DWA Report Number: P WMA 02/B810/00/1412/16

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA
DIRECTORATE: NATIONAL WATER RESOURCE PLANNING

Development of a Reconciliation Strategy for the Luvuvhu and Letaba Water Supply System

RECONCILIATION STRATEGY-EXECUTIVE SUMMARY

FINAL

January 2015

DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE LUVUVHU AND LETABA WATER SUPPLY SYSTEM

RECONCILIATION STRATEGY

REFERENCE

This report is to be referred to in bibliographies as:

Department of Water Affairs, South Africa, 2014. ***DEVELOPMENT OF A RECONCILLIATION STRATEGY FOR THE LUVUVHU AND LETABA WATER SUPPLY SYSTEM*:**

FINAL RECONCILIATION STRATEGY

EXECUTIVE SUMMARY

Prepared by:

WRP Consulting Engineers DMM Development Consultants, Golder Associates Africa, Worley Parsons, Kyamandi, Hydrosol and Zitholele Consulting.

Report No. P WMA 02/B810/00/1412/16

Title:	***Reconciliation Strategy – Executive Summary***
Authors:	*Study Team*
Project Name:	***Development of Water of a Reconciliation Strategy for the Luvuvhu and Letaba Water Supply System***
DWA Report No:	*P WMA 02/B810/00/1412/16*
Date:	*January 2015*

Consultants: WRP Consulting Engineers(Pty) Ltd in association with DMM Development Consultants, Golder Associates Africa, Worley Parsons, Kyamandi, Hydrosol and Zitholele Consulting

Approved for the Consultants by:

.....

P G van Rooyen

Study Leader

DEPARTMENT OF WATER AFFAIRS

Directorate: National Water Resource Planning

Approved for DWA by:

.....

T Nditwani

Acting Director: National Water Resource Planning

(Project Manager)

LIST OF REPORTS

The following reports form part of this study:

Report Title	Report number
Inception Report	P WMA 02/B810/00//1412/1
Literature Review Report	P WMA 02/B810/00//1412/2
Water requirements and Return Flow Report	P WMA 02/B810/00//1412/3
Rainfall analysis report	P WMA 02/B810/00//1412/4
Hydrology report (includes IAP)	P WMA 02/B810/00//1412/5
Water Conservation and Water Demand Management Report	P WMA 02/B810/00//1412/6
Water re-use report	P WMA 02/B810/00//1412/7
Water Quality Assessment Report	P WMA 02/B810/00//1412/8
Groundwater utilization scenarios	P WMA 02/B810/00//1412/9
Yield Analysis Report (include EWR)	P WMA 02/B810/00//1412/12
Planning Analysis Report	P WMA 02/B810/00//1412/13
Water Supply Schemes, Social and Environmental Aspects	P WMA 02/B810/00//1412/14
Final Reconciliation Strategy Report	P WMA 02/B810/00//1412/15
Executive Summary of Final Reconciliation Strategy	**P WMA 02/B810/00//1412/16**
Demographic and Economic Development Potential	P WMA 02/B810/00//1412/17

DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE LUVUVHU AND LETABA WATER SUPPLY SYSTEM

Final Reconciliation Strategy

EXECUTIVE SUMMARY

Table of Contents

DEVELOPMENT OF A RECONCILIATION STRATEGY FOR THE LUVUVHU AND LETABA WATER SUPPLY SYSTEM

Final Reconciliation Strategy

EXECUTIVE SUMMARY

1. PURPOSE OF THIS REPORT

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

This report contains water balances with the recommended intervention scenarios that provides selected solutions to make sufficient water available for the planning period, up to the year 2040.

2. INTRODUCTION

The Department of Water Affairs (DWA) has identified the need for the Reconciliation Study for the Luvuvhu-Letaba catchment because the water resources are almost fully developed and water requirements from the Letaba River currently exceed the yield capability of the system. Regulation for the Letaba catchment is mainly provided by Middle Letaba, Ebenezer and Tzaneen Dams. In the Luvuvhu catchment the recently completed Nandoni Dam is used in combination with Albasini, Vondo and Damani dams and managed as one system. It is expected that the total yield from this combined system will be fully utilized by around 2030, considering the high growth future water requirement projection scenario. The yield of the Albasini Dam has reduced over the years and as a consequence the dam is over allocated. The Shingwedzi catchment is situated almost entirely in the Kruger National Park and for all practical purposes no sustainable yield is derived from surface flow in the Shingwedzi catchment.

The main objective of the study was to compile a Reconciliation Strategy that will identify and describe water resource management interventions that can be grouped and phased to jointly form a solution to reconcile the water requirements with the available water for the period up to the year 2040, and to develop water availability assessment methodologies and tools applicable to this area, that can be used for decision support as part of compulsory licensing to

come. The development of the strategy requires reliable information on the water requirements and return flows (wastewater) as well as the available water resources for the current situation and likely future scenarios for a planning horizon of thirty years.

To achieve the above objectives, the following main aspects were covered in the study:

- Update the current and future urban and agricultural water requirements and return flows;
- Assess the water resources and existing infrastructure;
- Configure the system models (WRSM2005, WRYM, WRPM) in the Study Area at a quaternary catchment scale, or finer where required, in a manner that is suitable for allocable water quantification;
- To firm up on the approach and methodology, as well as modelling procedures, for decision support to the on-going licensing processes;
- To use system models, in the early part of the study, to support allocable water quantifications in the Study Area and, in the latter part of the study, to support ongoing licensing decisions, as well as providing information for the development of the Reconciliation Strategy;
- Formulate reconciliation interventions, both structural and administrative/regulatory;
- Document the reconciliation process including decision processes that are required by the strategy; and
- Conduct stakeholder consultation in the development of the strategy.

3. CONTEXT OF STUDY

The Luvuvhu and Letaba rivers flow through the Kruger National Park, join the Olifants River just upstream of the Mozambique border from where it flows into the Massingir Dam located in Mozambique. The Luvuvhu and Letaba River Systems can therefore be classified as directly supporting international obligations (Mozambique). Consequent thereof, any agreement between South Africa and Mozambique and Environmental Requirement flows for the Kruger National Park will have to be honoured.

Previous agreements between South Africa and Portugal still remain and in terms of these agreements, there are no limitations to further developments in the catchment by South Africa. The Government of South Africa is also a signatory to the Revised Protocol on Shared Watercourse Systems in the Southern African Development Community (SADC) Region. The character of this protocol promotes inter alia the sustainable, equitable and reasonable utilisation of shared watercourse systems and avoiding causing any negative impact to the neighbouring state.

An important aspect that has been written into the draft NWRS (2nd Edition) is the consolidation of certain WMAs to be managed by a single CMA. It will impact on the current Luvuvhu Letaba WMA and in future the Luvuvhu catchment will become part of the Limpopo

catchment to form a WMA and the Letaba catchment will become part of the Olifants catchment to form a separate WMA.

This water reconciliation strategy by DWA will be an input to the future CMS once the agency gets established. It is important that this reconciliation strategy is also in harmony with the to-be-established NWRS (2nd Edition).

4. STUDY PROCEDURE AND STAKEHOLDER ENGAGEMENT

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

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

The Preliminary Screening of Options was undertaken at a screening workshop which was held on 25 April 2012 where a list of possible reconciliation options were evaluated by the Study Steering Committee, to define the shortlist of options that was investigated further.

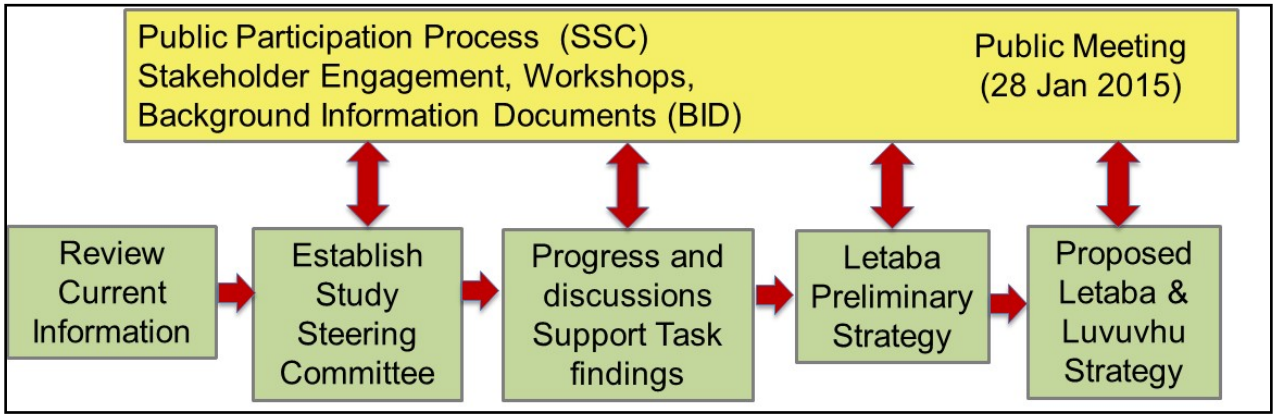


Table 4-1: Technical Studies and Public Participation Process

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

The development of the Final Reconciliation Strategy is the last step in the technical process and was presented to the broader public at the public meeting that took place on 28 January 2015.

5. SYSTEM DESCRIPTION

The study area comprises of the water resources of the catchments of the Luvuvhu, Mutale, Letaba and Shingwedzi rivers, linked to adjacent systems by inter-basin transfers.

The Groot Letaba River catchment utilize water from the Groot Letaba River and its tributaries with existing storage dams such as Dap Naude, Ebenezer, Magoebaskloof, Vergelegen, Hans Merensky, Tzaneen, Thabina, Thapane and Modjadji dams to supply water to various towns including Polokwane, Tzaneen, Haenertsburg, Modjadjiskloof and also to a number of rural villages. Water use in the Groot Letaba catchment is dominated by irrigation. In the Middle and Klein Letaba river catchment the water supply schemes are the Sekgopo and Tshitale/Sekgosese borehole schemes, as well as the Middle Letaba and Giyani water schemes using Middle Letaba and Nsami dams as their main resource of water. Some of the Middle Letaba water supply schemes also supply potable water to other sub-catchments, being Groot Letaba River and Luvuvhu River catchments. The surface water resources within the Letaba catchment are extensively developed. Faced with water shortages of increasing severity and frequency over the years, the main consumptive users of water have from time to time compete for the limited supplies and experienced significant levels of restrictions. This has resulted in the degradation of the riverine ecosystem. The water resources of the Groot Letaba are not sufficient to meet all its requirements all of the time.

A Feasibility Study of the Development and Management Options for the Letaba catchment proposed several options for augmenting water supply from the Groot Letaba River. These included some management interventions, as well as the construction of a dam at Nwamitwa and the possible raising of Tzaneen Dam. The Minister of Environmental and Water Affairs approved the implementation of the Groot Letaba Water Development Project (GLeWaP) and a notice in accordance with Section 110 of the National Water Act declaring the Minister's intent to implement the GLeWaP was gazetted on 21 December 2012.

Due to significant water supply shortages already experienced in the Middle Letaba Nsami dam sub-system, the construction of a pipeline from Nandoni Dam in the Luvuvhu River to Nsami Dam has already commenced. This pipeline will convey raw water from Nandoni Dam to the treatment plant at Nsami Dam.

The Luvuvhu River Catchment is located in the north-eastern corner of South Africa. It rises near to Louis Trichardt (Makhado) and flows in a north-easterly direction to its junction with the Limpopo River near to Pafuri.

Nandoni Dam and Xikundu Weir together with the existing Albasini, Vondo, Phiphidi and Tshakhuma dams and the associated bulk purified water supply infrastructure, are known as the Luvuvhu River Government Water Scheme. Nandoni Dam started to store water during 2002/03 and was able to augment the flow in the river from the winter of 2003. This scheme is managed as an integrated system to supply water for domestic/industrial, irrigation and for the ecological component of the reserve. Current planning is that the Nandoni System will in future partly or fully support a large number of Rural Water supply Schemes and towns. The main

bulk distribution pipeline is still under construction and most of these areas are not yet supported from Nandoni Dam.

Significant irrigation developments from surface and groundwater upstream of Albasini Dam resulted in a decrease in the yield available from Albasini Dam, to such and an extend, that the irrigation scheme downstream of Albasini Dam can very seldom be supplied with water from the dam, as the dam struggles to meet the urban/industrial demand of Louis Trichardt (Makhado). As result of land claims large areas that were previously irrigated is currently not utilised, although these areas still have allocations from several of the existing dams. It is currently not clear whether these allocations will in future again be utilised for irrigation purposes.

There are no major dams in the Shingwedzi basin due to the limited water resources and the absence of suitable dam sites. Rural Water Schemes (RWS) that operate in this catchment includes North and South Malamulele East RWS, which has its water source as the Malamulele Weir, Xikundo Weir and Minga Weir in the Luvuvhu River. Parts of the Middle Letaba RWS, Malamulele West, Giyani sub-systems F1 & F2 are located within the Shingwedzi catchment, currently receiving water from the Middel Letaba – Nsami sub-system. Water for a small irrigation area of 270ha is sourced from the Makuleke Dam on the Mphongolo River a tributary of the Shingwedzi River.

The water resources in the Mutale catchment are still underdeveloped as limited storage structures exist in this sub-catchment. Mukumbani Dam in the upper reaches of the Tshirovha River supplying water to the Mukumbani Tea Estate is the only dam in this catchment. The surface water appears to be of reasonable quality and has not been polluted to any great extent by the present developments. The Vondo North Rural RWS and the Damani RWS are partly located in the Mutale catchment and are supplied with water from Vondo and Damani dams respectively, which are both located in the Luvuvhu River catchment.

The remainder of the Rural Water Supply Schemes are supplied from Mutale surface (50%) and groundwater resources (50%), almost similar volumes used from both sources. Some irrigation did exist in the past, it is however uncertain how much of the irrigation is currently still practised.

6. THE RESERVE

The Reserve is that portion of the natural flow that has to be available in a river or stream in order to sustain the aquatic ecology, and also to provide for basic human needs. The work carried out in the Letaba Classification Study, consolidated the Ecological Water Requirement (EWR) scenarios for application in the water balance assessment of this study. This information was only available for the Letaba catchment. Six EWR sites are applicable and their ecostuatus are presented in **Table 6.1**. Only sites 3, 4 and 7 on the main stem of the Letaba were included as part of the analyses.

Table 6-1: Ecological Categories for the indicated sites (Letaba)

EWR site	Present Ecological State	recommended Ecological Category
1	C	C
2	D	D
3	C	B
4	C	B
5	CD	CD
7	C	B

Available Desktop EWR information were obtained for the Luvuvhu and Mutale catchments. EWRs were selected and included downstream of the major dams to take into account the EWR implications on the water balances. These Recommended Ecological Categories applied in the analysis are presented in **Table 6.2**.

Table 6-2: Ecological Category for the indicated sites (Mutale and Luvuvhu)

EWR site	Quaternary	recommended Ecological Category
Vondo	A91G	B/C
Albasini	A91B	D
Nandoni	A91H	B/C
Tshakhuma	A91D	C/D
Rambuda	A92D	B/C

7. HYDROLOGICAL ANALYSIS

There were several uncertainties identified around the previous available hydrological information such as low confidence water use assumptions, losses in the systems, impact of groundwater use on the available surface water flows etc. The recently completed Groot Letaba Water Development Project (GLeWaP) study strongly recommended the complete update and recalibration of the Groot Letaba hydrology to confirm the yield results for the proposed Nwamitwa Dam and the raising of Tzaneen Dam. For the first time groundwater-surface water interaction was taken into account in the generation of the natural flow sequences, by applying the techniques and simulation models that have been developed by DWA and the Water Research Commission.

A detailed Water Resources Simulation (WRSM2000) hydrological model was configured and calibrated as well as verification of simulated flows was done at 23 gauging sites throughout the Study Area. Further adaptions were made by also confirming the calibrations at dams where reasonable dam level comparisons were possible. Natural runoff simulations were carried out for the entire Luvuvhu and Letaba catchment based on the reasonable calibration of

the WRSM2000 at key points, and through model parameter transfer to areas not covered by the calibration.

Confidence in the simulation results for each catchment was determined based on criteria such as the availability of rainfall data, water- and land-use as well as the quality of observed calibration data. It was found that 57% of the natural Study Area MAR had a confidence level higher than 70%. A further 30% had a confidence level of between 50% and 70% and 13% had a confidence level of lower than 50%. The main reasons for the low confidence areas are the poor distribution of rainfall stations and the large areas of no or unacceptable flow gauging.

It was estimated that the total groundwater requirement at 2010 development levels was 160 million m^3/a in the study area. Only approximately 110 million m^3/a (on average) can be supplied from groundwater and this has an impact of approximately 58 million m^3/a on the surface water runoff reduction. This clearly shows the importance of simulating groundwater and related water use in combination with surface runoff and usage, which was carried out for the first time as part of this study. The runoff generated in the study area with 2010 groundwater abstractions taken into account, was estimated as 1 274 million m^3/a of which 38.5% is from the Groot Letaba, 12.1% from Klein Letaba, 30% from the Luvuvhu, 12.2% from the Mutale and 7.2% from the Shingwedzi River.

8. CURRENT AND PROJECTED WATER REQUIREMENTS

To determine the volume of water needed, information was gathered on the water requirements of the different sectors. The water use Validation Study served as the primary source of historical water use data. Groundwater resources play an important role in the water supply within this study area with approximately 22% of the total water requirement imposed on groundwater. The irrigation sector uses most of the groundwater with 29% of the irrigation supplied from groundwater. The total groundwater requirement is estimated to be almost 160 million m^3/a at the 2010 development level.

Table 8.1 summarises the water requirement for the Luvuvhu and Letaba River System for the all the user sectors, listing the 2010 water use as well as estimates for the indicated components up to the year 2040.

The possible estimated savings through WC/WDM in the urban and rural domestic sector was determined for each of the Water Services Schemes and for the larger towns in the study area. The focus of this component of the study was to develop a high level WC/WDM strategy and business plan for the Water Services Authorities that are supplied from the Luvuvhu and Letaba systems. WC/WDM business plans were prepared for the Mopani and Vhembe District Municipalities as well as for Polokwane Local Municipality.

WC/WDM savings was estimated to be in the order of 9 million m^3/a, representing an overall saving of 8%. Within the irrigation sector very limited (if any) savings can be achieved, as most of the irrigation schemes are already experiencing severe water shortages. In the case of commercial irrigation schemes, irrigators have in most cases already improved their irrigation efficiency to get maximum use from the available water.

Table 8-1: Total High growth water requirements (values in million m^3/a)

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Total urban/industrial/mining & rural dom		123,80	136,49	161,80	189,12	200,94	213,02	225,01
Total Irrigation		485,50	489,90	504,80	507,50	509,00	512,00	514,02
Total Water Requirements Study area		**609,30**	**626,39**	**666,60**	**696,62**	**709,94**	**725,02**	**739,03**
Reduction in runoff due to Afforestation		79,50	79,50	79,50	79,50	79,50	79,50	79,50
Reduction in runoff due to Invasive alien		11,30	11,30	11,30	11,30	11,30	11,30	11,30
Total Reduction in runoff		**90,80**	**90,80**	**90,80**	**90,80**	**90,80**	**90,80**	**90,80**
Total water requirements and reductior		**700,10**	**717,19**	**757,40**	**787,42**	**800,74**	**815,82**	**829,83**

9. WATER AVAILABILITY

Yield analyses were undertaken based on the revised hydrology for all major dams and relevant sub-systems. **Table 9.1** provides a summary of the yield results for existing and possible future infrastructure, indicating the high assurance yield (1 in 50 year or 98% assurance) for urban/domestic users and the low assurance yield (1 in 20 year or 95% assurance) which is mainly used for irrigation purposes.

The Ground Water Harvest Potential (Seward and Seymour, 1996) provides a basis for the evaluation of the volume of groundwater resources. The Harvest Potential for the study area was determined as 271 million m^3/a. It is however not possible to abstract all the ground water available. The Harvest Potential was then reduced by an exploitation factor, determined from borehole yield data, to obtain an exploitation potential, i.e. the portion of the Harvest Potential which can practically be exploited. The Exploitation Potential for the study area was on this basis determined as 184 million m^3/a. Approximately 81% of the groundwater within the study area can be regarded as potable due to water quality limitations in some areas. The Potable volume of groundwater that can be exploited within the study area was estimated as 158 million m^3/a. When only considering the groundwater available within the water services schemes, the potable exploitation potential within the schemes amounts to only 80 million m^3/a.

Groundwater use and availability were assessed and although there are areas where the use exceeds the potable exploitable groundwater potential, there still remain areas where further groundwater abstractions are possible.

Table 9-1: Existing and possible future System yield results

Dam name	FSV (million m^3)	Yield (million m^3/a)		
		HFY)	1 in 20 year	1 in 50 year
1) Dap Naude plus Ebenezer	72.8	36.2	43.8	40.5
2) Magoebaskloof plus Vergelegen	9.9	6.4	14.7	12.9
3) Hans Merensky	5.1	3.4	5.2	4.8
4)Tzaneen raised	182.4	45	60.0	51.7
5) Tzaneen raised plus Nwamitwa	369.0	61		
6) Tzaneen raised plus Nwamitwa & EWR	369.0	49		
7) Thabina	2.6	3.1	4.1	3.7
8) Middel Letaba plus Nsami	206.1	20.6	31.0	24.3
9) Thapane	1.07	1.1	1.6	1.4
10) Modjadji	7.2	3.5	4.4	3.8
11) Makuleke	13.0	0.1		
12) Albasini	28.4	1.4	3.7	2.5
13) Vondo	30.6	16.8	25.0	21.9
14) Phiphidi	0.19	0.2		
15) Damani	12.9	4.8	5.7	5.3
16) Nandoni plus weirs	166.1	62	83.0	70.0
17) Tshakuma	2.47	1.4	1.8	1.5
Possible Future dams				
1) Paswane dam	90.0	43.0	64.5	55.0
2) Xikundu Dam	139.0	51.0	71.5	62.5
3) Crystalfontein Dam with EWR	96.0	5.4	-	-
4) Majosi Dam with EWR	29.0	4.6	-	-
5) Rambuda Dam	13.5	12.6	18.7	16.7
6) Tswera Dam	131	53.0	69.4	62.1
7) Thengwe Dam	116	51.0	-	-

10. WATER QUALITY

The water quality trends in the middle to lower Luvuvhu River indicate a deterioration of the phosphates, nitrates and ammonia levels. The water quality of the Luvuvhu main catchment has remained very good, and on the whole falls within the interim RWQOs.

In general the water quality of the Shingwedzi River catchment has remained very good, it however shows contamination from the domestic wastewater treatment works, as well as general urban pollution from the larger villages.

The water quality of the Groot Letaba catchment has remained very good in the upper reaches of the catchment, moving towards a slight deterioration further downstream due to low flow conditions. The Great Letaba Irrigation Scheme covers an extensive area along the river to the

border of the Hans Merensky Game Park. Further downstream along the river at the gauging point B8H008, the water quality deteriorates with TDS (710 mg/l), sodium (138.5 mg/l) and chloride of 192.7 mg/l. This is at the confluence of the Klein Letaba and the border of the KNP.

The current water quality in the Klein Letaba River indicates ideal values of ammonia, sulphates and nitrates, with unacceptable phosphate values which are as a result of a number of WWTWs and waste disposal sites, leading to eutrophication.

Considering the number of densely populated and informal settlements in the study area and the potential for water use directly from the resources, bacteriological monitoring in the study area is inadequate, and needs to be increased at points up and downstream of the urban areas, and specifically at wastewater treatment works. This will also give a better understanding of the potential for cholera outbreaks.

The wastewater treatment works in the study area need to be upgraded to improve the quality of the effluent being discharged, as this is impacting on human health and increased eutrophication potential in the study area, which will in turn impact on other water users such as irrigation farmers and water treatment plants.

11. THE CURRENT AND FURURE WATER BALANCE

At the Screening Workshop held in April 2012, intervention options were identified for consideration in the study as measures to reconcile the water requirement and water availability. These consisted of options to reduce the water requirements as well as those that increase the water supply. The identified options are listed below for the indicated catchment areas:

<u>Options applicable to all Areas:</u>

- Water Conservation & Water Demand Management.
- Development of groundwater resources.

<u>Groot Letaba Catchment Options:</u>

- Raising of Tzaneen Dam.
- Construction of Nwamitwa Dam.
- Bulk Water Supply Infrastructure to distribute water from Nwamitwa Dam.
- Artificial recharge at Mulele on the Molototsi River.
- Groundwater regional scheme in conjunction with surface scheme.

<u>Middel and Klein Letaba Catchment Options:</u>

- Replacement of Middel Letaba canal with pipeline – reduce canal losses.
- Transfer Scheme from Nandoni Dam.
- Construction of new dam on Klein Letaba River:

– Majosi Dam, or

– Crystalfontein Dam.

Luvuvhu Mutale and Shingwedzi Catchment Options:

- Transfer water from Luvuvhu to Shingwedzi.
- Reconsider Makhado water supply combination using Albasini, Nandoni and smaller water resource schemes.
- Raising Vondo Dam.
- Mid Dzindi possible dam.
- Latonyanda possible dam.
- Paswane possible dam.
- Xikundu possible dam.
- Possible new dams on Mutale (Rambuda, Tswera & Thengwe).

Annual water balance diagrams were prepared for all the systems listed in **Table 9.1**, using the indicated yields, selecting options with the lowest URV's as well as the projected water requirements for the respective areas.

The water balances take into account the assurance of supply as required by different water use sectors. Water supply to urban/Industrial and rural domestic users is always provided at a higher assurance than water supply to irrigation. For the purpose of the water balances, a 98% assurance was assumed to be applicable to the urban/Industrial and rural domestic sector and a 95% assurance to the irrigation sector. The 98% assurance relates to shortages in supply that will on average be experienced once in 50 years (1 in 50 year) and the 95% assurance for irrigation, to shortages experienced on average once in 20 years (1 in 20 year). In several areas the actual supply to irrigation is well below the 95% assurance due to overutilization of the water resources. In some of these areas the irrigators were able to adapt to these low assurances, in which case the lower assurance of supply to irrigation was accepted for the purpose of the water balance. This approach was followed as there were insufficient water resources to improve the assurance of supply to irrigation in those areas.

The water balances indicated that the implementation of interventions will be critical to ensure sufficient water supply to the year 2040 for almost all the small and large water supply systems. In many of the sub-systems deficits are currently observed and in some areas these deficits are quite severe.

11.1 RECONCILING THE WATER REQUIREMENTS WITH THE WATER RESOURCE

The three major sub-systems, the Groot Letaba, the Middle Letaba Nsami and the Luvuvhu sub-system, are currently managed as individual systems. Within each of these systems there are a number of smaller sub-systems which are in some cases linked to the main sub-system. It is therefore required to prepare separate reconciliation balances and strategies that will cover each sub-system within the study area. This is necessary to identify the particular timeline and magnitude of interventions required during the planning horizon. Sub-system specific balances and strategies were therefore prepared, taking into account the existing linkages, currently planned links as well as proposed future links, to be able to obtain positive water balances over the planning period.

The executive summary will mainly focus on the three major sub-systems as they, to a large extent, also capture the smaller sub-systems. The Mutale system water balances was also included and described within the executive summary as possible future developments are being postulated to take place within the Mutale basin.

11.1.1 Groot Letaba Main System

Smaller sub-systems in the Groot Letaba which is not linked to the main water supply system are the Hans Merensky and Magoebaskloof Vergelegen dam sub-systems. Findings from their related water balances are briefly summarised below.

- Hans Merensky Dam water balance showed that the available yield is more than sufficient to support the irrigation and showed a slight excess of approximately 0.7 million m^3/a in the sub-system. No growth in demand is foreseen and this sub-system is thus in balance over the planning period to the year 2040.

- Magoebaskloof Vergelegen dam sub-system water balance showed that the urban requirements can easily be met at the required 98% assurance over the entire planning period. With the full irrigation allocation taken up over time, a small deficit is expected in future. For irrigation purposes the small deficit should not be a problem, as long as the irrigators are willing to operate at a slightly lower assurance. When the irrigators take up their full allocation it will not be possible to support any additional domestic requirements.

The water balance for the combined Dap Naudé Ebenezer dam sub-system showed that the system is in balance for the entire planning period up to 2040, but will not be able to support further growth in demands. During times of severe droughts, Ebenezer Dam is used to support Tzaneen Dam and is thus considered to be part of the Groot Letaba Main system.

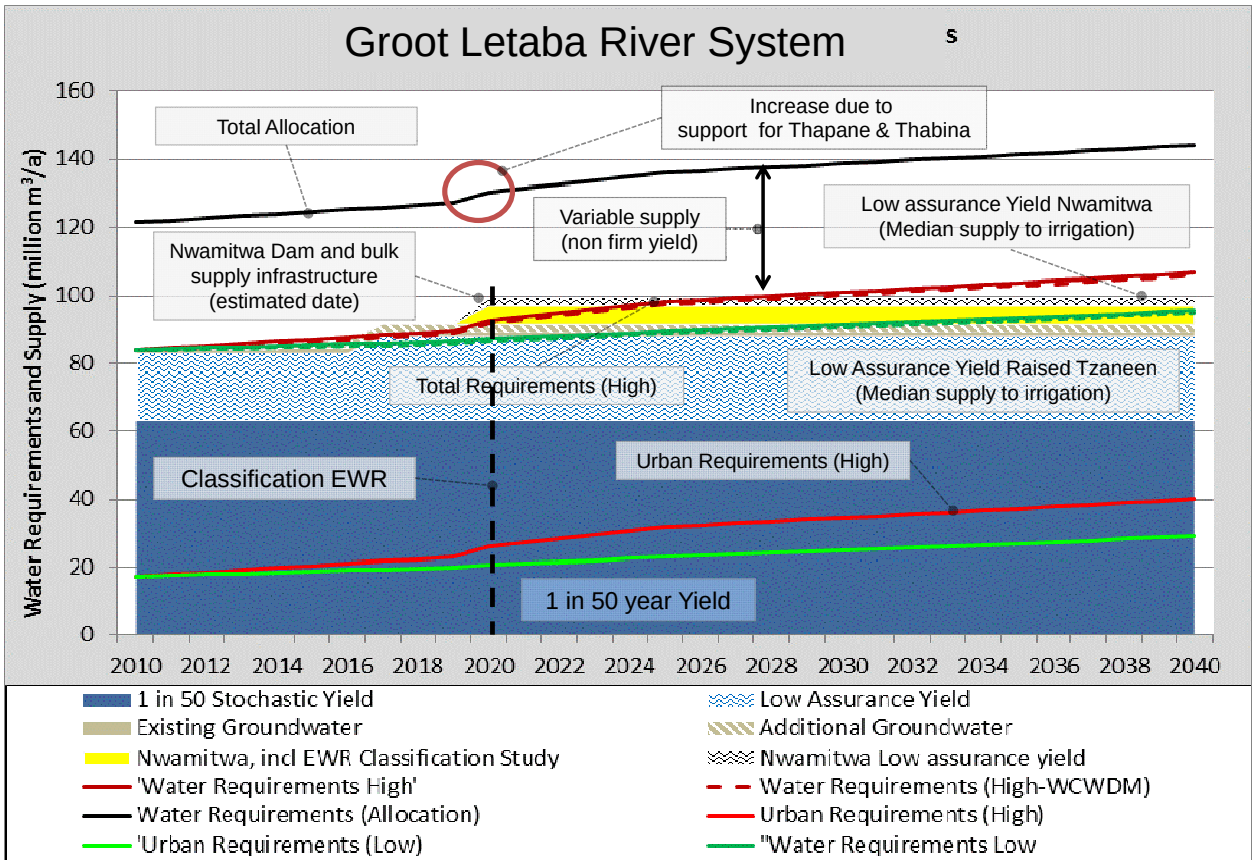
The water services schemes forming part of the Groot Letaba Main system are Siluwane-Nondweni Extended RWS, Ritavi/Letaba RWS, Tzaneen/Modjadjiskloof and Ritavi ll RWS. To be able to improve the water supply in this stressed system all the identified intervention options, need to be implemented. As this system is already severely stressed, the irrigators

that are supplied from the Groot Letaba main system, developed an operating policy to regulate the supply to irrigation. When this rule is implemented, the irrigators receive on average approximately 62% of their allocation.

Even with all the proposed intervention options in place, the Groot Letaba Main system will still not be able to supply the full irrigation allocation at a reasonable assured yield. It is thus of utmost importance that the irrigation users continue with this restriction rule, which will require some adjustments when the raising of Tzaneen Dam was completed and again when Nwamitwa Dam starts to deliver water. The water balance as given in **Figure 11.1** includes the assumption that the current assurance of supply to the irrigators, will be maintained over the planning period.

Most of the smaller sub-systems that support part of the rural domestic requirements in or close to the Groot Letaba Main system supply area, also require augmentation in future. These include the Thapane and Thabina sub-systems. The deficits as determined from their individual water balances were included in the Groot Letaba Main system water demand projection from 2020 onwards, to coincide with the time when Nwamitwa Dam starts to deliver water. Deficits in the Modjadji sub-system are expected from 2017 onwards

Figure 11-1: Water balance and reconciliation scenario for the Groot Letaba Main System



As the Groot Letaba Main system with all intervention options included can only remain in balance until 2030, it was found to be beneficial to rather impose the deficits in the Modjadji sub-system on the Middle Letaba sub-system and not on the Groot Letaba. As part of an exchange where certain areas within the Middle Letaba sub-system will receive water from Nandoni Dam it become possible to extend the Middle Letaba support to the Modjadji sub-system.

The Groot Letaba Main system water balance contains the following elements (**Figure 11.1**).

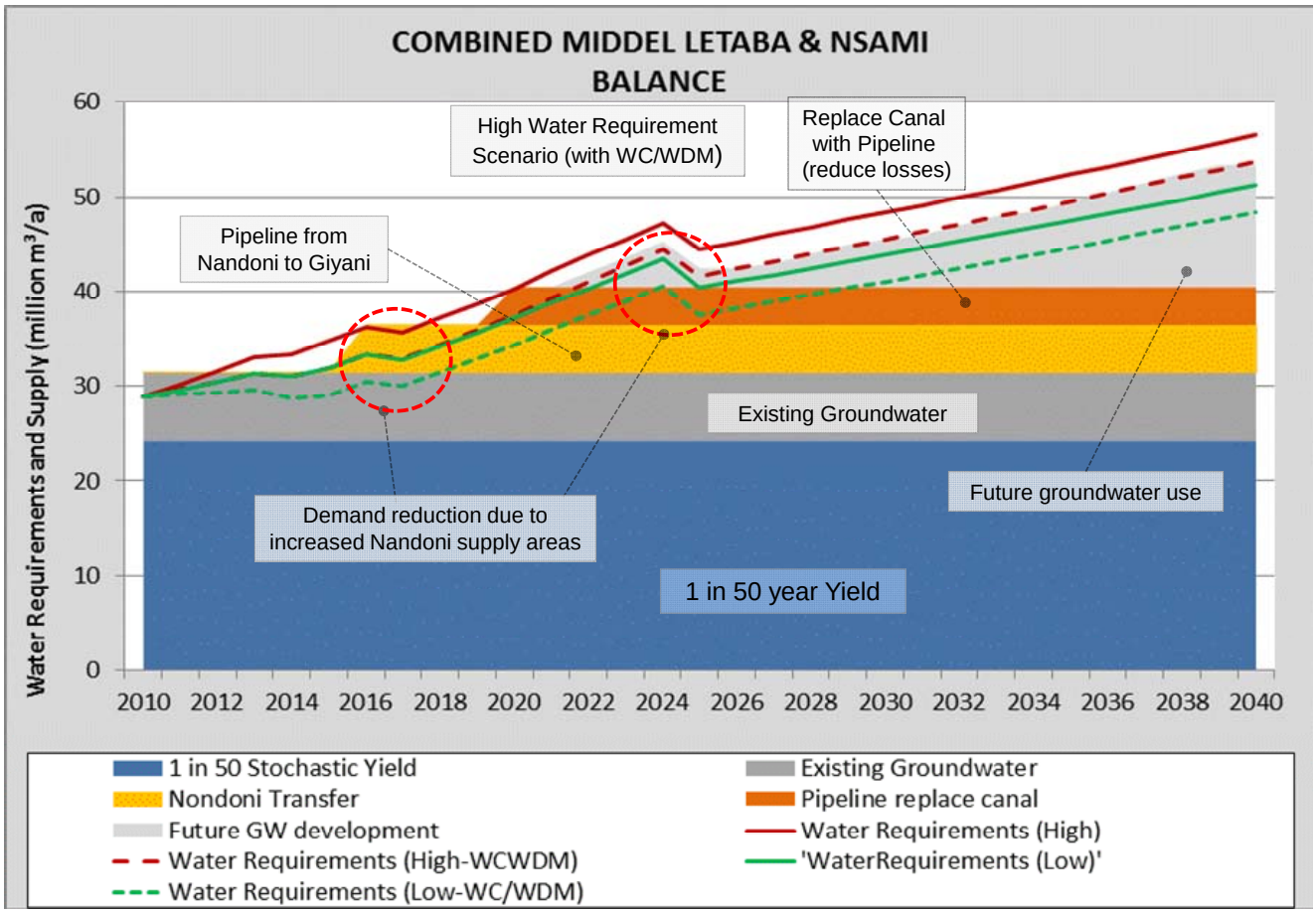
- Total yield (high and low assurance) of 84 million m^3/annum, reflecting an average supply of about 60% to the irrigators.
- Implementation of Water Conservation and Demand Management in the urban sector (dashed red line).
- Raising of Tzaneen Dam, main purpose is to improve the assurance of supply.
- Once Nwamitwa Dam is implemented (see yellow area), water is also supplied to the areas currently receiving water from Thabina and Thapane dams.
- Ebenezer Dam supports Tzaneen Dam when Tzaneen Dam reaches low storage levels.
- Water from existing and additional groundwater resources for target areas was added as yield.
- Implemented the Ecological Water Requirements for the scenario proposed by the Classification Study.

The intervention options incorporated in the reconciliation balance for Groot Letaba Main system can only supply the target water requirement scenario (High growth with WC/WDM) up to the year 2030.

11.1.2 Middle Letaba Nsami System

The Middle Letaba Nsami system is already in deficit from 2012 onwards. Even when taking into account that the total demand imposed on the Middle Letaba Nsami system will be reduced from certain years onwards, when parts of the water service schemes currently supplied Middle Letaba Dam, starts to receive support from Nandoni Dam, the system remains in deficit (See **Figure 11.2**). The possible Majosi and Crystalfontein dams were also evaluated as potential intervention options, but both resulted in fairly high URVs, and were therefore not used within the reconciliation scenario. These two dams might still be options to consider in the future beyond 2040.

Figure 11-2: Water balance and reconciliation scenario for the Middel Letaba Nsami System



The Middle Letaba Nsami System water balance contains the following elements

- Yield of both dams as well as the existing groundwater resources.
- Implementation of Water Conservation and Demand Management in the urban sector (dashed red line).
- Transfer from Nandoni Dam, indicated by the orange augmentation option.
- Some of the current Middle Letaba supply areas were already committed to receive water from Nandoni Dam by 2017 and some later by approximately 2024, reducing the load on Middle Letaba Dam, as indicated by the drop in demands as shown by the red and green demand projection lines.
- Replacement of the canal transferring water from Middel Letaba Dam to the waterworks at Nsami Dam, with a pipeline option as indicated by the brown intervention option.
- Developing additional groundwater resources from 2022.

By implementing all these interventions, sufficient water can be made available to supply the high water requirement scenario with WC/WDM until 2040.

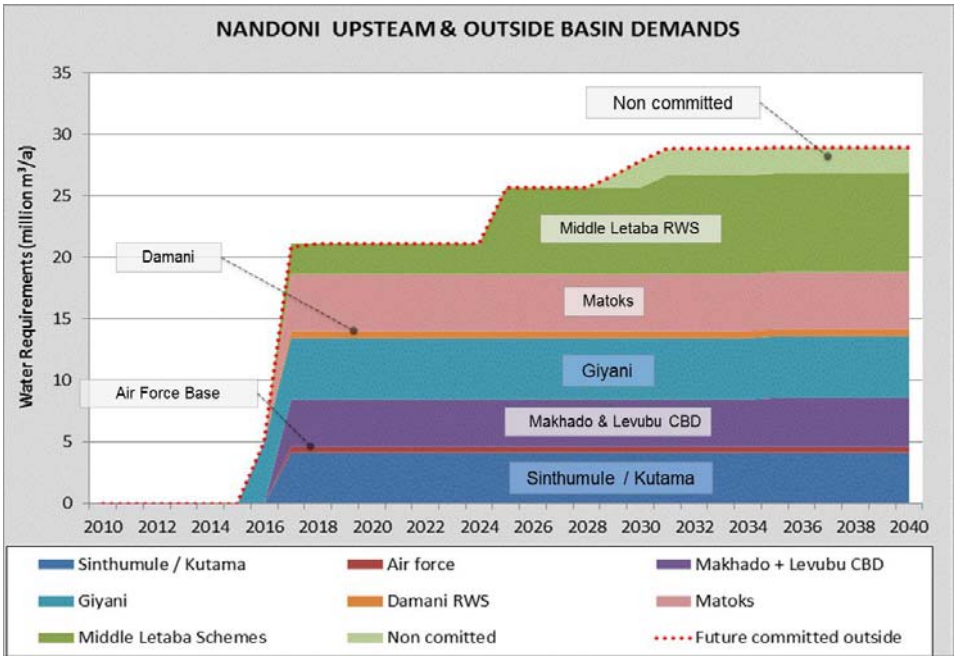
11.1.3 Luvuvhu System

The Luvuvhu system comprises several sub-systems of which some are currently linked. Nandoni Dam is the largest storage dam in the system and was only completed in 2004. Nandoni Dam will support almost all the sub-systems within, as well as some located outside the Luvuvhu catchment. This will result in links between all the main supply systems within the Luvuvhu catchment, as well as to several sub-systems outside the catchment. Deficits that still exist in the smaller sub-systems will be imposed as a demand on the larger Nandoni Dam system, as it is currently the only sub-system with significant surplus yield available in the Luvuvhu catchment.

A substantial volume of approximately 28 million m^3/a from the Nandoni yield was already committed to several other water services schemes located outside the supply area. A summary of these supply commitments are given in **Figure 11.3.**

The main water resources forming part of this integrated system are Nandoni Dam and the weirs downstream of Nandoni Dam, Vondo, Phiphidi and Tshakuma dams, with support from two run off river abstractions and related package plants at Dzindi and Dzingae, as well as groundwater abstractions. The Nandoni yield shown in the water balance (**Figure 11.4**) represents the yield available from Nandoni Dam in combination with the downstream weirs. The Greater Thohoyandou yield refers to the combined system yield from Vondo, Phiphidi and Tshakuma dams as well as the two package plants.

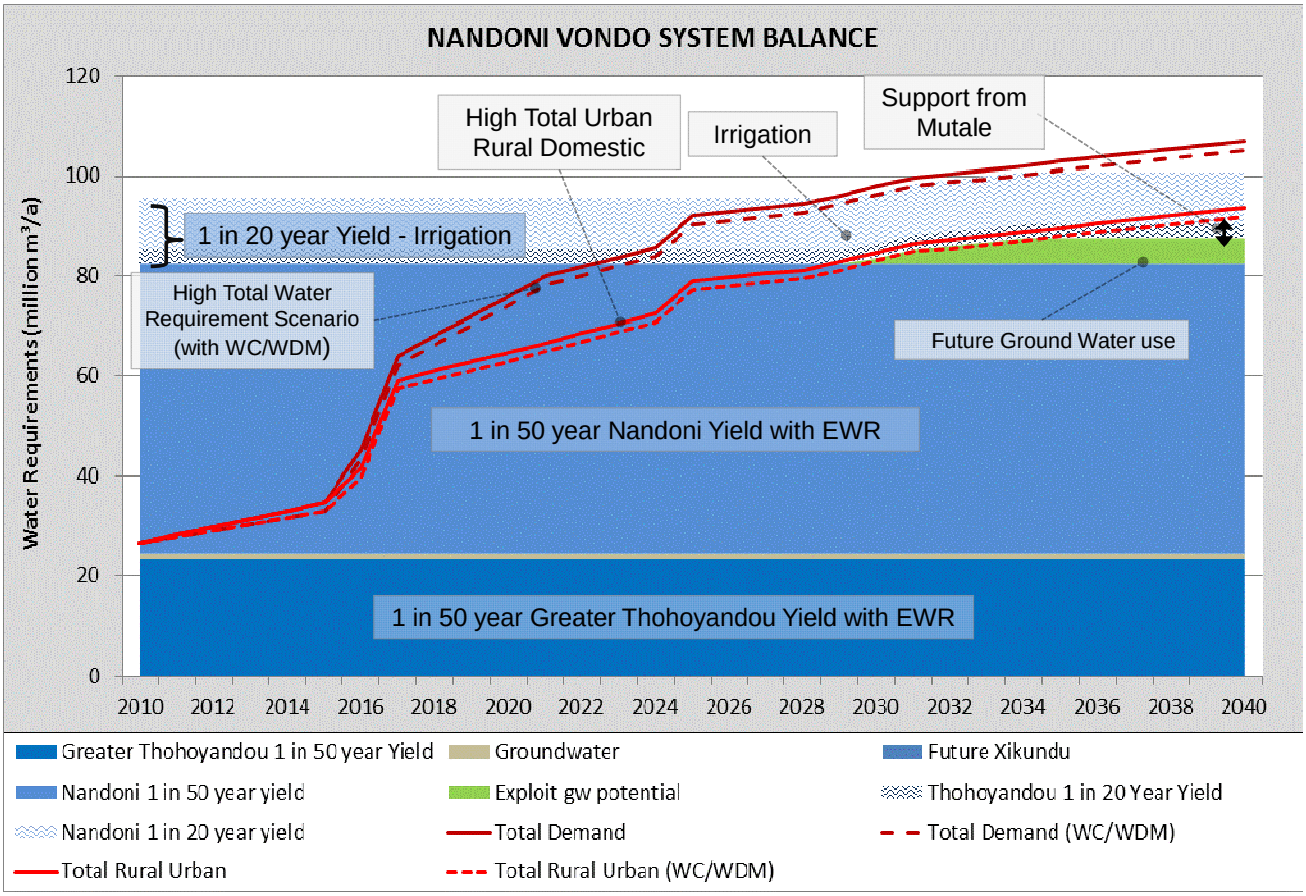
Figure 11-3: Support committed from Nandoni Dam in support other water services schemes



Deficits is expected to occur in this system from 2031 onwards, for both water use sectors, urban/rural domestic and irrigation. This system is thus already slightly over allocated;

although a relative small portion of the allocated future demand centres are currently receiving water from Nandoni Dam.

Figure 11-4: Water balance Nandoni and Greater Thohoyandou integrated System



The Nandoni and Greater Thohoyandou integrated System water balance contains the following elements:

- Total 1 in 50 year yield of 82 million m^3/a plus an incremental 1 in 20 year yield of 13 million m^3/a, resulting in a total yield of 95 million m^3/a.
- The Greater Thohoyandou sub-system includes Vondo, Tshakhuma, and Phiphidi dams as well as two runoff river package plants.
- Increased groundwater resources from 2030 onwards.
- Several areas located outside the Luvuvhu catchment were also committed to receive water from Nandoni Dam. These areas include Sinthumule/Kutama, Makhado, Giyani, Matoks, Middle Letaba supply areas as well as areas currently supplied from Damani Dam of which the bulk is located in the Mutale catchment. The inclusion of the deficits from these areas is evident in the sudden steep increases shown on the urban demand projection curve.

By implementing these interventions the system is able to supply the growth in demands until 2035. By then a dam in the Mutale River is an option that was identified for possible future

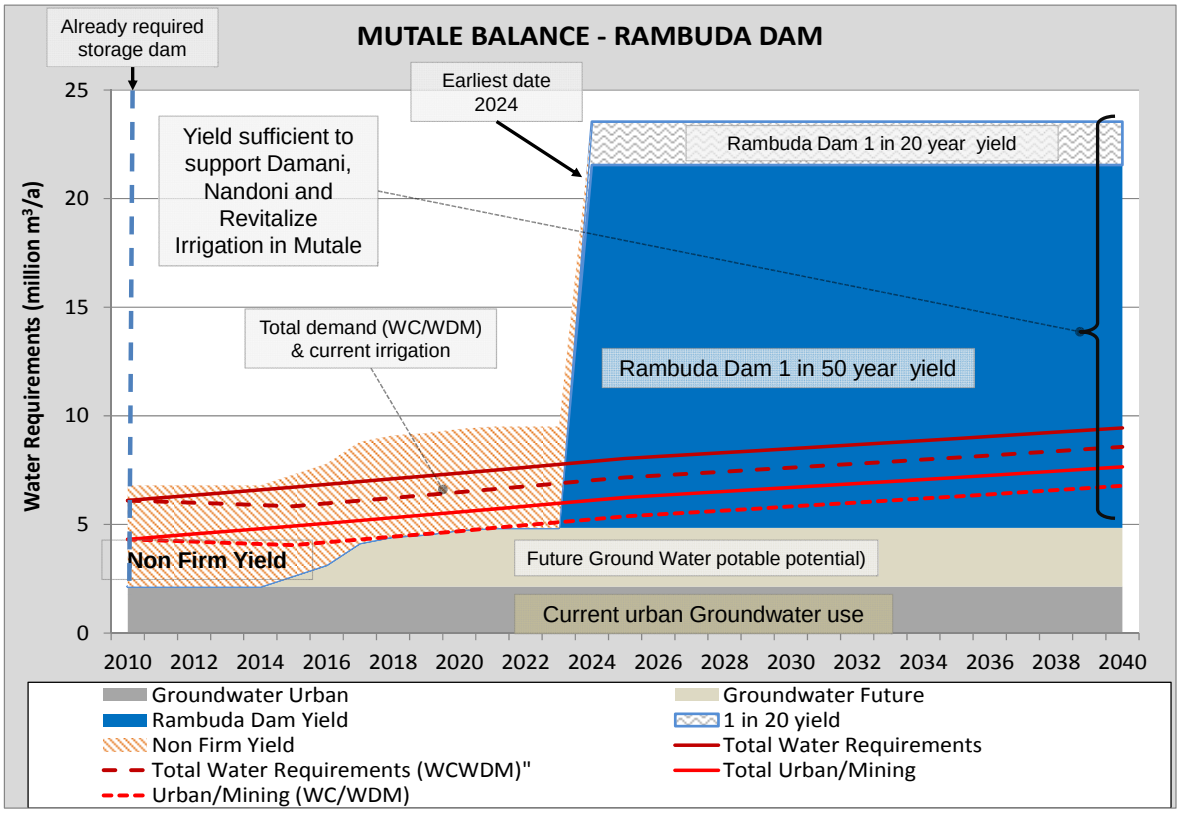
support. Another possibility to increase the Nandoni Dam sub-system yield is to better utilise the incremental flow downstream of Nandoni Dam by increasing the abstractions from the existing downstream weirs as well as to increase the weir capacities and the implementation of realtime monitoring. This option however still need to be investigated and is dependant on the setting of the eventual Ecological Water Requirments – to be determined as part of the Water Resource Classification of these river systems.

11.1.4 Mutale System

At 2010 development level a significant portion of the rural domestic requirement is supplied from sources with a non-firm yield and an unacceptable low level of assurance. Intervention options that can be implemented fairly quickly are WC/WDM and further exploitation of groundwater resources as indicated in **Figure 11.5**.

From the "Mutale River Water Resources Investigation" study the possible Rambuda downstream Dam and the Tswere Dam were identified as the most promising dam sites. The Rambuda Dam size is limited due to foundation problems at the site, while Tswera Dam can be constructed to quite a large capacity. Both these two possible future dams yield significantly more than the projected 2040 urban rural domestic requirement, including the current irrigation in the Mutale basin.

Figure 11-5: Mutale System water balance with intervention options – Rambuda Dam



The WC/WDM and additional groundwater resources can only maintain a positive water balance for the water supply to the urban and rural domestic requirements from 2018 to 2021. The earliest possible date to have a new storage dam in place was taken as 2024.

The Rambuda Dam site location relative to the demand centres is expected to be the preferred option as it will result in the lowest pumping costs. The dam size is unfortunately limited due to foundation problems. For the purpose of the executive summary only the water balance with the possible future Rambuda Dam is shown.

The possible Rambuda Dam can however provide more than sufficient yield to supply the existing irrigation requirements and the projected Mutale rural domestic requirements until 2040.

The remaining yield vailable after supplying the Mutale system requirements, will be sufficient to cover the deficits in the Integrated Nandoni system and to revitalise some of the irrigation in the Mutale basin.

12. THE LUVUVHU LETABA RECONCILIATION STRATEGY IN A NUTSHELL

The following measures are envisaged for the Luvuvhu and Letaba systems to maintain a water balance between the water needs and availability up to the year 2040.

(i) Ebenezer Dam to support users in the Groot Letaba System as in the past, by releasing water to Tzaneen Dam when it reaches low storage levels. Support from Ebenezer to Polokwane should not exceed 16.2 million m^3/a, which is in line with the average observed transfer over the last 10 to 13 years (as was incorporated in the projected water balances), although their current allocation is 12 million m^3/a. Further augmentation to Polokwane should therefore take place from the Olifants River System and not from Ebenezer Dam.

(ii) Plan and implement WC/WDM in the domestic water use sector. Targeted savings of at least 9 million m^3/a need to be obtained within the domestic/industrial water use sector and need to be achieved not later than the year 2020.

(iii) Continue with the implementation of the Groot Letaba Water Development Project (GLeWaP) as approved by the Minister of DWA and gazetted on 21 December 2012. The GleWaP entails the following:

a. The raising of the existing Tzaneen Dam by 3m to improve the assurance of supply to the users.

b. A new major storage dam on the Groot Letaba River just downstream of the Nwanedzi River confluence, at the site known as Nwamitwa on Janetsi Farm 463LT (Nwamitwa Dam). The proposed Nwamitwa Dam, developed to a level of 479.5 m above mean sea

level will increase the high assurance yield, and it is envisaged that first water will be stored by 2019,and

c. Development of bulk potable water supply infrastructure mainly to serve rural communities without adequate water supplies.

(iv) Implement the Ecological Water Requirements in the Groot Letaba for the scenario proposed by the Classification Study, once Nwamitwa Dam starts to deliver water.

(v) Additional monitoring of flows and dam balances are required to improve the confidence in the yield estimates of Thabina, Modjadji, and Thapane dams.

(vi) Groundwater is an important water resource, and in some areas the current level of use exceeds the availability. High level catchment wide groundwater assessments however indicated that additional groundwater abstraction is possible, as reflected on the water balances. These resources need to be exploited.

(vii) Augmentation is required from the Groot Letaba System after Nwamitwa Dam is in place, to the support areas currently receiving water from, Thapane and Thabina dams

(viii) Augment the Modjadji Dam supply area from the Middle Letaba System, after the demand load on the Middle Letaba sub-system was reduced sufficiently by means of support from the Integrated Nandoni sub-system.

(ix) Nandoni Dam needs to support part of Giyani as well as the already committed Middle Letaba Dam supply areas.

(x) Replace the Middle Letaba canal connecting Middle Letaba and Nsami dams, with a pipeline to reduce losses.

(xi) Nandoni Dam to be used to support the already committed areas located outside as well as inside the Luvuvhu catchment.

(xii) Remove unlawful use upstream of Albasini Dam, based on findings from the validation and verification process.

(xiii) Use a possible dam in the Mutale River (Rambuda or Tswera dam) to create additional yield in the system to augment future requirements in the Mutale and Luvuvhu.

(xiv) The actual water use needs to be monitored to confirm which water requirement scenario (projection) should be applied over the long term and whether this requires some adjustment to the strategy.

(xv) Investigate the possibility of increasing the yield of the Nandoni sub-system by improving the utilising of incremental flows downstream of Nandoni Dam. This can be done by

increasing the abstractions at the existing downstream weirs, by increasing the storage capacity of these weirs and by using real time monitoring. This option is dependant on the setting of the eventual Ecological Water Requirments which need to be determined as part of the Water Resource Classification of the river systems.

13. ACTIONS REQUIRED

13.1 SHORT TERM ACTIONS

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

- Verification of water entitlements from current Verification study. Once the extent of unlawful irrigation water use has been determined, the Department of Water Affairs need to prepare a compliance monitoring and enforcement plan. Areas where the removal of unlawful water use will impact significantly on the water resources need to be re-evaluated and water balances adjusted accordingly.
- Monitor water use to confirm water requirement projections before implementing options.
- Water Conservation and Water Demand Management. Implementation of these plans need to start in 2015
- Monitor observed flows and storage levels at strategic points. Quite a number of existing gauging points require attention to be able to provide reliable and very essential data required to manage this system properly, and to do sensible and realistic future planning of water resources and related assured water supply to users.
- Clarify future irrigation developments and revitalisation of previous irrigation schemes.
- Set clear targets for the construction of bulk water distribution systems.
- Continuous integration between Water Balances and water supply planning to water services schemes need to take place.

13.2 MEDIUM TO LONG-TERM ACTIONS REQUIRED:

The following medium to long-term actions are required

- Commission a Bridging study on the possible development and revitalisation of irrigation in the Mutale River.

- Pipeline to replace the canal between Middel Letaba and Nsami dams: Initiate an investigation to determine the most viable and cost effective pipeline route and size for the pipeline. This needs to be followed by the design, preparation of tenders, tender procedure, construction and commissioning of the construction work.
- Commission Classification study on the Luvuvhu and Mutale rivers.
- Investigate the possible increase of the Nandoni sub-system yield by improved utilising of downstream incremental flows.
- Commission Feasibility studies on groundwater development in relevant areas.
- Commission Feasibility studies on the construction of storage dam in the Mutale River.

13.3 TIMELINES AND RESPONSIBILITIES FOR ACTIONS REQUIRED

The timelines and responsibilities for the required actions are summarised in **Table 13.1.**

Table 13-1: Summary of short term and medium to long term actions

Action	Responsibility	Timeline
Verification of Water Entitlements	DWA Regional Office, Polokwane/Tzaneen	Process started already. Complete within 3 years, i.e. 2017.
Monitor water use to confirm water requirement projections before implementing options	Municipalities and WUAs, with support from Directorate Water Use Efficiency in DWA Head Office	Start as soon as possible
Develop WC/WDM plans for municipalities, WUAs and IBs not yet transformed into WUAs.	Municipalities and WUAs, with support from Directorate Water Use Efficiency in DWA Head Office	Start immediately. Plans must be in place and ready for implementation in 2015
Monitor observed flows and storage levels at strategic points.	DWA Regional Office, Polokwane/Tzaneen with support from Hydrology in DWA Head Office	Start as soon as possible
Clarify future irrigation developments and revitalisation of previous irrigation schemes in key areas	DWA Regional Office, Polokwane/Tzaneen with support from Limpopo Provincial Department of Agriculture	RESIS programme ongoing process.

Action	Responsibility	Timeline
Setting of clear targets for the construction of bulk water distribution systems related to the integrated Nandoni system	DWA Regional Office, Polokwane/Tzaneen with support from Municipalities and DWA Water Services Head office Pta	Start as soon as possible
Continuous integration between Water Balances and water supply planning	DWA Regional Office, Polokwane/Tzaneen with support from Municipalities and DWA Water Services Head office Pta and DWA National Water Resource Planning	Ongoing process
Commission a Bridging study on the possible development and revitalisation of irrigation in the Mutale River.	DWA; Options Analyses in Head Office with support from Department of Agriculture	Start at the latest in 2016
Initiate an investigation to determine the most viable and cost effective pipeline route and size for the pipeline replacing the canal between Middel Letaba and Nsami dams	DWA; Options Analyses in Head Office with support from DWA National Water Resource Planning and Municipalities	Start as soon as possible
The design of the pipeline between Middle Letaba and Nsami dams, the preparation of tenders, tender procedure, and construction.	DWA; Options Analyses in Head Office with support from DWA Water Services Head office Pta and Municipality	Start at the latest in 2015
Commission Feasibility studies on groundwater development in relevant areas	DWA National Hydrological Services Groundwater with support from National Water Resource Planning and Municipalities	Start at the latest in 2015
Commission Classification study on the Luvuvhu and Mutale rivers	DWA Head Office, RDM.	Start at the latest in 2016
Investigate the possible increase of the Nandoni sub-system yield by improved utilising of downstream	DWA; Options Analyses in Head Office with support from DWA National Water Resource Planning	Start at the latest in 2017

Action	Responsibility	Timeline
incremental flows. This need to be carried out in conjunction with determining the EWR for the river system.		
Commission Feasibility studies on the construction of storage dam in the Mutale River	DWA; Options Analyses in Head Office.	Start at the latest in 2017

14. IMPLEMENTATION ARRANGEMENTS

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

The strategy actions will be the responsibility of the respective institutions listed in **Table 13.1**. Detail project plans need to be compiled in which the actions will have to be broken down further with time lines and budgetary requirements for each organisation.

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

Particular attention needs to be given to strategy recommendations requiring negotiations with Mozambique. DWA International Liaisons will have to take the lead, most likely through the structures provided by LIMCOM.

Appendix A

MAPS

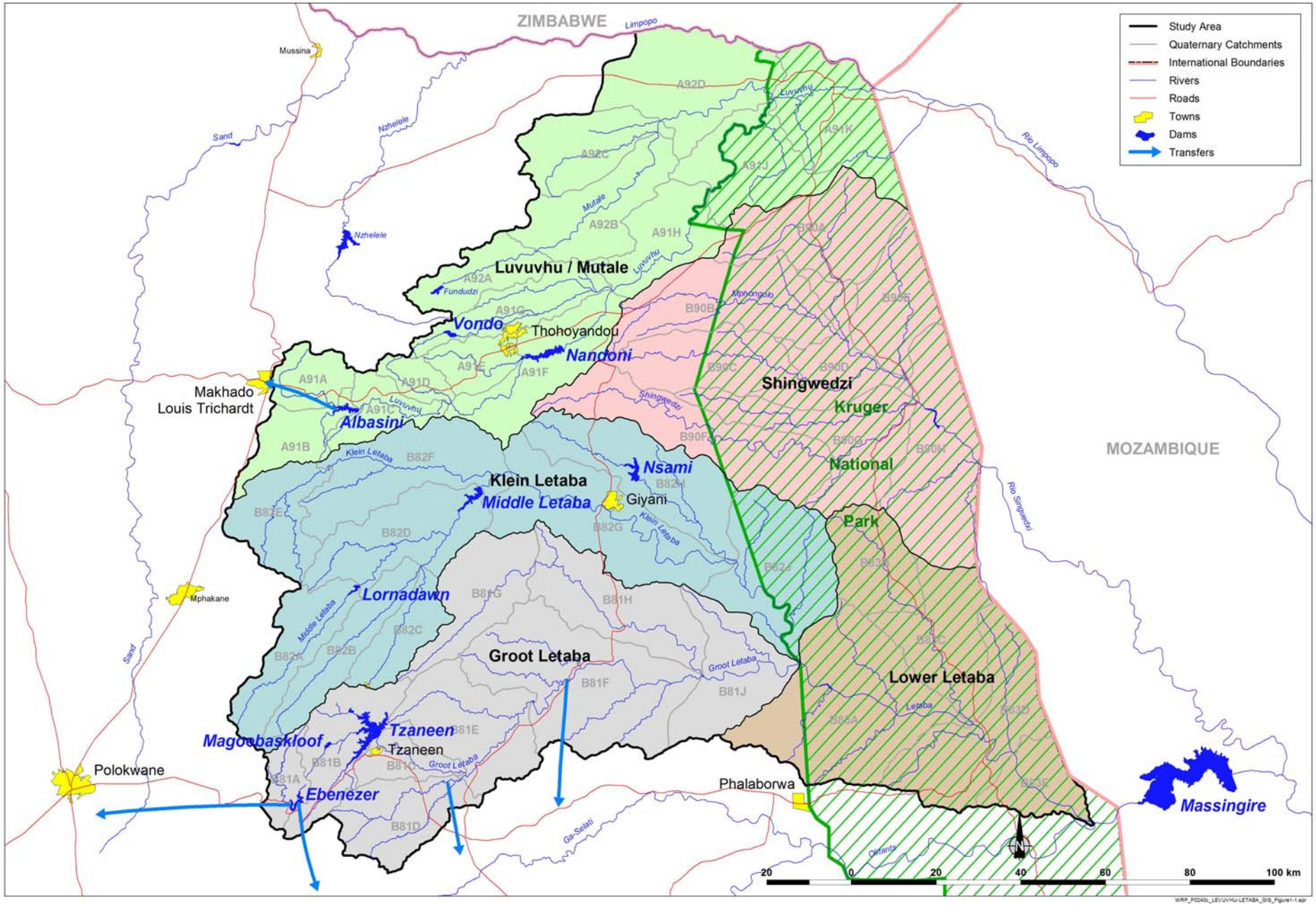


Figure A-1 Study Area

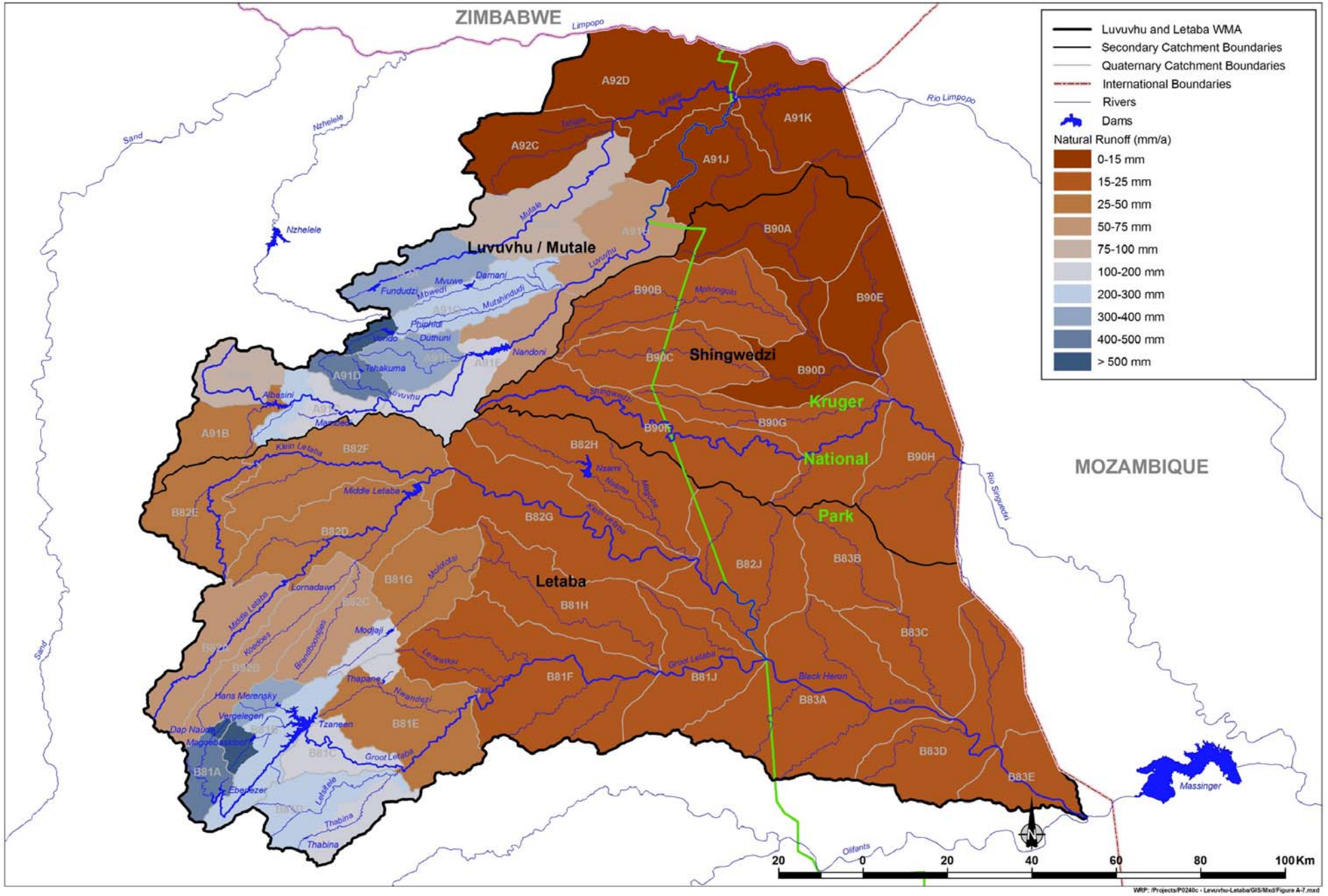


Figure A-2 Natural runoff in mm

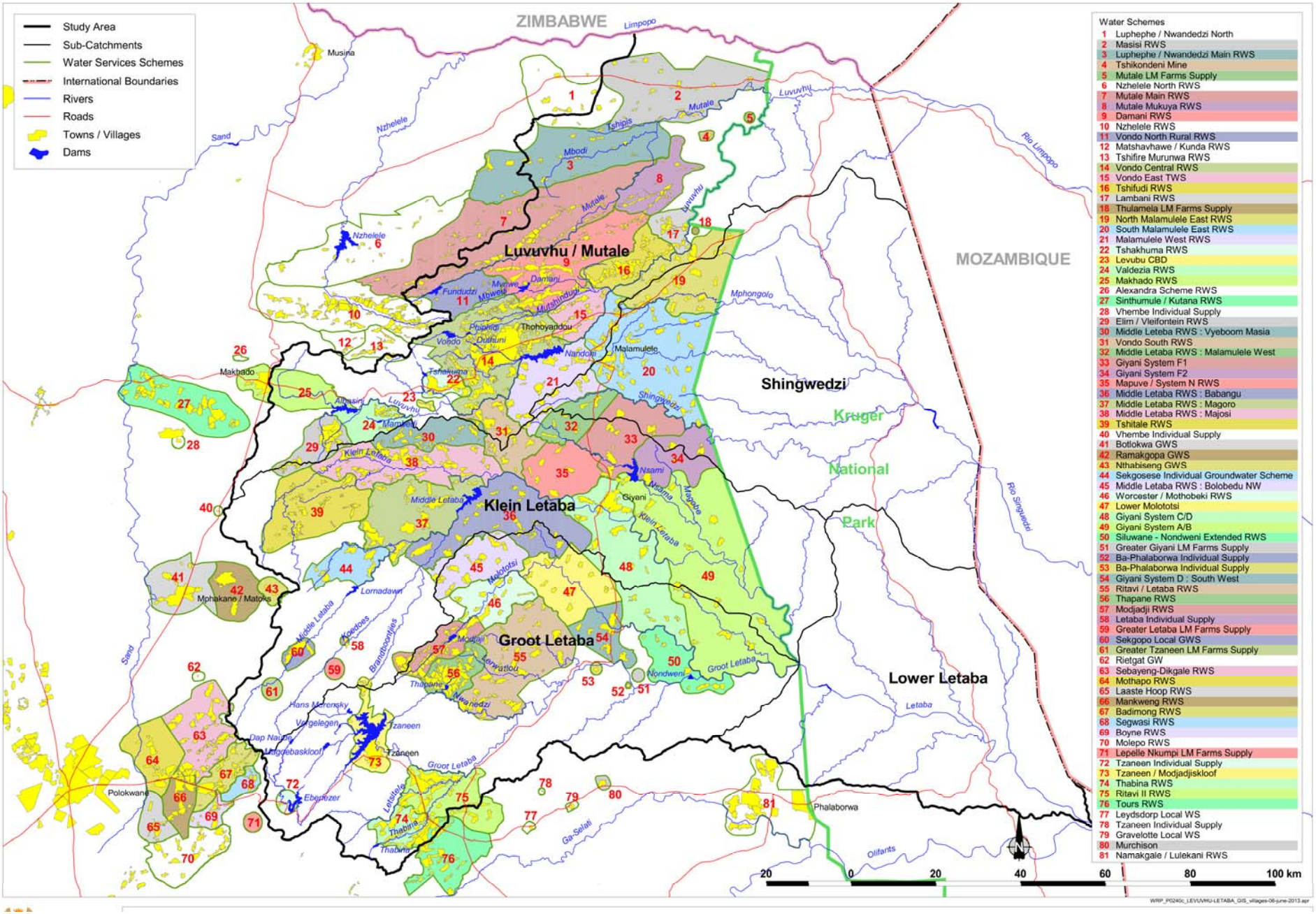


Figure A-3 Water Services Schemes

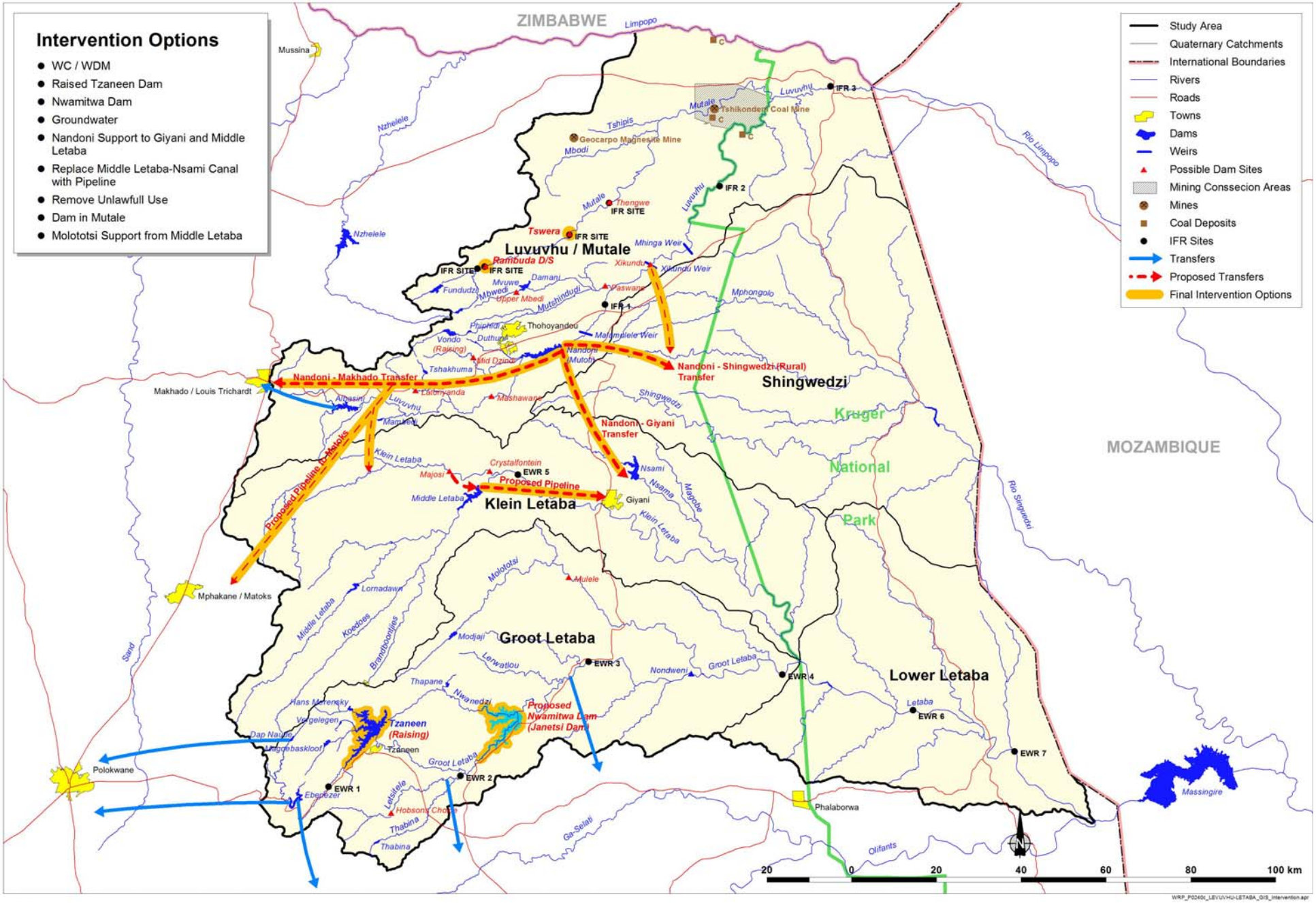


Figure A-4 Location of Key Intervention Options