the flow. Hydro electrical power generation is not a consumptive use, it converts the energy of the flowing water to electrical energy, and in doing so, reduce the flow rate of the water at most. He asked whether the allocation / distribution of irrigation systems along the river form part of the study. *Mr Tanner* said that the improvement of water usage is included in the study and secondly it needs to look at getting more value out of water usage. The team could possibly look into incentives.	**Task Team**
10	**EXPLANATION OF THE SELECTION CRITERIA (including the concepts Yield, Capital Costs, Operational Cost and URV)**	

	Andrew Tanner listed the criteria below, suggested by the study team to select the further structural interventions to be investigated:
	• Political acceptability;
	• Unit Reference Value (URV):
	  ○ Additional yield;
	  ○ Capital cost;
	  ○ Operational cost.
	• Environmental consequences;
	• Social consequences;
	• Management intensity;
	• Time for implementation;
	• Water quality impacts; and	

Item	Description	Action
	• Hydro power potential. He explained that criteria such as additional yield, capital cost and operational cost will all be contained in the one criterion URV. The SSC members agreed with the criteria except that political acceptability should also be interpreted as alignment to national policies/strategies.	
10.1	Ms Magda Lichthelm (DWA) referred to availability of skills and asked whether institutional arrangements and options for management will be considered. *Mr Tanner* responded that the criterion "management intensity" related to the level of resources that an Option required, but not specifically the skills. The institutional arrangements and who should be responsible for managing various options will need to be addressed in the strategy.	
10.2	Mr Pieter Venter (Black Mountain Mines) informed the SSC that once they can secure 75MW of power, they will be opening a mine at Gamsberg (±20km east of Aggeneys) which will produce 1 000 000 tons of zinc concentrate per annum when in full production (phase 3 of the project). Once the smelter is operational when 350MW of power is secured, the process will generate sulphuric acid not for the export market, but for local agricultural use. The mine currently supplies 99% of the financial / economic injection in the area and there are plans to move their operations to another area. To ensure that the town does not die down because of the relocation of their mining activities, they are currently doing studies to establish an olive farm to replace 20% of the current olive import into South Africa. However, to ensure that the olive farming is sustainable, they need to know what the water usage would be and secondly, whether there would be sufficient water to sustain such a development. *Mr Tanner* replied that the water requirements and source for the establishment of an olive farm need to be understood and DWA would have to consider a water use allocation.	**Task Team**
10.3	Mr Ian Midgley, Eskom, enquired how Eskom's hydro generation at the Vanderkloof Dam would be impacted on by the intervention options and what impact these intervention options and schemes will have on future power generation opportunities. Mr Tanner replied that intervention options could have positive or negative impacts on the power generation opportunities, depending on the specific intervention. If negative, the option could be either regarded as a fatal flaw or the impact must be fully discounted and compared with the discounted benefit. It may also be a possibility to shift the power generation opportunity to somewhere else.	
10.4	Ms Lichthelm draw the SSC's attention to page 11 of the Starter Document for Preliminary Screening of Augmentation and Intervention Options and asked to what extend will the Reducing Assurance of Supply be implemented. The working group described under **Item 8** will address this and it is an important option to investigate. A question was asked about the role of rain water harvesting.	

Item	Description	Action
	Mr Tanner replied that some Municipalities can utilise rainwater harvesting, mainly for dispersed housing and it is believed that DWA could influence expansion of this.	
10.5	Mr Andre Smit, Boegoeberg Water Users Association, informed the SSC that the canal and weir structure at Boegoeberg Dam needs to be rebuilt, as there are huge water losses. This was noted and must be brought under the attention of the DWA Regional Office. This is a bulk water resources study that looks at the entire system and although water might be lost through canal leakages by the local water provider, the bulk of the water will return to the river and will not be lost from the system. The need to reconstruct Boegoeberg Dam might affect the selection of Vioolsdrift vs. Boegoeberg	**JB/AT**
10.6	A SSC attendee said that the growing number of wind, solar power developments in the area needs to be included in the studies as they all require Water Use Licences. This was noted.	**Task Team**
10.7	Ms Lichthelm commented that the Square Kilometre Array Radio Telescope (SKA) is another future development but does not require a lot of water. Ms Lichthelm recommended that the SSC look at other possibilities to influence new developments to limit their water usage. *Mr Pieter van Rooyen, WRP,* responded to the new developments by commenting that such interventions could take 20 to 30 years and recommended that the SCC look at what the effect on water usage by these types of developments would be and also to look at different future projection time lines. Then based on these findings decide on the intervention to be utilised and how to package it. After that process one can look as to how it is phased and included in the reconciliation strategy.	**Task Team**
10.8	Ms Lichthelm also raised the FRACKING project that would have an impact on water usage and quality, should it be approved. The team is already in the process to obtain relevant information on the possible Fracking in the study area.	
10.9	Mr Midgley informed the SSC members that Eskom would formalise their integrated water resource planning process for their Concentrated Solar Plant (CSP) project. *Mr Tanner* requested that Mr Midgley forward the Eskom formulated integrated water resource plan to the Secretariat.	**Eskom**
11	**EXPLANATION OF THE MULTI-CRITERIA DECISION SUPPORT MATRIX**	
	Mr Tanner explained how the multi-criteria decision support matrix can enable you to select the possible interventions that warrant further investigation. Of importance is the weighting of each criterion which will add to the total score of the option. The SSC agreed each criterion should have a weight of 1 except for the URV criterion which will have a weight of 6. The typical scorecard and system of scoring was then explained.	
	Discussions and Questions Raised:	

Item	Description	Action
11.1	An attendee enquired whether economic benefit would be a separate issue. *Mr Tanner* replied that economic benefits are not criteria in this phase since it is assumed that the economic benefit from the additional water will be the same per cubic metre. This may vary with location and could be included in the next phase.	
11.2	Ms Lichthelm asked what about risk of water supply. *Mr Tanner* responded that such risk will be flagged and can lead to a fatal flow. If the risk is however small and can be managed the risk issue should be addressed. *Mr Pieter van Rooyen* cautioned the stakeholders of having too many criteria and suggested that they be grouped e.g. linking social consequences to political acceptability.	**Task Team**
11.3	Ms Lichthelm referred to political acceptability and asked if that means that what the SSC is doing, is in line with the President's views. Political acceptability should rather be "political acceptability / alignment to national policies and strategies".	
12	**PRESENTATION OF POSSIBLE RECONCILIATION OPTIONS**	
	The intervention options (see slides in **Appendix C)** were presented and the development options as well as management options where operating rules can be changed were explained one by one by both Messrs Tanner and Beumer. The scoring on the multi-criteria decision support matrix was done live and consensus was reached for each score. The yield, capital cost, operational cost and URV criteria were based on calculations which were done before the workshop and these scorings were shared with the audience.	
	Discussions and Questions Raised:	
12.1	Mr Geldenhuys raised the concern that the attendees had not yet had an opportunity to raise questions regarding the percentage demand to assurance of supply. *Mr Tanner* Noted that this will be taken forward and investigated by the task team looking at assurance of supply.	**Task Team**
12.2	Mr Pyke said that compulsory licencing does not address inappropriately miss allocations and this needs to be rectified and suggested that it is kept as an option specifically tailored for its purpose. *Agreed.*	**Task Team**
12.3	An attendee recommended that the promotion of utilising rainwater should also be taken forward. *Mr Tanner* replied that rainwater harvesting will not make a huge difference for a big system like the Orange and where the rainfall in the lower part of the Orange is very irregular. In general, the promotion of rainwater tanks in areas with regular rainfall will be promoted, but this will be a private initiative.	**Task Team**

Item	Description	Action
12.4	Mr. Geldenhuys, DWA Eastern Cape, commented that the reference to lightly infested invasive alien plants is not entirely correct. In the Kraai River catchment there is a very high infestation of Wattle trees. *Mr Pieter Van Rooyen* replied that it would be worth including it in the study. *Mr Tanner* made reference that it is something that could be looked at by DWA's Working for Water Programme.	**Task Team**
12.5	Mr Venter made reference to erosion protection and that erosion is caused by alien invaders and by removing them. Erosion control must therefore be stepped up. Agreed; but the Department of Agriculture will therefore have to play a major role in this regard.	
12.6	Mr Van Wyk raised the concern of over grazing on the Lesotho side of the basin that could also contribute to erosion. *Mr Tanner* responded that there are bi-lateral negotiations in place between South Arica and Lesotho where these aspects are discussed.	
12.7	Mr Lenka Thamae (ORASECOM) informed the workshop attendees that over grazing will be considered in another project and a strategy is being developed at the moment.	
12.8	Mr Rademeyer added that one must not only look at invasive plants but also at indigenous plants that is in the wrong place i.e. not suited for a specific area. *Mr Tanner* responded that note is taken of the alien invasion, over grazing and indigenous plant species as mentioned by the attendees.	
12.9	Nick Knoetze commented that name of the De Krans Dam is actually "Knoffelfontein Dam". He mentioned that this dam should not be discarded and questioned the reason for taking it off from the list, namely "sedimentation forecast is very high". Mr Knoetze mentioned that he knows the dam site very well and that it could be an ideal dam for establishing emerging farmers on the land. The dam is situated just downstream of the Riet and Modder River confluence. He requested that this dam be put back on the list for investigation. Agreed.	**AT/JB**
12.10	Mr Dries Visser made reference to the proposed Kloksfontein Dam and development that formed part of the Free State's 4 000ha for emerging farmers and mentioned that the new canal will run next to this development. It was also mentioned that all irrigation run-off water will flow into the proposed Kloksfontein Dam. The envisaged Kloksfontein Dam however poses a flood hazard and will inundate existing land and all agreed that it should be discarded. *Mr Beumer* replied that the proposed development was discarded.	
12.11	The question was asked whether the sedimentation problem in the basin would be addressed.	

Item	Description	Action
	Mr Beumer responded that the findings of sedimentation surveys can be obtained from the previous studies undertaken.	
13	**ADDITIONS FROM THE AUDIENCE**	
	Discussions and Questions Raised:	
13.1	An Attendee recommended that Gariep Dam be raised with 10m as it significantly increases the storage volume. *Mr Tanner* replied that this option is on the cards. It would however increase evaporation losses tremendously and social consequences need to be investigated.	**Task Team**
13.2	Mr Midgley commented that should the water level increase in Gariep, Eskom will have to investigate whether they can accommodate the higher pressures. It was agreed that it needs to be looked at, but since Gariep has been designed for a 10 m raising, it is suspected that the turbines will also be able to handle the higher water level.	**Eskom/ Task Team**
13.3	Mr Pyke stated that the Study Team will have to recalculate the URVs as Eskom's tariffs have not been taken into consideration. *Mr Tanner* responded that this had been factored in, a bit higher than Eskom's normal tariff.	
13.4	Mr Geldenhuys referred to the two Tables in the Starter Document (page 19) on the Vioolsdrift Dam i.e. regulating dam and yield dam and commented that they do not seem to be aligned. *Mr Mare* replied that the one table does not refer to total storage as the reregulating dam requires a very small active storage which can form part of a small or large dam. The yield referred to for the reregulating dam, is not yield in the true sense of the word, but rather a saving in operational losses. *Mr Tanner* responded that information has been sourced from various reports and it was suggested that one looks at regulating. With the discussion taken place and the comments received it is believed that this matter has come out as important to be assessed.	
13.5	It was agreed that the basic screening exercise as completed at the Workshop (summary, not detail) will be distributed with the Minutes and Attendees were requested to inform the Study Team should there be any additional criteria that need to be included.	**JB**
13.6	Mr Smit raised a concern regarding the structural problems at Boegoeberg Dam and pointed out that if the Vioolsdrift Option was chosen, Boegoeberg will have to be rebuilt / refurbished anyway. He asked the question whether that has been taken into account when assessing the Vioolsdrift and Boegoeberg options. If not taken into account, the preference may sway towards the Boegoeberg option. *Mr Tanner* responded that this could be one of those important criteria that need to be looked at.	**Task Team**

Item	Description	Action
14	**WAY FORWARD**	
	The remaining interventions that will be further investigated are: Tsoelike Dam } Mutually exclusive Ntoahae Dam } Lebelo Dam } Mutually exclusive Malatsi Dam } } Senqu Catchment Bosberg Dam Boskraai Dam } Upper Orange Gariep Dam Raising } New Boegoeberg Dam } Lower Orange Vioolsdrift Dam } Knoffelfontein Dam - Just below the confluence of the Modder and Riet Rivers. Boegoeberg will be put back on the list. All three operational options will be further investigated, i.e.: • Changing the minimum level (m.o.l.) of Gariep Dam • Changing the m.o.l. of Van Der Kloof Dam • Real time monitoring of the Orange and Vaal River flows downstream of Van Der Kloof Dam and adjusting releases from Van Der Kloof accordingly. Mr Tanner informed the attendees that the Task Team will now be working on the technical aspects; analyse previous work done, update the costing sheets i.e. what can be used and/or re-costed. The team will also look at current systems and include in the costing system, the yield results. The team will also do balances and check-lists, strategic interventions, etc. He thanked all for their useful inputs. Mr Seef Rademeyer thanked all present for their valuable contributions at the Workshop and to those who expressed their appreciation for what the Task Team is aiming to achieve. Mr Rademeyer stated that the Preliminary Strategy Document is needed by October 2013 and that the assurances will be discussed at the next SSC Meeting. He will be requesting the Task Team to run a couple of scenarios and these will be distributed before the next SSC Meeting.	**Task Team**
15	**DATE OF NEXT MEETING**	
	The next SSC Meeting (Meeting # 3) will take place on **Tuesday 22 October 2013** in Kimberley.	
16	**CLOSURE**	
	Mr Johan van Rooyen thanked Mr Seef Rademeyer and his team for a well prepared workshop and presentation and the valuable information presented.	

Appendix A: Attendance Record

Appendix B

Presentation: Status and Recap since the Previous meeting (PG van Rooyen)

See Appendix E

Appendix C

Presentations: Preliminary Screening Workshop
(J Beumer & A Tanner)

See Appendix E

Appendix D

Presentation: Water Balance and Risk Criteria (HG Maré)

See Appendix E

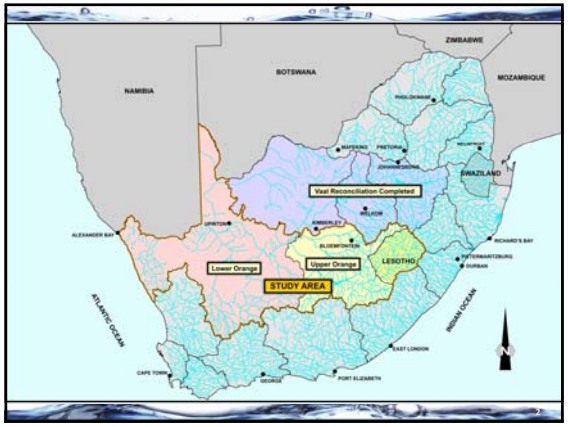
Development of Reconciliation Strategies for Large Bulk Water Supply Systems: Orange River

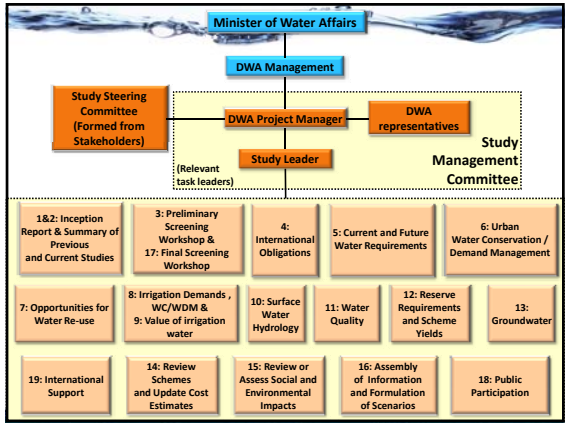
Status and recap since the previous meeting

7 February 2013

water affairs
Department: Water Affairs
REPUBLIC OF SOUTH AFRICA

1





Status

- First Steering Committe Meeting – 7 August 2012
  - Established the committee and introduced the study
- Prepared information for screening workshop
- Coordinate activities through Study Management Committee (SMC) meetings.
- Today's SSC: Require contributions in selecting intervention options for further investigation.
- SMC decided the public meeting in February 2013 is premature – use newsletter for communication.

Development of Reconciliation Strategies for Large Bulk Water Supply Systems: Orange River

Overview on Progress of Study Tasks

7 February 2013

water affairs
Department: Water Affairs
REPUBLIC OF SOUTH AFRICA

6

Task Progress (1 of 3)

- Inception Report & Summary of Previous and Current Studies
- Preliminary Screening Workshop
- International Obligations
- Current and Future Water Requirements
- Urban Water Conservation / Demand Management

Task Progress (2 of 3)

- Opportunities for Water Re-use
- Irrigation Demands WC/WDM & Value of irrigation water
- Surface Water Hydrology
- Water Quality
- Reserve Requirements and Scheme Yields
- Groundwater

Task Progress (3 of 3)

- International Support
- Review Schemes and Update Cost Estimates
- Review or Assess Social and Environmental Impacts
- Assembly of Information and Formulation of Scenarios
- Steering Committee & Public Participation

Stakeholder Engagement Programme

- Study Steering Committee (SSC) Meetings:
  - 1: Establish SSC, August 2012
  - 2: Preliminary Screening Workshop, Feb 2013
  - 3: Preliminary Strategy, October 2013
  - 4: Final Strategy, April 2014
- Public engagement:
  - Announce study through newsletters
  - Reconciliation Strategy, July 2014
    (meeting date to be confirmed)

Thank You

Questions for clarification?

Development Of Reconciliation Strategies For Bulk Water Supply Systems

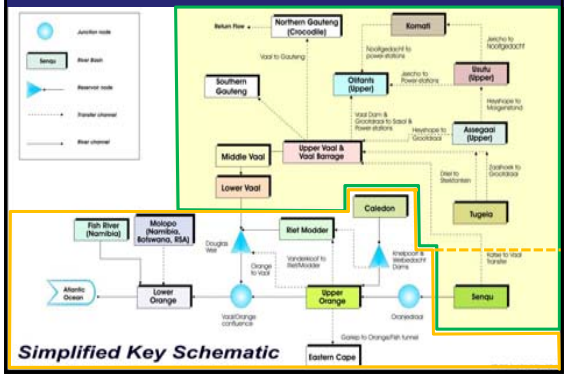
Orange River

Water Balance & Risk Criteria

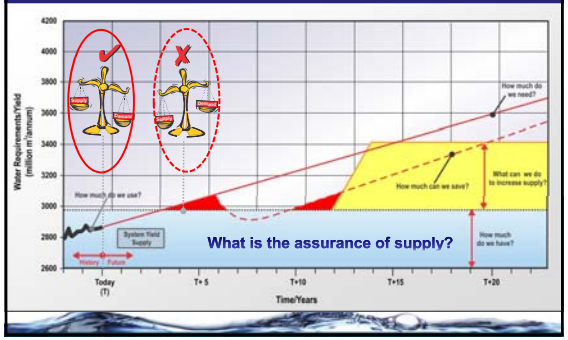
water affairs
Department: Water Affairs
REPUBLIC OF SOUTH AFRICA

Main Study Area

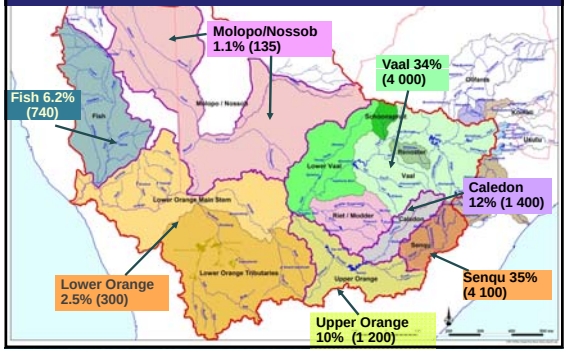
Integrated Orange / Vaal System



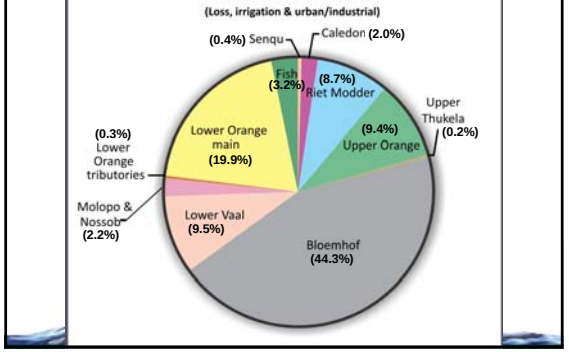
Water Balance



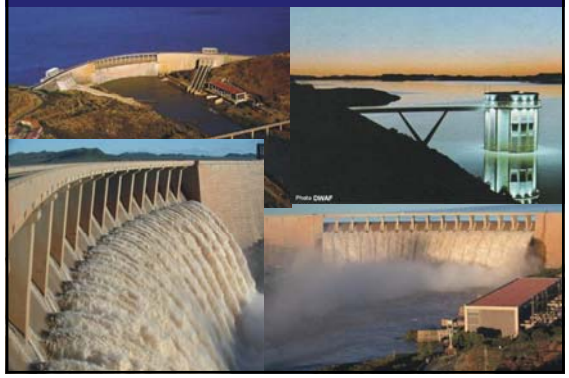
Mean Annual Runoff Total Basin Gross MAR (11 900 million m³/a)



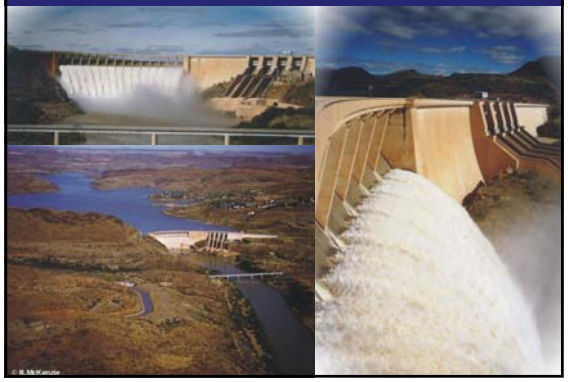
Orange Basin Total Demand



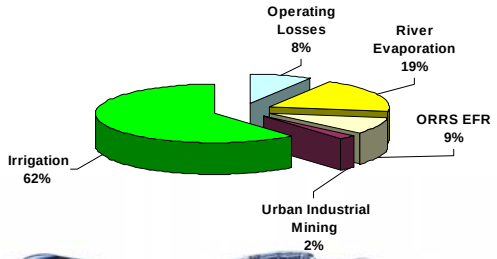
Gariep Dam



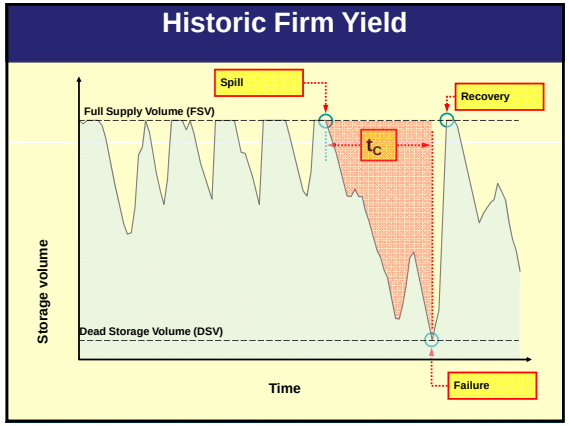
Vanderkloof Dam



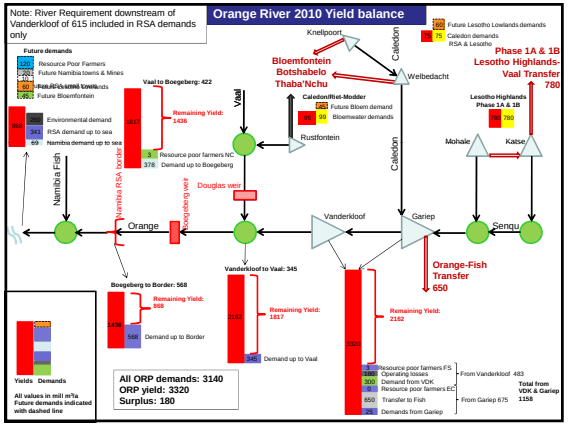
ORP Demand Distribution (3 140 million m³/a) 2010



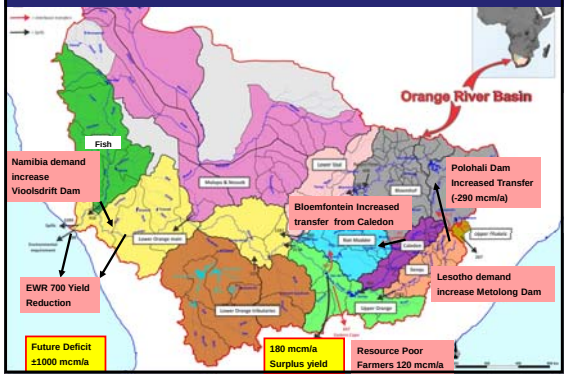
Historic Firm Yield



Orange River 2010 Yield balance



ORP System Yield & Future Impacts



Yield and Supply Assurance

ORP Long-term Stochastic Yield

Yield at given Assurance Level (million m^3/a)			
1 in 20 year 95%	1 in 50 year 98%	1 in 100 year 99%	1 in 200 year 99.50%
3900	3500	3200	3000

User supply assurance requirements (Priority Classification Table)

User group	Demand allocated to given assurance level (million m^3/a)			
	Total	1:20 Year (95%)	1:100 year (99%)	1:200 year (99.5%)
Urban	100%	20%	30%	50%
Irrigation	100%	50%	40%	10%
River requirements	100%	0%	0%	100%
Environmental	100%	32%	0%	68%

ORP Priority Classification Table (User supply assurance requirements)

User group	Description	Demand allocated to given assurance level (million m^3/a)			
		Total	1:20 Year (95%)	1:100 year (99%)	1:200 year (99.5%)
Urban	Percentage	100%	20%	30%	50%
	Volume	141	28	42	71
Irrigation	Percentage	100%	50%	40%	10%
	Volume	1839	920	736	184
River requirements and losses	Percentage	100%	0%	0%	100%
	Volume	874	0	0	874
Environmental requirement	Percentage	100%	32%	0%	68%
	Volume	285	91	0	194
Total Demand		3140	1039	778	1323
Cummulative Total			3140	2101	1323

Thank You

Development Of Reconciliation Strategies For Bulk Water Supply Systems

Orange River

Preliminary Screening Workshop

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Workshop Objectives

- To strengthen the partnership between DWA and key stakeholders
- To identify main concerns of the key stakeholders
- To identify reconciliation options
- To screen options and agree on options for further evaluation

– • –

- Record proceedings, distribute to stakeholders and consider in the study

Workshop Process

Item	Presenter/Facilitator
Catchment overview	Johnny Beumer
Current and future water balance and risk criteria	Pieter Van Rooyen
Identification of issues/challenges in the Orange catchment	Andrew Tanner
Explanation of the selection criteria	
Explanation of the multi-criteria decision support matrix	

Workshop Process (Continued)

Item	Presenter/Facilitator
Presentation of possible reconciliation options	Johnny Beumer
Opportunity for possible additions	Andrew Tanner
Assessment of options	
Agreement of options for further study	
Way forward	

Development Of Reconciliation Strategies For Bulk Water Supply Systems

Orange River

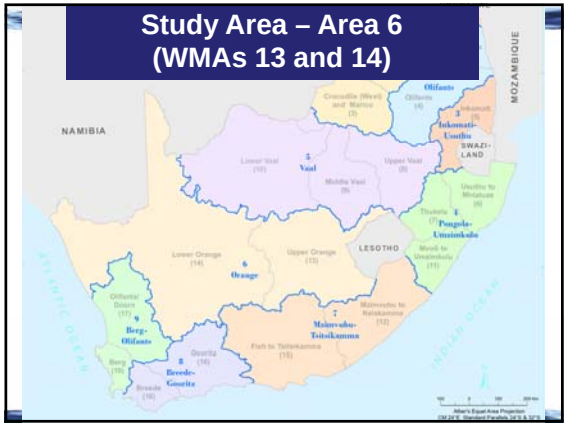
Study Area Overview

The Orange-Senqu River Basin

Orange River Basin – Shared Water Resource

- The Orange River Basin is shared with:
  Lesotho
  Botswana
  Namibia
- Decisions by other countries that will impact on the water availability or quality in South Africa must be taken into account

Study Area – Area 6 (WMAs 13 and 14)



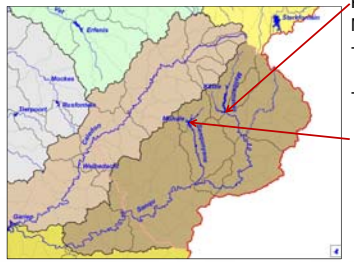
Study Area

- Vaal River Tributary:
  - Vaal River Reconciliation Study already done. Will not be repeated.
  - Strategies developed for Vaal which will have an impact on the Orange River will be taken into account.
- Eastern Cape:
  - Water is being transferred from the Orange River to the Fish and Sundays Rivers in the Eastern Cape.
  - WMA 15 needs to be taken into account

Overview of the Current Status Of The Study Area

- Study Area divided into four sub-areas, i.e.:
  - Senqu River catchment in Lesotho
  - Eastern Cape Rivers supported by the Orange
  - Upper Orange Water Management Area
  - Lower Orange Water Management Area

Senqu River Catchment Existing Major Infrastructure



Katse Dam on Malibamatso Tributary
- 45 km tunnel to Muela power station
- 38km tunnel to Ash River

Mohale Dam on Senqunyane Tributary
- 32 km tunnel to Matsoku weir and Katse Dam
- 6 km tunnel to Katse Dam

Katse Dam

Mohale Dam

Eastern Cape Rivers Receiving Water From The Orange

Orange-Fish Tunnel from Gariep Dam

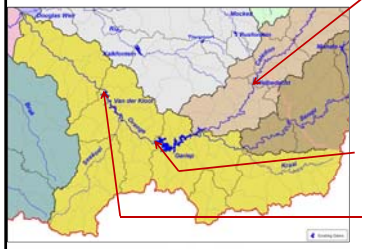
Grassridge Dam on Groot Brak River (tributary of Great Fish River)

Elandsdrift Weir on Great Fish River

Darlington Dam on Sundays River

Approx location of Lower Fish Government Water Scheme

Upper Orange WMA Existing Major Infrastructure



Welbedacht Dam on Caledon Tributary. Water pumped into Knelpoort Dam for Bloemfontein Water Supply

Gariep Dam on the main stem

Van Der Kloof Dam on the main stem. Van Der Kloof irrigation canals

Lower Orange WMA Existing Major Infrastructure

Boegoeberg Dam and Boegoeberg Irrigation Canals

Downstream of Boegoeberg canals are the Upington Islands and Kakamas Canals and various Irrigation Board Canals, e.g. Vioolsdrift

Vioolsdrift Irrigation Canals

Questions/Discussions

Current and Future Water Balance and Risk Criteria

Pieter Van Rooyen

Development Of Reconciliation Strategies For Bulk Water Supply Systems

Orange River

Identification Of Issues And Challenges in the Orange River Catchment

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Typical Issues/Challenges

- Areas with water shortages
- Planning by other entities that must be taken into consideration
- Water quality problems
- Illegal water use
- Current disputes between parties on water issues
- Over abstraction negatively impacting on water for basic human needs and the environment
- Water management problems
- Etc.

Issues/Challenges Senqu River Catchment

Issues/Challenges Eastern Cape (Concerning the Orange)

Issues/Challenges Upper Orange

Issues/Challenges Lower Orange

Development Of Reconciliation Strategies For Bulk Water Supply Systems

Orange River

SELECTION CRITERIA

Suggested Criteria

- Political acceptability
- Unit Reference Value
  - Additional yield
  - Capital costs
  - Operational cost
- Environmental consequences
- Social consequences
- Management intensity
- Time for implementation
- Water quality impacts
- Hydro power potential

Check for a fatal flaw which can exclude the option

Development Of Reconciliation Strategies For Bulk Water Supply Systems

Orange River

Multi-criteria Decision Matrix

Purpose Of The Matrix

- To prioritise between different development options considering a multitude of criteria in a systematic, transparent and collective manner
- To determine whether any of the development options have fatal flaws that will exclude these options for further consideration
- To provide a record of decision

Scoring for each criterion

- Positive – 3: Shown in green
- Medium/Neutral effect – 2: Shown in yellow
- Negative/Lowest benefit – 1: Shown in red

Suggested scoring thresholds

Political Acceptability	Very difficult to convince = 1	Political view can be swayed = 2	In line with political vision = 3
Unit Reference Value	>R 10/m^3 = 1	R 5/m^3 to R 10/m^3 = 2	0 - R 5/m^3 = 3
Environmental consequenses	High impact =1	Moderate impact = 2	Low impact = 3
Social consequences	Huge disruption = 1	Some disruption = 2	Minor disruption = 3

Suggested scoring thresholds

Management Intensity	High =1	Medium =2	Low =3
Implementing Time	>10 y = 1	5 y to 10 y = 2	< 5y =3
Water quality impact	Detrimental =1	Neutral = 2	Beneficial = 3
Hydro power potential	Low = 1	Medium = 2	High = 3

Typical Scorecard

Criteria↓ / Options →	A	B	C	D	E	F	G	H	J	K	L	Etc.	Weight
Political Acceptability	3	3	2	2	2	2	2	3	3	3	1	2	1
Additional Yield	3	3	3	3	3	3	2	2	2	3	3	3	0
Capital Costs	3	3	1	1	1	1	3	3	2	2	1	1	0
Operational Costs	3	3	1	3	3	3	3	3	3	3	1	1	0
URV	3	3	1	2	2	2	3	3	3	3	1	1	6
Environmental Consequences	3	3	2	2	2	3	3	3	3	3	2	2	1
Social Consequences	2	2	2	2	2	2	3	2	2	2	2	2	1
Management Intensity	3	3	1	3	3	3	3	3	3	3	1	1	1
Implementing Time	1	1	1	2	2	2	3	3	2	2	1	1	1
Water Quality Impacts	2	2	2	2	2	2	2	2	2	2	3	3	1
Hydropower Potential	3	3	3	3	3	1	1	1	2	2	3	3	1
Totals	35	35	19	30	28	26	35	35	35	35	19	20	13
Fatal Flaw?	N	N	N	N	N	N	N	N	N	N	N	N	

Discussion

Development Of Reconciliation Strategies For Bulk Water Supply Systems

Orange River

Identification Of Reconciliation Options

water affairs

Types of Reconciliation Options

- Options that will reduce water requirements → Management Options
- Options that will increase the water supply → Management Options / Development Options

Management Options That Will Reduce Water Requirements

- WC/WDM
- Eliminating unlawful water use
- Promoting rainwater harvesting
- Reducing assurances of supply
- Compulsory Licensing
- Water trading

Water Conservation and Water Demand Management (WC/WDM)

- WC/WDM is about using water more efficiently and reducing water losses.
- Applicable to all water use sectors. For the Orange we will focus on:
  - Urban
  - Industrial
  - Irrigation
- WC/WDM in the irrigation sector will not necessarily reduce the system water demand as water savings may lead to horizontal expansion.

Eliminating Unlawful Water Use

- A validation and verification study is currently conducted by the Free State Regional Office of DWA.
- Extent of unlawful water use in the Upper Orange will only be known after this study.
- Target date for completion – June/July 2013.

Promoting Rainwater Harvesting

- Urban water demand can be reduced if domestic users harvest rainwater from their roofs and store it in a rainwater tank next to the house.
- Only feasible for areas with regular rainfall.

Reducing assurances of Supply

- Generally accepted assurances of supply as follows:
  - Power generation: 99.5% (1 in 200 years risk of failure)
  - Domestic, industrial, and mining water use: 98% (1 in 50 years risk of failure)
  - Irrigation water use: 80% (1: 5 years risk of failure)
- Along the Orange the irrigators have the privilege of much higher assurances of supply.

Compulsory Licensing

- Compulsory Licensing can be used to correct water allocation imbalances.
- If everyone's water use is reduced by only a relative small % then the social consequences will probably not be that significant.
- Danger of social consequences for relative high reductions in allocations.
- It will require a high administrative input, will be time consuming and has risks of appeals.

Water Trading

- Water Trading could be linked to WC/WDM.
- Irrigators are given an opportunity to offer their saved water for sale without suffering economic prejudice.
- Funding could be obtained by either:
  - Charging a levy on all water users in the catchment, or
  - Funds from the fiscus, recovered through water tariffs
- Policy and guidelines required to avoid misuse and social consequences.

Water Trading (Continued)

- Also possible to buy/sell full water entitlement.
- Based on willing buyer/seller principle.
- Should be well regulated as it could lead to severe social impacts and job losses.

Management Options That Will Increase Water Availability

- System Operating Rules
- Removal of Invasive Alien Plants
- Erosion Protection
  - Measure to preserve the water availability
  - Measure which will improve water quality (prevent siltation)

System Operating Rules

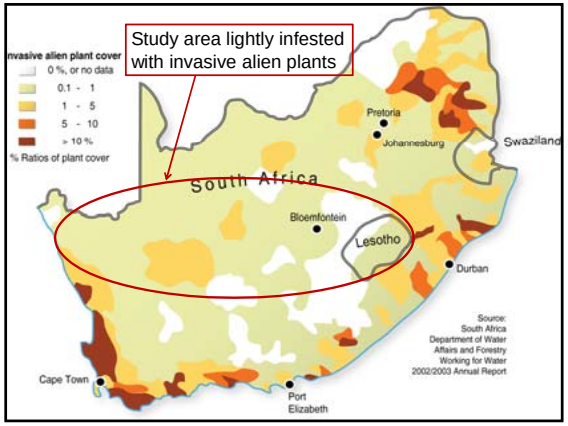
- This option entails the development of operating rules, which can lead to the reduction in losses and therefore making more water available
- Possibilities identified.
  - Lower the minimum operating water level (m.o.l) for Vanderkloof Dam. This could increase system yield by 143 million m^3/a. Disadvantage will be the reduction in power generation opportunities.

System Operating Rules (Cont.)

- Possibilities identified (continued)
  - Lower the m.o.l. for Gariep Dam in conjunction with Bosberg or Boskraai option. Power generation will then take place at Bosberg/Boskraai Dam.
  - Synchronise Vaal and Orange river flows by means of real time monitoring of flows. E.g. releases from Vanderkloof Dam could be reduced in times of spills in the Vaal River. According to LORMS 80 million m^3/a losses can be saved if this option is fully implemented.

Removal of Invasive Alien Plants

- Invasive alien plants use more water than indigenous plants especially in the riparian zones.
- By removing these plants and restoring indigenous vegetation, water can be freed up.
- Infestations along the Orange and tributaries are not high, therefore this is not an option that will make significant difference



Erosion Protection

- Promotion of sound grazing practices
- Collaboration with Department of Agriculture needed

Development Options That Will Increase Water Availability

- Treating waste water and water reuse
- Groundwater development
- New dams
- New transfer schemes

Treating Waste Water and Water Reuse

- Only local benefit – will not increase overall system yield.
- Could be an option for Bloemfontein.
- Included in the Reconciliation Strategy for the Greater Bloemfontein Area.
- Not foreseen within the planning horizon of this study (next 20 years) as there are more attractive options for Bloemfontein.

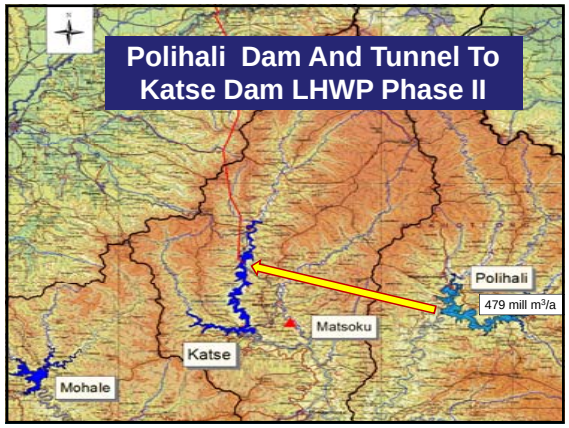
Development of Groundwater

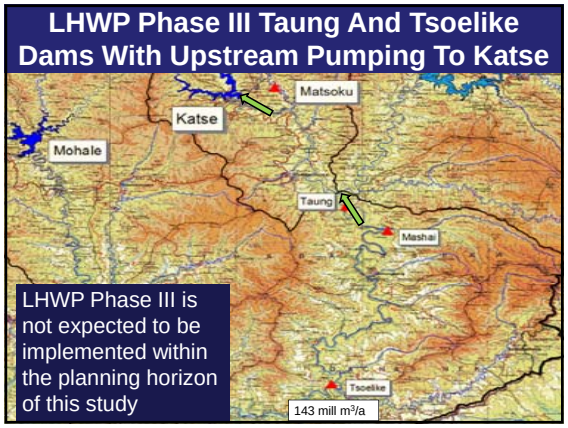
- Groundwater resources are underutilised in some areas of the Upper Orange WMA.
- Good option for smaller municipalities.
- Groundwater development potential in the Lower Orange WMA is lower than in the Upper Orange WMA.
- The groundwater quality is also poorer in the Lower Orange.

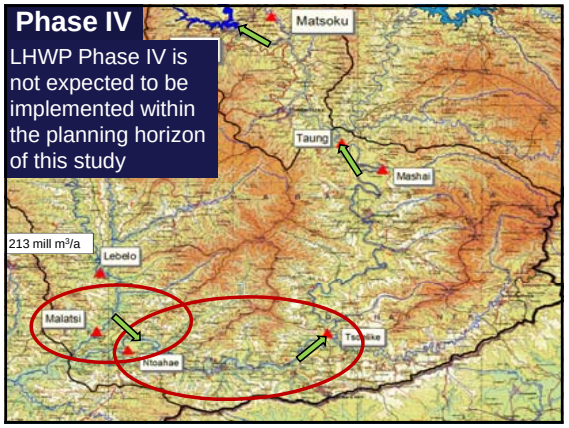
Development of New Dams and Transfer Schemes

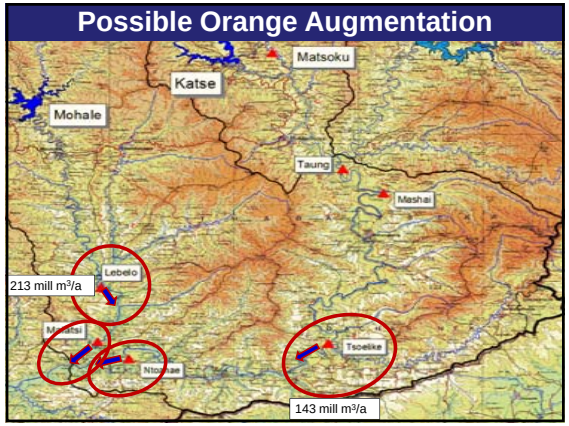
- Various options have been investigated in previous studies
- All these options are being reconsidered, taking cognisance of previous screening

Senqu Catchment Area









Senqu Options for Replacement Yield

- Malibamatso Tributary:
  - Tsoelike Dam – If no longer considered for LHWP Ph III.
  - Ntoahae Dam – If Tsoelike Dam is no longer considered for LHWP Ph III.
  - Tsoelike and Ntoahae Dams are mutually exclusive.
- Senqunyane Tributary:
  - Malatsi Dam – If no longer considered for LHWP Ph IV.
  - Lebelo Dam – If Malatsi Dam is no longer considered for LHWP Ph IV.
  - Malatsi and Lebelo Dams are mutually exclusive.

Discussion Senqu River Catchment

Eastern Cape

Development Options in the Eastern Cape

Water Transfers From the Mzimvubu Basin:

- Northern Transfer Option
- Southern Piped Transfer Option
- Southern Canal Transfer Option

Development Options in the Eastern Cape

Recommended Way Forward For Investigation

Compare all three options and consider the preferred option for further assessment

Discussion Eastern Cape

Upper Orange WMA

Upper Orange WMA

Name of Dam/Scheme	Conclusions of Previous Studies
Bosberg	**Still an option**
Boskraai	**Still an option**
Water transfer from Mzimvubu	**Still an option**
Raised Gariep Dam	**Still an option**
Torquay Dam	Less attractive than Vioolsdrift Dam
Drumbo Dam	Was part of Mzimvubu Transfer
De Kraal/Upper Kraai Dam	Dam will inundate existing irrigation and people will have to be reallocated
Theefontein/ Oranjedraai Dam	Was part of Orange/Vaal Transfer Scheme
Morgenson Dam	Was part of Orange/Vaal Transfer Scheme

Upper Orange WMA (Continued)

Name of Dam/Scheme	Reason for discarding by previous studies
Vanderkloof Dam Raising	Dam not designed for raising – will be very expensive
Havenga Bridge Dam	Only purpose considered was hydro power generation
Eksdale Weir	Torquay Dam would provide similar benefits and was a better option
Hereford Weir	Same as above
De Krans Dam	Sedimentation forecast very high

Upper Orange WMA (Continued)

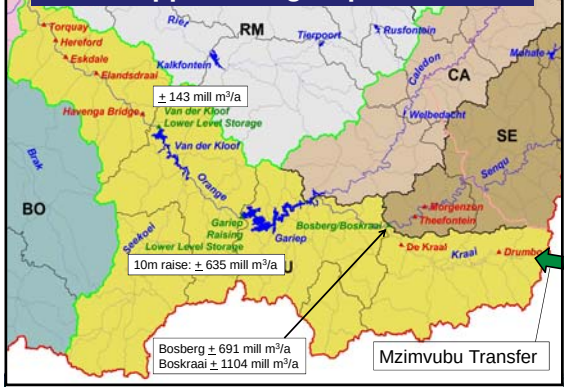
Name of Dam/Scheme	Reason for discarding by previous studies
Kloksfontein Dam (Off Channel)	Balancing water from Oranje/Riet canal. **Still an option**
Elandsdraai Dam	Only purpose considered was hydro power generation

Upper Orange WMA

Remaining Options:

- Water transfer from Mzimvubu Basin (only transfer into the Kraai tributary, not the further transfer from Orange to Vaal
- New Bosberg Dam
- New Boskraai Dam
- Raised Gariep Dam
- Kloksfontein Dam (Off Channel storage dam)

Upper Orange Options



Augmenting Bloemfontein And Other Towns With A Secured Water supply

- Water Reconciliation Strategy For Large Bulk water supply Systems For The Greater Bloemfontein Area was recently done
- Strategy prioritised as follows:
  - Urban WC/WDM
  - Groundwater interventions
  - Solving siltation problems at Welbedacht Dam
  - Developing additional yield in the Caledon River
  - Water Reuse, and
  - Augmenting from the Orange River

Discussion Upper Orange WMA

Lower Orange WMA

Lower Orange WMA

Name of Dam/Scheme	Reason for discarding by previous studies
Vioolsdrift Dam	**Still an option**
Lanyonvale Dam	New Boegoeberg Dam was a better option
New Boegoeberg Dam	Vioolsdrift Dam offered a more cost effective and practical solution
Kambreek Dam	Vioolsdrift Dam offered a more cost effective and practical solution
Ausjenker Dam	Too far downstream from water demands and still upsteam of Fish River confluence

Lower Orange WMA (Continued)

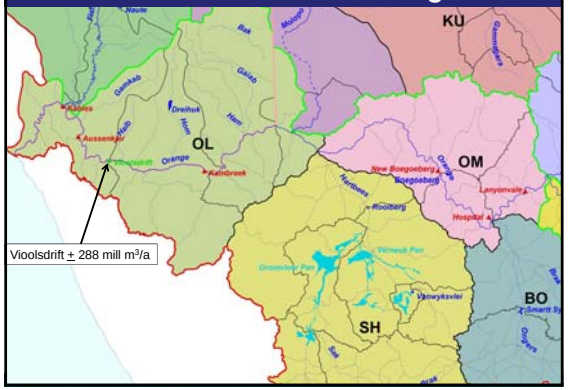
Name of Dam/Scheme	Reason for discarding by previous studies
Kabies Dam	Low water demands and cost of yield is very high
Hospital Dam	Vioolsdrift Dam offered a more cost effective and practical solution

Lower Orange WMA

Remaining Option:

- New Dam at Vioolsdrift
  - Reregulating dam
  - Yield dam

Dam Sites – Lower Orange



Discussion Lower Orange WMA

Development Of Reconciliation Strategies For Bulk Water Supply Systems

Orange River

Assessment Of Options

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Link to assessment matrix