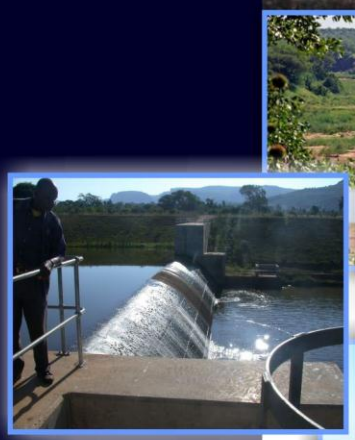
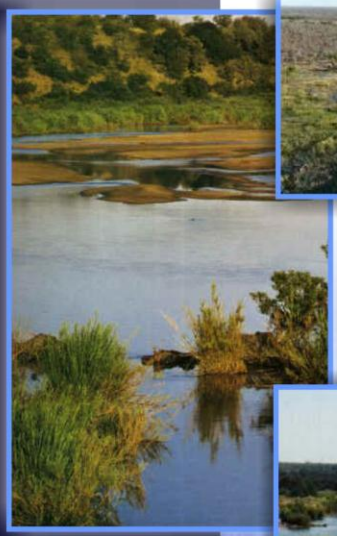
water affairs

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

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

PRELIMINARY SCREENING WORKSHOP STARTER DOCUMENT





April 2012

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

STARTER DOCUMENT

LIST OF AUGMENTATION AND INTERVENTION OPTIONS

FIRST DRAFT

April 2012

PRELIMINARY SCREENING WORKSHOP

STARTER DOCUMENT

1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

This Starter Document presents information on the intervention options (focusing on potential infrastructure solutions) that were identified to reconcile the water requirments with the available water resources in the study area. These options will be presented and discusses at the Screening Workshop with the aim to obtain comments as well as to add additional or exclude options where appropriate.

The document gives a brief background on how the options were identifieid, describes the sub-areas (catchments) according to which the options were grouped and presents salient information on each option in tabular form - see **Anexture A**.

1.2 BACKGROUND TO IDENTIFIED OPTIONS

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

Task 1 of the study, “Summary of Current and Previous Studies”, therefore, involved compiling a Literature Review Report containing information from all known previous water resource studies, which serve as information source for this Starter Document and preparation for the Screening Workshop.

1.3 PURPOSE OF SCHREENING WORKSHOP

The purpose of the screening workshop is to provide the opportunity for the stakeholders to evaluate the scenarios or options presented by the DWA and the study team and to add additional options where appropriate. Stakeholders have to share their views and also provide their agreement on the options to concider for further evaluation and the level of further investigations that is required.

2 STUDY AREA AND RESOURCE STATUS OVERVIEW

The study area comprises of the water resource of the catchment of the Luvhuvhu, Mutale, Letaba and Shingwedzi rivers linked to adjacent systems as indicated by the inter-basin transfers on Figure 2.1.

For the purpose of the evaluation of options and the screening workshop the study area was sub-devided into the following sub-areas.

- Luvuvhu River main catchment
- Mutale River catchment
- Shingwedzi River catchment
- Groot Letaba River catchment
- Middle & Klein Letaba River catchments

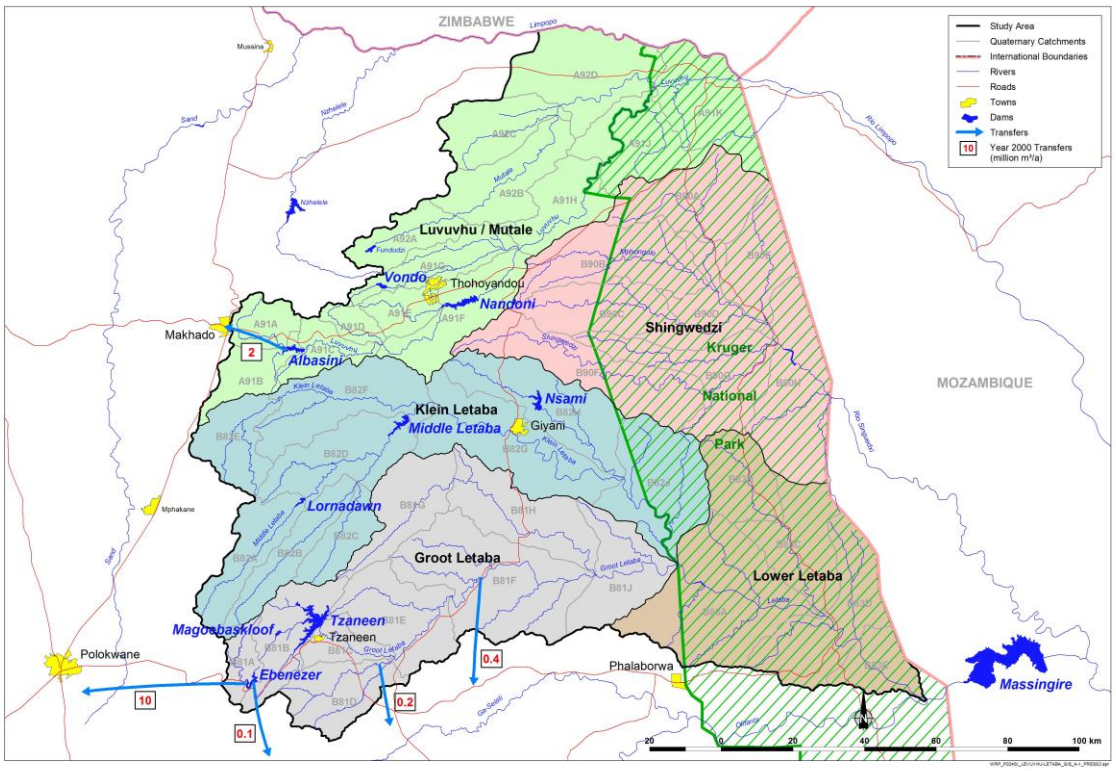


Figure 2.1: Study Area and sub catchments

2.1 CURRENT STATUS IN LUVUVHU AND MUTALE CATCHMENTS

The Luvuvhu system comprises of five sub-systems, the Albasini, Vondo, Nandoni, Tshakhuma and Damani sub-systems. The Nandoni Dam completed in 2005 makes up the

Nandoni Dam sub-system which is the largest and most recent development in the Luvuvhu River system. The key purpose of this dam as planned for in terms of the White Paper, was to supply regional bulk water to Thohoyandou, Malumulele, Louis Trichardt and environs (Makhado LM) and other towns in the area as well as the revitalization of a 1100ha subsistence irrigation schemes. In addition water is supplied to Matoks and for mining which used to be supplied from the Middle Letaba scheme. The Vondo, Nandoni and Tshakuma sub-systems are all used to supply overlapping demand centers which are interlinked and therefore almost act as a combined system.

At the moment the water use from Nandoni Dam is still below its yield. 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 (see discussions under Letaba). This is not a permanent arrangement, as the local resources in the Giyani area, specifically groundwater, can be developed to meet these needs. 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 2018.

The yield of the Albasini Dam has reduced over the years and as a consequence the dam is over allocated. The yield of the Alabasini Dam is not sufficient to supply all the water requirements of irrigators in the Levubu Government Water Scheme. These irrigators also make use of farm dams and groundwater to supplement their supplies.

Albasini will still be in a deficit, even when Makhado is fully supplied from Nandoni Dam, as planned. Reduction in the excessive canal losses and even some reduction in the total allocated irrigation area might be required to be able to supply the users at their required assurance levels.

The Damani sub-system still has a small surplus available, but insufficient to be used in support of any of the other sub-systems

Large scale utilization of the groundwater resource occurs mostly downstream of the Albasini Dam where it is used by irrigators and in the vicinity of Thohoyandou where it is used to supply rural communities.

2.2 CURRENT STATUS IN LETABA AND SHINGWEDZI CATCHMENTS

The Letaba River catchment is drained by the Groot Letaba River and its major tributaries the Klein Letaba, Middle Letaba, Letsitele and Molototsi rivers. The Shingwedzi River and its major tributaries the Shisha, Mphongolo and Phugwane drain the Shingwedzi River catchment.

The Shinwedzi 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. Water use in the catchment is negligible. The two main tributaries of the Letaba River, the Klein and Groot Letaba, have their confluence on the western boundary of the Kruger National Park, whilst the Letaba River flows into the Olifants River just upstream of the

border with Mozambique.

The main urban areas in these catchments are Tzaneen and Nkowakowa in the Groot Letaba River catchment and Giyani in the Klein Letaba River catchment. The Letaba River catchment (and 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.

Surface water resources are extensively developed with a large number of small to major dams constructed to meet domestic (urban and rural), irrigation and industrial water needs. The water supply schemes generally consist of dams for storage, bulk water pipelines and canals for conveyance. Regulation is mainly provided by the Middle Letaba, Ebenezer and Tzaneen Dams.

The Middle Letaba demand imposed on the Middle Letaba Dam exceeds the yield from the dam by far. There is however a lot of wastage that can be reduced in the Giyani area. With the water purification plant at Nandoni Dam completed, it will be used to take over the supply to Waterval, Elim and Vleyfontein taking some pressure off the Middle Letaba Dam. The area under irrigation from the Middle Letaba Dam may also have to be substantially reduced to improve domestic supplies. (See details on the possible support from Nandoni Dam to Giyani as included in the Luvuvhu Basin section).

There are a large number of existing boreholes in the Giyani area, many of which are not operational. Operationalising only those boreholes yielding 50m3 or higher would provide a considerable volume of water to Giyani. These boreholes should be linked up to a bulk supply system (not single borehole supplies) and distributed from strategic reservoirs to the area. With a proper management programme and operational rules in place this would offer a sustainable water supply at a high level of assurance.

The Greater Tzaneen Local Municipality is supplied from the Tzaneen and Ebenezer dams on the Groot Letaba River. The Groot Letaba River Water Development Project (GLRWDP) consisting of building of the Nwamitwa Dam, the raising of Tzaneen Dam and building of a potable water supply system is in the planning stage moving towards implementation. The aims of the GLRWDP are to:

- Improve water supplies to communities in the Southern part of the Mopani District Minicipality (which includes Tzaneen).
- Improve the water availability for the ecological system in the Groot Letaba River.
- Enable the establishment of resource poor farmers.
- Stabilize commercial irrigation.

3 SUMMARY OF IDENTIFIED OPTIONS

Several potential future options were identified from the summarized information in the Literature Review Report. These options are only listed in this section with details on each of the options given in the summary tables given in Section 4.

Table 3.1: List of intervention Options in Luvuvhu Main Catchment

No:	Option	Comments
Lu1	Reconsideration of supply to Louis Trichardt from Abasing and smaller resources	Other sources include groundwater, Latonyanda Dam, reduction in irrigation scheme area and upstream irrigation abstractions. Dleeete option
Lu2	Reconsideration of supply to supply to Louis Trichardt from mainly Nandoni Dam	Reduce supply from Albasini, reduce irrigation system losses & improve supply to irrigation.
Lu3	Reconsideration of supply to supply to Louis Trichardt from Nandoni and Albasini dams	An combination of options 1 & 2.
Lu4	Groundwater utilisation Nandoni supply area	Reduce or eliminate supply from Nandoni to areas with surplus groundwater resources and increase supply to areas of over exploitation of groundwater.
Lu5	Raising of Vondo Dam	Will be able to supply a larger portion of the higher lying parts of Thohoyandou and reduce the load on Nandoni.
Lu6	Mid Dzindi Dam	Located in Duthuni River upstream of Nandoni. Mainly operational benefit.
Lu7	Latonyanda Dam	Move yield upstream. Operational benefits mainly Form part of options Lu1 & Lu3.
Lu8	Paswane Dam	Located on the lower end of the Mutshindudi River. Good future option to reduce load on Nandoni by supplying the lower Nandoni supply area as well as part of the EWR for KNP.
Lu9	Xikundu Dam	Located downstream of the confluence of the Mutshindudi and Luvuvhu rivers. Possibility of a larger storage dam in future. Similar advantage as option Lu8.

The location of the identified options is shown on **Figure 3.1**.

Table 3.2: List of intervention Options in Mutale Catchment

No:	Option	Comments
Mu1	Water conservation and demand management	WC/WDM in domestic and agricultural sector.
Mu2	Groundwater Development	The total net potential increase in the utilizable water from groundwater is about 2 million m^3/a.
Mu3	A new dam on the Mutale River	The two most viable dam sites identified are Rambuda downstream and Tswera.
Mu4	Abstraction from the Limpopo River	Possibility for future coal mines in the North Estern part of the catchment.

Table 3.3: List of intervention Options in Shingwedzi Catchment

No:	Option	Comments
Sw1	Groundwater Development	Identification and development of additional groundwater units to rural supply where shortage occur.
Sw2	Transfer of water from the Luvuvhu (Xikundu Weir & Nandoni Dam)	Part of the area is already supplied from the Luvuvhu River. This would mean a futher extention of the supply network with focus on water from Xikundu Weir.

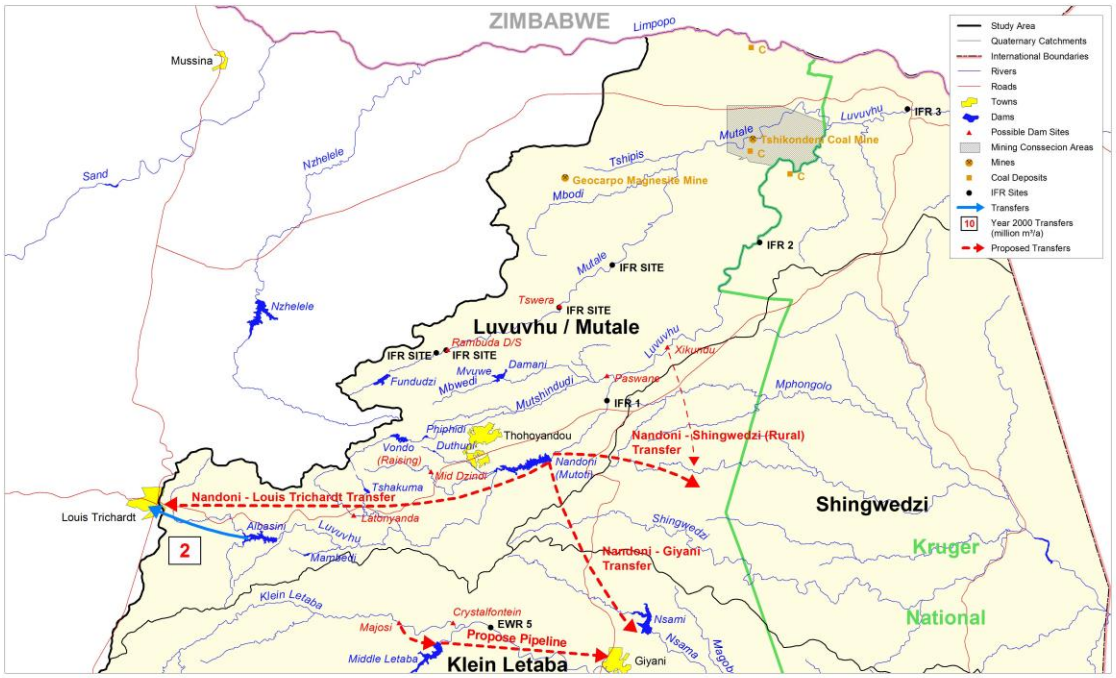


Figure 3.1: Location of options in the Luvuvhu, Mutale & Shingwedzi catchments

Table 3.4: List of intervention Options in Groot Letaba Catchment

No:	Option	Comments
GL1	Raising of Tzaneen Dam	Raising of spillway (labyrinth option) Yield increase 6 million m^3/a (Already in planning).
GL2	Construction of Nwamitwa Dam	30m high embankment type dam 143.8 million m^3 storage (Already in planning)
GL3	Bulk Water Supply Infrastructure from Nwamitwa Dam	Potensial supply area of the future Nwamitwa Dam and regional bulk water supply infrastructure to serve the rural settlements in the area
GL4	Letsitele River Valley Dam (Hobsons Choice)	33.5m high Storage capacity 14.2 million m^3/a
GL5	Mulele Dam	Dam site on Molototsi River expected yield 8.6 million m^3/a. Major drawbacks high sediment, inundation of extensive areas under dry land crops. Possible to rather use for artificial groundwater recharge
GL6	Groundwater development	Development of groundwater on a regional scalemin conjunction with bulk water supply systems

Table 3.5 List of intervention Options in Middle and Klein Letaba Catchments

No:	Option	Comments
MKL1	Water Conservation and Water Demand Management	Implement WC/WDM measures to reduce water losses from the distribution infrastructure and to achieve more efficient water use
MKL2	Development of groundwater resources	To develop the under-utilised groundwater resource to augment the water resources in the area and reduce dependency on the overstressed surface water resource
MKL3	Replace Middle Letaba Dam to Nsami Dam canal with a pipeline	Losses need to be confirmed first.
MKL4	Transfer Scheme from Nandoni Dam	Scheme is already in process
MKL5	Construction of new dam on Klein Letaba River	Located just upstream of confluence of Middle and Klein Letaba rivers. Two possible sites Majosi and Crystalfontein. Can be storage dams or diversion weirs to divert water into Middle Letaba Dam.
MKL6 & 7	Remove/buy out all irrigation from Middle Letaba Scheme and reduce upstream irrigation	Yield from Middle Letaba Dam not sufficient to supply irrigation. Shortage on domestic demands is already experienced.

See **Figure 3.2** for the location of the different options

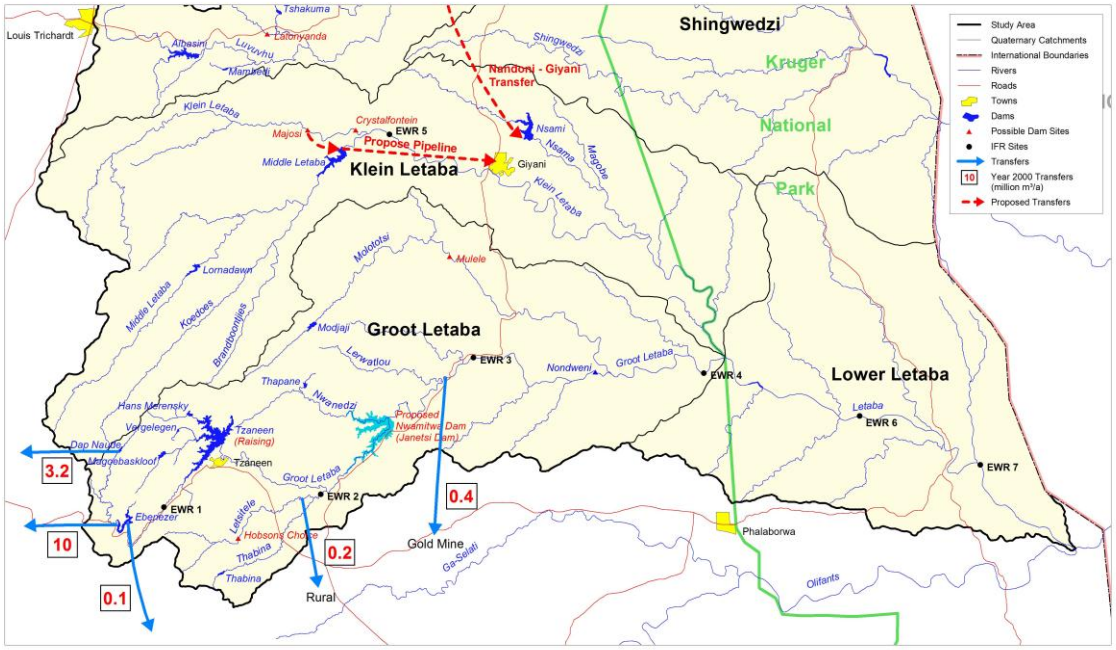


Figure 3.2: Location of options in the Groot and Klein Letaba catchments

Table A-1: Augmentation options identified from the literature – Luvuvhu Main catchment Area

No:	Name of option and source	Report & Level of Assessment	Date of Assessment	Key Features

Lu1	<u>Reconsideration of supply to Louis Trichardt from Albasini Dam</u>
	
	Albasini Dam, groundwater, Latonyanda Dam, Reduction in irrigation and upstream abstractions
		Luvuvhu Letaba Water Resource Situation Assessment
		
		(Reconnaissance)
			2003	• Infrastructure to supply additional transfers from Albasini to Louis Trichardt.
				• Re-allocate available water from Albasini through:
				  ○ Reduction in canal losses on the irrigation supply system.
				  ○ Buying out the some of the irrigation.
				  ○ Construct infrastructure to supply a larger portion if the irrigation area from the Latonyanda River.
				  ○ Using groundwater to supply part of the irrigation requirement.
				• Improve Albasini yield by:
				  ○ Reduce upstream irrigation from surface water.
				  ○ Reduce groundwater abstractions within the Albasini Dam catchment.

	Proposed assessments in the Reconciliation Study			**Comments:**
	• Need to determine the possible saving in losses within the irrigation supply system. • Determine the work required and related cost to achieve this saving in losses. • Determine the possibility of buying out irrigation within the Albasini Scheme, the effects of that and the related cost. • Re-evaluate the option of utilizing Latonyanda River and possible dam to support the Albasini Irrigation. • Evaluate and analyse the possibility of reducing irrigation and groundwater abstractions upstream of Albasini Dam and related cost.			• Also see options 2 and 3 • Surface/Groundwater interaction will be modelled for the first time. Scenario analysis to determine the effect of upstream groundwater abstractions can now be done • Verification of water use, when completed will indicate whether there are any un-lawfull abstractions taking place upstream of Albasini Dam. • Albasini Dam Historic Firm Yield 4.91million m^3/a. • Albasini sub-system Historic Firm Yield 10.38 million m^3/a (2005 demand 22.33 million m^3/a). • Irrigation demand 15.15 million m^3/a & canal losses 4.5 million m^3/a. Urban demand 2.64 million m^3/a (2005 level).

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Lu2	Reconsideration of supply to Louis Trichardt primarily from Nandoni Dam	Luvuvhu Letaba Water Resource Situation Assessment (Reconnaissance)	2003	• Reduce the existing supply from Albasini Dam to Louis Trichardt. • Supply the bulk of the requirement for Louis Trichardt from Nandoni Dam. • Improve the supply to irrigation from Albasini Dam.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Determine if sufficient water is available in Nandoni dam for this purpose. • Determine the related cost. • Determine the assurance of supply to irrigation.			• Irrigation demand 15.15 million m^3/a & canal losses 4.5 million m^3/a. Urban demand 2.64 million m^3/a (2005 level). • Also see options 1 and 3.

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features

Lu3	Reconsideration of supply to Louis Trichardt from Nandoni & Albasini dams
	
	(Combination of options 1 & 2)
		Luvuvhu Letaba Water Resource Situation Assessment
		
		(Reconnaissance)
			2003	• Continue with existing supply of 2.4 million m^3/a from Albasini Dam to Louis Trichardt.
				• Increase the supply from Albasini Dam to Louis Trichardt.through:
				  ○ Reduction in canal losses on the irrigation system.
				  ○ Buying out the some of the irrigation within the scheme.
				• Utilize another source such as Latonyanda river/possible dam to take over irrigation currently supply from Albasini Dam.
				• Use groundwater to supply a portion of the irrigation demand
				• Improve from Albasini dam as described for option 1.

	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Need to determine the possible saving in losses within the irrigation supply system. • Determine the work required and related cost to achieve this saving in losses. • Determine the possibility of buying out irrigation within the Albasini Scheme, the effects of that and the related cost. • Re-evaluate the option of utilizing Latonyanda River and possible dam to support the Albasini Irrigation. • Evaluate and analyse the possibility of reducing irrigation and groundwater abstractions upstream of Albasini Dam and related cost. • Determine if sufficient water is available in Nandoni dam for this purpose and the related cost.			• This is an combination of options 1 and 2. • Surface/Groundwater interaction will be modelled for the first time. Scenario analysis to determine the effect of upstream groundwater abstractions can now be done. • Verification of water use, when completed will indicate whether there is any un-lawfull abtsractions taking place upstream of Albasini Dam. • Abasini Dam Yield 4.91million m^3/a (HFY). • Albasini sub-system yield 10.38 million m^3/a (HFY) (2005 demand 22.33 million m^3/a). • Irrigation demand 15.15 million m^3/a & canal losses 4.5 million m^3/a. Urban demand 2.64 million m^3/a (2005 level).

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Lu4	Groundwater utilisation Nandoni Supply area Nandoni Dam and groundwater resources	Luvuvhu Letaba Water Resource Situation Assessment (Reconnaissance)	2003	• Areas of over exploitation of groundwater are found in the Thohoyandou area and downstream of Albasini Dam. • Existing distribution system. • Planned future distribution system and demand centres to be included.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Overview of the characteristics of the groundwater resource. • Assessment of Groundwater harvest potential, exploitation potential, baseflow per Quaternary catchment or groundwater unit and groundwater quality as per the GRAII and WSAM databases. • Derivation of a groundwater balance compared to harvest potential and recharge and level of use. • Need to determine areas of over exploitation of groundwater use. • Determine areas of excess groundwater resources not yet utilised. • Plan areas to be supplied from Nandoni accordingly. • Costing and economic analysis (strategic level).			• This option need to take into account the most recent planning regarding the Nandoni water supply distribution system and planned areas for future supply. • The maintenance of groundwater supply systems is a disadvantage in rural supply schemes. • Groundwater supply systems can be developed fairly quickly. . Proper development and management of these resources and related systems are however required. • Should consider al the groundwater options already included in the groundwater strategy. • Nandoni Historical Firm Yield 46.7 million m^3/a, 98% stochastic yield 76.5 million m^3/a.

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Lu5	Raising of Vondo Dam Vondo Dam	Water Resources Planning of the Luvuvhu River Basin (Reconnaissance)	1990	• Supply higher parts of Thohoyandou. • Reduce demand on Nandoni Dam.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Determine the increase in yield. • Determine the possibility of raising Vondo from structural point of view. • Cost related to raising & economic analysis(strategic level).			• Vondo dam was raised before, need to confirm if further raising is possible. • Vondo yield 13.4 million m^3/a (HFY).

Note: HFY = Historical Firm Yield.

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Lu6	Mid-Dzindi Dam Dzindi Dam in Duthuni River	Luvuvhu Dam Feasibility Study (Feasibility)	1997	• Dam located in Duthuni River upstream of Nandoni Dam. • Increase system yield. • Reduce pumping costs. • Reduce Nandoni Dam yield.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Re-determine yield benefit and yield reduction on Nandoni Dam. • Cost & economic evaluation(strategic level).			• Moving yield upstream to higher location to reduce pumping costs. • HFY 17.5 million m^3/a (1 MAR dam).

Note: HFY = Historical Firm Yield.

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Lu7	Latonyanda Dam Latonyanda Dam in Latonyanda River	Luvuvhu Dam Feasibility Study (Feasibility)	1997	• Will reduce Nandoni Yield. • Will reduce demand imposed on Nandoni. • Provide yield replacement in Albasini dam. • Will mainly provide operational benefits.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Re-determine yield benefit and yield reduction on Nandoni Dam • Cost & economic evaluation(strategic level).			• Also see Option 1 & 3. • Do we agree with the previous economic evaluation. • Historic Firm Yield for 1 MAR dam 4.4 million m^3/a.

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Lu8	Paswane Dam Paswane Dam In Mutshindudi River	Luvuvhu dam Feasibility Study (Feasibility)	1997	• Dam is located at lower end of the Mutshindudi River d/s of Vondo Dam just before confluence with the Luvuvhu River d/s of Nandoni. • Can be used to supply Lower Nandoni supply area as well as part of EWR for KNP. • Provide yield replacement in Nandoni Dam. •
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Re-determine yield benefit and load reduction on Nandoni Dam • Cost & economic evaluation(strategic level).			• Might be a follow up option after Nandoni fully utilized. • HFY Yield 43 million m^3/a

Note: HFY = Historical Firm Yield.

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Lu9	Xikundu Dam In Luvuvhu River	Luvuvhu dam Feasibility Study (Feasibility)	1997	• Xikundu Weir was buildt at this site. • Possibility of a larger storage dam in future. • Provide yield replacement inNandoni Dam.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Re-determine yield benefit and load reduction on Nandoni Dam. • Cost & economic evaluation(strategic level).			• HFY 88 million m^3/a if Nandoni did not exist. • HFY with Nandoni in place now need to be determined. • Operating rules will also play an important part in the available yield.

Note: HFY = Historical Firm Yield.

Table A-1b: Issues identified – Luvuvhu Main catchment Area

Issues Luvuvhu Basin			
No.	**Water resource/sub-system**	**Issue description**	**Action**
1	Nandoni water supply system	A large number of demand centres are in the planning process to be supplied from Nandoni Dam and the list keeps growing. Decission need to be taken to decide who will in the end received water from Nandoni to avoid over allocation of the resource	All possible supply options will be evaluated as part of the reconciliation process and prioritised.The priority list will be used as the basis to decide on the demand centres that will be recommended for support or full supply from the Nandoni water supply system.
2	Nandoni water supply system	Reduction in the Nandoni Sub-system Yield – sensitive to operating rule	The Nandoni Sub-system should be operated in order to maximise the utilisation of the incremental inflow between Nandoni Dam and Mhinga Weir.
3	Upper Luvuvhu Basin	Tshivahe Tea plantations and related water requirements need to be confirmed, as large areas of these plantations is currently not being utilised.	Obtain future planning.
4	Phiphidi, Tshakhuma and Damani dams	Area capacity information on these dams is required.	Follow up on available information. Request surveys is no data is available.
5	Irrigation related data	There are various uncertainties regarding irrigation developments in this area. Irrigation is a large consumer of water in this catchment and will have a significant impact on the water balance.	Irrigation related information will be updated using information from the Validation Verification study and compared with previous results.
6	Water use from Malamulele, Xikundu and Tshakuma WTWs	The 2005 operating analysis study indicated that the water supply from these WTWs significantly exceeded the estimated projected demands at the time based on population numbers.	This might be as result of incorrect population figures and or serious water concervation water demand management issues. Population figures will be evaluated and updated as part of the reconciliation study and WC/WDM task forming part of this study will provide perspective on this issue.

7	EWRs	EWR currently used as part of the operating rule for Nandoni Dam is based on outdated methodology and need to be updated. This can have a significant impact on the yield available from Nandoni Dam.	The most recent information in this regard will be sourced from the RDM office.
8	Losses in Luvuvhu River downstream of Nandoni Dam	The initial estimates of losses between Nandoni Dam and Mhinga Weir need to be confirmed. This estimation was made before the Nandoni System became operational.	Evaluate observed releases and flow data in this system taking into account the abstraction along the river reach to improve the loss estimations.
9	Water use information	The WC/WDM strategy study stated that water use information in this catchment is very poor.	All available information will be sourced and will be used as basis regarding assumtions made for water use in systems where no or very little information is used. Limited measurements might be done as part of this study in critical areas.

Table A-2: Augmentation options identified from the literature – Mutale River Catchment Area

No.	Name of option	Report & Level of Assessment	Date of Assessment	Key Features
Mu1	Water conservation and demand management	Mutale River Water Resources Investigation & Luvuvhu / Letaba Water Resources Situation Assessment Study (Reconnaissance)	1999 & 2003	• Existing water shortages could be reduced through improvements in the efficiency of water use through water conservation and demand management. • Introduction of more ecologically sound agricultural practices including realistic stock levels. • It was recommended that water conservation and demand management objectives and goals that are likely to be achieved in the Mutale River Catchment should be identified and that measures should be taken to implement these.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Identify potential savings that can be achieved through imporved irrigation efficiencies • Identify potential savings that can be achieved in the urban/domestic sector. • Identify WC/WDM objectives and goals that are likely to be achieved in the Mutale River Catchment should be identified and that measures should be taken to implement these.			

No.	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Mu2	Groundwater Development	Mutale River Water Resources Assessment (Reconnaissance)	1999	• In the southwest catchment the net incremental benefit of using groundwater is in the order of 1 million m3/a to 2 million m^3/a. • The sustainable exploitable groundwater potential in the northeast of the study area is estimated at 1.6 million m^3/a. However, the poor quality of the groundwater will result in only 0.4 million m^3/a being suitable for domestic use. • The total net potential increase in the utilisable water resources from groundwater is about 2 million m^3/a at most. A large number of boreholes spread over a large area will however be necessary, which could potentially result in high operating costs and unit costs of distribution pipelines.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Overview of the characteristics of the groundwater resource. • Re-assessment of Groundwater harvest potential, exploitation potential, baseflow per Quaternary catchment or groundwater unit and froundwater quality as per the GRAII and WSAM databases. • Derivation of a groundwater balance compared to harvest potential and recharge and level of use. • Need to determine areas of over exploitation of groundwater use. • Determine areas of excess groundwater resources not yet utilised. • Investigate/confirm identified groundwater quality issues. • Costing and economic analysis(strategic level).			• The maintenance of groundwater supply systems is a disadvantage in rural supply schemes. • Groundwater supply systems can be developed fairly quickly. . Proper development and management of these resources and related systems are however required.

No:	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Mu3	A new dam on the Mutale River	Mutale River Water Resources Assessment Reconnaissance	1999	• Four Dam sites were identified (Rambuda middle, Rambuda downstream, Thegwe and Tswera). • On the basis of the socio-economic, cultural and/or ecological considerations the Rambuda middle and Thegwe dam sites are unlikely to be acceptable for development. • The cost of water secured by a dam at Rambuda middle is considered to be far too high. The Thengwe dam site is also situated downstream of the areas of the largest water requirements and therefore the cost of conveying the water to the consumers will be much higher then the other dams. • The most viable dam sites are the Rambuda downstream site and the Tswera site. • The potential storage at the Rambuda downstream site is limited, due to uncertain foundation conditions on the left flank. (5 million m^3/a yield). • With a dam at Tswera the net incremental yield of the system at Tswera that has the lowest URV is 16.5 million m3/a. • The consumptive water requirements are mostly situated upstream of Tswera and therefore its usefulness could be limited. Given this limitation it may become necessary to construct both Tswera and Rambuda downstream sites to effectively supply water to the existing consumers.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Use results of the investigations of future water requirements, their spacial distribution and the effects of water conservation and demand management measures on these requriements to conduct further investigations on dams sites. • Re-determine yields of identified dam sites with updated hydrology • Cost & economic evaluation(strategic level).			• Mutale River was previously regarded as the tributary that should supply water for EWR purposes, as very little development exists in this catchment. • Tswera Dam HFY 16.5 million m^3/a • Rambuda downstream site HFY 5 million m^3/a

No:	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Mu4	Abstraction from the Limpopo River	Luvuvhu / Letaba Water Resources Situation Assessment Study (Reconnaissance)	2003	• If development of coalfields in the northern part of the sub-catchment takes place in the future, water could be abstracted from the Limpopo River to supply the water requirements of the mines.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Confirm water availablilty from the Limpopo River (Existing data). • Confirm future water requirements and their spacial distribution in relative to the Limpopo River to confirm whether the option is viable. • Further technical investigations and economic analyses should be conducted should the option seem viable.			

Table A-2b: Issues identified – Mutale River catchment Area

Issues Mutale River Basin			
No.	**Water resource/sub-system**	**Issue description**	**Action**
1	Groundwater	Total dissolved solids, Fluoride and Nitrate are at unacceptable levels in the northern part of the study area up to the Limpopo River	
2	Entire Mutale basin	Water shortages are currently experiences in this catchment. It was stated as unlikely that the water shortages will be reduced to acceptable levels through improved efficiencies only.	To be addressed through this Reconcilitation study
3	Nwanenedi-Luphephe and Masisi Regional Water Schemes and related transfer to Mutale River catchment	DWA reserved an allocation of 1.135 million m^3/a from the Nwanedzi/Luphephe Dam located in the Nwanedi catchment just north of the Mutale River, to supply water to the Nwanenedi-Luphephe and Masisi Regional Water Schemes. According to the Nwanedi River Water Resources Investigation (DWA Report A800/00/0298) part of this allocation ± 0.9 million m^3/a and possibly more in future should be transferred to the Mutale River catchment. This should be reviewed as the estimated water use for Nwanenedi-Luphephe and Masisi Regional Water Schemes by 2020 is already about 2.4 million m^3/a, which is far in excess of the DWA reserved allocation.	Need to be taken into account in water balances to be produced from the reconciliation study. Need detail layout of the option and sources.
4	Supply of the ecological component of the reserve	To be able to supply the ecological component of the reserve, without creating additional storage in the system, will result in existing shortages to be aggravated further which in turn will have an adverse impact on the economy.	To be addressed through this Reconcilitation study

Table A-3: Augmentation options identified from the literature – Shingwedzi River catchment Area

No:	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Sw1	Groundwater Development	Luvuvhu Letaba Water Resource Situation Assessment (Reconnaissance)	2003	Identification and development of additional groundwater units to rural water supply requirements where shortages occur.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Overview of the characteristics of the groundwater resource • Re-assessment of Groundwater harvest potential, exploitation potential, baseflow per Quaternary catchment or groundwater unit and froundwater quality as per the GRAII and WSAM databases. • Derivation of a groundwater balance compared to harvest potential and recharge and level of use. • Need to determine areas of over exploitation of groundwater use • Determine areas of excess groundwater resources not yet utilised • Investigate/confirm identified groundwater quality issues • Costing and economic analysis(strategic level).			• The maintenance of groundwater supply systems is a disadvantage in rural supply schemes • Groundwater supply systems can be developed fairly quickly. . Proper development and management of these resources and related systems are however required.

No:	Name of option & source	Report & Level of Assessment	Date of Assessment	Key Features
Sw2	Transfer from (Nandoni Dam) Xikundu Weir	Luvuvhu Letaba Water Resource Situation Assessment (Reconnaissance)	2003	Establishment of a transfer link to the transfer water from Nandoni Dam in the Luvuvhu sub-catchment, to augment the water resources in the Shingwedzi sub-catchment.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Determine if sufficient water is available in Nandoni Dam for this purpose and the related cost.			• Part of the area is already supplied from the Luvuvhu River and must be taken into account in the overall planning.

Table A-3b: Issues identified – Shingwedzi River catchment Area

Issues Shingwedzi River Basin			
No.	**Water resource/sub-system**	**Issue description**	**Action**
1	Surface Water	Surface water resources in this catchment are very limited and not sufficient to supply the current demands in the basin.	Need to be taken into account the the reconciliation strategies. Currently groundwater resources and transfers from surface water in the Luvuvhu catchment are already utilised to some extent to overcome this problem..
2			

Table A-4: Augmentation options identified from the literature – Groot Letaba River catchment Area

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
GL1	Raising of Tzaneen Dam	Groot Letaba River Water Development Project (Preliminary Design)	2010	A labyrinth spillway option is recommended for the raising of Tzaneen and will result in an additional yield of 6.0 x 10^6 m^3/annum at a 98% assurance level.
	Proposed assessments in the Reconciliation Study			**Comments & Issues:**
	• Re-determine incremental yield benefit based on revised hydrology. • Improve on loss estimation for releases from Tzaneen Dam in support of Nwamitwa Dam.			• Losses between Tzaneen Dam and the future Nwamitwa Dam is high. • Good estimate of losses is not available • An additional yield of 6.0 x 10^6 m^3/annum at a 98% assurance level.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
GL2	Construction of Nwamitwa Dam	Groot Letaba River Water Development Project (Preliminary Design)	**2010**	A 34m high composite dam with a central conventional gravity concrete ogee spillway section and earth fill embankment flanks. Storage Capacity = 187 x 10^6 m^3.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Re-determine incremental yield benefit. • Improve on loss estimation for releases from Tzaneen Dam in support of Nwamitwa Dam.			• Losses between Tzaneen dam and the future Nwamitwa Dam is high. • Good estimate of losses is not available. • HFY 14 million m^3/a.

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
GL3	Bulk Water Supply Infrastructure	Concept	2010	Potential supply area of the proposed Nwamitwa Dam and regional bulk water supply infrastructure required to serve the rural settlements in the supply area.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Compare updated yield with demand centre requirements,			

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
GL4	Construction of the Letsitele River Valley Dam also referred to as Hobsons Choice Dam	Groot Letaba Water Resource Development Feasibility Study (Feasibility)	1998	A 33.5 m high composite dam with a central conventional gravity concrete ogee spillway section and earth fill embankment flanks. Storage Capacity = 14.2 x 10^6 m^3, Yield at 98% assurance = 26.6 x 10^6 m^3/annum.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Re-determine incremental yield benefit • Update cost and economic evaluation(strategic level).			• Dam can be used in support of Nwamitwa. Keep storage upstream in Hobsons Choice Dam, reduce evaporation losses from Nwamitwa. Only support when required. • Previous study concluded that a major storage dam is not cost effective. • Need to confirm with previous PSP

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
GL5	Construction of the Mulele Dam	Letaba Water Resource Development Study Pre-feasibility Study (Pre-feasibility)	1994	Dam site on the Molototsi River will give a yield at 98% assurance of 8.6 x 10^6 m^3/annum. Major drawbacks are the high sediment load in the river and the inundation of extensive areas under dry land crops.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Evaluate possibility of dam/weirs to be used for artificial recharge of groundwater			• Possibility of sand abstraction schemes along the river also to be considered • Possibility of dam to be used for groundwater recharge

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
GL6	Groundwater Development		2010	• Development of groundwater on a regional scalemin conjunction with bulk water supply systems
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Overview of the characteristics of the groundwater resource • Re-assessment of Groundwater harvest potential, exploitation potential, baseflow per Quaternary catchment or groundwater unit and froundwater quality as per the GRAII and WSAM databases. • Derivation of a groundwater balance compared to harvest potential and recharge and level of use. • Need to determine areas of over exploitation of groundwater use • Determine areas of excess groundwater resources not yet utilised • Investigate/confirm identified groundwater quality issues • Costing and economic analysis(strategic level).			• The maintenance of groundwater supply systems is a disadvantage in rural supply schemes • Groundwater supply systems can be developed fairly quickly. . Proper development and management of these resources and related systems are however required. • By linking up with the bulk water supply system, will also reduce water quality related problems from groundwater sources.

Table A-4b: Issues identified – Groot Letaba River catchment Area

Issues Letaba Basin			
No.	**Water resource/sub-system**	**Issue description**	**Action**
1	Upstream of Nwamitwa & Tzaneen Dams	Reliability of hydrology	Re-do hydrology
2	Between Tzaneen & Nwamitwa dams	Losses unknown	Firm up on losses
3	Raised Tzaneen Dam incremental Yield	Reliability of the yield and incremental yield available from Tzaneen Dam and the raised Tzaneen Dam.	These yields will be updated as part of the Reconciliation Study by using the updated hydrology that is currently in process. This is done as part of the Reconciliation Study.
4	Future Nwamitwa Dam	Reliability of the yield for this dam.	This yield will be updated as part of the Reconciliation Study by using the updated hydrology that is currently in process. This is done as part of the Reconciliation Study.
5	Groot Letaba System	Surface water resources in this catchment are extensively developed on over allocated. Users are faced with water shortages of increasing severity and frequency to such and extent that the main users have from time to time compete for the limited supplies by taking extraordinary measures.	Raising of Tzaneen and and building of Nwamitwa Dam are the next indrastructure developments in line to improve the water supply and assurance. The reconciliation study will in the strategy re-evaluate the situation and add additional possible intervention options to achieve a water balnce over time.
6	Water use in the catchment	Due to the stressed nature of this catchment it was stated that a through verification and validation study on water uses be untdertaken.	This study is already in progress and the information available from this study will be used as far as possible as input to the reconciliation strategy study. It is however possible that the final information from the verification validation study will not be available in time.

Table A-5: Augmentation options identified from the literature – Middle and Klein Letaba River catchment Area

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
MKL1	WC/WDM	Middle Letaba Water Supply Scheme: WC/WDM Situation Assessment (Reconnaissance)	2003	Implementation of WC/MDM measures to reduce of water losses from the distribution infrastructure and achieve more efficient use of the resource in areas around Giyani where the current per capita water use is very high (above 300 ℓcd).
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Review situation assessment. • Determine potential savings through WC/WDM measures • Incorporate as option in recon study			

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
MKL2	Development of the Groundwater Resource	A Reconnaissance Study to Augment the Water Resources of the Klein Letaba River catchments (Reconnaissance)	2003	To develop the under-utilised groundwater resource to augment the water resources in the area and reduce dependency on the overstressed surface water resource.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Overview of the characteristics of the groundwater resource • Re-assessment of Groundwater harvest potential, exploitation potential, baseflow per Quaternary catchment or groundwater unit and froundwater quality as per the GRAII and WSAM databases. • Derivation of a groundwater balance compared to harvest potential and recharge and level of use. • Need to determine areas of over exploitation of groundwater use • Determine areas of excess groundwater resources not yet utilised • Investigate/confirm identified groundwater quality issues • Costing and economic analysis(strategic level).			• The maintenance of groundwater supply systems is a disadvantage in rural supply schemes • Groundwater supply systems can be developed fairly quickly. . Proper development and management of these resources and related systems are however required.

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
MKL3	Replacement of Middle Letaba Dam – Nsami Dam Transfer Canal with a Pipeline	A Reconnaissance Study to Augment the Water Resources of the Klein Letaba River catchments (Reconnaissance)	2003	An investigation should first be carried out to determine the extent of water losses from the existing canal, and if the figures justify carry out further steps for the replacement of the canal with a pipeline and associated pumping infrastructure.
	Proposed assessments in the Reconciliation Study			**Comments:**
	• Confirm the loss estimations • Re-check the require size of the pipeline • Update the previous costing and economic analysis(strategic level).			

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
MKL4	Transfer Scheme from Nandoni Dam	A Reconnaissance Study to Augment the Water Resources of the Klein Letaba River catchments (Reconnaissance)	2003	Establishment of a transfer link to the transfer water from Nandoni Dam in the Luvuvhu sub-catchment, to augment the water resources in the Klein – Middle Letaba area
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Determine and evaluate the effect of the transfer on the Nadoni system available yield • Refine the volume to be transferred and future time scale for transfers • Costing and economic analysis(strategic level).			Demand imposed on Nandoni in Luvuvhu basin. Need to be taken into account in the Luvuvhu basin water balance and planning

No.	Name of option	Level of Assessment	Date of Assessment	Key Features

MKL5	Construction of a New Dam on the Klein Letaba River	A Reconnaissance Study to Augment the Water Resources of the Klein Letaba River catchments
		
		(Reconnaissance)
			2003	• A composite structure, consisting of a central contrete gravity section and zoned earthfill embankment flanks was recommended following investigations of earlier studies.
				• Two possible sites on the Klein Letaba River was investigated
				  o Majosi Dam
				  o Crystalfontein site
				• The possible dam sites on the Klein Letaba River (Majosi & Crystalfontein) have two sub-options
				  o A large storage Dam linked with the Middle Letaba supply system
				  o A smaller diversion type of structure, diverting water via a canal into Middle Letaba Dam, using Middle as the storage facility

	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Re-determine incremental yield benefit for the different options • Update cost and economic evaluation for the different options(strategic level).			• Crystalfontein Large Dam (117.8 mcm store) HFY 10.5 million m^3/a with no EWR with class D EWR reducwe to 7.7 million m^3/a. • Majosi Large Dam (83.9 mcm store) HFY 8 million m^3/a no EWR and with EWR Class D 6.1 million m^3/a.

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
MKL6	Remove / buy out all irrigation from Middle Letaba Dam	Was not included as a recommendation in previous studies	n.a.	Removal of all existing irrigation supplied from the Middle Letaba Scheme.
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Determine the extent of iirigation still active in the scheme • Assess the importance of this irrigation • Determine the benefit of removing this irrigation from the system			

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
MKL7	Remove / buy out irrigation upstream of Middle Letaba Dam	Was not included as a recommendation in previous studies	n.a.	
	Proposed assessments in the Reconciliation Study:			**Comments:**
	• Determine the extent of existing irrigation in the catchment. • Determine the effect of this irrigation on the yield available from Middle Letaba Dam			The lawfulness of this irrigation need to be followed up after the completion of the Validation Verification study.

Table A-5b: Issues identified – Middle & Klein Letaba River catchment Area

Issues Middle & Klein Letaba Basin			
No.	**Water resource/sub-system**	**Issue description**	**Action**
1	Groundwater systems	Operational & Maintenance of groundwater supply systems	
2	Surface Water	Operational & Maintenance of infrastructure	
3	Middle Letaba Dam	Extensive irrigation development upstream of the dam	Determine the extent of this irrigation and the effect of that on the Middle Letaba Dam yield.
4	Middle Letaba Dam	Middle Letaba Dam is over allocated	Irrigation supply from the dam need to re-evaluated
5	Middle Letaba Nsami Dam system	The system is over allocated	Groundwater investigation and greater use of groundwater. Transfer of water from the Nandoni System. This and other options will be conciderred as part of the Reconciliation study.