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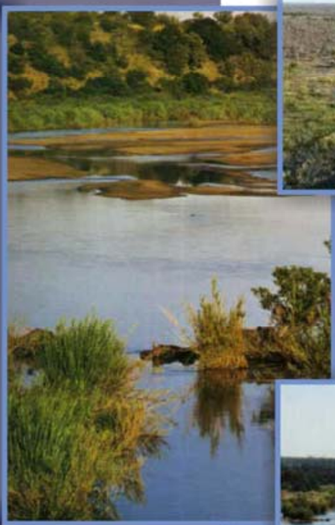
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: NATIONAL WATER RESOURCE PLANNING

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

WATER REQUIREMENTS AND RETURN FLOWS



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

WATER REQUIREMENTS AND RETURN FLOWS

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Authors:	*Study Team*
Project Name:	***Development of a Reconciliation Strategy for the Luvuvhu and Letaba Water Supply System***
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(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

Water Requirements and Return flows

EXECUTIVE SUMMARY

The Department of Water Affairs (DWA) has identified the need for the Reconciliation Study for the Luvuvhu-Letaba WMA. The WMA is almost fully developed and demands from the Letaba River currently exceed the yield capability of the system. Regulation for the Letaba WMA is mainly provided by Middle Letaba, Ebenezer and Tzaneen Dams. In the Luvuvhu WMA the recently completed Nandoni Dam will be used in combination with Albasini, Vondo and Damani dams to be managed as one system. It is expected that the total yield from this combined system will be fully utilized by around 2020, considering only the current planned projected demands. The yield of the Albasini Dam has reduced over the years and as a consequence the dam is over allocated. The Shinwedzi 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 is 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 will be 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.*

The primary purpose of this report is to:

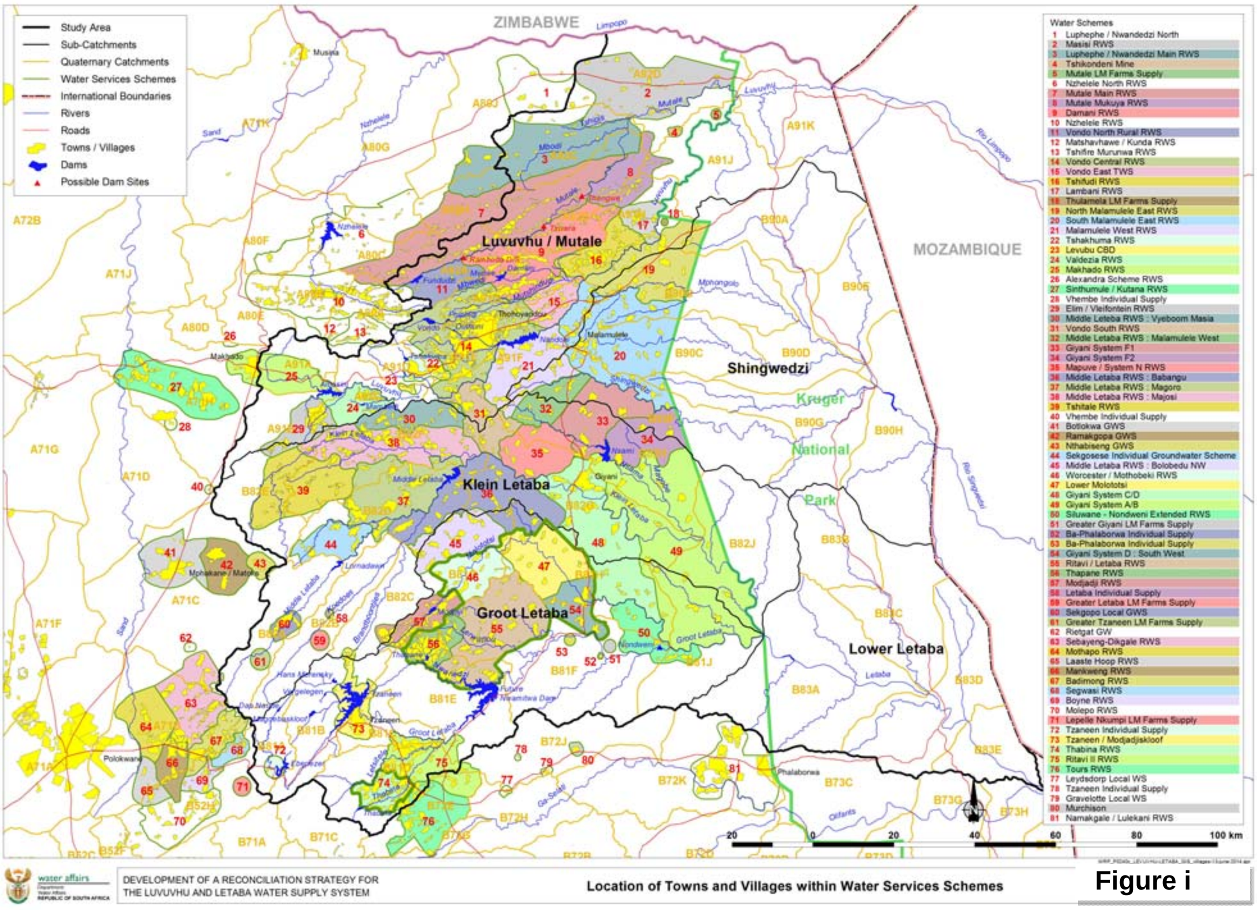
- *Document and describe the current water demands in the main water-use sectors, including irrigation, which is the largest water use sector. In this regard, a comprehensive record of water usage will be determined and documented in the report. The water demand information will take cognisance of the supply from groundwater since some of the areas are supplied from groundwater and opportunities to further develop and utilise groundwater exist in the study area. Details on groundwater resources and related supply and demands will however be documented in a separate report on ground water.*
- *Document and describe the estimated future water requirements until 2040 and the methodology followed to develop the water requirement projections.*
- *Present water conservation and water demand management (WC/WDM) findings in the Irrigation Sector and address the opportunities for potential water savings in the sector through identified WC/WDM strategies.*

Urban/industrial and domestic water requirements: *Population growth estimations and the related economic growth characteristics within the study area formed the basis for the calculation of the urban/industrial and domestic water requirement calculations. Demographic development determinants identified as likely factors to cause different water resource responses: migration, mortality, fertility, and HIV/AIDS, etc. were taken into account as well as* economic development, *as it is impossible for all the smaller settlements and service areas in the study area to grow at the same rate as larger economic nodes such as Tzaneen, Thohoyandou, Giyani and Makhado. The following economic development determinants have been identified as likely factors to cause different water resource responses: Gross Domestic Growth (GDP) growth, employment per sector, and growth relative to other areas.*

For the moderate growth scenario, it is expected that population growth in the study area will largely follow historical growth trends, and a decrease in the overall population growth rate will be evident. Fertility rates will reduce, and mortality rates will remain fairly high. In addition to this, there is continuing out-migration to large economic hubs such as Gauteng, and internal migration exists *from rural areas to urban nodes as people try to access employment and better services. In the moderate growth scenario, economic growth remains relatively low. In the high growth scenario, economic growth will initially be low, but will peak in 20 years after which it will gradually flatten out. There is a large focus on the development of rural areas, and the installation of infrastructure and services will result in declining out-migration to urban areas in search of improved services. Health services are expected to improve, which will result in declining mortality. Urbanisation levels within the study area are expected to decrease, and there is a focus on agriculture, mining and tourism development, especially in rural areas*.

The future urban and rural domestic requirements were based on the high population growth projection in combination with a rapid implementation regarding the increase in levels of service (LOS). This water requirement projection was referred to as the high projection and was used in the water balances for planning purposes.

*A total of 81 of the Water Services Schemes were defined within and close to the study area. These schemes do not necessarily fall within the sub-catchments but in many cases fall within more than one sub-catchment. Some of the schemes located outside the study area (Luvuvhu Letaba catchments) are in fact supplied with water sources from the study area (See **Figure i**)*



Location of Towns and Villages within Water Services Schemes

Figure i

*The urban/industrial and rural domestic water requirements and expected growth until 2040 were determined for each of the water services schemes and are summarised on a sub-catchment basis in **Table i**.*

Table i: Summary of Urban/Industrial & Rural Domestic high growth water requirements

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Groot Letaba								
Surface water	Transfers to Polokwane	20.17	20.17	20.17	20.17	20.17	20.17	20.17
Surface water	Urban/industrial & rural domestic	27.80	31.74	38.80	46.41	50.18	54.03	58.01
Groundwater	Urban/industrial & rural domestic	3.41	3.41	3.41	3.41	3.41	3.41	3.41
Groot Letaba total		**51.38**	**55.32**	**62.38**	**69.99**	**73.76**	**77.61**	**81.59**
Klein and Middle Letaba								
Surface water	Urban/industrial & rural domestic	18.37	22.23	29.17	36.64	39.92	43.29	46.16
Groundwater	Urban/industrial & rural domestic	7.51	7.60	7.77	7.95	8.01	8.08	8.15
Surface water	Middle Letaba Canal losses	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Klein and Middle Letaba total		**29.88**	**33.83**	**40.94**	**48.58**	**51.94**	**55.37**	**58.32**
Luvuvhu and Shingwedzi								
Surface water	Urban/industrial & rural domestic	38.65	44.18	56.65	70.15	75.38	80.73	86.40
Groundwater	Urban/industrial & rural domestic	5.13	5.08	5.08	5.08	5.08	5.08	5.08
Luvuvhu and Shingwedzi total		**43.78**	**49.26**	**61.73**	**75.23**	**80.46**	**85.81**	**91.48**
Mutale								
Surface water	Urban/industrial & rural domestic	2.41	2.78	3.43	4.11	4.56	5.02	5.47
Groundwater	Urban/industrial & rural domestic	2.14	2.14	2.14	2.14	2.14	2.14	2.14
Mutale total		**4.55**	**4.92**	**5.57**	**6.25**	**6.70**	**7.16**	**7.61**
Total Study area								
Surface water	Urban/industrial & rural domestic	111.40	125.10	152.21	181.48	194.21	207.23	220.21
Groundwater	Urban/industrial & rural domestic	18.19	18.23	18.40	18.58	18.64	18.71	18.78
Total Study area		**129.59**	**143.33**	**170.61**	**200.06**	**212.85**	**225.94**	**239.00**

*Most of the industrial water requirements were captured in the water requirement projections as given in **Table i**. There are however a few larger industrial developments in the Groot Letaba catchment requiring 1.73 million m^3/a as well as mining water requirements in the Groot Letaba and Mutale catchments of 2.48 million m^3/a. From current available information no significant growth in the water requirements for these large industrial and mining developments are expected.*

***Irrigation** is the largest water user sector (70%) in the WMAs. Significant irrigation activities occur in the Upper Great Letaba as well as in the Upper Luvuvhu catchments. A wide range of crops are being irrigated in these areas from formal canal and run-of-river Government Water Schemes, farm dams, run-of-river abstractions, and groundwater resources.*

Most of the irrigation information was obtained from the Validation and Verification (V&V) Study (DWA, 2013b), the Water Management Plan for the Luvuvhu Government Water Scheme (DWA, 2012c), and a research paper on the transformation of Irrigation Boards to Water User Associations in South Africa (IWMI, 2004). Results from the validation-component of the (V&V) Study (DWA, 2013b) provided essential information on the current and historical characteristics of irrigation in the Letaba, Luvuvhu and Shingwedzi catchments, which include the extent of cultivated areas, crop types, irrigation systems and associated efficiencies, methodologies for irrigation volume calculations, sources of water and associated return flows.

*The bulk of the irrigation development (56%) is located in the Groot Letaba catchment followed by the Klein/Middle Letaba and Luvuvhu/Shingwedzi catchments with each just over 21% of the total irrigation requirements and less than 1% in the Mutale catchment. (See **Table ii**)*

Almost 30% of the irrigation requirements are met from groundwater resources with the bulk of the groundwater abstractions (73.5%) located in the Groot Letaba and Luvuvhu river catchments.

Table ii: Irrigation demands summary for surface water and groundwater sources in the Luvuvhu/Letaba catchment at 2010 development.

Sub-catchment	***Irrigation Demand (million m^3/a)***		
	Total	***From Surface Water***	***From Ground Water***
Groot Letaba	*256.6*	*206.1*	*50.5*
Klein & Middle Letaba	*98.2*	*62.3*	*35.9*
Letaba Total	***354.8***	***268.4***	***86.4***
Luvuvhu & Shingwedzi	*99.4*	*50.5*	*49.0*
Mutale	*4.4*	*4.4*	*0.0*
Luvuvhu Mutale Total	***103.9***	***54.9***	***49.0***
Total Irrigation	***458.7***	***323.3***	***135.4***

Significant areas of smallholder irrigation were developed during South Africa's previous political dispensation in the so-called black independent states of Venda, Lebowa and Gazankulu. About 60 of these Schemes totalling about 10 000ha exist within the Luvuvhu/Letaba WMA and with a potential irrigation water demand of 81 million m^3/a. Although basic infrastructure and irrigable soils exist for a substantial area of irrigation on these smallholder schemes, only a very small percentage of the area is being effectively utilised at present. Most of them use run-of-river water extracted from weirs by small canals for flood irrigation or direct pumping to storage dams on the schemes. The Limpopo Provincial Department of Agriculture has, over the years, attempted to revitalise many of these schemes in order to stimulate the rural economy of the provinces.

Unfortunately many of these efforts have not been successful for a number of reasons including the very unreliable water supply. Government is still committed to rehabilitate those schemes where a reasonable assurance of supply can be established in the future

In the light of the severe water shortages in all the main sub-catchments, it is highly unlikely that all these schemes will be revitalised. It will be essential that any plans for revitalising schemes be coordinated with the Department of Water Affairs and the water availability assessed in advance.

Based on the water availability and possible future infrastructure developments the revitalising of some of these schemes were however included in the irrigation water requirement growth projection as summarised in ***Table iii.***

Table iii: Expected irrigation water requirement growth until 2040

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Surface water	Irrigation Schemes	135.30	139.70	154.60	157.30	158.80	161.80	163.82
Surface water	Diffuse irrigation	214.80	214.80	214.80	214.80	214.80	214.80	214.80
Groundwater	Diffuse irrigation	135.40	135.40	135.40	135.40	135.40	135.40	135.40
Total Irrigation		**485.50**	**489.90**	**504.80**	**507.50**	**509.00**	**512.00**	**514.02**

Water conservation and water demand management in the irrigation sector*: The severe water shortages and related low assurance of supply to irrigation schemes have been a major incentive for irrigators to maximise irrigation water use efficiency. In the case of commercial irrigation schemes, irrigators have in most cases already improved their irrigation efficiency to get optimal use from the available water. This applies particularly to the large block of commercial irrigators supplied from Tzaneen Dam on the Great Letaba River and irrigators from Albasini Dam on the Luvuvhu River, where the survival strategy in the latter scheme has been to move more and more to groundwater supply.*

In the case of the smallholder irrigation schemes, the assurance of supply has become so low that most schemes in the WMA utilise irrigation water extremely diligently to maximise the benefit from the scarcely available water. This usually takes the form of drastically reduced areas planted (compared to the irrigable areas on the schemes) and sub-optimal application rates.

Nevertheless there are opportunities to improve water use efficiency and to reduce widespread losses and these are outlined below. However in the light of the very low assurance of supply, it is unlikely that any “savings”, resulting from WC/WDM initiatives, will result in significant additional water availability for other uses in the short-to-medium term. Opportunities for irrigation water saving include:

- *Institutional support, DWA should provide support to WUA’s through the promotion and review of Water Management Plans (WMP) and the monitoring of the implementation of these plans. This will have long-term implications to improved water-use efficiency at* *distributor level and at irrigator level.*

- *Upgrading of canals and storage dams on schemes with aged infrastructure is probably the single most important initiative to reduce losses and improve water use efficiency. Potential savings of about 15 million m^3/a are estimated if canals were repaired. However it is unlikely that any significant impact on water resources will be achieved in the short-to-medium term because of financial constraints.*

- *The installation of efficient measuring devices on all regulated irrigation schemes should become a high priority for DWA and WUA/Irrigation Boards, and where possible incentives for farmers to purchase such devices should be sought.*

- *Incentive systems should wherever possible be considered for WUAs and IBs as well as individual farmers to improve water use efficiency and encourage water saving. In the case of irrigators the following options should be addressed by DWA:*

    - *The introduction of sale-by-volume, where effective water measuring devices are available. However, the protection of irrigation water entitlements per farm should be secured.*

  In the case of water suppliers, the following incentive options should be considered by DWA:

    - *Promoting water markets where income from the sale of saved water would be a significant incentive, even though it would not necessarily free-up water for alternative distribution and use.*

- *The purchase of water entitlements (or parts of entitlement) from irrigation farmers by the State, as described in this report, should be considered by DWA.*

- *Unlawful irrigation water use in all three sub-catchments should be addressed with more urgency. The irrigation validation and verification of registered use studies are presently underway in the Luvuvhu/Letaba catchment, but the process is complex and slow. Unless the DWA is seen to be identifying this proliferation and taking the necessary regulatory steps to control it, unregistered water use for irrigation will become difficult to reverse. The problem is exacerbated by the exploitation of groundwater for irrigation which often impacts indirectly on surface water resources.*

***Afforestation**: There are significant commercial forestry activities in the Upper Letaba and Luvuvhu Catchments. The bulk of the afforestation activities occur in the Upper Letaba catchments covering a total area of 414 km^2 and results in a reduction in runoff of approximately 55 million m^3/a. This is followed by the Upper Luvuvhu catchment containing 140km^2 of afforestation developments which reduce the runoff by 20 million m^3/a. A small amount of afforestation is found in the Upper Mutale catchment, just over 23 km^2 with a related reduction in runoff of 4.4 million m^3/a.*

***Invasive Alien Plants**: The highest density of IAPs in the Water Management Area are located in on the main stem of the Groot Letaba River, downstream of Tzaneen Dam and in the lower reaches of the Mutale river. The condensed are covered by IAPs in the Letaba catchments amounts to 135 km^2 which resulted in an estimated reduction in runoff of 9 million m^3/a. The Luvuvhu catchment contains a condensed IAP area of 15.4 km^2 resulting in a runoff reduction of 1.8 million m^3/a. A relative small condensed area (10.6 km^2) of IAPs is found in the Mutale catchment relating to a reduction in runoff of only 0.4 million m^3/a.*

*A summary of the total study area water requirements is given in **Table iv**.*

Table iv: Total Study area Water Requirement Summary

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Total urban/industrial/mining & rural domestic		133.80	147.54	174.82	204.27	217.06	230.15	243.21
Total Irrigation		485.50	489.90	504.80	507.50	509.00	512.00	514.02
Total Water Requirements Study area		**619.30**	**637.44**	**679.62**	**711.77**	**726.06**	**742.15**	**757.23**
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 plants		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 reduction in runoff		**710.10**	**728.24**	**770.42**	**802.57**	**816.86**	**832.95**	**848.03**

The portion of the total water requirement for irrigation however decreases over time from 68% to 61% with the Urban/Industrial/Mining/Rural-domestic increasing from 19% to 29% by 2040. This does not reflect a decrease in irrigation over time, but rather that the Urban/Industrial/Mining/Rural-domestic requirements are increasing at a much higher rate.

The reduction in runoff due to afforestation and IAPs combined amounts to approximately 13% of the total study area water requirement. This should be reduced in future by the removal of invasive alien plants which contributes to just over 12% of the reduction in runoff.

***International Obligations**: The international agreement between South Africa and Mozambique does not specify a minimum flow quantity or quality. South Africa however is party to international policies and protocol and the flow across the border must be reasonable (both in terms of quantity and quality). As part of these international policies and protocol, there are specific provisions in terms of which State Parties shall exchange information and consult each other and, if necessary, negotiate the possible effects of planned measures on the condition of a shared watercourse.*

Depending on the outcome of such possible negotiations, there might be some limitations on development in the RSA, or the minimum flows that need to enter Mozambique. These limitations are currently not known and can impact on the water balances, specifically those relating to the Mutale catchment.

***Recommendations and conclusions**: From the work carried out and data obtained as part of this study task, the following were concluded and recommended*

- *At 2012 development level only 14% of the Urban/Industrial/Mining/Rural-domestic water requirement is supplied from groundwater resources. There is still significant groundwater potential in some areas that should be utilised for this water use sector as the surface water resources are limited and already over utilised in some areas.*

- *At 2012 development level the irrigation sector represents 68% of the total study area water requirement and is expected to increase only by approximately 29 million m^3/a by 2040, as available water resources are very limited. Due to the low assurance of existing surface water resources used for irrigation purposes, some areas started to utilise groundwater resources. At 2012 development level approximately 28% of the irrigation water requirements were already supplied from groundwater resources.*

- *The current irrigation development, crop combinations and irrigation systems used were mainly obtained from the Validation of Water use task and study. The verification study is still underway to verify which of the current irrigation as identified through the validation study, are indeed lawful abstractions. It is of utmost importance that this process be completed and that all unlawful abstractions be eradicated as the water resources in many areas within the study area is already over utilised and in some cases resulted in significant reductions in the yield available from existing dams.*

- *There are uncertainties concerning the development of new irrigation schemes, the revitalising of existing inactive schemes and to what extent existing irrigation allocations that formed part of land claims, will be taken up in future. These need to be clarified, and should take into account the availability of water from the water resources within these affected areas.*

- *No extension off commercial afforestation should be allowed within the study area, as water resources are very limited and in some places already over utilised.*

- *Invasive alien plants need to be removed to increase runoff in the study area by almost 11 million m^3/a. Need to focus on the high impact areas (A91A and A91G) in the Upper Luvuvhu and Mutshindudi a tributary of the Luvuvhu.*

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

Water Requirements and Return Flows

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

Water Requirements and Return Flows

1 INTRODUCTION

1.1 BACKGROUND

The Department of Water Affairs (DWA) has identified the need for the Reconciliation Study for the Luvuvhu-Letaba WMA. The WMA is almost fully developed and demands from the Letaba River currently exceed the yield capability of the system. Regulation for the Letaba is mainly provided by Middle Letaba, Ebenezer and Tzaneen Dams. The recently completed Nandoni Dam located in the Luvuvhu basin will be used in combination with Albasini, Vondo and Damani dams to be managed as one system. It is expected that the total yield from this combined system will be fully utilized by around 2020, considering only the current planned projected demands. The yield of the Albasini Dam has reduced over the years and as a consequence the dam is over allocated. The Shinwedzi 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 urban areas in these catchments are Tzaneen and Nkowakowa in the Groot Letaba River catchment, Giyani in the Klein Letaba River catchment and Thohoyandou and Makhado (Louis Trichardt) in the Luvuvhu catchment. An emergency water supply scheme to transfer water from Nandoni Dam is currently under construction to alleviate the deficits of the stressed Middle Letaba sub-system in the Letaba River basin. Other future developments planned to be supplied from Nandoni Dam will already utilize the full yield available from the Nandoni sub-system by 2021, without supporting Giyani. Supporting Giyani from Nandoni will bring this date forward to approximately 2018

Intensive irrigation farming is practised in the upper parts of the Klein Letaba River catchment (upstream and downstream of the Middle Letaba Dam), the Groot Letaba (downstream of the Tzaneen Dam) and Letsitele Rivers, as well as in the upper Luvuvhu River catchment. Vegetables (including the largest tomato production area in the country), citrus and a variety of sub-tropical fruits such as bananas, mangoes, avocados and nuts are grown. Large areas of the upper catchments have been planted with commercial forests in the high rainfall parts of the Drakensberg escarpment and on the Soutpansberg. The area, particularly the Groot Letaba sub-area, is a highly productive agricultural area with mixed farming, including cattle ranching, game farming, dry land crop production and irrigated cropping. Agriculture, with the irrigation sector in particular, is the main base of the economy of the region. Large scale utilization of the groundwater resource occurs mostly downstream of the Albasini Dam in the Luvuvhu catchment, where it is used by irrigators as well as in the vicinity of Thohoyandou where it is used to supply rural communities. The limited mineral resources in the Luvuvhu basin are dominated by deposits of cooking coal in the northeast near Masisi. In addition to irrigation water supply from the dams in the study area, towns, villages and rural settlements are also supplied with potable water.

DWA and other institutions involved in the management of the water resource and supply systems of the Luvuvhu-Letaba catchments, have in the past carried out various studies on intervention measures to improve the water supply situation. The knowledge base that has been created by these studies provides a sound and essential platform from which the Reconciliation Strategy will be developed. In order to harness this information a Literature Review Report (DWA, 2013) was compiled to summarise the available information in one document and also present a synthesis of the information by highlighting the pertinent aspects of Integrated Water Resource Management that will be assessed and incorporated in the Reconciliation Strategy.

1.2 MAIN OBJECTIVES OF THE STUDY

The main objective of the study is 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 will be 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.

1.3 STUDY AREA

The study area comprises of the water resources of the catchment of the Luvuvhu, Mutale, Letaba and Shingwedzi rivers linked to adjacent systems as indicated by the inter-basin transfers on **Figure 1.1**. This area represents the entire WMA 2 and includes tertiary catchments A91, A92, B81, B82, B83 and B90. Adjacent areas supplying water to this WMA or getting water from this WMA are also part of the study area.

The Luvuvhu-Letaba water management area (WMA) is located in the north-eastern corner of South Africa, where it borders on Zimbabwe in the north and on Mozambique along the eastern side. It falls entirely within the Northern Province, and adjoins the Olifants and Limpopo WMAs to the south and west respectively. The Luvuhu-Letaba WMA forms part of the Limpopo River Basin, an international river shared by South Africa, Botswana, Zimbabwe and Mozambique.

Approximately 35% of the land area of the WMA along the eastern boundary falls within the Kruger National Park. The rivers flowing through the park are of particular importance to the maintenance of ecosystems.

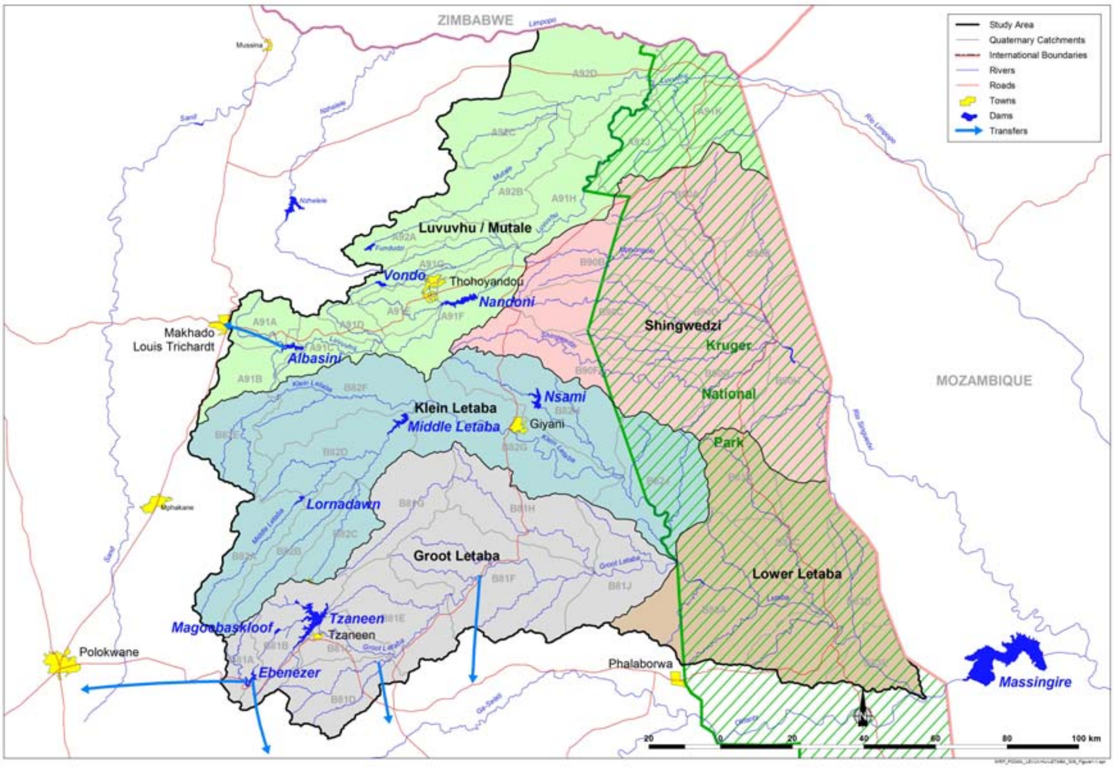


Figure 1.1: Study Area

The confluence of the Luvuvhu and Limpopo rivers forms the common point where South Africa borders on both Zimbabwe and Mozambique. The Shingwedzi River first flows into the Rio des Elephantes (Olifants River) in Mozambique, which then joins the Limpopo River

The two main branches of the Letaba River, the Klein and Groot Letaba, have their confluence on the western boundary of the Kruger National Park. The Letaba River flows into the Olifants River just upstream of the border with Mozambique (**Figure 1.1**).

The topography is marked by the northern extremity of the Drakensberg range and the eastern Soutpansberg, which both extend to the western parts of the water management area, and the characteristic wide expanse of the Lowveld to the east of the escarpment. Climate over the water management area is generally sub-tropical, although mostly semiarid to arid. Rainfall usually occurs in summer and is strongly influenced by the topography.

Along the western escarpment rainfall can be well over 1 000 mm per year, while in the Lowveld region in the eastern parts of the water management area rainfall decreases to less than 300 mm per year and the potential evaporation is well in excess of the rainfall. Grassland and sparse bushveld shrubbery and trees cover most of the terrain, marked by isolated giant Boabab trees.

The geology is varied and complex and consists mainly of sedimentary rocks in the north, and metamorphic and igneous rocks in the south. High quality coal deposits are found near Tsikondeni and in the northern part of the Kruger National Park. The eastern limb of the mineral rich Bushveld Igneous Complex touches on the southern parts of the WMA. With the exception of sandy aquifers in the Limpopo River valley, the formation is of relatively low water bearing capacity. A wide spectrum of soils occurs in the WMA, with sandy soils being most common.

1.4 SYSTEM DESCRIPTION

1.4.1 Current status of Letaba systems

The Letaba River catchment is drained by the Groot Letaba River and its major tributaries are the Klein Letaba, Middle Letaba, Letsitele and Molototsi rivers.

The surface water resources within this sub-catchment are extensively developed with a large number of small to major dams constructed to meet domestic (urban and rural), irrigation and industrial water needs. Faced with water shortages of increasing severity and frequency, the main consumptive users of water have from time to time competed for the limited supplies by taking extraordinary measures to survive. This has resulted in the degradation of the riverine ecosystem. The water resources of the Great Letaba are not sufficient to meet all its requirements all of the time.

1.4.2 Current status of Luvuvhu systems

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

The new Nandoni Dam and Xikundu Weir together with the existing Albasini, Vondo, Phiphidi and Tshakhuma dams 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. Damani, Mambedi and Frank Ravelle dams are also part of the Luvuvhu River System, but are used to supply local water requirements and are therefore managed independently. Mambedi Dam was severely damaged during a flood event and is no longer in use.

The Xikundu / Malamulele sub-system consists of three weirs and respective water works, which are the Mhinga Weir and Treatment Works, Malamulele Weir and Treatment Works and Xikundu Weir and Treatment Works. The sub-system covers the Tshifundi RWS, Lambani RWS, North Malamulele East RWS and South Malamulele East RWS.

Significant irrigation developments from surface and groundwater upstream of Albasini Dam has resulted in a decrease in the yield available from Albasini Dam, to such and extend that the irrigation scheme downstream of Albasini dam can very seldom be supplied with water as the dam struggles to meet the urban/industrial demand of Makhado. The Albasini irrigation scheme now mainly relies on groundwater. As a result of land claims large areas that were previously irrigated are 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.

1.4.3 Current status of Mutale catchment

The Mutale catchment is mostly semi-arid, with the majority of the runoff originating in the south western, wetter part of the catchment. More than 80% of the MAR originates from less than 40% of the catchment area. The flow in the Mutale River is partly regulated by Lake Funduzi (about 20 million m^3 of active storage) in the upper reaches of the river. The water from the Mukumbani Dam in the upper reaches of the Tshirovha River is exported to the Mukumbani Tea Estate. No other significant dams exist in the Mutale catchment. The water resources in the Mutale catchment are still under-utilised as limited development exists in this sub-catchment.

1.5 PURPOSE OF THIS REPORT

The purpose of this report is to:

- **Document and describe the current water demands in the main water-use sectors, including irrigation, which is the largest water use sector**. In this regard, a comprehensive record of water usage will be determined and documented in the report. The water demand information will take cognisance of the supply from groundwater since some of the areas are supplied from groundwater and opportunities to further develop and utilise groundwater exist in the study area. Details on groundwater resources and related supply and demands will however be documented in a separate report on ground water.

- **Document and describe the estimated future water requirements** until 2040 and the methodology followed to develop the water requirement projections.

- **Present water conservation and water demand management (WC/WDM) findings in the Irrigation Sector** and address the opportunities for potential water savings in the sector through identified WC/WDM strategies.

- **Document and describe return flows and their impact on the water balance of the study area.**

2 URBAN/INDUSTRIAL AND RURAL DOMESTIC WATER REQUIREMENT

2.1 METHODOLOGY

Population growth estimations and the related economic growth characteristics within the study area form the basis for the calculation of the urban/industrial and domestic water requirement calculations. The demographic component of this task forms a critical sub-task of the water requirements task and a separate report was prepared on the demographics for the purpose of this study (DWA 2013a).

Based on available statistics, a 2008 base figure was determined to form the starting point for the demographic modelling. The number of households per settlement from the 2008 DWA settlements database was used to determine the base, as this correlates with the 2008 Spot Building Count data. Household sizes were refined for each area based on Census 2001 information and updated knowledge on changes in socio-economic circumstances. The population per settlement was then calculated based on the number of households from the 2008 DWA settlements database and refined household sizes. Calculations were done on a low (settlement) level to enable grouping of settlements into different water schemes. Although possible inaccuracies exist on settlement level due to limited up-to-date data, the information becomes more accurate when grouped on a higher level.

Figure 2.1 below provides a spatial representation of where development is foreseen to be concentrated, based on information sourced from municipal documents and discussions with municipal officials.

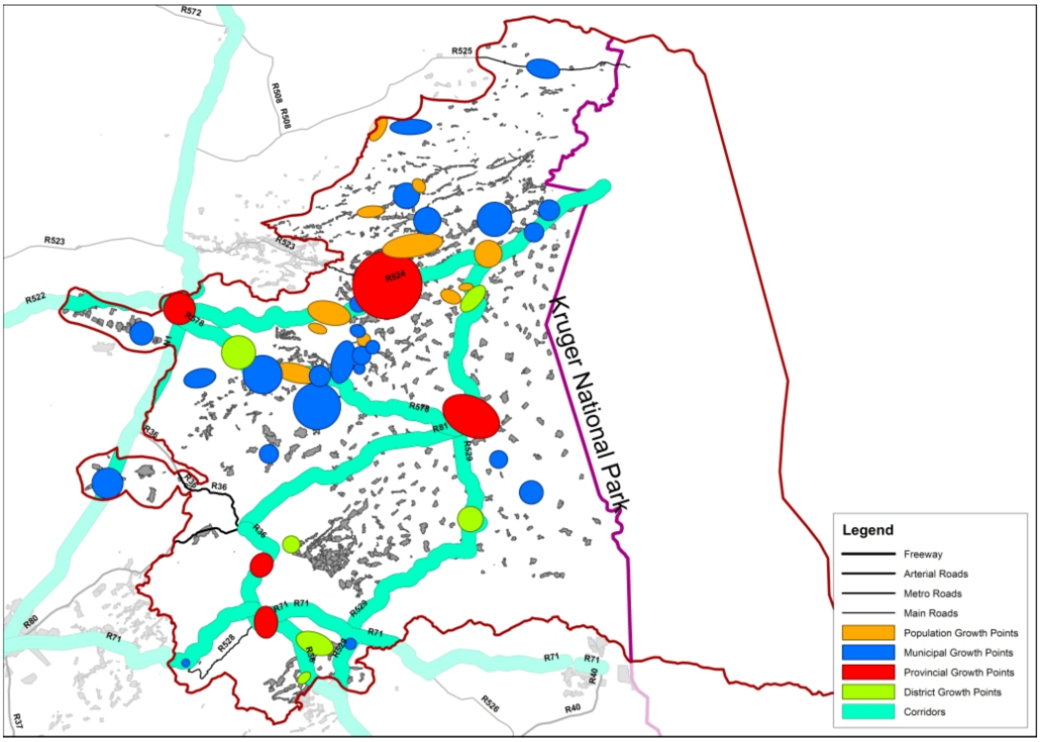
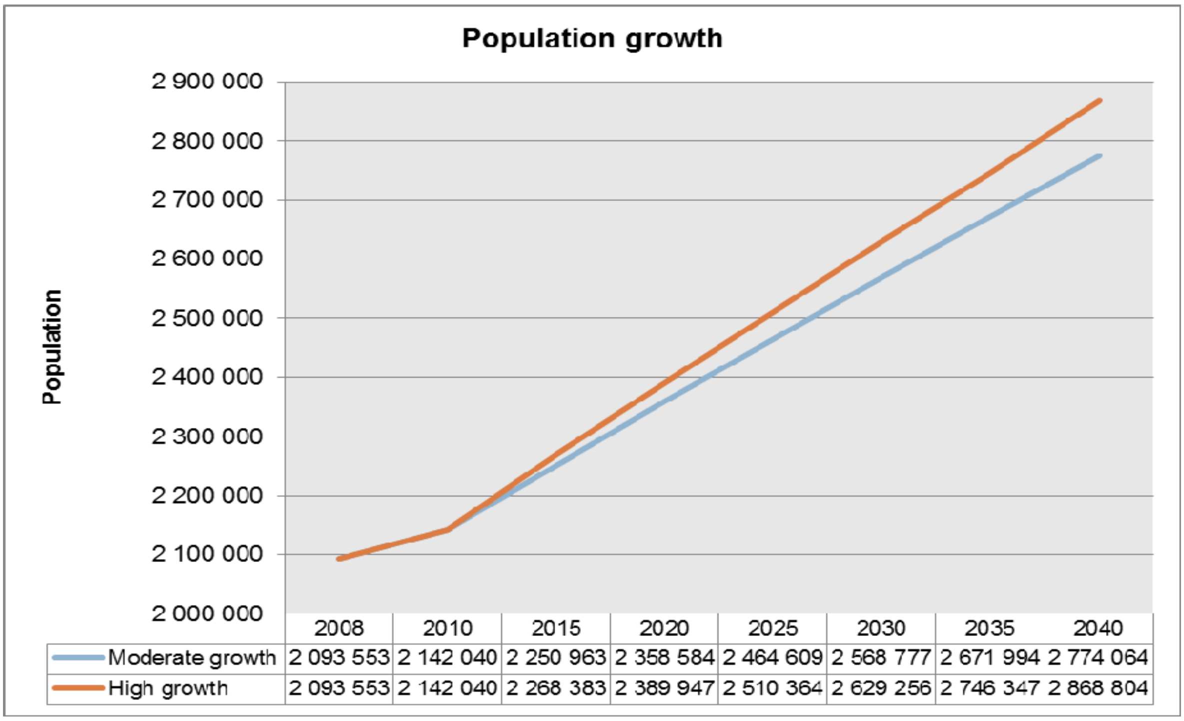


Figure 2-1: Spatial development ***(Source: Kayamandi Development Services, 2012)***

As can be seen from **Figure 2.1**, growth points are mainly concentrated in the north-western portion of the study area, and are mostly located on or near transport routes.

Different growth scenarios for development were determined. The following demographic development determinants have been identified as likely factors to cause different water resource responses: migration, mortality, fertility, and HIV/AIDS, etc. For the moderate growth scenario, it is expected that population growth in the study area will largely follow historical growth trends, and a decrease in the overall population growth rate will be evident. Fertility rates will reduce, and mortality rates will remain fairly high. In addition to this, there is continuing out-migration to large economic hubs such as Gauteng, and internal migration exists from rural areas to urban nodes as people try to access employment and better services. In the moderate growth scenario, economic growth remains relatively low. In the high growth scenario, economic growth will initially be low, but will peak in 20 years after which it will gradually flatten out. There is a large focus on the development of rural areas, and the installation of infrastructure and services will result in declining out-migration to urban areas in search of improved services. Health services are expected to improve, which will result in declining mortality. Urbanisation levels within the study area are expected to decrease, and there is a focus on agriculture, mining and tourism development, especially in rural areas.

The graph a below shows the projected growth of population for the Luvuvhu and Letaba WSS up to 2040 for the moderate and high growth scenarios



	2008	2010	2015	2020	2025	2030	2035	2040
Moderate growth	2 093 553	2 142 040	2 250 963	2 358 584	2 464 609	2 568 777	2 671 994	2 774 064
High growth	2 093 553	2 142 040	2 268 383	2 389 947	2 510 364	2 629 256	2 746 347	2 868 804

Figure 2-2: Population growth in the Luvuvhu and Letaba WSS (2008 to 2040) (**Source: Kayamandi calculations, 2012)**

From the above graph it is evident that the base 2008 population for the Luvuvhu and Letaba WSS was 2 093 553 people. The population for the Luvuvhu and Letaba WSS for 2010 was determined to be 2 142 040 people in both the moderate and the high scenarios, indicating a 1.2% growth between 2008 and 2010 in both growth scenarios. However, from 2015 onwards, there is a distinction in the rate of growth between the two scenarios.

Growth scenarios take economic development also into account, as it is impossible for all the smaller settlements and service areas in the study area to grow at the same rate as larger economic nodes such as Tzaneen, Thohoyandou, Giyani and Makhado, as various factors affect each area according to their individual characteristics. The following economic development determinants have been identified as likely factors to cause different water resource responses: Gross Domestic Growth (GDP) growth, employment per sector, and growth relative to other areas.

In addition to the above, strategic processes and forces such as political, administrative and spatial manifestations, anchor projects, etc. can influence water demand, were taken into account. The economy could grow faster in line with government policies, economic interventions and major projects, or it could show slower growth rates if policy directives and major interventions are not put into action.

The economic growth results were focussed on providing information and an overview of the proposed commercial and industrial land in the study area, as well as the determined take-up and utilisation of this land. This growth forecast provides an indication of the required future land for economic growth and the expected take-up rate and location of developments. Based on the modelling undertaken and the projected future growth in population (and related residential take-up) as well as projected economic growth and economic take-up (comprised of commercial and industrial), the below spatial representation of anticipated future growth is shown in **Figure 2.3**.

Evidently, economic and residential growth and development in the Luvuvhu and Letaba WSS is concentrated in the main economic nodes, such as Tzaneen, Thohoyandou, Makhado, Greater Giyani, Greater Letaba, etc.

The water requirement projections were based on the population projections derived from the above process and the water use categories as developed by DWS: Water Resource Planning Systems. The categories or levels of service (LOS) were updated for the Luvuvhu and Letaba WSS as part of the demographics task. The average water consumption used per water use category (presented in Table 2-1)

Historical water use profiles were consulted, and updated to the present with reference to obtained actual water use and the revised water use categories. Future water use profiles were estimated based on historical trends on the one hand, and on three scenarios of likely changes in service provision based on current service levels, Departmental policies, economic trends and population growth prospects. Water requirement projections were derived according to the projected population (high growth scenario) for the three scenarios below and the most probable scenario was selected as the high scenario for planning purposes according to the areas current LOS:

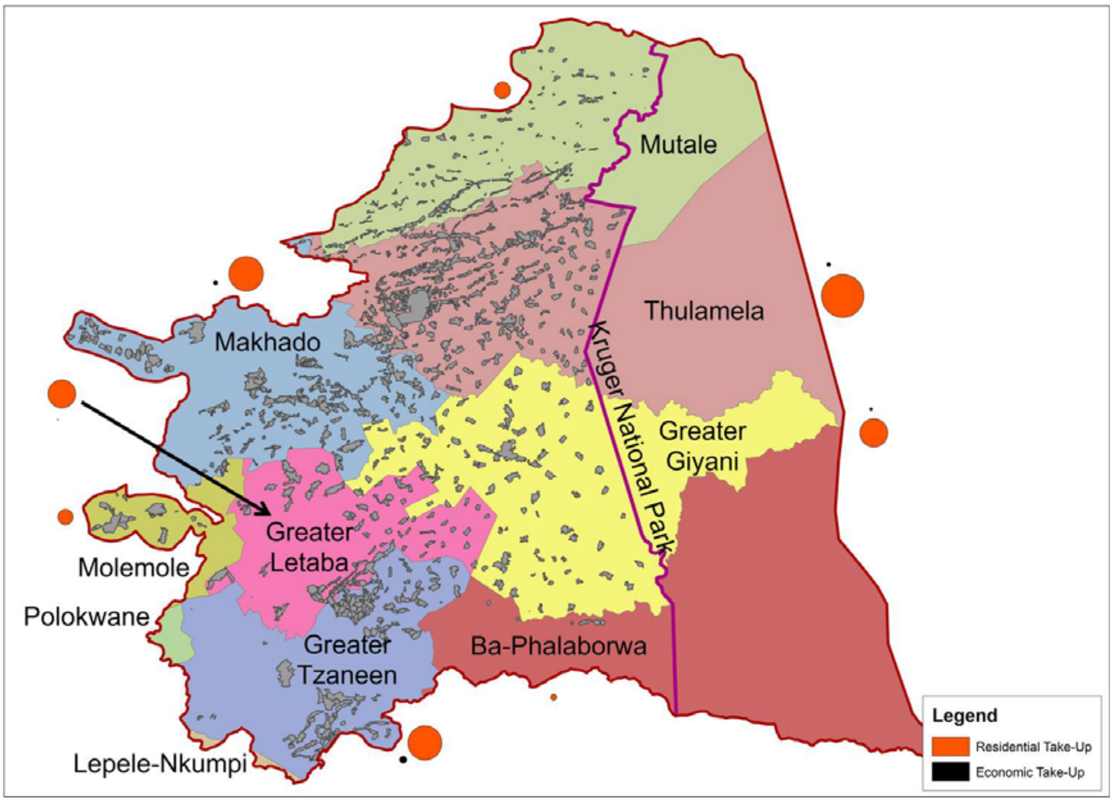


Figure 2-3: Spatial indication of future land take-up per use, 2010-2040 *(Source: Kayamandi Development Services, 2012)*

Scenario 1:

- Level of Service (LOS) assumed to be at a minimum of Residential Low Income for all households by 2025.
- 5% increase in Residential Medium Income by 2025 i.e. people moving up from the Residential Low-Income to the Residential Medium-Income category.
- A further 10% increase in Residential Medium Income by 2040 i.e. people moving up from the Residential Low Income to the Residential Medium Income category (total increase in Residential Medium Income of 15%)

Scenario 2:

- Level of Service (LOS) assumed to be at a minimum of Yard Connection Level for all households by 2025
- 5% increase in Residential Low Income by 2025 i.e. people moving up from Yard Connections to the Residential Low Income Category.

- A further 10% increase in Residential Low Income by 2040 i.e. people moving up from Yard Connections to the Residential Low Income Category (total increase in Residential Low Income of 15%)

Table 2-1: Updated water use categories and per capita use

<table>
<tr><th>Category</th><th colspan="2">Dwelling Type</th><th>Average Unit Consumption (l/c/d)</th></tr>
<tr><td>1</td><td rowspan="3">House Connections</td><td>Low Income</td><td>98</td></tr>
<tr><td>2</td><td>Medium Income</td><td>145</td></tr>
<tr><td>3</td><td>High Income</td><td>280</td></tr>
<tr><td>4</td><td colspan="2">Yard Connections</td><td>55</td></tr>
<tr><td>5</td><td colspan="2">Stand Pipes</td><td>25</td></tr>
<tr><td>6</td><td colspan="2">Informal (Squatter Camps)</td><td>12</td></tr>
<tr><td>7</td><td colspan="2">Shared Services (Back Yard) Dwellers</td><td>40</td></tr>
<tr><td>8</td><td colspan="2">No Services</td><td>12</td></tr>
</table>

Scenario 3:

- Level of Service (LOS) assumed to be at a minimum of Stand Pipes level for all households by 2025
- 5% increase in Yard Connections by 2025 i.e. people moving up from the Stand Pipes to Yard Connections.
- A further 10% increase in Yard Connections by 2040 i.e. people moving up from the Stand Pipes to Yard Connections (total increase in Yard Connections of 15%)
- A theoretical water requirement projection was derived using the average water consumption figures from

- **Scenario 1:**
- **Level of Service (LOS) assumed to be at a minimum of Residential Low Income for all households by 2025.**
- **5% increase in Residential Medium Income by 2025 i.e. people moving up from the Residential Low-Income to the Residential Medium-Income category.**
- **A further 10% increase in Residential Medium Income by 2040 i.e. people moving up from the Residential Low Income to the Residential Medium Income category (total increase in Residential Medium Income of 15%)**
-
- **Scenario 2:**
- **Level of Service (LOS) assumed to be at a minimum of Yard Connection Level for all** households by 2025

5% increase in Residential Low Income by 2025 i.e. people moving up from Yard Connections to the Residential Low Income Category.

A further 10% increase in Residential Low Income by 2040 i.e. people moving up from Yard Connections to the Residential Low Income Category (total increase in Residential Low Income of 15%)

Table 2-1, which were applied to the population estimates split into the water use categories (LOS) for the Luvuvhu and Letaba WSS. The water requirement projections derived from the current (2010) water use information were assessed against the theoretical projection and where no actual recorded water use information was available, the theoretical water requirement projections were adopted.

2.2 DEMAND CENTRE GROUPING AND DEFINITION

The following three district municipalities and local municipalities are partly or fully located within the study area.

- Capricorn District Municipality
    - Lepelle-Nkumpi Local Municipality
    - Molemole Local Municipality

  - Polokwane Local Municipality

- Mopani District Municipality
  - Ba-Phalaborwa Local Municipality
  - Greater Giyani Local Municipality
  - Greater Letaba Local Municipality
  - Greater Tzaneen Local Municipality
- Vhembe District Municipality
  - Makhado Local Municipality
  - Mutale Local Municipality
  - Thulamela Local Municipality

Figure 2.4 shows the location of the district and local municipalities and the slightly extended study area used for the Demographic and Economic Development Potential task that included areas outside the main study area which is also supplied with water from the Luvuvhu and Letaba basins.

The main towns located in the study area are Tzaneen, Giyani, Thohoyandou and Makhodo (Louis Trichardt) and several small towns. Although Polokwane is located outside the main study area it is partly supplied with water from the Groot Letaba basin and was therefore included in this study. Most of the local municipalities are very rural in nature, comprising of many rural villages. The DWA Directorate Water Services has sub-divided the area into several water supply schemes that were used as the basis for the water demand projections developed for this study. The locations of these schemes are shown in **Figure 2.5**. The villages and towns were grouped into these schemes.

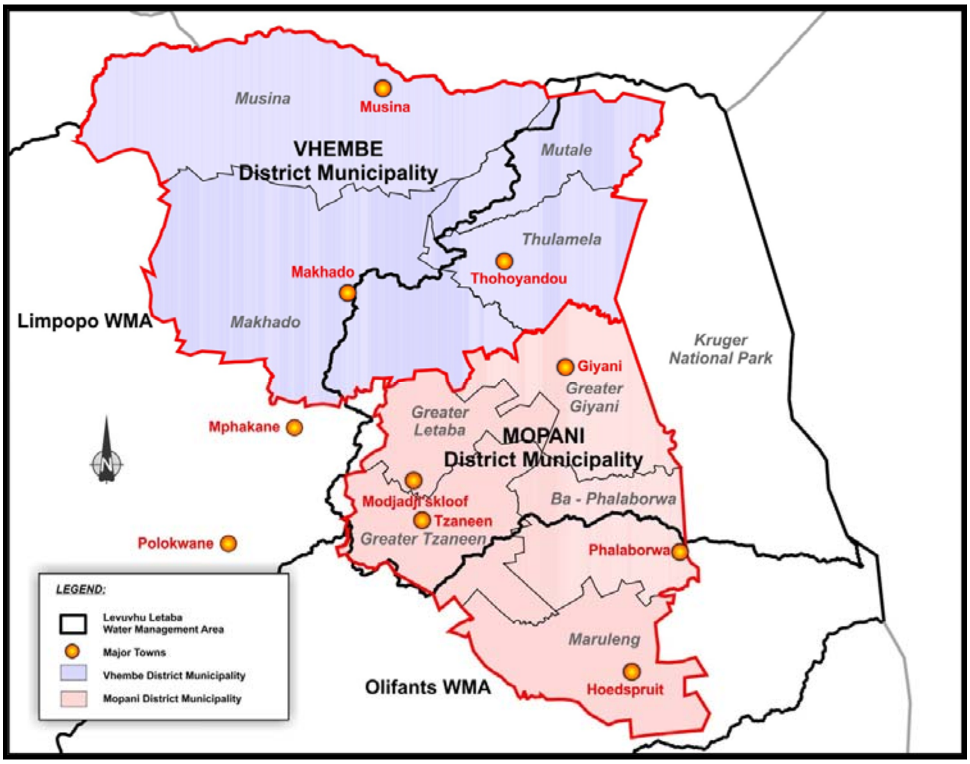


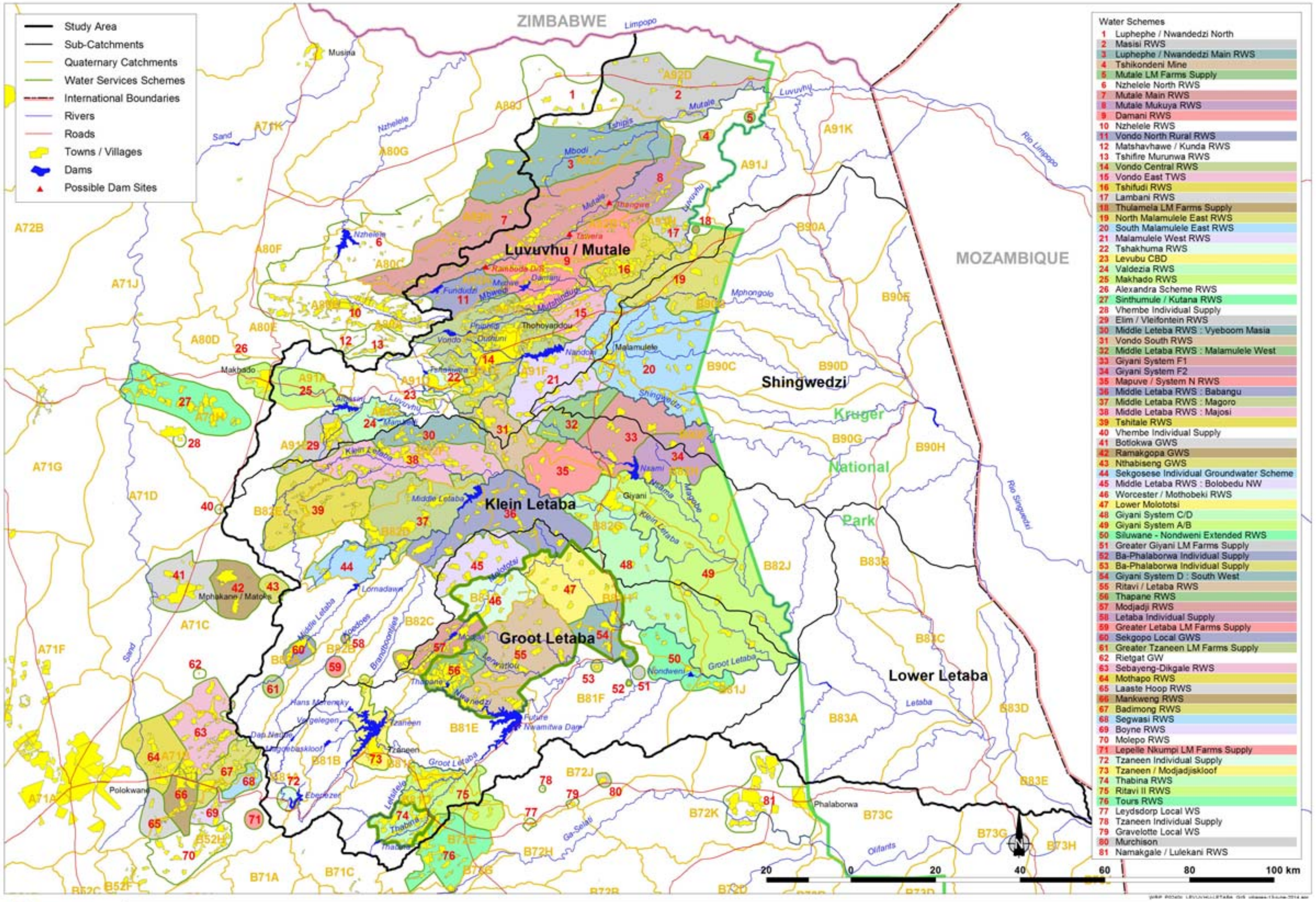
Figure 2-4: Location of District and Local Municipalities

Demand centres such as larger towns with clearly different characteristics than the rest of the users in the scheme, were treated separately for the purpose of determining the water requirements.

A total of 81 of the Water Services Schemes are defined within and close to the study area. These schemes do not necessarily fall within individual sub-catchments but in many cases fall within more than one sub-catchment. Some of the schemes located outside the study area (Luvuvhu Letaba catchments) are in fact supplied with water sources from the study area. (See **Figure 2.5**).

A list of all the Water Services Schemes is given in **Table 2.2** and are grouped per river catchment. Below **Table 2.2** notes are given indicating which of the Schemes are located outside or partly outside the Luvuhu Letaba basin but are supplied with water resources from within the basin.

Information on the current actual water use was obtained from the Validation Study and hydrology related work carried out as part of this study. For the purpose of the hydrology and system analyses it is important to allocate these demands at the point of abstraction to increase the accuracy of the model and to obtain realistic results. It was thus important that the water demands from the validation and hydrology work are aligned with those obtained from the demographic task.



water affairs
Department: Water Affairs
REPUBLIC OF SOUTH AFRICA

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

Location of Towns and Villages within Water Services Schemes

Figure 2.5

Table 2-2: List of Water Services Schemes within and related to the study area

	Sub-catchment	Scheme no.	Scheme Name
	Groot Letaba		
1		73	Tzaneen / Modjadjiskloof
2		72	Haenertsburg (Tzaneen Individual Supply)
3		75	Ritavi ll RWS
4		74	Thabina RWS
5		57	Modjadji RWS
6		46	Worcester / Mothobeki RWS
7		45	Middle Letaba RWS: Bolobedu NW
8		47	Lower Molototsi
9		55	Ritavi / Letaba RWS
10		54	Giyani System D South West
11		50	Siluwane-Nondweni Extended RWS
12		56	Thapane RWS
	Middel & Klein Letaba		
1		49	Giyani System A/B (Partly upper portion only)
2		60	Sekgopo Local GWS
3		44	Sekgosese Individual Ground Water Scheme
4		39	Tshitale RWS
5		30	Middle Letaba RWS: Vyeboom Masia
6		38	Middle Letaba RWS: Majosi
7		37	Middle Letaba RWS: Magoro
8		36	Middle Letaba RWS: Babangu
9		35	Mapuwe / System N RWS
10		32	Middle Letaba RWS: Malamulele West
11		33	Giyani System F1
12		34	Giyani System F2
13		48	Giyani System C/D
14		49	Giyani System A/B
	Shingwedzi		
1		19	North Mamamulele East
2		20	South Mamamulele East
3		21	Mamamulele West (partly only)
4		32	Middle Letaba RWS: Malamulele West (Partly)
5		33	Giyani System F1 (Partly only)
6		34	Giyani System F2 (Partly Only)
	Mutale		
1		2	Masisi RWS
2		3	Luphephe/ Nwandedzi main
3		4	Tshikondeni Mine

	Sub-catchment	Scheme no.	Scheme Name
4		7	#Mutale main RWS
5		8	Mutale Mukuya RWS
	Luvuvhu		
1		9	#Damani RWS
2		11	Vondo North Rural RWS
3		14	Vondo Central RWS
4		15	Vondo East TWS
5		16	Tshifudi RWS
6		17	Lambani RWS
7		19	North Mamamulele East (Partly only)
8		20	South Mamamulele East (Partly only)
9		21	Mamamulele West
10		22	Tshakhuma RWS
11		23	Levubu CBD
12		24	Valdezia RWS
13		25	#Makhado RWS
14		27	*Sinthumule/ Kutana RWS
15		28	*Vhembe Individual Supply
16		29	Elim/Vleifontein RWS
17	WSS in Sand River to	41	*Botlokwa GWS
18	In future be supplied	42	*Ramakgopa GWS
19	From Luvuvhu	43	*Nthabiseng GWS

Notes * - Schemes located outside the catchment but supplied with water resources within the given catchment.
- Schemes located partly outside the given catchment but supplied with water from the given catchment

2.3 CURRENT AND FUTURE WATER REQUIREMENT PROJECTIONS

The future urban and rural domestic requirements were based on the high population growth projection in combination with a rapid implementation of the increase in levels of service (LOS). This water requirement projection was referred to as the high projection and was used in the water balances for planning purposes. The low water requirement projection was also based on the high population growth, but used a gradual implementation for the increase in levels of service.

2.3.1 Water services schemes related to the Groot Letaba catchment

The Polokwane Local Municipality, although located outside the Groot Letaba catchment, receives a considerable portion of its water supply from Dap Naudé and Ebenezer dams located in the Upper Groot Letaba River. The current licenced allocation to Polokwane of 18.52 million m^3/a, comprise of 12 million m^3/a from Ebenezer and 6.52 million m^3/a from

Dap Naudé Dam. Observed data for the transfers from Ebenezer and Dap Naudé dams as obtained from the related DWS dam balances (B8R001 & B8R006) showed an average transfer of 4 million m^3/a from Dap Naudé and 16.2 million m^3/a from Ebenezer Dam over the last 10 to 15 years, thus in total 20.2 million m^3/a. The transfer from Dap Naudé Dam is well below the allocation of 6.52 million m^3/a, but higher than the Dap Naudé Dam yield of approximately 3 million m^3/a. For the purpose of the water requirements it was therefore assumed that 4 million m^3/a will be supplied from Dap Naudé and 16.17 million m^3/a from Ebenezer Dam, which is in line with the actual use from the two dams (**Table 2.3**).

Table 2-3: Groot Letaba WSS high growth water requirement projection

Scheme no	Scheme Name & Source	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
73	Ebenezer Dam	2.32	2.42	2.58	2.74	2.89	3.04	3.20
	Tzaneen dam	1.28	1.28	1.28	1.28	1.28	1.28	1.28
	Magoebaskloof Vergelegen	2.25	2.39	2.62	2.86	3.10	3.35	3.61
	Tzaneen / Modjadjiskloof	**5.85**	**6.09**	**6.48**	**6.88**	**7.27**	**7.67**	**8.09**
Transfer & 72	Dap Naudé Dam #	4.00	4.00	4.00	4.00	4.00	4.00	4.00
	Ebenezer Dam #	16.17	16.17	16.17	16.17	16.17	16.17	16.17
	Polokwane & Haenertsburg	**20.17**	**20.17**	**20.17**	**20.17**	**20.17**	**20.17**	**20.17**
75	Groundwater	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Surface water Groot Letaba River	9.56	11.07	13.81	16.79	18.20	19.65	21.21
	Ritavi II RWS	**10.31**	**11.82**	**14.56**	**17.54**	**18.95**	**20.40**	**21.96**
74	Groundwater	1.05	1.05	1.05	1.05	1.05	1.05	1.05
	Thabina Dam (surface water	3.73	4.63	6.27	8.05	8.71	9.38	10.10
	Thabina RWS	4.78	5.68	7.32	9.10	9.76	10.43	11.15
57 46 47	Modjadji RWS	2.01	2.27	2.73	3.22	3.47	3.73	4.00
	Worcester / Mothobeki RWS	0.65	0.73	0.88	1.04	1.12	1.21	1.29
	Lower Molototsi	0.49	0.55	0.67	0.79	0.85	0.91	0.98
	Total Modjadji Dam Supply area	**3.15**	**3.55**	**4.28**	**5.05**	**5.44**	**5.85**	**6.27**
45	Groundwater	0.44	0.44	0.44	0.44	0.44	0.44	0.44
	Middle Letaba Dam *	0.67	0.84	1.14	1.46	1.61	1.75	1.78
	Middle Letaba RWS: Bolobedu NW	**1.11**	**1.28**	**1.58**	**1.90**	**2.05**	**2.19**	**2.22**
55	Groundwater	0.26	0.26	0.26	0.26	0.26	0.26	0.26
	Surface water Groot Letaba River	2.44	2.71	3.20	3.72	4.04	4.38	4.73
	Ritavi / Letaba RWS	**2.70**	**2.97**	**3.46**	**3.98**	**4.30**	**4.64**	**4.99**
56	Groundwater	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	Thapane dam with support	1.43	1.60	1.90	2.22	2.44	2.66	2.90
	Thapane RWS	**1.73**	**1.90**	**2.20**	**2.52**	**2.74**	**2.96**	**3.20**
54	Groundwater	0.61	0.61	0.61	0.61	0.61	0.61	0.61
	Middle Letaba Nsami Scheme *	0.75	0.95	1.32	1.72	1.90	2.07	2.27
	Giyani System D South West	**1.36**	**1.56**	**1.93**	**2.33**	**2.51**	**2.68**	**2.88**
50	Groundwater	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Surface water Groot Letaba River	0.23	0.29	0.40	0.52	0.56	0.60	0.65
	Siluwane-Nondweni Ext RWS	**0.23**	**0.29**	**0.40**	**0.52**	**0.56**	**0.60**	**0.65**
Total	**Groundwater**	**3.41**	**3.41**	**3.41**	**3.41**	**3.41**	**3.41**	**3.41**
	Surface Water	**47.97**	**51.91**	**58.97**	**66.58**	**70.35**	**74.20**	**78.18**
	Total	**51.38**	**55.32**	**62.38**	**69.99**	**73.76**	**77.61**	**81.59**

Notes: # - Water transferred to demand centres outside the catchment (Polokwane)
*- Surface water support from water resources outside the Groot Letaba catchment

All the other Water Services Schemes (WSS) receiving water from the Groot Letaba River catchment are located in the catchment and are together with the Polokwane transfers listed in **Table 2.3,** showing current and expected future water requirements for the high growth scenario. Most of these WSS utilise surface as well as groundwater resources as shown in **Table 2.3**.

Two of the WSS, although located within the Groot Letaba catchment, in fact receives water from neighbouring catchments. These are, the Middle Letaba RWS: Bolobedu NW and the Giyani System D South West WSS receiving water from resources in the Middle Letaba and Klein Letaba catchments.

For the purpose of the groundwater water requirements projections, it was assumed that the volume currently supplied from groundwater will remain the same in future, and that the growth in the water requirements will be supplied from surface water. The only exception was when a specific WSS is currently only using groundwater as its resource, it was then assumed that future growth in water requirements will still be supplied from only the groundwater resources. This will not necessarily reflect the true utilisation of future resources used, but will however be addressed when the water balances were carried out after the completion of the yield results from the different resources.

Almost 7% of the urban and rural domestic requirements within the Groot Letaba catchment is supplied from groundwater and just over 93% from surface water resources at 2012 development level.

2.3.2 Water services schemes related to the Klein and Middle Letaba catchment

There are a total of 14 different WSS within the Klein and Middle Letaba catchments with 29% of the total 2012 water requirement supplied from groundwater and 71% from surface water. Details of the current and projected water requirements are given in **Table 2.4.**

Several of the WSS are located partly in the Groot Letaba catchments as well as in the Shingwedzi River catchment. These schemes however receives their water from the Klein and Middle Letaba catchment water resources as indicated in **Table 2.4.**

Table 2-4: Klein and Middle Letaba WSS high growth water requirement projection

Scheme no	Scheme Name	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
60	Groundwater	0.24	0.30	0.43	0.56	0.59	0.63	0.67
	Sekgopo Local GWS	**0.24**	**0.30**	**0.43**	**0.56**	**0.59**	**0.63**	**0.67**
44	Groundwater	0.25	0.27	0.31	0.36	0.39	0.42	0.45
	Sekgosese Individual GW Scheme	**0.25**	**0.27**	**0.31**	**0.36**	**0.39**	**0.42**	**0.45**
39	Groundwater	0.44	0.44	0.44	0.44	0.44	0.44	0.44
	Surface Water (new resource)	0.45	0.54	0.70	0.87	0.98	1.09	1.21
	Tshitale RWS	**0.89**	**0.98**	**1.14**	**1.31**	**1.42**	**1.53**	**1.65**
29	Groundwater	0.48	0.48	0.48	0.48	0.48	0.48	0.48
	Surface Water Middle Letaba Dam #	2.06	2.44	3.13	3.87	4.20	4.54	4.61
	Elim/Vleifontein	**2.54**	**2.92**	**3.61**	**4.35**	**4.68**	**5.02**	**5.09**
30	Groundwater	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	Surface Water Middle Letaba Dam	0.37	0.48	0.69	0.92	1.02	1.12	1.23
	Middle Letaba RWS: Vyeboom Masia	**0.77**	**0.88**	**1.09**	**1.32**	**1.42**	**1.52**	**1.63**
38	Groundwater	0.88	0.88	0.88	0.88	0.88	0.88	0.88
	Surface Water Middle Letaba Dam	1.31	1.64	2.24	2.88	3.16	3.45	3.76
	Middle Letaba RWS: Majosi	**2.19**	**2.52**	**3.12**	**3.76**	**4.04**	**4.33**	**4.64**
37	Groundwater	1.05	1.05	1.05	1.05	1.05	1.05	1.05
	Surface Water Middle Letaba Dam	0.85	1.14	1.65	2.21	2.46	2.71	2.76
	Middle Letaba RWS: Magoro	**1.90**	**2.19**	**2.70**	**3.26**	**3.51**	**3.76**	**3.81**
36	Groundwater	0.51	0.51	0.51	0.51	0.51	0.51	0.51
	Surface Water Middle Letaba Dam	1.23	1.49	1.96	2.47	2.69	2.92	2.97
	Middle Letaba RWS: Babangu *	**1.74**	**2.00**	**2.47**	**2.98**	**3.20**	**3.43**	**3.48**
35	Groundwater	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	Surface Water Middle Letaba Dam	0.34	0.48	0.72	0.98	1.06	1.14	1.22
	Mapuwe / System N RWS	**0.51**	**0.65**	**0.89**	**1.15**	**1.23**	**1.31**	**1.39**
32	Groundwater	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Surface Water Middle Letaba Dam	0.25	0.30	0.40	0.50	0.55	0.59	0.65
	Middle Letaba RWS: Malamulele West $	**0.36**	**0.41**	**0.51**	**0.61**	**0.66**	**0.70**	**0.76**
33	Groundwater	0.23	0.23	0.23	0.23	0.23	0.23	0.23
	Middle Letaba Nsami dams	0.78	0.94	1.21	1.51	1.64	1.77	1.91
	Giyani System F1 $	**1.01**	**1.17**	**1.44**	**1.74**	**1.87**	**2.00**	**2.14**
34	Groundwater	0.28	0.28	0.28	0.28	0.28	0.28	0.28
	Middle Letaba Nsami dams	0.19	0.26	0.38	0.52	0.58	0.64	0.71
	Giyani System F2 $	**0.47**	**0.54**	**0.66**	**0.80**	**0.86**	**0.92**	**0.99**
48	Groundwater	1.97	1.97	1.97	1.97	1.97	1.97	1.97
	Middle Letaba Nsami dams	8.41	9.98	12.80	15.85	17.19	18.56	20.02
	Giyani System C/D *	**10.38**	**11.95**	**14.77**	**17.82**	**19.16**	**20.53**	**21.99**
49	Groundwater	0.51	0.51	0.51	0.51	0.51	0.51	0.51
	Middle Letaba Nsami dams	2.15	2.55	3.27	4.05	4.40	4.75	5.12
	Giyani System A/B *	**2.66**	**3.06**	**3.78**	**4.56**	**4.91**	**5.26**	**5.63**
Total	**Groundwater**	**7.51**	**7.60**	**7.77**	**7.95**	**8.01**	**8.08**	**8.15**
	Surface Water	**18.37**	**22.23**	**29.17**	**36.64**	**39.92**	**43.29**	**46.16**
	Total	**25.88**	**29.83**	**36.94**	**44.58**	**47.94**	**51.37**	**54.32**

Notes: * - Scheme is located partly in Groot Letaba catchment but receives surface water from Klein Letaba
$ - Scheme is located partly in Shingwedzi but receives surface water from Klein Letaba
# - Scheme will in future receive support from Nandoni Dam

2.3.3 Water services schemes related to the Luvuvhu and Shingwedzi catchments

The Luvuvhu River catchment (Mutale excluded) contains the highest number (19) of WSS of which five (WSS 41, 42, 43, 27, 28) are located outside the Luvuvhu catchment in the Sand River catchment, but will in the near future receive water from Nandoni Dam (see **Table 2.5**).

Three of the WSS (19, 20, 21) located in both the Shingwedzi and Luvuvhu catchment receives water from the Luvuvhu River. Another two WSS (9, 11) are located mainly in the Mutale River Catchment and are currently receiving water from the Luvuvhu River catchment.

Table 2-5: Luvuvhu WSS high growth water requirement projection

Scheme no	Scheme Name	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
9	Groundwater	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	Surface Water Damani Dam $	2.51	3.51	5.31	7.25	7.77	8.30	8.86
	Damani RWS	**2.86**	**3.86**	**5.66**	**7.60**	**8.12**	**8.65**	**9.21**
11	Groundwater	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Vondo Dam &	0.11	0.13	0.15	0.18	0.20	0.22	0.24
	Vondo North Rural RWS	**0.11**	**0.13**	**0.15**	**0.18**	**0.20**	**0.22**	**0.24**
14	Groundwater	0.14	0.14	0.14	0.14	0.14	0.14	0.14
	Vondo & Phiphidi & Nandoni dams	15.66	18.02	22.37	27.15	28.96	30.82	32.80
	Vondo Central RWS	**15.80**	**18.16**	**22.51**	**27.29**	**29.10**	**30.96**	**32.94**
15	Groundwater	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	Vondo & Phiphidi & Nandoni dams	0.39	0.44	0.52	0.61	0.67	0.74	0.81
	Vondo East RWS	**0.43**	**0.48**	**0.56**	**0.65**	**0.71**	**0.78**	**0.85**
16	Groundwater	0.27	0.27	0.27	0.27	0.27	0.27	0.27
	Nandoni Dam lower Luvuvhu	0.93	1.03	1.22	1.41	1.56	1.71	1.87
	Tshifudi RWS	**1.20**	**1.30**	**1.49**	**1.68**	**1.83**	**1.98**	**2.14**
17	Groundwater	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Nandoni Dam lower Luvuvhu	0.23	0.27	0.34	0.41	0.46	0.51	0.56
	Lambani RWS	**0.23**	**0.27**	**0.34**	**0.41**	**0.46**	**0.51**	**0.56**
19	Groundwater	0.16	0.16	0.16	0.16	0.16	0.16	0.16
	Nandoni Dam lower Luvuvhu *	3.48	4.35	5.91	7.58	8.08	8.59	9.13
	North Mamamulele East	**3.64**	**4.51**	**6.07**	**7.74**	**8.24**	**8.75**	**9.29**
20	Groundwater	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Nandoni Dam lower Luvuvhu *	4.12	5.03	6.69	8.47	9.05	9.64	10.27
	South Mamamulele East	**4.23**	**5.14**	**6.80**	**8.58**	**9.16**	**9.75**	**10.38**
21	Groundwater	0.21	0.21	0.21	0.21	0.21	0.21	0.21
	Nandoni Dam *	0.89	1.00	1.19	1.39	1.51	1.64	1.78
	Mamamulele West	**1.10**	**1.21**	**1.40**	**1.60**	**1.72**	**1.85**	**1.99**
22	Groundwater	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	Tshakuma Dam	1.51	1.65	1.90	2.16	2.36	2.56	2.77
	Tshakhuma RWS	**1.68**	**1.82**	**2.07**	**2.33**	**2.53**	**2.73**	**2.94**
23	Groundwater	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	Nandoni Dam	0.03	0.06	0.07	0.09	0.11	0.13	0.15
	Levubu CBD WS	**0.10**	**0.13**	**0.14**	**0.16**	**0.18**	**0.20**	**0.22**

Scheme no	Scheme Name	Water Requirements (million m³/a)						
		2012	2015	2020	2025	2030	2035	2040
24	Groundwater	0.31	0.31	0.31	0.31	0.31	0.31	0.31
	Nandoni Dam	0.02	0.05	0.10	0.15	0.19	0.23	0.27
	Valdezia RWS	**0.33**	**0.36**	**0.41**	**0.46**	**0.50**	**0.54**	**0.58**
25	Groundwater	1.20	1.20	1.20	1.20	1.20	1.20	1.20
	Albasini & Nandoni dams	2.51	2.68	2.96	3.24	3.42	3.60	3.79
	Makhado RWS	**3.71**	**3.88**	**4.16**	**4.44**	**4.62**	**4.80**	**4.99**
27	Groundwater	0.94	0.94	0.94	0.94	0.94	0.94	0.94
	Albasini & Nandoni dams #	2.64	2.95	3.49	4.05	4.47	4.89	5.34
	Sinthumule/Katana RWS	**3.58**	**3.89**	**4.43**	**4.99**	**5.41**	**5.83**	**6.28**
28	Groundwater	0.28	0.28	0.28	0.28	0.28	0.28	0.28
	Albasini & Nandoni dams #	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	Air force Base	**0.58**	**0.58**	**0.58**	**0.58**	**0.58**	**0.58**	**0.58**
31	Groundwater	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	Vondo & Phiphidi & Nandoni dams	1.38	1.66	2.18	2.73	2.92	3.11	3.32
	Vondo South RWS	**1.43**	**1.71**	**2.23**	**2.78**	**2.97**	**3.16**	**3.37**
41, 42, 43	Groundwater	0.83	0.83	0.83	0.83	0.83	0.83	0.83
	Nandoni Dam #	1.93	2.72	4.15	5.71	6.28	6.86	7.47
	Matoks (Botlokwa, Nthabiseng, Ramakgopa)	**2.76**	**3.55**	**4.98**	**6.54**	**7.11**	**7.69**	**8.30**
Total	**Groundwater**	**5.13**	**5.08**	**5.08**	**5.08**	**5.08**	**5.08**	**5.08**
	Surface Water	**38.65**	**44.18**	**56.65**	**70.15**	**75.38**	**80.73**	**86.40**
	Total	**43.78**	**49.26**	**61.73**	**75.23**	**80.46**	**85.81**	**91.48**

Notes: $ - Scheme is located partly in Mutale catchment but receives surface water from Luvuvhu
* - Scheme is located partly in Shingwedzi catchment but receives surface water from Luvuvhu
# - Scheme is located or partly in Sand River catchment but will receive surface water from Nandoni Dam in future

Almost 12% of the total 2012 water requirements listed in **Table 2.5** is supplied from groundwater, with just over 88% from surface water. It is important to note that not all the schemes listed in **Table 2.5** are currently supplied from the Luvuvhu. When these WSS (41, 42, 43, 27, 28) are excluded from the calculation the groundwater supply portion reduce to just over 8% with the remainder from surface water.

2.3.4 Water services schemes related to the Mutale catchment

The Mutale River catchment contains the smallest number (5) of WSS although two schemes currently supplied from the Luvuvhu catchment in fact is mostly located in the Mutale catchment. These include the Vondo North Rural Water Scheme and the Damani Rural Water Scheme.

The use of groundwater resources is very important in this catchment with 47% (**Table 2.6**) of the total domestic requirement dependent on this resource. The remaining 53% receives water from the river streams without any significant storage, which in general result in a low assurance of supply to these users.

Table 2-6: Mutale River WSS high growth water requirement projection

Scheme no	Scheme Name	Water Requirements (million m^3/a)						
		2012	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
2	Groundwater	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	Mutale possible Dam	0.03	0.07	0.15	0.23	0.29	0.34	0.40
	Masisi RWS	**0.53**	**0.57**	**0.65**	**0.73**	**0.79**	**0.84**	**0.90**
3	Groundwater	0.77	0.77	0.77	0.77	0.77	0.77	0.77
	Mutale possible Dam	0.07	0.17	0.35	0.53	0.64	0.76	0.88
	Luphephe / Nwanedzi Main RWS *	**0.84**	**0.94**	**1.12**	**1.30**	**1.41**	**1.53**	**1.65**
4	Groundwater	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	Mutale possible Dam	0.49	0.49	0.49	0.49	0.49	0.49	0.49
	Tshikondeni Coal mine	**0.55**	**0.55**	**0.55**	**0.55**	**0.55**	**0.55**	**0.55**
7	Groundwater	0.70	0.70	0.70	0.70	0.70	0.70	0.70
	Mutale possible Dam	1.63	1.83	2.18	2.54	2.80	3.06	3.30
	Mutale Town *	**2.33**	**2.53**	**2.88**	**3.24**	**3.50**	**3.76**	**4.00**
8	Groundwater	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Mutale possible Dam	0.19	0.22	0.26	0.30	0.34	0.37	0.41
	Mutale Mukuya RWS	**0.30**	**0.33**	**0.37**	**0.41**	**0.45**	**0.48**	**0.52**
Total	**Groundwater**	**2.14**	**2.14**	**2.14**	**2.14**	**2.14**	**2.14**	**2.14**
	Surface Water	**2.41**	**2.78**	**3.43**	**4.11**	**4.56**	**5.02**	**5.47**
	Total	**4.55**	**4.92**	**5.57**	**6.25**	**6.70**	**7.16**	**7.61**

Notes: * - Scheme is located partly in Nzhelele catchment but receives surface water from Mutale

2.4 RETURN FLOWS

There is limited information on return flows in all water-use sectors and limited planning in relation to wastewater use within the WMA. Only three local municipalities have information on return flows. The Makhado Local Municipality plans to re-use effluent from their wastewater treatment works as an added source of water from 2015 onwards, with estimates of 1.33 million m^3/a for 2015, 1.45 million m^3/a for 2020, 1.58 million m^3/a for 2025 and 1.7 million m^3/a for 2030. However there is no mention on how and where they intend re-using the wastewater. For more detail on the Urban/Industrial and rural domestic return flows the reader is referred to the Water Re-use Report produced as one of the deliverables from this study (DWA 2013c).

The Greater Tzaneen Local Municipality indicated that a total volume of 5.217 million m^3/a is discharged from all the wastewater treatment works into the resource. There is no mention on the intentions of re-using the water. Greater Giyani Local Municipality indicated that a total volume of waste water received and treated is 0.95 million m^3/a. The treated effluent is not recycled and 0.8 million m^3/a of effluent is discharged into the Klein Letaba River.

The assessment of wastewater treatment works in the Luvuvhu/Letaba WMA indicated the following:

- Most municipalities in this area do not measure the volume of effluent entering the

WWTW or that discharged as treated effluent;

- In all cases where data was available, the effluent discharged is also of poor quality with high nutrients and faecal contamination; and

- There are areas of water deficit where treated wastewater could be considered for agricultural or limited urban use.

3 INDUSTRIAL AND MINING REQUIREMENTS

3.1 MINING WATER REQUIREMENTS

The Mutale Local Municipality is rich in mineral resources, with copper reserves close to Makuya; diamond reserves near Mangwele; coal reserves at Sanari, Mukomawabani and Pafuri; and magnesite in Tshipise. The Tshikondeni coal mine is the largest mine in the area, and is located in the Tshipise coal field which stretches from east to west along the northern half of the municipal area. Promising coal reserves are located directly south of the Tshikondeni mine, but no conclusive expansions are in the pipeline. There is however a number of diamond and coal mines that have closed down in the area. Tshikondeni is an underground coal mine that started operations in 1984, the mine employs 770 people and currently produces 414ktpa of premium hard coking coal. Tshikondeni mine obtains its water from Unwa Dam (since 1998) and boreholes of which 0.55 million m^3/a is from the dam and 0.06 million m^3/a from boreholes. Unwa Dam is an off-channel storage dam on the Mutale River with a capacity of 0.2 million m^3.

Ba-Phalaborwa Local Municipality has the highest concentration of minerals in the Mopani District, and the mining and quarrying sector is subsequently a major contributor to the local economy. The most mined resources in the municipal area are copper and phosphate in the Phalaborwa area, with gold and antimony in the Murchison Greenstone Belt which stretches from Tzaneen in an easterly direction. Phalaborwa Mining Company, situated close to Phalaborwa but outside the study area, operates South Africa's largest copper mine. Most of the finished copper product is for local consumption, while most of the vermiculite is exported. Phalaborwa is the only producer of refined copper in South Africa and supplies the country with the majority of its copper needs. Consolidated Murchison Mine (Metorex Group), situated at Gravelotte close to Phalaborwa is located on the single largest antimony ore-body known in the world, having produced in excess of nine million tons of high-grade stibnite ore. Gold is produced at Consolidated Murchison as a coproduct of antimony. Significant amounts of zinc and copper have also been mined from the Murchison Greenstone Belt by the Maranda and Ramotshidi mines. The Consolidated Murchison Gold Mine has an allocation of 1.75 million m^3/annum and the Maranda Mining Co an allocation of 0.12 million m^3/annum from Tzaneen Dam.

The Makhado Local Municipality is not characterised by any major form of mining activity, the potential for mining exists, especially to the north of the Soutpansberg. In terms of the mentioned mining potential, the Mopane coal field occurs in the study area, and stretches in an east-west direction to the north of the Soutpansberg. The Makhado Project situated near Makhado is owned by Coal of Africa. The project plan foresees a production of five million tons of coking coal per year.

In the Greater Giyani Local Municipality the Giyani Greenstone Belt is known to host gold deposits, but is not currently being exploited. The Greenstone Belt holds the potential to still host significant shallow deposits.

3.2 INDUSTRIAL WATER REQUIREMENTS

Most of the industrial water requirements are captured in the urban/industrial requirements of the larger towns in the study area such as Tzaneen, Giyani, Louis Trichardt/Makhado and Thohoyandou as well as in the transfers to Polokwane.

Releases are made from Tzaneen Dam for industrial purposes located downstream of the dam along the Groot Letaba River. These include the Koedoe co-operative, Northern canners, Letaba Citrus Processors and Consolidated Citrus Containers, with a total water requirement of 1.73 million m^3/a. No or very limited growth is expected in the water requirements of this industrial development.

4 IRRIGATION WATER REQUIREMENTS AND RETURN FLOWS

4.1 CURRENT IRRIGATION WATER USE

4.1.1 Introduction

Irrigation is the largest water user sector (70%) in the WMAs. Significant irrigation activities occur in the Upper Great Letaba as well as in the Upper Luvuvhu catchments. A wide range of crops are being irrigated in these areas from formal canal and run-of-river Government Water Schemes, farm dams, run-of-river abstractions, and groundwater resources. The location of the main irrigation developments is shown in **Figure 4.1**.

The main crops grown under irrigation by commercial farmers in the WMAs include sub-tropical orchard crops (48%) such as citrus, banana, macadamia nut and litchi and high-value annual vegetable crops (40%) such as tomato, cabbage and butternut. Tomato makes up 50% of the total vegetable production in the catchment.

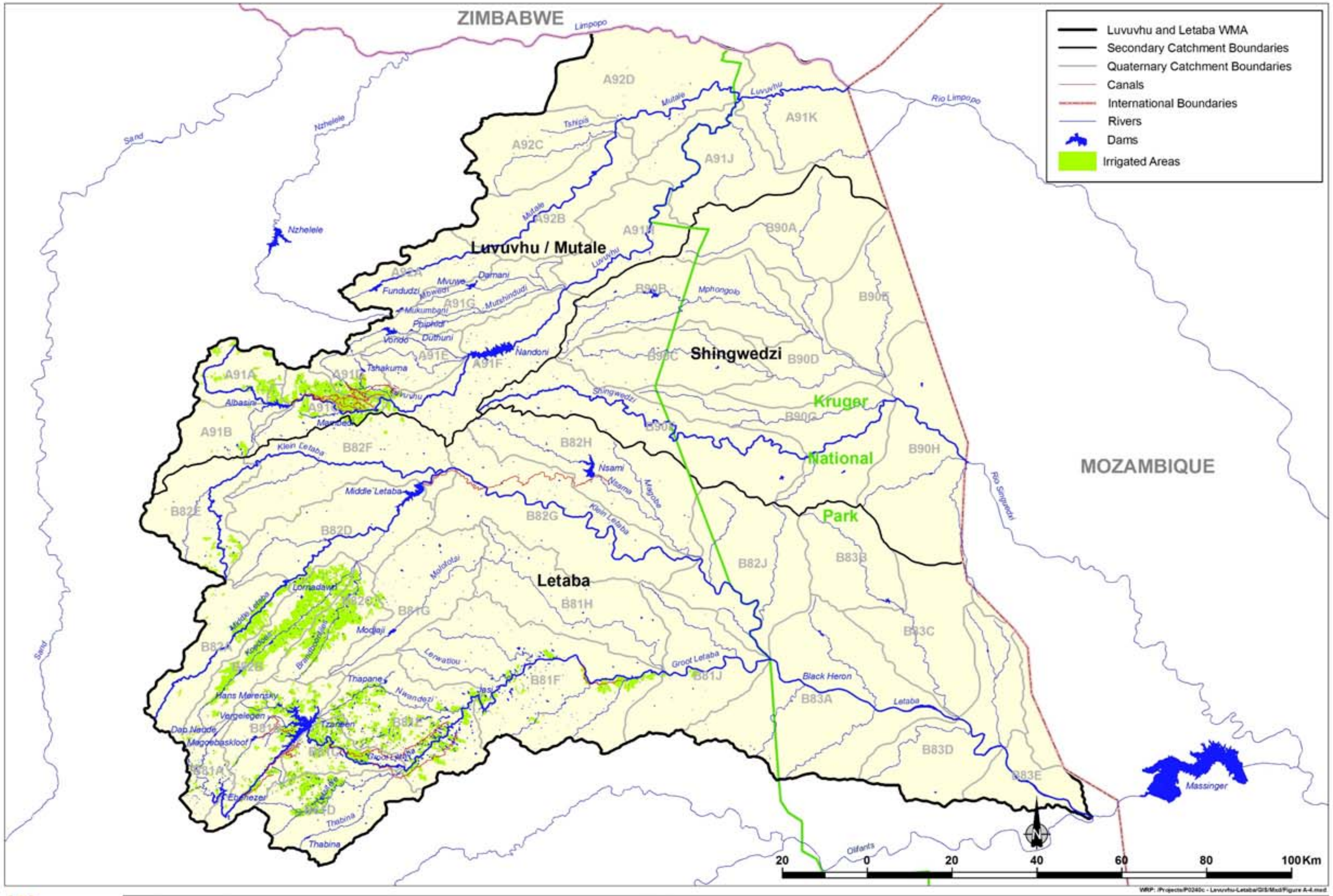
The main crops grown on the smallholder irrigation schemes are vegetable crops such as cabbage, tomato, sweet potato, and field crops such as maize, chilli and dry bean.

Detailed information was obtained from the Validation and Verification (V&V) Study (DWA, 2013b), the Water Management Plan for the Luvuvhu Government Water Scheme (DWA, 2010), and a research paper on the transformation of Irrigation Boards to Water User Associations in South Africa (IWMI, 2004).

Results from the validation-component of the (V&V) Study (DWA, 2013b) provided essential information on the current and historical characteristics of irrigation in the Letaba, Luvuvhu and Shingwedzi catchments, which include the extent of cultivated areas, crop types, irrigation systems and associated efficiencies, methodologies for irrigation volume calculations, sources of water and associated return flows. Detailed information regarding allocations and canal infrastructure capacities were also obtained from the V&V Study. The DWA, Water Use Efficiency Directorate study (DWA 2010) on “The Development of a Comprehensive Water Conservation and Water Demand Management Strategic Business Plan for the Luvuvhu-Letaba Water Management Area” provided valuable base information on irrigation water-use efficiencies and WC/WDM issues.

4.1.2 Groot Letaba irrigation

The catchment: The Groot Letaba River receives its head waters from the mountain escarpment around the Tzaneen area. The Groot Letaba River together with its major tributaries the Klein Letaba, Middle Letaba, Letsitele and Molototsi River form the Letaba River catchment are the main surface water resources feeding into several large medium and smaller dams from where water is supplied to the users.



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

Irrigated Areas, Canals and Farm Dams

Figure 4.1

The topography of the Letaba is characterized by mountains and hills with the highest elevation of more than 2000m above sea level in the west with gentle slopes in the eastern side. The mean annual rainfall of the Letaba River is about 612mm/annum with the highest rainfall months being January and February.

Irrigation: Commercial irrigation water usage on the Groot Letaba falls under the jurisdiction of the Letaba Water Users Association which was previously called the Letaba Irrigation Board. The Letaba Water Users Association is the mother body of several water users associations along the Letaba River.

The main commercial irrigation schemes within the study area are the Ebenezer Dam Irrigation Scheme, Magoebaskloof Dam Irrigation Scheme, Hans Merensky Dam Irrigation Scheme and Tzaneen Dam Irrigation Scheme.

The dams are mainly operated by DWA while the Letaba WUA provides funds and information for the management of the dams. The Ebenezer Dam is located upstream of the Letaba River on the confluence of the Broederstroom and Helpmekaar Rivers. The Tzaneen Dam is located about 30km downstream of the Ebenezer Dam, immediately upstream of Tzaneen town.

Canals: There are six canals in the catchment namely George's Valley, Pusela, Letsitele, N and N, Letaba North and Masalal canal. The Letsitele canal is privately owned. The Masalal canal is an earth canal while the rest of the canals are concrete lined. The George's Valley and the Pusela canals are located between the Ebenezer and the Tzaneen Dam. The Letaba North, N&N, and the Masalal canals are located between the Tzaneen and Nondweni Weir.

Table 4.1 shows the length, capacity and irrigation area of each canal in the Groot Letaba catchment.

Table 4-1: Groot Letaba irrigation canals: Length, capacity, area and quota.

Canal	Length (km)	Capacity (m^3/s)	Area (ha)	Quota (million m^3/a)
Georges Valley	11	0.196	376	2.5
Pusela	29	1.06	997	7
Letaba North	43.2	2.60	951	27.8
N & N	35.4	1.59	1278	13.3
Masalal	20	Not known	726	6.7

The George's valley's open canal is about 11 kilometres long and is joined with a siphon pipe of approximately two kilometres in length. There are no pumps along this canal as water moves by gravity to 17 irrigating farmers. The Georges Valley canal has a capacity of 0.196 m^3/s. The canal is scheduled for 376 hectares while the annual quota is 2.5 million m^3/a.

The Pusela canal is the next canal downstream of the George's Valley canal. It is located about seven kilometres upstream Tzaneen. The Pusela canal is 29km long and has several distributing canals attached to it, and provides irrigation water to 130 farmers. The canal can discharge at a capacity of 1.06 m^3/s. The irrigation area around this canal has an annual quota of 7 million m^3/a for an area of 997 ha.

About 5km downstream of the Tzaneen Dam is the Letaba North canal. The Yamorna weir provides water that is diverted into the 43.2 kilometres long canal. The maximum discharge capacity of the canal is 2.60 m^3/s. The scheduled area that is supplied by this canal is 951 ha with an annual allocation of 27.8million m^3/a.

The N&N (Junction) weir supplies water to the N&N canal. This canal is located approximately 15km downstream of the Tzaneen Dam. The canal forms a network with diverting smaller canals while the main canal runs for a distance of about 35.4km The canal is concrete-lined and has a discharge capacity of 1.59m^3/s. The total annual allocation of the area supplied by this canal is 13.3 million m^3/year for a scheduled area of 1 278 ha.

Finally the Masalal canal is situated downstream of the Merensky nature Reserve. This canal receives its water from the Prieska Weir. The canal is 20km long and supplies water to a rural community and irrigating farmers. This is an earth canal with an unknown discharge capacity. The canal supplies a scheduled area of 726 ha with an annual allocation of 6.7 million m^3/a.

Irrigation requirements: The irrigation requirements in the Groot Letaba catchment are shown by quaternary in **Table 4.2** and are presented as requirements from irrigation schemes (canals and run of river) as well as for diffuse irrigation (surface water and groundwater). The figures represent 2010 validation data.

The total area under irrigation is 31 160 ha with a water requirement of 256, 6 million m^3/a. This is the largest irrigation requirement in the Luvuvhu/ Letaba catchment.

The catchment as a whole is in deficit, although users upstream of the Tzaneen Dam enjoy a relatively high level of assurance, while users downstream experience shortages and low levels of assurance.

All users in the irrigation sector in the Groot Letaba catchment are supplied 50% to 60% of their allocation, as the current water availability cannot support the demand. Each month the irrigation water users are entitled to a twelfth of their annual allocation so as to ensure that water is available throughout the year. Most farmers have holding dams where they store their water that can then be used as required by their crops.

Table 4-2: Irrigation requirements in the Groot Letaba catchment

Quaternary	Scheme				Diffuse				Total		Location
	Canals		RoR		Surface		Groundwater				
	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	
B81A	0.0	0.0	0.0	0.0	2.6	1.3	0.3	0.1	2.9	1.5	Above Tzaneen dam
B81B	16.9	10.1	5.1	1.9	24.3	16.6	3.7	2.5	50.0	31.0	Above Tzaneen dam
B81C	29.1	23.3	7.2	3.6	11.7	11.6	5.4	5.4	53.4	43.8	Below Tzaneen dam
B81D	0.0	0.0	0.0	0.0	32.8	33.3	1.0	1.1	33.8	34.4	Letsitele catchment
B81E	47.3	27.9	9.6	4.8	32.8	37.8	18.7	21.5	108.4	92.1	Nwamitwa sub-catchmrent
B81F	0.0	0.0	34.1	17.7	4.5	5.8	9.3	11.9	47.9	35.4	Below Nwamitwa Dam
B81G	0.0	0.0	1.2	1.7	2.8	4.3	3.6	5.5	7.6	11.5	Upper Molototsi river
B81H	0.0	0.0	0.0	0.0	1.1	2.0	1.4	2.5	2.5	4.5	Lower Molototsi river
B81J	0.0	0.0	0.0	0.0	5.2	2.6	0.0	0.0	5.2	2.6	Great Letaba U/S of KP
Sub-total	**93.2**	**61.3**	**57.1**	**29.7**	**117.8**	**115.1**	**43.5**	**50.5**	**311.6**	**256.6**	

Note * - Theoretical demand

Farming practices:

- Letaba WUA: The major crops, grown by these mainly large-scale farmers, are high value fruit and nut orchard crops, which have very high establishment costs, a number of years to first harvest and high operating and maintenance costs. Potentially devastating financial losses during allocation shortfalls, have resulted in high levels of water-use efficiency by irrigators. There may be limited scope for further improvements.

- Georges valley:

- The majority of the farmers in this area use micro jet irrigation systems on the dominant fruit and nut orchard crops. There are no formal irrigation scheduling systems in place and application rates are not measured. There appears to be opportunity for improving water-use efficiency despite the reduced allocations.

Illegal water use for irrigation: Illegal abstractions are a major problem in the system. Illegal abstractors normally introduce pumps into the river. According to the Letaba WUA illegal abstractors in the catchment may be classed according to different levels namely:

- Riparian users: riparian users may be using water to water their small gardens and may not even be aware of the offence they are committing.

- Violating farmers

- Municipalities

The water bailiff is responsible for patrolling and reporting illegal abstractors. The Letaba WUA has the right to hold a tribunal and issue a judgment for an illegal abstractor.

4.1.3 Klein Letaba irrigation

The catchment: The Middle Letaba is a tributary of the Klein Letaba River and feeds into the Middle Letaba Dam. The confluence of the Middle and Klein Letaba rivers is just downstream of the Middle Letaba Dam. Another tributary of the Klein Letaba, the Nsama River flows into the Nsami Dam where after it joins the Klein Letaba further downstream. The Klein Letaba eventually flows into the Groot Letaba at the point where the two rivers enters the Kruger National Park.

Canals: Water is released from the Middle Letaba Dam into the Middle Letaba canal, which is then diverted into various networks along the canal using pipes. There are ten pump stations along the Middle Letaba canal that pump water into a number of small balancing Dams. The 60km canal finally flows into Nsami Dam and is currently very old and in a poor state of repair. Water losses, before the water reaches the balancing dams, are therefore high. The canal is also filled with sediment and grass.

Irrigation and irrigation requirements: Irrigation water below the dam is controlled by the Middle Letaba WUA which consists of 222 farms that collectively have 1500 ha of irrigable land. Farmers in the area grow cash crops such as maize, tomato, cabbage, butternut, onion, green pepper and spinach.

There are many large farms upstream of Middle Letaba Dam such as the ZZ2 tomato company which utilise large farm dams that have been constructed in the upper reaches of the catchment.

The Middle Letaba WUA faced serious water shortages over the years, which could partly be as a result of the expansion of the upstream irrigation. This has prompted the proposal for the construction of a diverting weir in the Klein Letaba to transfer water from the Klein Letaba into Middle Letaba Dam.

Most of the irrigation water use in this catchment therefore occurs upstream of the Middle Letaba Dam and is sourced from small dams and from groundwater.

Irrigation downstream of the Middle Letaba Dam has fallen largely into disuse, apparently due to decreasing assurance of supply as more and more of the yield of the Middle Letaba Dam is supplied to Giyani.

The irrigation requirements for the Klein Letaba catchment are shown by quaternary in **Table 4.3**.

The total irrigation area is 10 740ha with a total water demand of 98,2million m^3/a, with almost 37% of the irrigation supplied from groundwater.

Farming practices:

A majority of the farmers in the area use the drip system while some use sprinklers and a few use the furrow system. According to the Middle Letaba WUA, most farmers do not apply any water conserving practices and there is no formal management structure in place. In summer farmers normally irrigate every three days while in winter they irrigate every six days. There is no form of regular maintenance of the irrigation systems that is practiced.

Table 4-3: Irrigation requirements in the Klein Letaba catchment

Quaternary	Scheme				Diffuse				Total		Location
	Canals		RoR		Surface		Groundwater				
	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	
B82A	0.0	0.0	0.0	0.0	3.3	2.8	1.7	1.5	5.1	4.3	U/S of Middle Letaba dam
B82B	0.0	0.0	0.0	0.0	46.7	41.8	22.4	20.1	69.1	61.9	U/S of Middle Letaba dam
B82C	0.0	0.0	0.0	0.0	15.7	15.1	11.4	10.9	27.1	26.0	U/S of Middle Letaba dam
B82D	0.0	0.0	0.0	0.0	0.5	0.6	0.5	0.5	1.0	1.1	U/S of Middle Letaba dam
B82E	0.0	0.0	0.0	0.0	0.9	0.8	1.6	1.4	2.4	2.3	Upper Klein Letaba
B82F	0.0	0.0	0.0	0.0	0.2	0.2	1.5	1.4	1.7	1.6	Klein Letaba
B82G	0.0	0.0	0.0	0.0	1.0	1.1	0.0	0.0	1.0	1.1	D/S of Middle Letaba dam
B82H	0	0	0	0	0	0	0	0	0	0	D/S of Nsami dam
Sub-total	**0.0**	**0.0**	**0.0**	**0.0**	**68.4**	**62.4**	**39.0**	**35.9**	**107.4**	**98.2**	

Note * - Theoretical demand

Illegal water use for irrigation and other uses:

There is concern that significant areas of unregistered irrigation is taking place upstream of the Middle Letaba dam. In addition downstream of the dam there is substantial abuse of the canal for unlawful abstraction. Although this area falls under the Middle Letaba WUA there is no effective monitoring of unlawful use.

4.1.4 Luvuvhu and Shingwedzi River Irrigation

Luvuvhu River catchment: Albasini Dam is located in the headwaters of the Luvuvhu River. A canal system runs from the Albasini Dam, which is the primary canal of the scheme and traverses the government water scheme with the intent to supply irrigators on the left bank of the Luvuvhu River.

Albasini Dam is currently used to supply Makhado with water as well as the Albasini Government Water Scheme (irrigation) downstream of Albasini Dam. The total area under irrigation within the Albasini Government Water Scheme is 1 908ha. Based on a quota of 8 400 m^3/ha/a it results in a total requirement of 16.02 million m^3/a. However, the Albasini Government Water Scheme is supplied from four different sources: Albasini Dam and canal, Levubu Weir and canal, Latonyanda Stream weir and canal and the Barotta Stream weir and canal system. From Albasini Dam only 871ha of irrigation is supplied with a total demand of 7.3 million m^3/a.

Significant developments over the years upstream of Albasini Dam has resulted in a decrease in the yield of the dam. These developments mainly include abstractions for irrigation from farm dams, run-of-river abstractions as well as from groundwater. This depletion has become so serious that no water could be supplied to the irrigators through the canal from Albasini Dam for some years. The irrigation supply area is now largely dependent on groundwater as its main source of irrigation water, due to the reduction in supply from Albasini Dam over the years.

The irrigation area has in some of these schemes reduced significantly over time due to the lack of water as well as result of land claims in some areas. There is still uncertainty whether these irrigation schemes will be revitalised, specifically those affected by land claims.

Table 4-4: Irrigation in the Luvuvhu and Shingwedzi catchments

Quaternary	Scheme				Diffuse				Total		Location
	Canals		RoR		Surface		Groundwater				
	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	Area (km^2)	million m^3/a*	
A91A	0.0	0.0	0.0	0.0	5.3	4.9	9.3	8.5	14.7	13.4	Luvuvhu U/S of Albasini Dam
A91B	0.0	0.0	0.0	0.0	2.9	2.9	7.6	7.5	10.5	10.4	U/S of Albasini Dam
A91C	5.1	9.7	0.0	0.0	19.3	17.0	29.1	26.9	53.5	53.6	D/S of Albasini Dam
A91D	6.4	6.1	0.0	0.0	9.3	6.7	9.2	6.1	24.9	18.9	Lutanyanda River (canal)
A91E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	U/S of Nandoni dam
A91F	0.0	0.0	0.0	0.0	3.4	3.2	0.0	0.0	3.4	3.2	D/S of Nandoni dam
A91G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	D/S of Vondo dam
A91H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Lower Luvuvuhu (U/S of KP)
Sub-total	**11.5**	**15.8**	**0.0**	**0.0**	**40.3**	**34.7**	**55.2**	**49.0**	**106.9**	**99.4**	

Note * - Theoretical demand

The total commercial irrigation requirements for the Luvuvhu Shingwedzi catchments are shown by quaternary catchment and are presented as requirements from irrigation schemes (canals and run of river) and diffuse irrigation (surface water and groundwater) in **Table 4.4**. The figures represent 2010 validation data. All the irrigation in the Shingwedzi catchment is considered as smallholder irrigation and are included in Section 4.1.7 under the RESIS (Revitalisation of Smallholder Irrigation Schemes) programme and summarised in **Table 4.9**.

The total irrigation area and irrigation water demand in the Luvuvhu/Shingwedzi catchment is 10 690ha and 99.4 million m^3/a respectively of which almost 50% is supplied from groundwater.

4.1.5 Mutale River catchment:

The source of the Mutale River is at the Soutpansberg range on the north western side of the Luvuvhu/Letaba WMA. The river rises at an altitude of about 870m and is approximately 120km long. It then joins the Luvuvhu River as it enters the Kruger National Park. Rainfall is higher in the upper reaches of the river and declines towards the north easterly lower lying areas. The temperatures are cooler along the mountain ranges and warmer in the lower lying area. The Tshiombo valley lies in the upper reaches of the Mutale River.

The Mutale WUA was a former homeland scheme and is now under DWA and the Department of Agriculture control/supervising. The Mutale WUA consists of four schemes namely: Tshiombo, Tshino, Rambanda and Palmarivity scheme. Most of the farms in the Mutale catchment are under land claims and this has resulted in a major drawback in as far as functionality of the schemes is concerned. The Tshiombo Scheme in the Tshiombo Valley is the largest and most active irrigation scheme in the Mutale catchment.

The scheme is made up of 1 150 hectares which is divided into 930 plots. The Tshiombo scheme receives water that is diverted into the canal from a weir across the Mutale River. Water flows by gravity along the 15km long canal to the users. All the irrigation taking place in the Mutale catchment is recorded as part of the Smallholder Schemes under the RESIS

(Revitalisation of Smallholder Irrigation Schemes) programme and summarised in **Table 4.9**.

4.1.6 Irrigation water requirements summary

The bulk of the irrigation development (56%) is located in the Groot Letaba catchment followed by the Klein/Middle Letaba and Luvuvhu/Shingwedzi catchments with each just over 21% of the total irrigation requirements and less than 1% in the Mutale catchment. (See **Table 4.5**)

Almost 30% of the irrigation requirements are met from groundwater resources with the bulk of the groundwater abstractions (73.5%) located in the Groot Letaba and Luvuvhu river catchments.

Table 4-5: Commercial Irrigation demands summary for surface water and groundwater sources in the Luvuvhu/Letaba catchment at 2010 development.

Sub-catchment	Irrigation Demand (million m^3/a)		
	Total	From Surface Water	From Ground Water
Groot Letaba	256.6	206.1	50.5
Klein & Middle Letaba	98.2	62.3	35.9
Letaba Total	**354.8**	**268.4**	**86.4**
Luvuvhu & Shingwedzi	99.4	50.5	49.0
Mutale	0.0	0.0	0.0
Luvuvhu Mutale Total	**99.4**	**50.5**	**49.0**
Total Irrigation	**454.2**	**318.9**	**135.4**

When considering only the Irrigation Schemes which are fed from controlled canal systems (**Table 4.6**), the total area under irrigation is 14 610ha for the Letaba systems and 1 150ha for the Luvuvhu/Mutale systems. The irrigation demands for these Schemes are 94.3 million m^3/a for the Letaba system and 15.6 million m^3/a for the Luvuvhu/Mutale system.

Approximately 24% of the irrigation developments currently takes place within dam/canal controlled schemes.

The irrigation demand is in most areas supplied at a very low assurance, but particularly in the Groot Letaba downstream of Tzaneen Dam where on average approximately 60% of the irrigation requirement is met.

Table 4-6. Irrigation areas and irrigation water requirements on canal-controlled irrigation schemes in the Letaba/Luvuvhu catchment

Irrigation Scheme/Canal name	Location (sub-catchment)	Present Day Development (2010)	
		Area under irrigation (ha)	Allocation (million m^3/a)
LETABA			
Ebenezer Scheme		**2 420**	**11.4**
George's Valley	B81B4	580	2.5
Pusela	B81B4, B81B1A, B81C	1 210	7.0
Run-of-River	B81B4	510	1.9
Politsi Scheme	**B81B3**	**560**	**11.1**
Tzaneen Scheme		**11 630**	**71.8**
Ledzee	B81C	240	2.1
Noord	B81C & B81E	3 250	28.8
N&N	B81E	3 050	13.0
Run-of-River	B81C to B81J	5 090	27.9
Sub-Total		**14 610**	**94.3**
LUVUVHU			
Luvuvhu Scheme		**990**	**15.6**
Albasini	A91C1, A91C2,A91D1	250	7.8
Luvuvhu Main	A91C2	260	2.7
Latonyanda	A91D1	480	5.1
Barotta	**A91D1**	**150**	**-**
Sub-total		**1 150**	**15.6**
Total		**15 760**	**109.8**
		15 760	**109.8**

4.1.7 Revitalisation of Smallholder Irrigation Schemes (RESIS)

Significant areas of smallholder irrigation were developed during South Africa's previous political dispensation in all the so-called black independent states of Venda, Lebowa and Gazankulu. About 60 of these Schemes totalling about 10 000ha exist within the Luvuvhu/Letaba WMA and with a potential irrigation water requirement of 81 million m^3/a.

Most of them use run-of-river water extracted from weirs by small canals for flood irrigation or direct pumping to storage dams on the schemes. The Limpopo Provincial Department of Agriculture has, over the years, attempted to revitalise many of these schemes in order to stimulate the rural economy of the provinces. Unfortunately many of these efforts have not been successful for a number of reasons including the very unreliable water supply. Government is still committed to rehabilitate those schemes where a reasonable assurance of supply can be established in the future (RESIS, 2013).

Table 4-7. RESIS Schemes in the Groot Letaba catchment

RESIS SCHEMES IN GREAT LETABA (17/01/2012)							
Name	**District**	**Municipality**	**Irrigated Area (ha)**	**Annual requirement (m³/a)**	**Commissioning Date**	**Estimated present use (%)**	**Water Source**
Selwane	Mopani	BaPhalaborwa	72	554,400	After 2016		Great Letaba River
Belasting	Mopani	Baphalaborwa	115	885,500	After 2016		Great Letaba River
Makhuba	Mopani	Baphalaborwa	88	677,600	After 2016		Great Letaba River
Masalal	Mopani	Baphalaborwa	174	1,339,800	After 2016		Great Letaba River
Mohale	Mopani	Baphalaborwa	103	793,100	After 2016		Great Letaba River
Prieska		BaPhalaborwa	81	623,700	After 2016		Great Letaba River
Waterbok	Mopani	Baphalaborwa	251	1,932,700	After 2016		Great Letaba River
Sub-total			**884**	**6,806,800**		30	
MariveniA10:B10	Mopani	Greater Tzaneen	**313**	**2,410,100**	After 2016	30	Great Letaba River
Berlyn Citrus	Mopani	Greater Tzaneen	**147**	**1,131,900**	After 2016	50	Great Letaba River
Nondweni	Mopani	Baphalaborwa	203	1,563,100	After 2016		Lower Letaba River
Mabunda (Lower Letaba)	Mopani	Greater Giyani	300	2,310,000	After 2016		Lower Letaba River
Sub-total			**503**	**3,873,100**		30	
Trust Farms	Mopani	Greater Tzaneen	74	569,800	After 2016		Letsitele River
Lephepane	Mopani	Greater Tzaneen	42	323,400	After 2016		Letsitele River
Combe bank	Mopani	Greater Tzaneen	135	1,039,500	After 2016		Letsitele River
Naphuno Farms	Mopani	Greater Tzaneen	160	1,232,000	After 2016		Letsitele River
Sub-total			**411**	**3,164,700**		10	
Thabina	Mopani	Greater Tzaneen	**69**	**531,300**	Operational 2012	100	Thabina River
Total			**2327**	**17,917,900**			

The most recent initiative entitled the Revitalisation of Smallholder Irrigation Schemes (RESIS) commenced in 1998 and completed its first phase in 2004 during which about 20 schemes underwent infrastructure upgrading and the establishment of farmer-led management structures. A second phase followed in 2005 with the focus more on infrastructure upgrade and government-sponsored production. The lack of funds and the severe shortage of water in recent years has seen this programme being largely placed on hold. However there is still an expectation within the Limpopo Department of Agriculture that a significant number of these Schemes will be brought back into production with the related irrigation water demand.

Table 4-8. RESIS Schemes in the Klein Letaba catchment

RESIS SCHEMES IN KLEIN LETABA (17/01/2012)							
Name	**District**	**Municipality**	**Irrigated Area (ha)**	**Annual requirement (m³/a)**	**Rehabilitation Date**	**Estimated present use (%)**	**Water Source**
Middle Letaba Hlaneki	Mopani	Greater Giyani	1200	9,240,000	On Hold water shortage	0	Middle Letaba Dam & Canal
Middle Letaba Bend	Mopani	Greater Giyani	1433	11,034,100	On Hold water shortage	0	Middle Letaba Dam & Canal
Modjadji (Lenokwe)	Mopani	Greater Letaba	24	184,800	After 2016	15	Molototsi River
Middle Letaba Homu	Mopani	Greater Giyani	125	962,500	On Hold water shortage	0	Nsami Dam
Sekgopo	Mopani	Greater Letaba	253	1,948,100	After 2016	10	Molototsi River
Molototsi Mango	Mopani	Greater Giyani	940	7,238,000	After 2016	20	Molototsi River
		Total	**1193**	**9,186,100**			

Tables 4.7; **4.8** and **4.9** list the Smallholder Irrigation Schemes in the catchment (as at January 2012) and provide an insight into the overall area under irrigation and projected water demand. The estimated present water use (expressed as a percentage of total requirement) and the proposed date for rehabilitation are also shown).

The main crops grown on the smallholder irrigation schemes are vegetable crops such as cabbage, tomato, sweet potato, and field crops such as maize, chilli and dry bean.

Table 4-9. RESIS Schemes in the Luvuvhu and Shingwedzi catchment

RESIS SCHEMES IN LUVUVHU (17/01/2012)								
Name	District	Municipality	Irrigated Area (ha)	Annual requirement (m³/a)	Rehabilitation date	Present use estimate (%)	Catchment	Water Source
Dzindi	Vhembe	Thulamela	137	1,054,900	After 2016		A91E	Dzindi River
Muledane	Vhembe	Thulamela	48	369,600	After 2016		A91E	Dzindi River
Tshwinga	Vhembe	Thulamela	50	385,000	After 2016		A91E	Dzindi River
Khumbe	Vhembe	Makhado	145	1,116,500	After 2016		A91E	Dzondo River
Tsianda	Vhembe	Thulamela	70	539,000	After 2016		A91E	Dzondo River
Palmaryville	Vhembe	Thulamela	93	716,100	After 2016		A91E	Lutavhe River
Sub-total			**543**	**4,181,100**		**15**		
Dovheni	Vhembe	Thulamela	56	431,200	After 2016		A91F?	Levuvhu River
Mangondi	Vhembe	Thulamela	17	130,900	After 2016		A91F	Levuvhu River
Morgan	Vhembe	Thulamela	75	577,500	After 2016		A91F	Levuvhu River
Nesengani	Vhembe	Makhado	71	546,700	After 2016		A91F	Levuvhu River
Tshimbupfe	Vhembe	Makhado	12	92,400	After 2016		A91F	Levuvhu River
Dzwerani	Vhembe	Thulamela	25	192,500	After 2016		A91F	Levuvhu River
Madzivandila College	Vhembe	Thulamela	30	231,000	After 2016		A91F	Nandoni Dam
Sub-total			**286**	**2,202,200**		**15**		
Lambani	Vhembe	Thulamela	44	338,800	After 2016		A91H	Levuvhu River
Mhinga	Vhembe	Thulamela	229	1,763,300	After 2016		A91H	Levuvhu River
Tshaulu	Vhembe	Thulamela	150	1,155,000	After 2016		A91H	Levuvhu River
Phaswana	Vhembe	Thulamela	235	1,809,500	After 2016		A91H	Mutshindudzi River
Sub-total			**658**	**5,066,600**		**15**		
Barotta	Vhembe	Makhado	175	1,347,500	After 2016		A91D	Luvhungwe River
Murara	Vhembe	Thulamela	37	284,900	After 2016		A91G	Murara River
Malavuwe	Vhembe	Thulamela	26	200,200	After 2016		A91G	Mutshindudzi River
Matsika	Vhembe	Thulamela	102	785,400	2013		A91G	Mutshindudzi River
Sub-total			**165**	**1,270,500**		**20**		
La-Rochelle	Vhembe	Makhado	**200**	**1,540,000**	After 2016	**25**	A91C	River
Rambuda	Vhembe	Mutale	104	800,800	After 2016		A92A	Tshala River
Mutshenzheni	Vhembe	Thulamela	60	462,000	After 2016		A92A	Tshiombo Weir & Canal / Mutale River
Maraxwe	Vhembe	Thulamela	128	985,600	2013		A92A	Tshiombo Weir & Canal / Mutale River
Mianzwi	Vhembe	Thulamela	125	962,500	2013		A92A	Tshiombo Weir & Canal / Mutale River
Matangari	Vhembe	Thulamela	363	2,795,100	After 2016		A92A	Tshiombo Weir & Canal / Mutale River
Matombotswuka	Vhembe	Thulamela	258	1,986,600	After 2016		A92A	Tshiombo Weir & Canal / Mutale River
Mbaela	Vhembe	Thulamela	101	777,700	Operational	100	A92A	Tshiombo Weir & Canal / Mutale River
Tshiombo	Vhembe	Thulamela	137	1,054,900	2015		A92A	Tshiombo Weir & Canal / Mutale River
Sanari	Vhembe	Mutale	39	300,300	After 2016		A92A?	Mutale River
Makon+M3+B37:N37	Vhembe	Thulamela	200	1,540,000	After 2016		A92A	Mutale River
Sub-total			**1515**	**11,665,500**		**15**		
Mutele	Vhembe	Mutale	**33**	**254,100**	After 2016	**10**	A92D	Mutale River
Britz	Vhembe	Thulamela	70	539,000	After 2016	10	A92B	Mutale River
Makuleke	Vhembe	Thulamela	225	1,732,500	Operational	100	B90B	Makuleke Dam (Shinwedzi catchment)
Total			**7037**	**54,184,900**				

A summary of the RESIS schemes in the three sub-catchments, showing total irrigation areas and annual irrigation demand if fully developed is shown in **Table 4.10.**

It is clear from these figures that although basic infrastructure and irrigable soils exist for a substantial area of irrigation on the smallholder schemes, only a very small percentage of the area is being effectively utilised at present. Small holder irrigation schemes currently operational only include 225ha under the Makuleke Dam scheme in the Shingwedzi catchment and the 101ha within the Tshiombo Scheme in the Mutale catchment.

In the light of the severe water shortages in all the main sub-catchments, it is highly unlikely that all the schemes listed will be revitalised. It will be essential that any plans for revitalising schemes must be coordinated with the Department of Water Affairs and water availability need to be assessed in advance.

Table 4-10 RESIS Schemes in the overall Luvuvhu/Letaba catchment

TOTAL ALL RESIS SCHEMES LUVUVHU/LETABA (17/01/2012)		
Catchment	**Irrigated Area (ha)**	**Annual requirement (Mill. m^3/a)**
Great letaba	2 327	17,9
Klein Letaba	1 193	9,2
Luvuvhu/ Mutale	7 037	54,2
Total	**10 557**	**81,3**

4.2 WATER CONSERVATION AND WATER DEMAND MANAGEMENT IRRIGATION

4.2.1 Introduction

In a catchment that shows such high levels of water stress such as the Luvuvhu/Letaba catchment, every opportunity to save water and to improve water use efficiency must be investigated. By the year 2000, the irrigation sector was using 75% of the available water resources in the Luvuvhu/Letaba catchment and in 2004 the Department of Water Affairs estimated that water losses in the catchment's irrigation sector could be as high as 30%, indicating that there may be opportunities for valuable water savings in this sector. However very low assurances of supply to irrigators in the catchment in recent years have, out of necessity, led to significantly improved irrigation water use efficiency.

This section of the report investigates the WC/WDM opportunities in the catchment.

The only significant studies on irrigation WC/WDM in the Luvuvhu/Letaba catchments in recent years has been the “Middle Letaba Water Supply Scheme: WC/WDM Situation assessment” (DWA 2003) and the DWA, Water Use Efficiency Directorate study (DWA 2010) on The Development of a Comprehensive Water Conservation and Water Demand Management Strategic Business Plan for the Luvuvhu-Letaba Water Management Area.

It is not intended to replicate all the detailed findings of these reports here but only to incorporate a summary of their findings that need to be addressed to reduce losses and improve water-use efficiency in this water stressed catchment.

4.2.2 Definition of WC/WDM

- **Water Demand Management**

Water demand management may be defined as a management approach to increase the availability of water cost-effectively through more equitable, more efficient and more eco-friendly allocation and usage.

This is chiefly attained through the promotion of sound policy, the application of selected incentives and influencing and regulating of the demand, by maximising the participation and defining accountability and responsibility of both political stakeholders and civil society stakeholders.

- **Water Conservation**

Water conservation may be defined as the:

- Minimization of loss or waste of water.
- Maintenance or improvement of water quality.
- Care and protection of water resources.
- Efficient and effective use of water.

In the context of the objectives of this study, water conservation and improved water use efficiency should be seen in terms of how they can result in a net saving of water for either future irrigation expansion or usage by an alternative sector.

The key aspects of Irrigation WC/WDM in the Luvuvhu/Letaba catchment that have been addressed in this study are:

- The role of institutional structures in WC/WDM.
- Water allocation methods on controlled schemes.
- Condition of bulk irrigation infrastructure.
- Water measurement systems and devices
- On-farm irrigation practices.
- Illegal use of water for irrigation
- Incentives for water saving

4.2.3 The role of institutional structures in WC/WDM.

It appears that in most Water User Associations and Irrigation Boards in the study area there is inadequate use of the legislation and related authority and responsibilities to have effective impact on WC/WDM imperatives in the catchment. The best laid principles and plans for improved irrigation water use efficiency and related savings are unlikely to be implemented, unless the water management structures are in place and are effective.

Universally, water resource management policy and strategy is focusing progressively more on decentralized management, operation and maintenance of water delivery through participation by the stakeholders and water users. Also related to this is the practice of focusing water resource management away from the development of new systems and infrastructure to provide more water, to the improved management of existing water resources and the improvement of water use efficiency and water conservation. These improvements are often implemented through Water Management Plans with a focus on Best Management Practices, which in turn is based on internationally recognised benchmarks for the various water use sectors.

The main benefits of the Water Management Plan approach is that it is structured for stakeholder and water user participation in planning and implementation and it is conducive to ready integration into a broader Water Resource Management Strategy for the Basin area as a whole.

The Water Act provides guidelines for the implementation of water conservation and water demand management in the irrigation sector and the Department of Water Affairs (DWA) has developed WC/WDM strategies and guideline documents for agriculture.

The Act requires that WC/WDM be driven primarily by Water User Associations (WUAs).

WUAs (or existing Irrigation Boards) are, in turn, required to submit annual business plans, to a catchment management agency, or the DWA in the absence of a catchment management agency.

The development of a Water Management Plan (WMP) by a WUA is central to implementing water conservation and water demand management in the irrigation sector. The WMP sets out benchmarks and best management practices for WC/WDM and a manageable and affordable programme for their implementation by both the water supplier, in the case of controlled irrigation schemes and individual irrigators over time. The water management plan is therefore the primary tool with which the irrigation sector can implement WC/WDM initiatives in controlled irrigation areas.

The “best practice” initiatives that have the greatest impact on improved water use efficiency on these Schemes are:

- Effective measurement of irrigation water through sluices and water meters and the use of computerised telemetry systems. You can’t manage what you can’t measure.
- Creating a sense of awareness amongst staff and irrigators about irrigation efficiency and its benefits.
- Preparation of an annual Water Management Plan which allows for a systematic and practically achievable improvement in bulk infrastructure such as canals and storage dams, and improvement in water management and water-use efficiency.

Existing WUA’s and Irrigation Boards in the Luvuvhu/Letaba catchment need strengthening and support so that at the very least they can be more effective in, installing and managing water measurement, dealing with illegal water use within the boundaries of the WUA and improving the maintenance of canals as a sense of responsibility is instilled in a functional structure.

There appears to be inadequate involvement of the DWA within the catchment in encouraging and auditing WC/WDM. Some irrigators feel that if the audit function was emphasised and performed regularly by DWA, more WUAs would give attention to WC/WDM.

4.2.4 Water allocation methods on controlled schemes.

The practice of allocating (and charging) for water on an “irrigation area” basis and a “standard volume (quota) per unit area” (m^3/ha/a), rather than charging on a volumetric basis, is a major disincentive for water saving in the catchment.

Existing water savings, within a given farm allocation, achieved through efficient water management and irrigation scheduling, are frequently applied to an expanded irrigation area or saved to make up the deficit resulting from reduced releases. This negates the opportunity to make an overall saving of irrigation water.

The irrigation demand is in most areas supplied at a very low assurance. For example in the Groot Letaba downstream of Tzaneen Dam, on average approximately 60% of the irrigation requirement is met. This very low assurance of supply to Schemes in recent years has provided the incentive to minimize on-farm losses and to maximize irrigation efficiencies, particularly on the high-value orchard crops that are seriously at risk when scheduled allocations are cut due to water shortages.

4.2.5 Condition of bulk irrigation infrastructure.

A common challenge facing most Irrigation Boards / WUAs is aging infrastructure. Most irrigation schemes in the Luvuhu/Letaba catchments have been in existence for a very long time and require major rehabilitation work and capital investment to get them back to peak operating condition.

Open canals play a major role in the bulk reticulation of water to irrigation Schemes in the catchment. Besides the substantial losses due to direct evaporation from canals, the condition of open canals is of particular concern, with leakage a common problem on all schemes, even those with concrete lined canals.

Table 4-11. Irrigation canals in the Luvuvhu/Letaba Catchment

Irrigation Canals	Location	Length (km)	Concrete Lined	Condition
Great Letaba		**138**		
George Valley	Between Ebenezer dam and Tzaneen dam	11	Yes	Satisfactory but leaks common
Pusela	Between Ebenezer dam and Tzaneen dam	29	Yes	Satisfactory but leaks common
Letaba North	Between Tzaneen dam and Nondweni weir	43	Yes	Satisfactory but leaks common
N&N	Between Tzaneen dam and Nondweni weir	35	Yes	Satisfactory but leaks common
Masalal	Between Tzaneen dam and Nondweni weir	20	No (earth canal)	Poor with high level of losses
Middle Letaba	Below the Middle Letaba Dam	**60**	Yes	Poor with high level of losses
Luvuvhu		**109**		
Albasini main + branches	Downstream of the Albasini dam	19	Yes	Poor with high level of losses
Latonyanda main +branches	Downstream of the Albasini dam	90	Yes	Poor with high level of losses
Mutale		**15**	Yes	Poor with high level of losses
TOTAL		**322**		

Other infrastructure related to the canals such as siphons and balancing dams also appear to need repair in many parts of the catchment, but particularly in the Luvuvhu/Mutale area. **Table 4.11** shows the location, length and condition of the main irrigation canals in the Luvuvhu/Letaba catchment.

Estimation of canal transmission losses:

Large transmission losses were identified during the "Glewap" exercise and other studies on the lower reaches of the Letaba. It was not possible to quantify these losses because of the lack of acceptable gauging stations in this part of the Letaba. There is a shortcoming in the current WRSM2000 model where the transmission losses can only be specified as one monthly value and the water is lost in the balance and not incorporated as an input to the groundwater module.

According to earlier studies carried out by Reid et al (Water SA 1986) measured conveyance losses in the Levubu were in the magnitude of 37%.

Information gathered more recently (DWA: 2010) from other irrigation schemes in South Africa, where the WAS system has been applied, showed that on average lined canal water losses are in the order of 26% of the volume released (with a standard deviation of 11%) and can be as high as 55%. Efficiency levels in earthen canals are highly variable, depending mainly on the soil type and length of the canal. However losses as high as 30-40% are not uncommon.

From the limited quantified evidence and other circumstantial evidence, it appears that losses (excluding evaporation losses) in the order of 20% occur on average from all the lined canals in the Luvuvhu/Letaba catchment and 30% from unlined canals.

No estimate of the return flows as a consequence of leaking canals has been made in previous studies in the Luvuvhu/Letaba catchment. Estimates for the Orange River canal systems are about 50% recovery by return flows.

The total allocation of irrigation water via canals is 110 million m^3/a (**Table 4.5**). Assuming a 50% return flow, net losses due to leaking canals could therefore be in the order of 15 million m^3/a. This is equivalent to 3% of the total 459million m^3 annual irrigation water requirements in the Luvuvhu/Letaba catchment as a whole.

To achieve this degree of water saving would require a massive investment in canal rehabilitation over a long period of time, which is unlikely under the present economic climate in South Africa. However, any program or initiative to reduce losses from canals or replace sections of canals with underground piping (losses on the Middle Letaba Nsami canal could be reduced by approximately 4 million m^3/a, by replacing the canal with a pipeline) will have a significant impact on available irrigation and domestic water resources and should be a priority for DWA and WUA's.

4.2.6 Water measurement systems and devices

The lack of accurate water measurement on many Schemes in the catchment is seen as a major constraint to improved irrigation efficiency. It is difficult to manage and monitor what you cannot measure. Most Irrigation Boards/WUAs have insufficient and/or inaccurate measuring equipment on their main water conveyance systems, making it difficult to measure losses and allocations to irrigators. Ownership issues complicate this.

In the Groot Letaba catchment, the Letaba Irrigation Board was among the first to install water meters in South Africa. The LWUA has 150 meters in use, and four canal intake-measuring devices. However many challenges have been encountered with the telemetry systems, including theft and difficulty of maintaining and monitoring meters at pumps in remote areas of the river. The use of cellphone-based telemetry has also been investigated.

For the catchment as a whole, water meters remains the highest priority as far as water management is concerned as all problems point to the unavailability of water use information. The water meters can provide users with important information from which they can improve their efficiency.

A sound information management system (IMS) to capture data from the meters is an essential tool. The IMS should be real-time and should provide the irrigators with information regarding the water currently available in the system, with probabilities of rainfall events in coming days.

Accurate dam release information needs to be kept in the WMA, which would enhance future timing and management of releases as opposed to releasing water 24 hours a day regardless of whether farmers need to irrigate or not.

4.2.7 On-farm irrigation practices.

Groot Letaba: Most of the farmers under the Groot Letaba WUA are large scale farmers who use drip or micro irrigation. Each farmer is allocated water according to their registered allocation. However farmers registered according to their previous usage which is the amounts they were using before the New Water Act was passed. Other farmers, especially the historically disadvantaged individuals, have joined the association and thus the demand for irrigation water has increased. This has put a large strain on the available water and hence the decision to supply farmers 50% of the annual allocation which is released on monthly basis.

The Georges Valley canal has the outlet sluice gates welded into a fixed position to make sure all uses only have access to the allocation. The welded equipment may however be resized if a farmer’s allocation changes. The WUA believes that this system works well for them and is transparent. The annual allocation of farmers in the Georges valley is 6 620m^3/ha. Each month, therefore, a farmer is allocated a twelfth of their allocation. The canals are opened for 24 hours a day even during the rainy season. If the water is not used it returns to the river. The water flows by gravity through the canal, however pumps are used whenever necessary.

A large number of farmers in this area use micro-jet irrigation systems and a few use drip systems. Although formal irrigation scheduling systems are not commonly used, these irrigation systems are by design, efficient systems. In addition, with a 50% reduction in allocations becoming the norm, farmers have the incentive (and necessity) to utilise their limited water resources as sparingly as possible.

Klein Letaba: In the irrigation areas up-stream of the Middle Letaba dam, the majority of the farmers use drip and micro-jet irrigation systems on high value vegetable crops (mainly tomato) and irrigation efficiency is reasonably high because of pumping cost constraints. Downstream of the Middle Letaba Dam, sprinklers and furrow flood irrigation are common. According to the WUA water management standards are low. However the assurance of supply is so low that effective commercially orientated irrigation is extremely difficult to establish.

Mutale: Furrow irrigation is the most dominant in the Mutale catchment. A small number of irrigators use the “floppy” sprinkler system. Each farmer owns about 1.2 hectares of land which makes up the 930 plots in all. Farmers have no specific scheduling methods as they prefer to use water as much as they can when water is available.

4.2.8 Estimation of water losses through inefficient in-field irrigation

In the DWA 2010 study (DWA 2010) on WC/WDM an estimate of irrigation inefficiencies was devised in the absence of adequate irrigation water use data. The system used was a “water balance” approach which used historical irrigation information from the “Schoeman en Vennote” study to estimate irrigation efficiency at quaternary catchment level and hence provide information on which areas need to be given priority in improving irrigation efficiency. The method is based on specific crop water requirements according to the SAPWAT model. Monthly effective rainfall is calculated using SAPWAT formulas, so as to determine theoretical irrigation water requirements. The real irrigation water use was compared with the theoretical irrigation requirement in order to determine irrigation water losses.

The highest irrigation efficiency was found to be 92 % while the lowest was 62%. From a statistical analysis it was found that 27% of the irrigators fell outside the normal distribution, while 73% of the farmers formed part of the normal distribution i.e. 27% of the farmers had a potential to improve and recover some savings.

The benchmark value that all the farmers were expected to achieve was calculated to be 80%.

The amount of irrigation water that could be saved within the overall Luvuvhu Letaba catchment if all the farmers reach the 80% efficiency was found to be about 11million m^3/a.

This is equivalent to about 2.0% of the total irrigation requirement.

This approach does not take into account likely return flows as a consequence of over irrigation. In any event, however the quantum is very small and indicates the impact of reduced water allocations on forcing improvement in irrigation efficiencies, especially for orchard crops with very high establishment costs.

Certain quaternaries were identified as showing a high potential to save irrigation water. In the Luvuvhu/Mutale, quaternary catchment A92A and A92C are priorities. In the Middle Letaba, Quaternary catchments B82F and B82J and in the Groot Letaba catchment, B81H and B81J.

4.2.9 Illegal use of water for irrigation

Unlawful abstraction of water from irrigation canals, directly from rivers or even from boreholes that extract groundwater close to rivers, occurs throughout the catchment, but is particularly prevalent in the Middle Letaba, both above and below the Middle Letaba Dam. Illegal abstractors in this area also contribute towards vandalism as they cut through the canal in order to install pumps.

In the Mutale catchment, illegal abstractions, which normally take place at night, are a major problem in the area. A tribunal attempts to deal with illegal abstractions.

There is also evidence of illegal abstraction the Groot Letaba River.

This phenomenon requires urgent attention by the authorities (at government level and at WUA level) as it is a significant contributor to the chronic water shortages experienced throughout the catchment.

4.2.10 Incentives for irrigation water saving

There are inadequate incentives for **farmers** to save water. There is a perception amongst farmers that if they use less water than their allocation, then in terms of the new Water Act, which no longer recognizes a “right” to water, they run the risk of losing a portion of their allocation. The water allocation is attached to the property and determines the value of the property. Any reduction in allocation would devalue the property.

There are inadequate incentives for **IB’s /WUAs** to save water. Their operational budgets are based on selling a certain volume of water to irrigators. If water is saved, the WUA will have less revenue and may not be able to meet its obligations to member irrigators. Furthermore, the “catchment management charge” to WUAs is based on the total allocation to the Scheme.

However, the very low assurance of supply to schemes in recent years has provided the incentive to minimize on-farm losses and to maximize irrigation efficiencies, particularly on the high-value orchard crops that are seriously at risk when scheduled allocations are cut due to water shortages.

4.2.11 Purchasing water entitlements

Another approach to reduce water use would be for the Minister to levy an additional water use charge on all users of water originating in the Luvuvhu Catchment in terms of Section 57 of the NWA. This levy would have to be in accordance with the pricing strategy which provides for, inter alia, setting water use charges for achieving the equitable and efficient allocation of water (Section 56 (c) of the NWA). The financial contributions of all the water users would be ring-fenced and used to buy out water entitlements from those water users who are willing to sell, e.g. by tender process. This process can then be continued until the necessary water balance is achieved. Alternatively the purchase of water entitlements can be funded by Government.

Whichever financing strategy is followed, the purchase of water entitlements can lead to financial and social consequences such as irrigated land value reduction, strain on the viability of WUA’s and IB’s with reduced levee income, and job losses of farm workers. This option must therefore be considered with great caution. Checks and balances need to be built into the process to mitigate these consequences.

The linking of WC/WDM savings to such a selling opportunity is a possible measure that 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, either funding mechanism can be used, 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.

Capacity building

Extension and training is needed to help irrigators identify ways to use less water. In the DWA 2010 (DWA 2010) study the priority areas in terms of inefficiency were identified (priority quaternaries include (A92A, A92C, B82F and B82J, B81H and B81J).

The institutional structures need to be strengthened in the WMA to ensure that water losses at any point in the system can be linked to the person/organisation concerned.

4.2.12 Summary of irrigation water saving potential

The losses due to the inefficiencies described above are either lost to direct evaporation, to deep percolation into the groundwater system or make their way back into the catchment river systems as a “return flow”. This return flow forms an integral part of the river system’s water resources downstream. Achievable savings in irrigation water, through improved best practice at both distributor level and irrigator level, and the period over which the savings can be achieved are therefore very difficult to estimate for a diverse catchment such as the Luvuvhu Letaba catchment. The influencing factors, which are extremely complex and interactive, include financial elements in terms of funding of infrastructure upgrade (e.g. canal repairs), technical elements, institutional and water management elements, legislative issues and perhaps, above all, incentive factors (or lack thereof) for both irrigation water distributors and irrigators.

In addition the likelihood that savings made by individual farmers, through improved irrigation practices and improved water management, will be used to either sustain the existing enterprises during the frequent shortfall in allocations or increase their irrigation areas, further complicates the estimation of achievable savings.

Any attempt to quantify practically-achievable savings of irrigation water on an annual basis over a number of years must therefore be broad and largely intuitive.

The only information on quantified potential savings that were identified in this study, as reported above, include:

- Canal leakage reduction: 15 million m^3/a, or 3% of total irrigation requirement.
- On-farm irrigation efficiency improvement: 11 million m^3/a, or 2% of total irrigation requirement.

Other key areas of potential saving that were identified but no quantified include;

- Improved water measurement at all levels in the system.
- Reduction of illegal water use.

4.2.13 Conclusions and recommendations

The severe water shortages and related low assurance of supply to irrigation schemes have been a major incentive for irrigators to maximise irrigation water use efficiency. In the case of commercial irrigation schemes, irrigators have in most cases already improved their irrigation efficiency to get optimal use from the available water. This applies particularly to the large block of commercial irrigators supplied from Tzaneen Dam on the Groot Letaba and irrigators from Albasini Dam on the Luvuvhu River, where the survival strategy for the latter area has been to move more and more to groundwater supply.

In the case of the smallholder irrigation Schemes, the assurance of supply has become so low that most schemes in the WMA utilise irrigation water extremely diligently to maximise the benefit from the scarcely available water. This usually takes the form of drastically reduced areas planted (compared to the irrigable areas on the schemes) and sub-optimal application rates.

Nevertheless, there are opportunities to improve water use efficiency and to reduce widespread losses and these are outlined below. However in the light of the very low assurance of supply, it is unlikely that any “savings”, resulting from WC/WDM initiatives, will result in significant additional water availability for other uses in the short-to-medium term.

Opportunities for irrigation water saving:

- **Institutional support:** The DWA should provide support to WUA’s through the promotion and review of Water Management Plans (WMP) and the monitoring of the implementation of the plans. This will have long-term implications to improved water-use efficiency at distributor level and at irrigator level**.** The development of a WMP by a WUA is central to implementing water conservation and water demand management in the irrigation sector. The WMP sets out benchmarks and best management practices for WC/WDM and a manageable and affordable programme for their implementation by both the water supplier, in the case of controlled-irrigation schemes and individual irrigators over time. Strengthening and support of WUA’s will ensure that they become more effective in, installing and managing water measurement devices, dealing with illegal water use within the boundaries of the WUA and improving the maintenance of canals.

- **Infrastructure upgrade/repair:** Where bulk water reticulation infrastructure on regulated schemes is the responsibility of the DWA, repair and maintenance programs should be established and funding sought for this purpose. Where infrastructure is owned by IBs or WUAs, they should be encouraged to repair and maintain their bulk infrastructure. There are 300km of concrete-lined canals in all the major irrigation areas of the catchment and 20km of the unlined Masalal canal on the Groot Letaba.

  Upgrading of canals and storage dams on schemes with aged infrastructure is probably the single most important initiative to reduce losses and improve water use efficiency.

  Potential savings of about 15 million m^3/a are estimated if canals were repaired. However it is unlikely that any significant impact on water resources will be achieved in the short-to-medium term because of financial constraints.

- **Water measurement**: The installation of efficient measuring devices on all regulated irrigation schemes should become a high priority for DWA and WUA/Irrigation Boards and where possible incentives for farmers to purchase such devices should be sought.

- **Incentives**: Incentive systems should wherever possible be considered for WUAs and IBs as well as individual farmers to improve water use efficiency and encourage water saving. In the case of irrigators the following options should be addressed by DWA:

  - The introduction of sale-by-volume, where effective water measuring devices are available. However, the protection of irrigation water entitlements per farm should be secured.

  In the case of water suppliers, the following incentive options should be considered by DWA:

  - Promoting water markets where income from the sale of saved water would be a significant incentive, even though it would not necessarily free-up water for alternative distribution and use.

- **The purchase of water entitlements**: The purchase of water entitlements (or parts of entitlement) from irrigation farmers by the State, as described in this report, should be considered by DWA.

- **Unlawful irrigation water use:** Unlawful irrigation water use in all three sub-catchments should be addressed with more urgency. The irrigation validation and verification of registered use studies are presently underway in the Luvuvhu/Letaba catchment, but the process is complex and slow. Unless the DWA is seen to be identifying this proliferation and taking the necessary regulatory steps to control it, unregistered water use for irrigation will become difficult to reverse. The problem is exacerbated by the exploitation of groundwater for irrigation which often impacts indirectly on surface water resources.

4.3 IRRIGATION WATER RETURN FLOWS AND RE-USE

There is no observed information available on irrigation return flows within the study area. The expected return flows from irrigation areas were thus estimated based on the irrigation application efficiency and assuming that only 50% of the non-effective irrigation will result in return flows.

These return flow estimations were done on a quaternary catchment basis. The total return flows back into the system for each quaternary catchment were expressed as a percentage of the irrigation supply. The assumed expected return flows and irrigation application efficiencies are summarised in **Table 4.12**.

Table 4-12: Area weighted application efficiency and return flow percentages

Quaternary/quinary catchment	Application efficiency (Given as a %)	Return flows (as % of supply)
A91A	87.9	6.0
A91B	86.4	6.6
A91C	88.5	5.8
A91D	90.3	4.9
A91F	90.0	5.0
A92A	85.0	7.5
A92B	85.0	7.5
B81A	79.7	10.2
B81B	82.1	8.9
B81C	83.2	8.4
B81D2	68.5	15.8
B81D1	81.0	9.5
B81E3	87.8	6.1
B81E1	83.6	8.2
B81E2	77.6	11.2
B81F1	80.5	9.7
B81F2&3	86.9	6.5
B81G	65.9	17.0
B81H	61.6	19.2
B81J	65.2	17.4
B82A	92.4	3.8
B82B	91.6	4.2
B82C	90.0	4.9
B82D	90.0	5.0
B82E	90.4	4.8
B82F	93.1	3.5
B90B	85.0	7.5

The assumed values as obtained from (DWA **2013b**) are also given in **Table 4-12.**

4.4 PROJECTED FUTURE IRRIGATION WATER REQUIREMENTS

Most of the existing irrigation schemes as well the smaller private irrigation developments already experience severe water shortages and related low assurance of supply. In the case of the smallholder irrigation schemes, the assurance of supply has become so low that a large portion of these irrigation schemes drastically reduced areas planted, and in some areas are non-existent. It was therefore assumed that in general irrigation will not increase and that the irrigation water requirements remained the same over the planning period. There are however a few exceptions where growth were considered a possibility. These possible future irrigation developments are summarised in **Table 4.13**.

Table 4-13: Possible future growth in irrigation

Scheme	Irrigation water requirement		Notes
	Current use (million m^3/a)	Possible future (million m^3/a)	
Groot Letaba Catchment			
Magoebaskloof & Vergelegen dams	3.6	13	Land claims previously tea plantations. Now to be taken up by Magoeba Tribe
Tzaneen Dam Groot Letaba WUA	0	20.4 (31)	Allocated to resource poor farmers not yet utilised. Full allocation 31 million m^3/a. Due to low assurance and related operating rule on average only 20.4 can be supplied
Luvuvhu catchment			
Albasini Dam Irrigation allocation 7.8 million m^3/a	2.4	7.3	Dam yield reduced significantly over time due to upstream development. Currently only 2.4 irrigated using groundwater
Damani Dam. Domestic requirement high.	0	4	Allocation to irrigation not yet developed. Yield might not be insufficient to support both domestic and irrigation
Nandoni Dam	3.2	13.3	Only a small portion of the allocation to irrigation already developed.
Vondo Dam	0	2.8	Previous tea plantations and land claims. Full allocation expected to be taken up soon
Mutale catchment			
Possible future dam and existing Tshiombo scheme	1.8	9.0 (just indicative, still to be determined)	Tshiombo Weir & canal currently partly in use. With future dam in place will be able to support more irrigation.

The rate at which the possible future irrigation will be developed is unknown and depend on several factors such as water availability, removal of unlawful irrigation, development initiatives for resource poor farmers etc.

5 AFFORESTATION

5.1 METHODOLOGY

The information on the forestry areas and the distribution of the tree species was provided by the V&V Study (DWA, 2013b). This information were used as input to the WRSM2000 rainfall runoff model, specifically as input to the streamflow reduction module imbedded in the WRSM2000 model. This module uses the CSIR method to determine the reduction in runoff due to afforestation within a sub-catchment. The methodology was developed by Dr David Scott (Scott and Smith, 1997) and takes into account percentage area, rotation length and percentage optimal growth for each of the different tree types such as pines, eucalypts and wattle.

By using the final calibrated WRSM2000 model, the reduction in runoff as result of afforestation in each of the sub-catchments on a monthly basis were determined and documented to be used in the water resource models (WRYM and WRPM) to determine or take into account the impact of the afforestation on the runoff in the streams and rivers as well as on the yield characteristics of the dams in the different sub-systems.

5.2 CURRENT AND FUTURE AFFOREASTATION AREAS AND RUNOFF REDUCTION

There are significant commercial forestry activities in the Upper Letaba and Luvuvhu Catchments. The distribution of the forestry activities in the WMA is provided in **Figure 5.1**. The bulk of the afforestation activities occur in the Upper Letaba catchments covering a total area of 414 km^2 and results in a reduction in runoff of approximately 55 million m^3/a. This is followed by the Upper Luvuvhu catchment containing 140km^2 of afforestation developments which reduce the runoff by 20 million m^3/a. A small amount of afforestation is found in the Upper Mutale catchment, just over 23 km^2 with a related reduction in runoff of 4.4 million m^3/a. A summary of the commercial forestry activities as well as the present day (2010) runoff reduction due to these activities in the Luvuvhu Mutale catchment is provided in **Table 5.1**

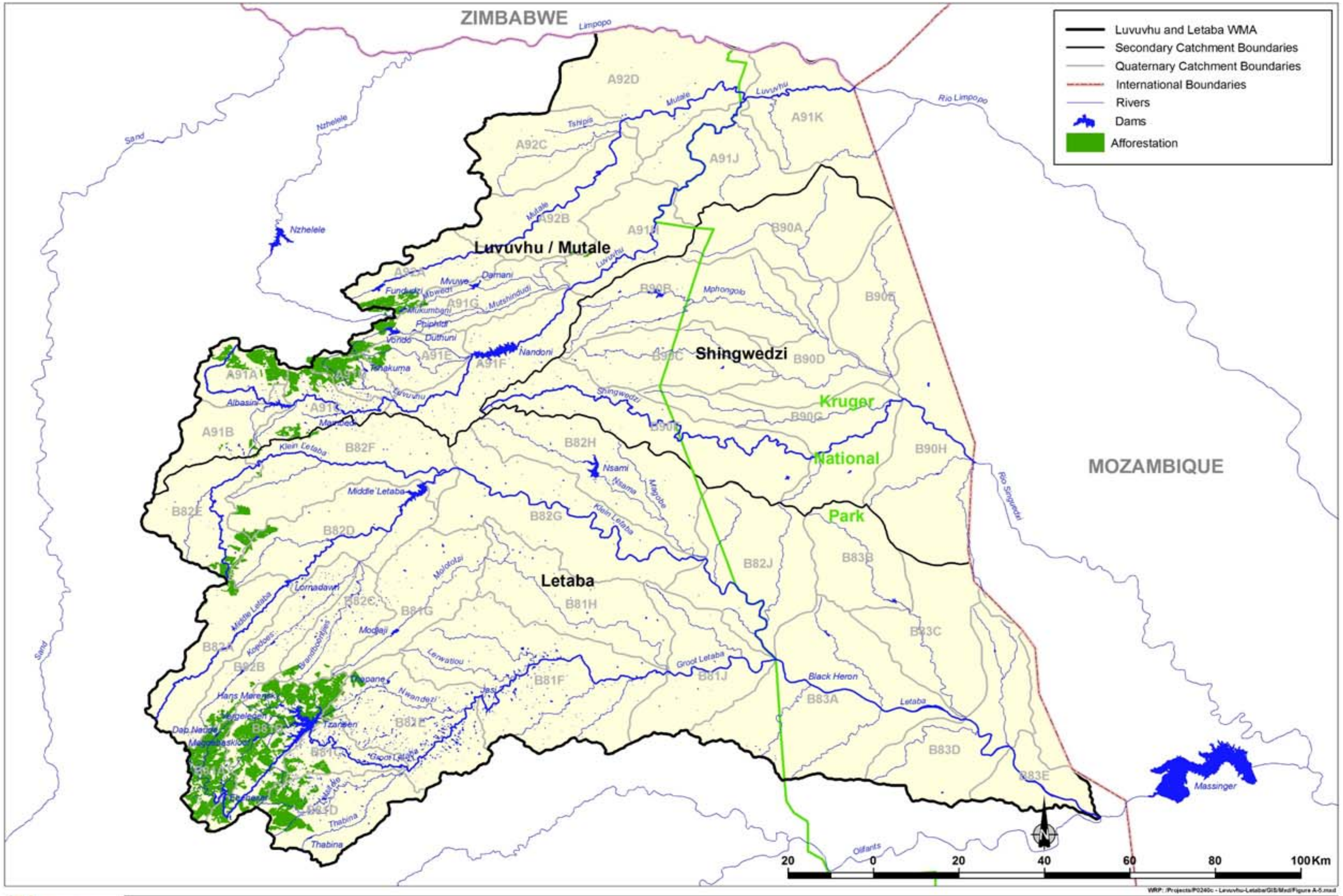
Table 5-1: Summary of commercial forestry distribution and estimated runoff reduction for 2010 development levels in the Luvuvhu and Mutale catchments

Quaternary	%Eucalyptus	%Pine	Area of Forestry km2	2010 Development Runoff Reduction (million m^3/a)
A91A	63%	37%	39.4	3.7
A91B	100%	0%	1.6	0.1
A91C1	73%	27%	26.7	4.5
A91D1	38%	62%	7.7	2.2
A91D2	38%	62%	31.9	5.4
A91E	6%	94%	8.6	1.7
A91G1	8%	92%	22.9	2.4
A91H	100%	0%	0.8	0.0
A92A	0.0%	100%	23.2	4.4
Sub-Total			**162.8**	**24.4**

A summary of the commercial forestry activities as well as the present day (2010) runoff reduction due to these activities in the Letaba catchment is provided in **Table 5.2**.

Table 5-2: Summary of commercial forestry distribution and estimated runoff reduction for 2010 development levels in the Letaba catchment

Quaternary	%Eucalyptus	%Pine	Area of Forestry km2	2010 Development Runoff Reduction (million m^3/a)
Letaba				
B81A	83%	17%	97.8	16.6
B81B	91%	9%	182.8	23.6
B81C	100%	0%	11.2	1.5
B81D	91%	10%	50.9	10.7
B81E	100%	0%	11.7	0.4
B81G	100%	0%	0.5	0.1
B82A	96%	4%	4.9	0.3
B82B	94%	6%	7.9	0.5
B82C	100%	0%	5.0	0.3
B82D	100%	0%	11.4	0.4
B82E	100%	0%	18.7	0.4
B82F	100%	0%	11.0	0.3
Sub-Total			**413.8**	**55.1**



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

Forestry

Figure 5.1

6 REDUCTION IN RUNOFF AS RESULT OF INVASIVE ALIEN PLANTS (IAP)

6.1 METHODOLOGY

The IAP distribution and extent of IAP were obtained from the Agricultural Research Council's report National Invasive Alien Plant Survey (**ARC, 2010**). This latest survey provided the spatial distribution of IAPs in the WMA as well as the predominant species per quaternary catchment as well as the compacted densities.

Invasive Alien Plants (IAP) reduce the available runoff in a catchment, more so than indigenous species as also experienced with afforestation in a catchment, but not as severe. The process followed to determine the reduction in runoff due to IAP is very similar to that used for afforestation. The IAP module in the WRSM2000 model is used for this purpose instead of the afforestation module.

The methodology used in the IAP module to determine the reduction in runoff was developed by Dr David le Maittre (Le Maittre and Gorgens, 2001) and takes account of percentage area, age and percentage optimal growth for each of the different types of IAPs. The IAP types used for this purpose are tall trees, medium trees and tall shrubs. The IAPs are further sub-divided based on location into riparian and non-riparian IAPs. Non-riparian alien vegetation is treated in a similar manner to afforestation. For alien vegetation in the riparian zone the module allows for the fact that it will be able to draw additional water from the stream and adjacent area. The GIS grid information was obtained from the survey and buffered 100m on either side of the rivers to calculate the percentage of the IAPs that occur in the riparian zones per quaternary of the catchment.

6.2 CURRENT IAP AREAS AND RUNOFF REDUCTION

The highest density of IAPs in the Water Management Area are located on the main stem of the Groot Letaba river, downstream from Tzaneen Dam and in the lower reaches of the Mutale river. The condensed are covered by IAPs in the Letaba catchments amounts to 135 km^2 which resulted in an estimated reduction in runoff of 9 million m^3/a. The Luvuvhu catchment contains a condensed IAP area of 15.4 km^2 resulting in a runoff reduction of 1.8 million m^3/a. A relative small condensed area (10.6 km^2) of IAPs is found in the Mutale catchment relating to a reduction in runoff of only 0.4 million m^3/a.

Table 6-1: Summary of IAP distribution and estimated runoff reduction for 2010 development levels in the Luvuvhu and Mutale.

Quaternary	Condensed Area (km^2)	Area in Riparian (km^2)	% in Riparian Zone	% Tall Trees	% Medium Trees	% Tall Shrubs	2010 Development Runoff Reduction$^{(1)}$ (million m^3/a)
A91A	6.2	0.03	0.47	0	69	31	0.6
A91B	2.9	0.00	0.08	100	0	0	0.1
A91G	6.3	0.02	0.26	40	0	60	1.1
A92A	1.6	0.00	0.26	100	0	0	0.2
A92B	9.0	0.00	0.00	100	0	0	0.2
Sub-Total	**26.0**	**0.05**	**0.19**				**2.2**

Details of the location, areas covered, types of IAP and the expected reduction in runoff are summarised in **Table 6.1** and **6.2** for the Luvuvhu and Letaba catchments respectively.

Table 6-2: Summary of IAP distribution and estimated runoff reduction for 2010 development levels in the Letaba catchment.

Quaternary	Condensed Area (km^2)	Area in Riparian (km^2)	% in Riparian Zone	% Tall Trees	% Medium Trees	% Tall Shrubs	2010 Development Runoff Reduction[(1)] (million m^3/a)
B81A	2.3	0.03	0.72	0	0	100	0.7
B81B	9.4	0.00	0.14	100	0	0	0.8
B81C	14.4	0.02	0.00	87	0	0	1.6
B81D	40.3	0.00	0.65	92	2	6	4.2
B81E	11.3	0.00	0.09	100	0	0	0.2
B81G	6.0	0.02	0.06	98	0	2	0.2
B81J	0.8	0.01	0.17	100	0	0	0.0
B82A	11.3	0.00	0.20	68	0	32	0.6
B82D	10.3	0.26	0.15	2	12	86	0.5
B82E	28.8	0.01	0.23	46	12	42	0.4
Sub-Total	**134.6**	**0.35**	**0.26**				**9.1**

7 INTERNATIONAL OBLIGATIONS

The international agreement between South Africa and Mozambique does not specify a minimum flow quantity or quality. South Africa however is party to international policies and protocol and the flow across the border must be reasonable (both in terms of quantity and quality). As part of these international policies and protocol there are specific provisions in terms of which State Parties shall exchange information and consult each other and, if necessary, negotiate the possible effects of planned measures on the condition of a shared watercourse.

Depending on the outcome of such possible negotiations, there might be some limitations on development in the RSA, or the minimum flows that need to enter Mozambique. These limitations are currently not known and can impact on the water balances, specifically those relating to the Mutale catchment.

8 SUMMARY

The bulk of the water use in the study area is located within the Groot Letaba catchment, and represents approximately 57% of all the total water demand, with included the reduction in runoff due to afforestation and invasive alien plants as applicable to the 2012 development level.

Within the Groot Letaba irrigation represents the largest water use sector requiring 71% of the total water requirement (see **Table 8.1**). This is followed by the reduction in runoff due to afforestation and invasive alien plants using 15% of the total requirement and then the Urban/Industrial/Mining/Rural domestic requirement (14%).

Table 8-1: Groot Letaba Catchment Water Requirement Summary

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Surface water	Transfers to Polokwane	20.17	20.17	20.17	20.17	20.17	20.17	20.17
Surface water	Urban/industrial & rural domestic	27.80	31.74	38.80	46.41	50.18	54.03	58.01
Groundwater	Urban/industrial & rural domestic	3.41	3.41	3.41	3.41	3.41	3.41	3.41
Total urban & rural domestic		**51.38**	**55.32**	**62.38**	**69.99**	**73.76**	**77.61**	**81.59**
Surface water	Large industries	1.73	1.73	1.73	1.73	1.73	1.73	1.73
Surface water	Mining	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Total urban/industrial/mining & rural domestic		**54.98**	**58.92**	**65.98**	**73.59**	**77.36**	**81.21**	**85.19**
Surface water	Irrigation Schemes	91	91	91	91	91	91	91
Surface water	Allocation to resource poor farmers	31	31	31	31	31	31	31
Surface water	Diffuse irrigation	115.1	115.1	115.1	115.1	115.1	115.1	115.1
Groundwater	Diffuse irrigation	50.5	50.5	50.5	50.5	50.5	50.5	50.5
Total Irrigation		**287.6**	**287.6**	**287.6**	**287.6**	**287.6**	**287.6**	**287.6**
Total Groot Letaba Water requirement		**342.58**	**346.52**	**353.58**	**361.19**	**364.96**	**368.81**	**372.79**
Reduction in Runoff								
Reduction in runoff due to Afforestation		52.9	52.9	52.9	52.9	52.9	52.9	52.9
Reduction in runoff due to Invasive alien plants		7.7	7.7	7.7	7.7	7.7	7.7	7.7
Total Reduction in runoff		**60.6**	**60.6**	**60.6**	**60.6**	**60.6**	**60.6**	**60.6**
Total water requirements and reduction in runoff		**403.18**	**407.12**	**414.18**	**421.79**	**425.56**	**429.41**	**433.39**

The Klein and Middle Letaba catchments represent only 19% of the total study area water requirement. The largest water user is irrigation requiring almost 75% of the total water requirement in this catchment (See **Table 8.2**). The Urban/Industrial/Mining/Rural-domestic requirement takes just above 22% with reduction in runoff due to afforestation and invasive alien plants in the order of 3%.

The Luvuvhu catchment support most of the requirements in the Shingwedzi catchment as well as in some areas within the Sand River catchment to the west of the study area. All these demands were captured in **Table 8.3**, although some of the demand centres are not located within the catchment boundaries of the Luvuvhu and Shingwedzi rivers (Mutale tributary excluded).

Table 8-2: Klein and Middle Letaba Water Requirement Summary

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Surface water	Urban/industrial & rural domestic	18.37	22.23	29.17	36.64	39.92	43.29	46.16
Groundwater	Urban/industrial & rural domestic	7.51	7.60	7.77	7.95	8.01	8.08	8.15
Surface water	Middle Letaba Canal losses	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Total urban/industrial & rural domestic		**29.88**	**33.83**	**40.94**	**48.58**	**51.94**	**55.37**	**58.32**
Surface water	Irrigation Schemes	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Surface water	Diffuse irrigation	62.4	62.4	62.4	62.4	62.4	62.4	62.4
Groundwater	Diffuse irrigation	35.9	35.9	35.9	35.9	35.9	35.9	35.9
Total Irrigation		**98.9**	**98.9**	**98.9**	**98.9**	**98.9**	**98.9**	**98.9**
Total Klein & Middle Letaba Water requirement		**128.78**	**132.73**	**139.84**	**147.48**	**150.84**	**154.27**	**157.22**
Reduction in Runoff								
Reduction in runoff due to Afforestation		2.2	2.2	2.2	2.2	2.2	2.2	2.2
Reduction in runoff due to Invasive alien plants		1.4	1.4	1.4	1.4	1.4	1.4	1.4
Total Reduction in runoff		**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**	**3.6**
Total water requirements and reduction in runoff		**132.38**	**136.33**	**143.44**	**151.08**	**154.44**	**157.87**	**160.82**

Table 8-3: Luvuvhu and Shingwedzi Catchments Water Requirement Summary

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Surface water	Urban/industrial & rural domestic	38.65	44.18	56.65	70.15	75.38	80.73	86.40
Groundwater	Urban/industrial & rural domestic	5.13	5.08	5.08	5.08	5.08	5.08	5.08
Total urban/industrial & rural domestic		**43.78**	**49.26**	**61.73**	**75.23**	**80.46**	**85.81**	**91.48**
Surface water	Irrigation Schemes	10.90	15.30	30.20	32.20	32.20	32.20	32.20
Surface water	Diffuse irrigation	34.70	34.70	34.70	34.70	34.70	34.70	34.70
Groundwater	Diffuse irrigation	49.00	49.00	49.00	49.00	49.00	49.00	49.00
Total Irrigation		**94.60**	**99.00**	**113.90**	**115.90**	**115.90**	**115.90**	**115.90**
Total Luvuvhu & Shingwedzi Water requirement		**138.38**	**148.26**	**175.63**	**191.13**	**196.36**	**201.71**	**207.38**
Reduction in Runoff								
Reduction in runoff due to Afforestation		20	20	20	20	20	20	20
Reduction in runoff due to Invasive alien plants		1.8	1.8	1.8	1.8	1.8	1.8	1.8
Total Reduction in runoff		**21.8**	**21.8**	**21.8**	**21.8**	**21.8**	**21.8**	**21.8**
Total water requirements and reduction in runoff		**160.18**	**170.06**	**197.43**	**212.93**	**218.16**	**223.51**	**229.18**

The combined Luvuvhu Shingwedzi catchments represents 23% of the total study area water requirements. Irrigation is also the largest water user in these two catchments comprising 59% of the total water requirement in these two sub-catchments.

The Urban/Industrial/Rural-domestic requirement in these two sub-catchments is fairly high at 27% and the reduction in runoff mainly as result of afforestation at approximately 14% of the total requirement in these two sub-catchments.

The Mutale sub-catchment represents the lowest overall water requirement comprising only 2% (see **Table 8.4**) of the total study area water requirements at 2012 development level. In the Mutale sub-catchment the Urban/Industrial/Mining/Rural-domestic sector requires the most water representing 36% of the total water requirement within this sub-catchment. The reduction in runoff mainly as result off afforestation has the second largest impact on the water resources in this sub-catchment comprising 33% of the total water requirement. At 2012 development level irrigation requirements only forms 31% of the total sub-catchment water requirement. The irrigation portion can however increase significantly in future, depending on the revitalising of existing schemes in particular when a dam is being built in the Mutale catchment.

Table 8-4: Mutale Catchment Water Requirement Summary

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Surface water	Urban/industrial & rural domestic	2.41	2.78	3.43	4.11	4.56	5.02	5.47
Groundwater	Urban/industrial & rural domestic	2.14	2.14	2.14	2.14	2.14	2.14	2.14
Total urban & rural domestic		**4.55**	**4.92**	**5.57**	**6.25**	**6.70**	**7.16**	**7.61**
Surface water	Mining	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Groundwater	Mining	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Total urban/industrial/mining & rural domestic		**5.16**	**5.53**	**6.18**	**6.86**	**7.31**	**7.77**	**8.22**
Surface water	Irrigation Schemes	1.80	1.80	1.80	2.50	4.00	7.00	9.02
Surface water	Diffuse irrigation	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Groundwater	Diffuse irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Irrigation		**4.40**	**4.40**	**4.40**	**5.10**	**6.60**	**9.60**	**11.62**
Total Mutale Water requirement		**9.56**	**9.93**	**10.58**	**11.96**	**13.91**	**17.37**	**19.84**
Reduction in Runoff								
Reduction in runoff due to Afforestation		4.40	4.40	4.40	4.40	4.40	4.40	4.40
Reduction in runoff due to Invasive alien plants		0.40	0.40	0.40	0.40	0.40	0.40	0.40
Total Reduction in runoff		**4.80**	**4.80**	**4.80**	**4.80**	**4.80**	**4.80**	**4.80**
Total water requirements and reduction in runoff		**14.36**	**14.73**	**15.38**	**16.76**	**18.71**	**22.17**	**24.64**

From **Table 8.5** and **8.6** summarising the total study water requirements and percentage distribution respectively it is evident that irrigation is overall the largest water user at 68% for the year 2012.

The portion of the total water requirement for irrigation however decreases over time to 61% with the Urban/Industrial/Mining/Rural-domestic increasing from 19% to 29% by 2040. This does not reflect a decrease in irrigation over time, but rather that the Urban/Industrial/Mining/Rural-domestic requirements are increasing at a much higher rate (See **Table 8.5**).

Table 8-5: Total Study area Water Requirement Summary

Water resource	Description	Water Requirements (million m^3/a)						
		2012	2015	2020	2025	2030	2035	2040
Total urban/industrial/mining & rural domestic		133.80	147.54	174.82	204.27	217.06	230.15	243.21
Total Irrigation		485.50	489.90	504.80	507.50	509.00	512.00	514.02
Total Water Requirements Study area		**619.30**	**637.44**	**679.62**	**711.77**	**726.06**	**742.15**	**757.23**
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 plants		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 reduction in runoff		**710.10**	**728.24**	**770.42**	**802.57**	**816.86**	**832.95**	**848.03**

Table 8-6: Total Study area Water Requirement Summary Percentage distribution

Water resource	Description	Water Requirements expressed as % of the total at given date						
		2012	2015	2020	2025	2030	2035	2040
Total urban/industrial/mining & rural domestic		19%	20%	23%	25%	27%	28%	29%
Total Irrigation		68%	67%	66%	63%	62%	61%	61%
Total Water Requirements Study area		**87%**	**88%**	**88%**	**89%**	**89%**	**89%**	**89%**
Reduction in runoff due to Afforestation		11%	11%	10%	10%	10%	10%	9%
Reduction in runoff due to Invasive alien plants		2%	2%	1%	1%	1%	1%	1%
Total Reduction in runoff		**13%**	**12%**	**12%**	**11%**	**11%**	**11%**	**11%**
Total water requirements and reduction in runoff		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

The reduction in runoff represents approximately 13% to 11% over the projection period of the total study area water requirement. This should be reduced in future by the removal of invasive alien plants, which contributes to just over 12% of the reduction in runoff.

9 CONCLUSIONS AND RECOMMENDATIONS

From the work carried out and data obtained as part of this study task the following were concluded and recommended.

- Urban/Industrial/Mining/Rural-domestic water requirement represents approximately 19% of the total study area water requirement in 2012 and is expected to increase by almost 110 million m^3/a representing approximately 30% of the total water requirement by 2040. At 2012 development level only 14% of the Urban/Industrial/Mining/Rural-domestic water requirement is supplied from groundwater resources. There is still significant groundwater potential in some areas that should be utilised for this particular water use sector, as the surface water resources are limited and already over utilised in some areas.

- Irrigation is the largest water use sector in almost all the sub-catchments, except in the Mutale River catchment. At 2012 development level the irrigation sector represents 68% of the total study area water requirement, and is expected to increase only by approximately 29 million m^3/a by 2040, as available water resources is very limited. Due to the low assurance of existing surface water resources used for irrigation purposes, some areas started to utilise groundwater resources. At 2012 development level approximately 28% of the irrigation water requirements were already supplied from groundwater resources.

- There are uncertainties concerning the development of new irrigation schemes, the revitalising of existing inactive schemes, and to what extent existing irrigation allocations that formed part of land claims, will again be taken up in future. These need to be clarified, and should take into account the availability of water from the water resources within these affected areas.

- The current irrigation development, crop combinations and irrigation systems used were mainly obtained from the Validation of Water use task and related study. The verification study is still underway to verify which of the current irrigation as identified through the validation component of the study, are indeed lawful abstractions. It is of utmost importance that this process be completed and that all unlawful abstractions be eradicated as the water resources in many areas within the study area is already over utilised and in some cases resulted in significant reductions in the yield available from existing dams.

- No extension off commercial afforestation should be allowed within the study area, as water resources are very limited and in some places already over utilised.

- Invasive alien plants need to be removed to increase runoff in the study area by almost 11 million m^3/a. Need to focus on the high impact areas (A91A and A91G) in the Upper Luvuvhu and Mutshindudi a tributary of the Luvuvhu.

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