P WMA 12/T30/00/5212/13

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: OPTIONS ANALYSIS

FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT

BULK WATER DISTRIBUTION INFRASTRUCTURE

OCTOBER 2014

FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT APPROVAL

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LIST OF REPORTS

REPORT TITLE	DWS REPORT NUMBER
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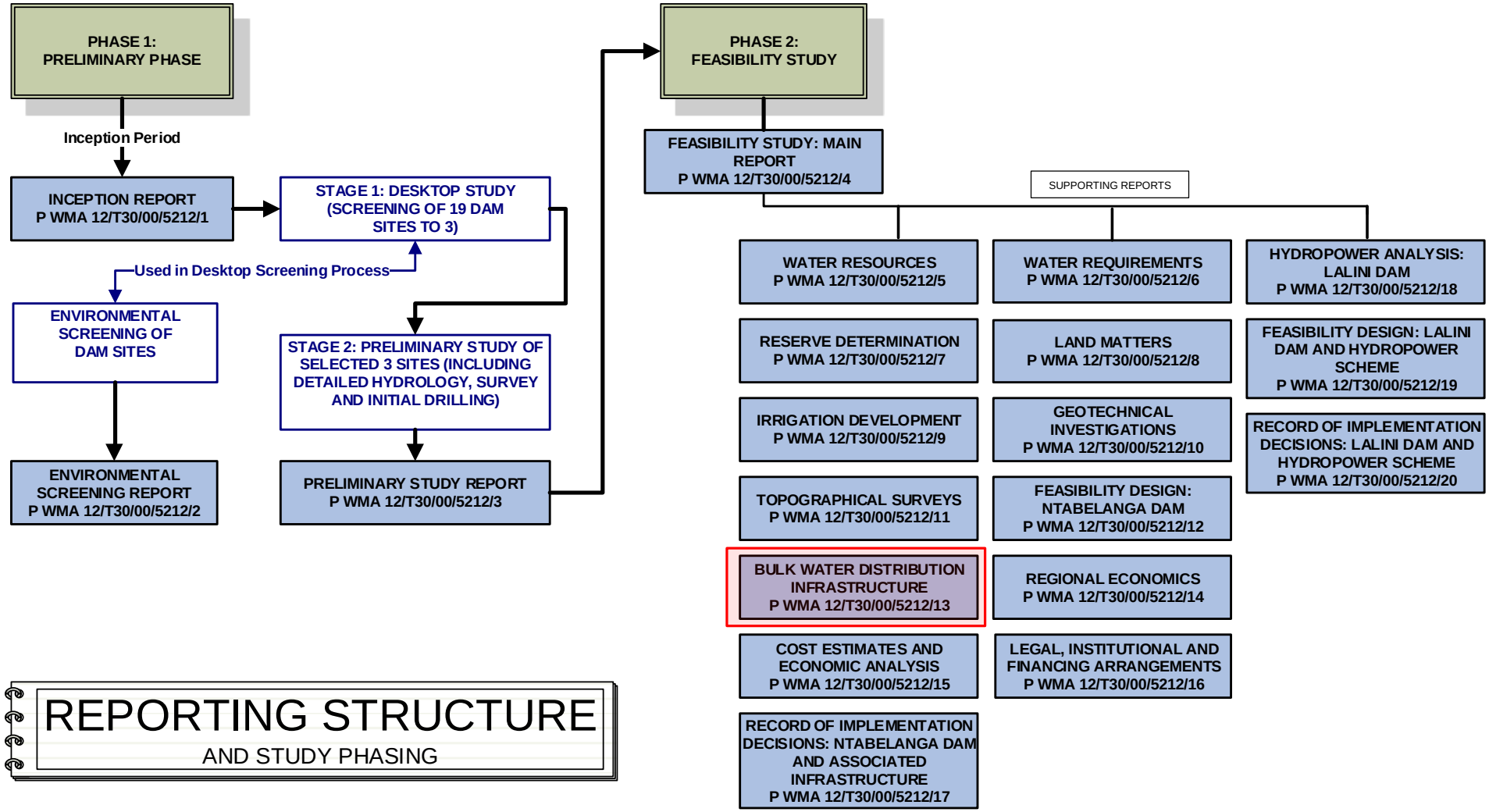
Record of Implementation Decisions: Lalini Dam and Hydropower Scheme	P WMA 12/T30/00/5212/20



REPORTING STRUCTURE
AND STUDY PHASING

REFERENCE

This report is to be referred to in bibliographies as:

Department of Water and Sanitation, South Africa (2014). ***Feasibility Study for the Mzimvubu Water Project: Bulk Water Distribution Infrastructure***

DWS Report No: P WMA 12/T30/00/5212/13

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Note on Departmental Name Change:

In 2014, the Department of Water Affairs changed its name to the Department of Water and Sanitation, which happened during the course of this study. In some cases this was after some of the study reports had been finalized. The reader should therefore kindly note that references to the Department of Water Affairs and the Department of Water and Sanitation herein should be considered to be one and the same.

Note on Spelling of Laleni:

The settlement named Laleni on maps issued by the Surveyor General is locally known as Lalini and both names therefore refer to the same settlement.

EXECUTIVE SUMMARY

INTRODUCTION

The Mzimvubu River catchment in the Eastern Cape Province of South Africa is within one of the poorest and least developed regions of the country. Development of the area to accelerate the social and economic upliftment of the people was therefore identified as one of the priority initiatives of the Eastern Cape Provincial Government.

Harnessing the water resources of the Mzimvubu River, the only major river in the country which is still largely unutilised, is considered by the Eastern Cape Provincial Government as offering one of the best opportunities in the Province to achieve such development. In 2007, a special-purpose vehicle (SPV) called ASGISA-Eastem Cape (Pty) Ltd (ASGISA-EC) was formed in terms of the Companies Act to initiate planning and to facilitate and drive the Mzimvubu River Water Resources Development.

The five pillars on which the Eastern Cape Provincial Government and ASGISA-EC proposed to model the Mzimvubu River Water Resources Development are:

- *Forestry;*
- *Irrigation;*
- *Hydropower;*
- *Water transfer; and*
- *Tourism.*

As a result of this the Department of Water and Sanitation (DWS) commissioned the Mzimvubu Water Project with the overarching aim of developing water resources schemes (dams) that can be multi-purpose reservoirs in order to provide benefits to the surrounding communities and to provide a stimulus for the regional economy, in terms of irrigation, forestry, domestic water supply and the potential for hydropower generation amongst others.

The study commenced in January 2012 and was completed by October 2014 in three stages as follows:

- *Inception;*
- *Phase 1 – Preliminary Study; and*
- *Phase 2 – Feasibility Study.*

The purpose of this study was not to repeat or restate the research and analyses undertaken on the several key previous studies described below, but to make use of that information previously collected, to update and add to this information, and to undertake more focussed and detailed investigations and feasibility level analyses on the dam site options that have then been identified as being the most promising and cost beneficial.

Report numbers P WMA 12/T30/00/5212/2 to 20 describe the feasibility study processes undertaken to select a preferred dam site that would be developed to meet the development goals and social benefits described above.

PURPOSE OF REPORT

This report outlines the feasibility stage design of the bulk water supply infrastructure for both domestic potable water, and irrigation raw water, including the design criteria adopted, population and household demographics, preliminary design of the scheme, preliminary cost estimates and power requirements for the scheme.

The project footprint is defined as being the area of supply that is possible from the dam system extending outside the catchment into three District Municipalities (DM), namely the Joe Gqabi DM in the north west, the OR Tambo DM in the south west and the Alfred Nzo DM in the east and north east.

The location of the Ntabelanga Dam and the area to be supplied with potable water are given in Figures 1 to 3.

The design criteria adopted are the normal standards used for most water supply infrastructure projects in South Africa. The reference documents used are the "Guidelines for the Development of Human Settlements" (Department of Housing) and the DWS "Technical Guidelines for the Development of Water and Sanitation Infrastructure".

Unit water demands and peak factors were taken from these publications. The unit water demands of 60 litres per capita per day (ℓ/c/d) and 125 ℓ/c/d for rural and urban demands respectively, are in line with the guideline design documents. Water loss allowances in the conveyance systems and at the Water Treatment Works are according to the above DWS guidelines.

The settlements to be supplied with water and their population growth projections are included herein as Appendix A. More details on the projection of water requirements of this area are given in the Water Requirements Report No. P WMA 12/T30/00/5212/6.

DOMESTIC BULK WATER DISTRIBUTION

The design horizon for this project is to the year 2050. The assumption made is that the commissioning of the dam and its water treatment works would coincide with the completion of the bulk water distribution infrastructure for conveyance of water to all of the customers to be served within the supply area. It is assumed that the actual bulk water distribution infrastructure will be implemented in phases, with Primary and Secondary pipelines and reservoirs being developed at the same time as the dam and water treatment works, and the tertiary lines to the many settlements in the supply area, being implemented under the usual bulk infrastructure grant funding available to the respective DMs, with a target of reaching all settlements by 2020 or earlier, if such funding can be made available.

Population figures have been developed from national census databases together with the other information provided by the DWS and DMs in the project area. The annual population growth rate is 1% in line with the planning documentation for the project. The population figures show the population in the project area to be supplied to be 502 822 which increases to 726 616 by the year 2050.

The projected average daily water demands from the scheme for domestic purposes increase from an average of 62 764 m^3/day in 2020 to 84 596 m^3/day in year 2050. The peak demands range from 75 316 m^3/day in 2020 to 101 515 m^3/day in the year 2050. See Water Requirements report.

A water treatment works (WTW) with capacity to supply the above water requirement would be constructed close to the Ntabelanga Dam, and would be supplied with raw water by a gravity pipeline fed from multiple draw-offs at the dam outlet works. For details of this raw water supply arrangement, please see Dam Feasibility Design Report No. P WMA 12/T30/00/5212/12.

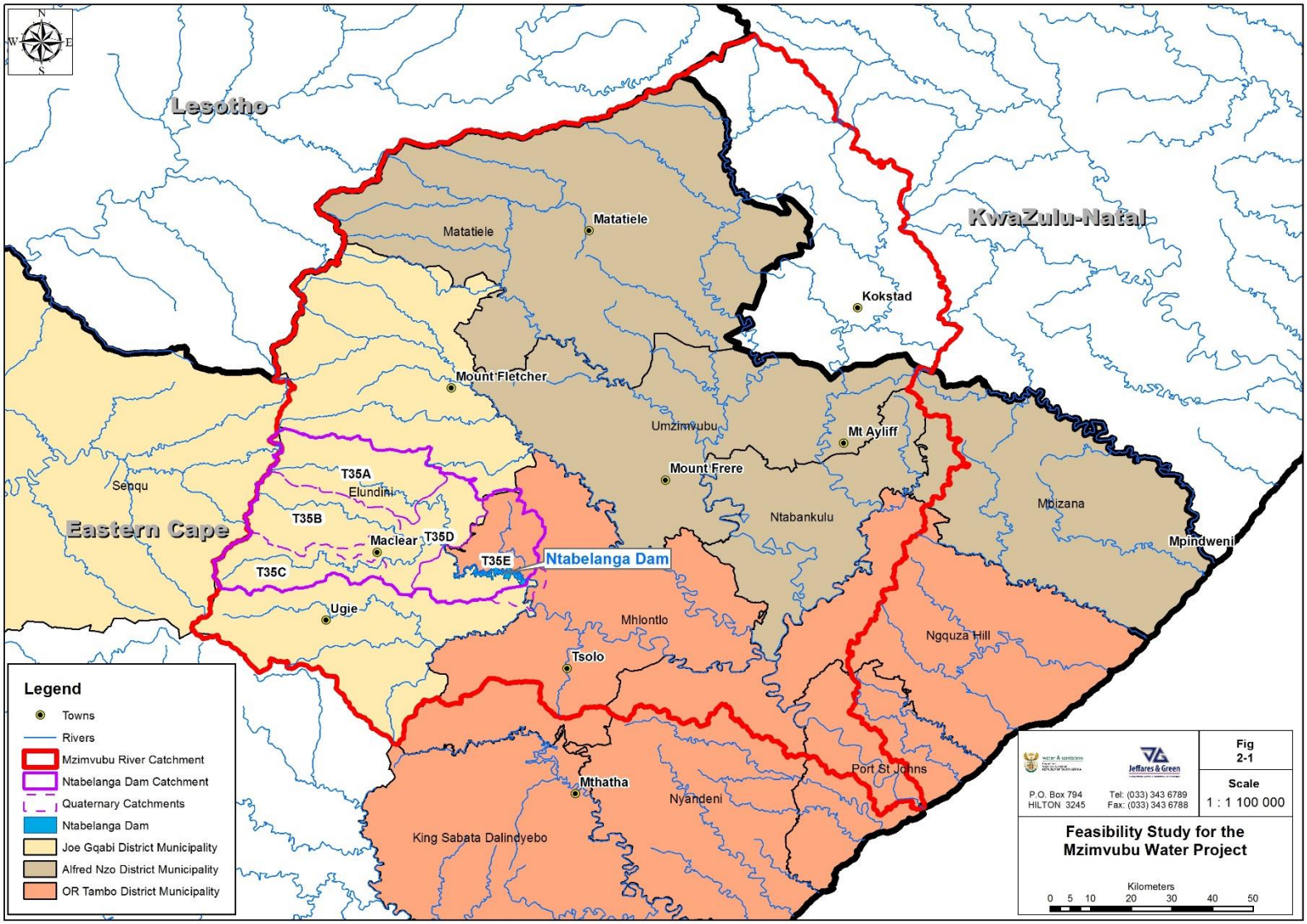

Figure 1: Locality Map of the Mzimvubu River Catchment Area at Ntabelanga Dam

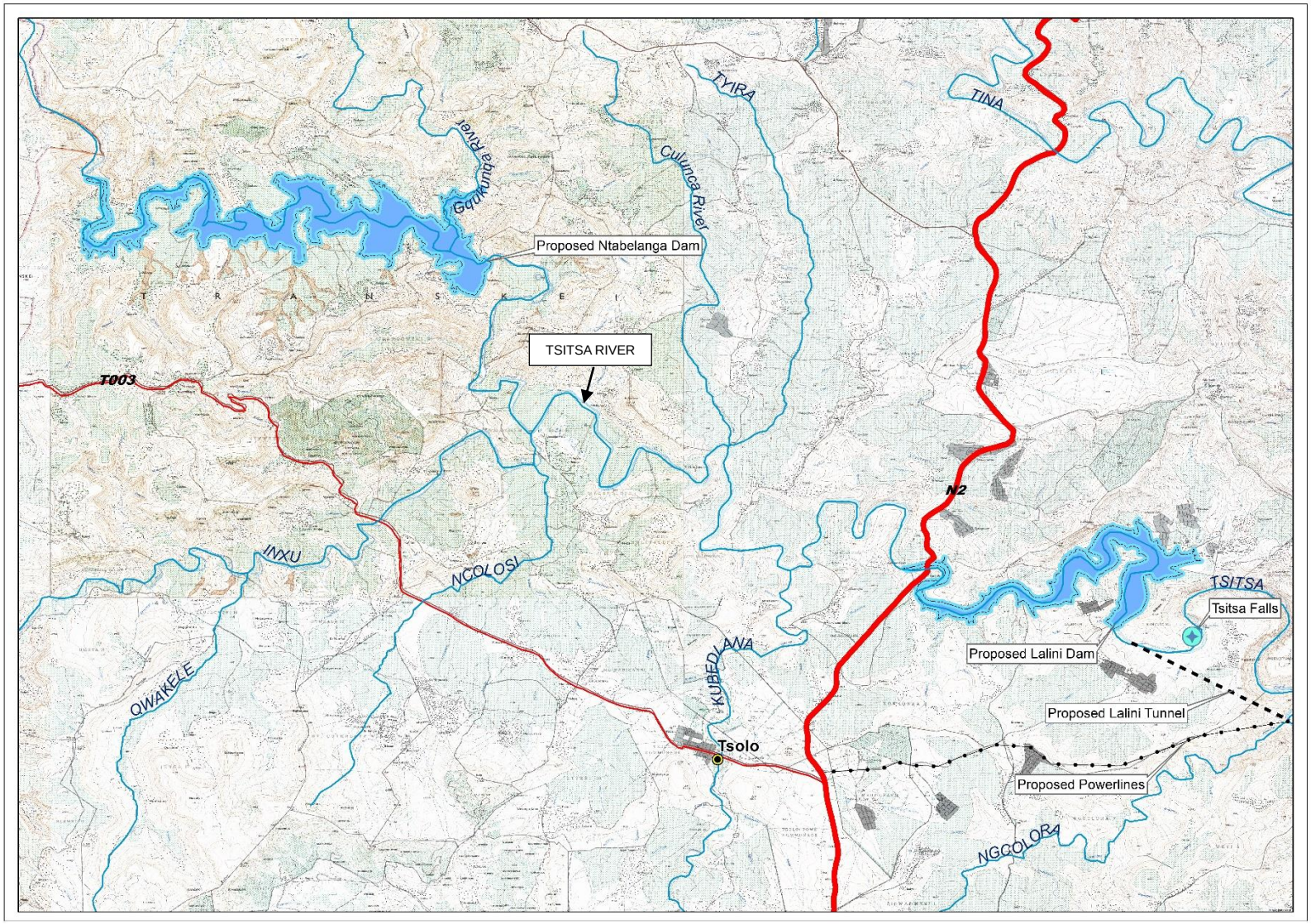

Figure 2: Locality of Ntabelanga Dam Relative to the Lalini Dam

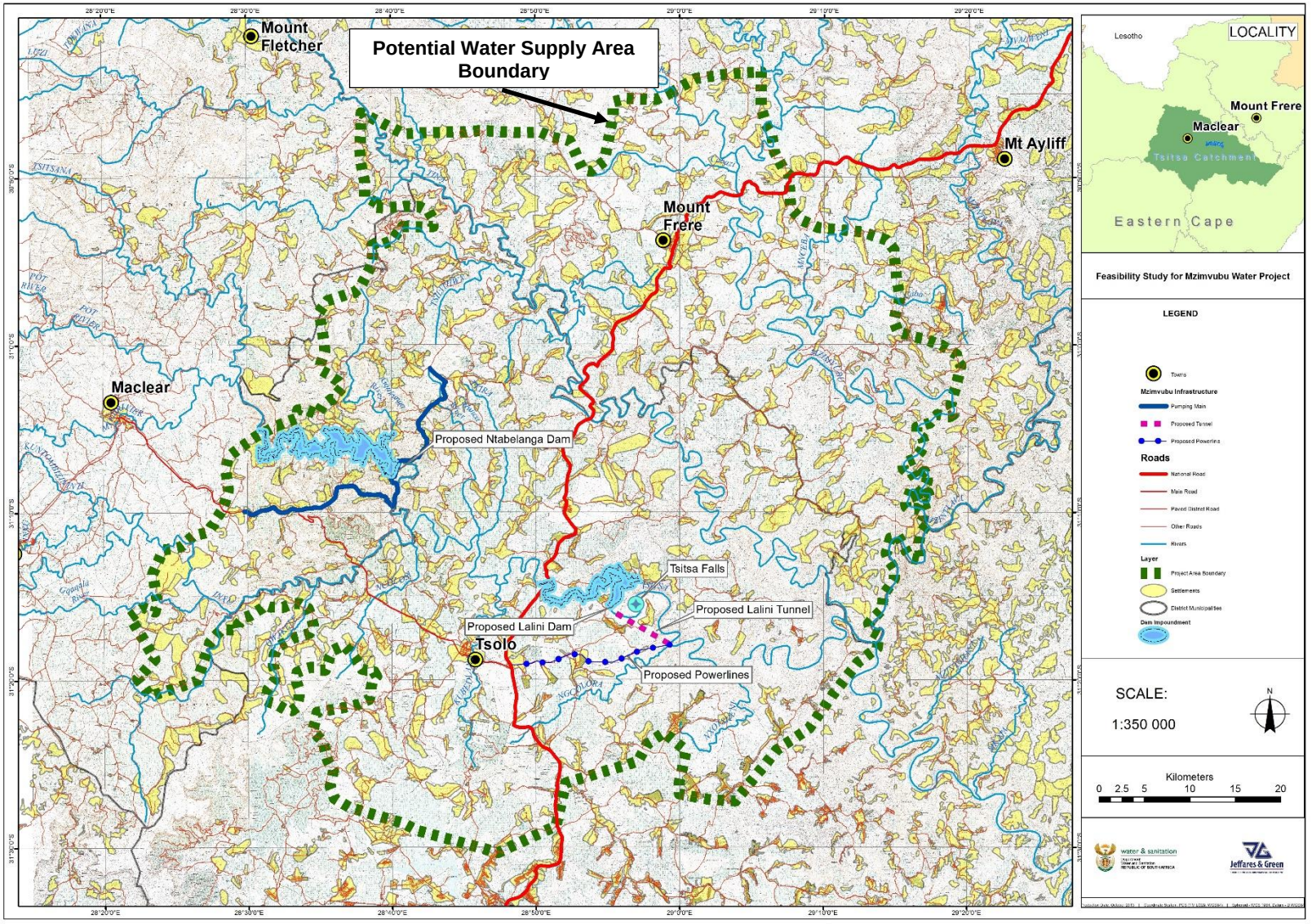

Figure 3: Potential Ntabelanga Water Supply Area Boundary

The location of this water treatment works relative to the dam is shown on Figure 4, and a conceptual layout and hydraulic flow regime of the water treatment works itself is shown on Figures 5 and 6.

The treatment processes envisaged are conventional and will include:

- *Flocculation*
- *Coagulation*
- *Settlement in Clarifiers*
- *Filtration in Rapid Gravity Filters*
- *Disinfection using Chlorine gas*

It is recommended that regular water quality sampling and testing be implemented as soon as possible to inform the detailed design and optimisation of the water treatment works processes. Given that there are many proprietary treatment process available, it is common practice that large water treatment works are procured through a design and build contracting approach, and in order to ensure that the best solution is selected, such historical water quality information would be essential.

Treated water will be transferred from the clear water pumping stations PS1 and PS3 at the water treatment works to four primary command reservoirs. Treated water will then be delivered to the projected 726 616 consumers predominantly by gravity via the secondary bulk conveyance pipelines and command reservoirs, which feed the tertiary lines to villages and urban centres such as Tsolo and Mount Frere.

The bulk infrastructure required for the scheme is split operationally into four supply zones taking into consideration the logical routing of main bulk supply pipelines, the terrain and elevation variations, and the pattern of the settlements to be supplied within the project area. This is shown in Figure 7.

This system is further split into primary, secondary and tertiary infrastructure. The primary infrastructure consists of the water treatment works (supplied with raw water from the Ntabelanga Dam), potable water pumping stations from the treatment works to transfer water to primary command reservoirs, and the bulk water pipelines delivering from this primary storage to the downstream bulk water infrastructure.

Secondary infrastructure links these primary command reservoirs to the secondary command storage reservoirs, which then, via the tertiary lines, feed the village reservoirs located at the settlements. The design approach is to assume the need to construct a new village reservoir at each settlement, but some of the secondary command reservoirs are existing, albeit that some of these storage facilities will need to be expanded to meet minimum storage requirements.

The DWS Guidelines require 48 hrs of total system annual average daily demand (AADD) to be available in bulk storage, and this has been allowed for as follows:

Village bulk storage: 24 hrs x AADD
Secondary command reservoirs: 8 hrs x AADD
Primary command reservoirs: 16 hrs x AADD

Pipelines range in size from 50 mm diameter to 900 mm diameter. The materials chosen for pipelines are High Density Polyethylene (HDPE) for the smallest pipelines, Polyvinylchloride (PVC) for the range from 75 mm to 355 mm, and steel pipelines for all high pressure, above ground, pumping applications, and for sizes greater than 355 mm. The usage of HDPE and PVC pipes for the smaller diameters, and modular systems for the smaller reservoirs will allow the usage of a labour-based construction approach for the tertiary lines and for parts of the secondary system, thus providing job creation opportunities.

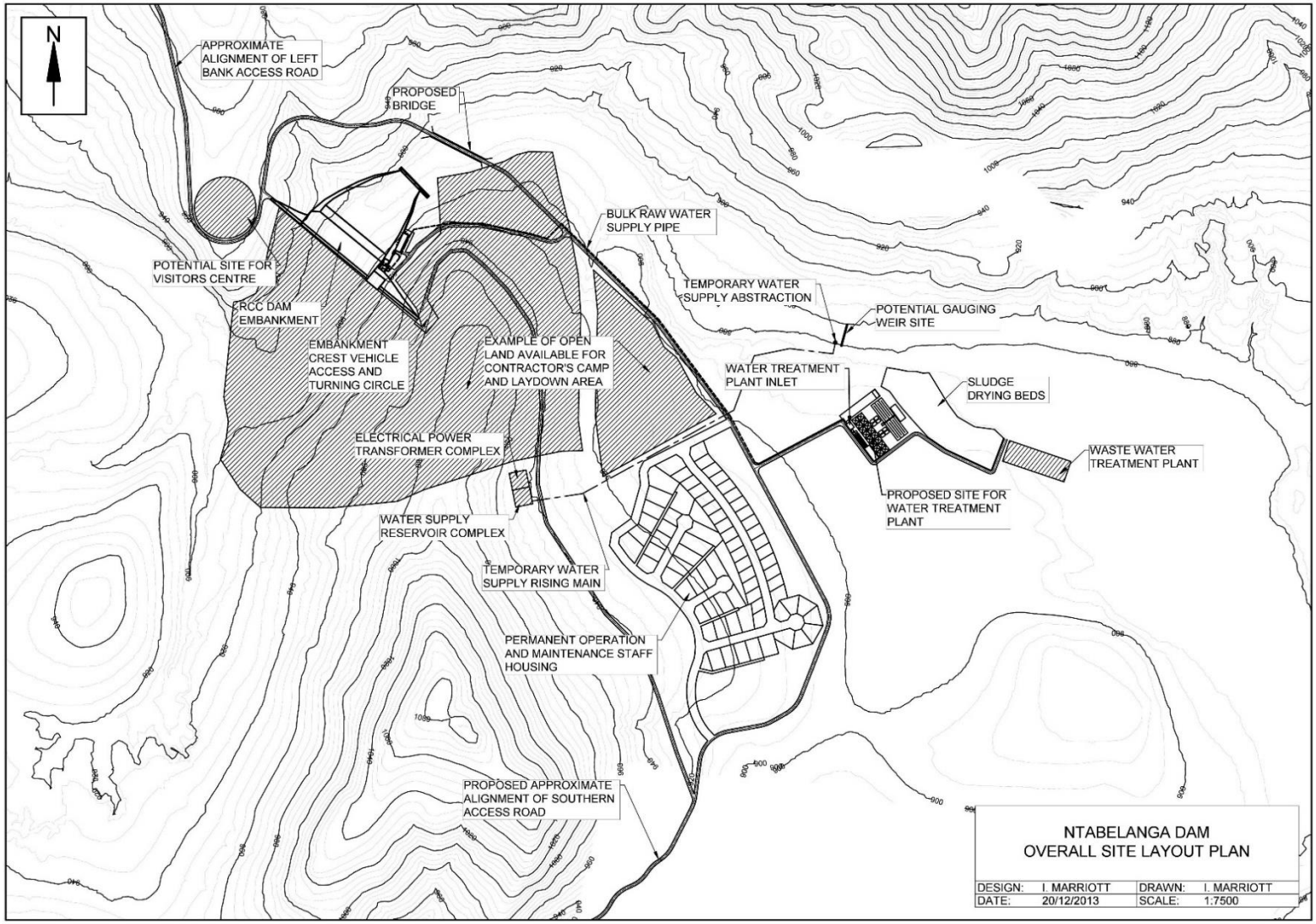

Figure 4: Location of Water Treatment Plant Relative to the Dam

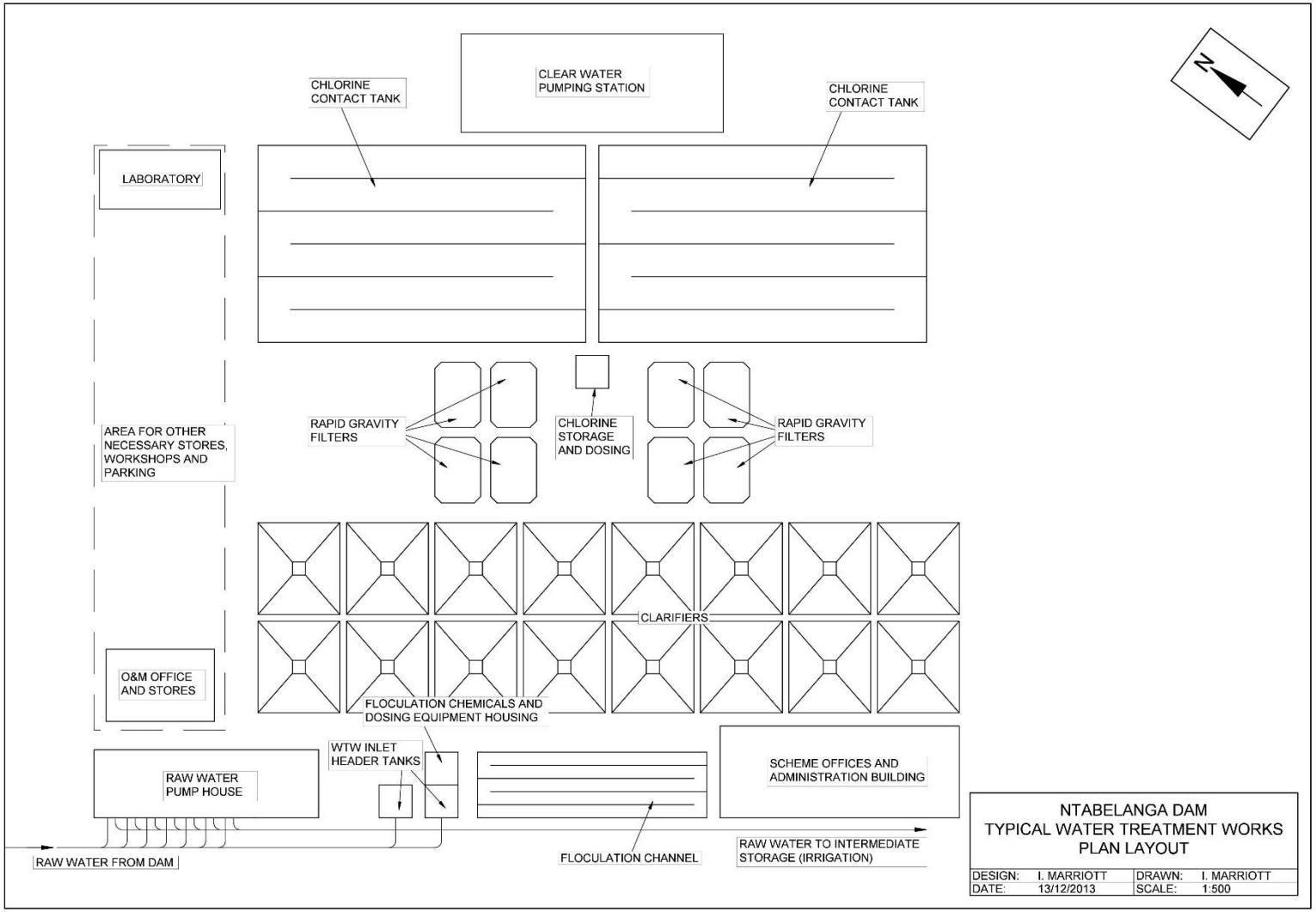

Figure 5: Typical Arrangement of the Water Treatment Works

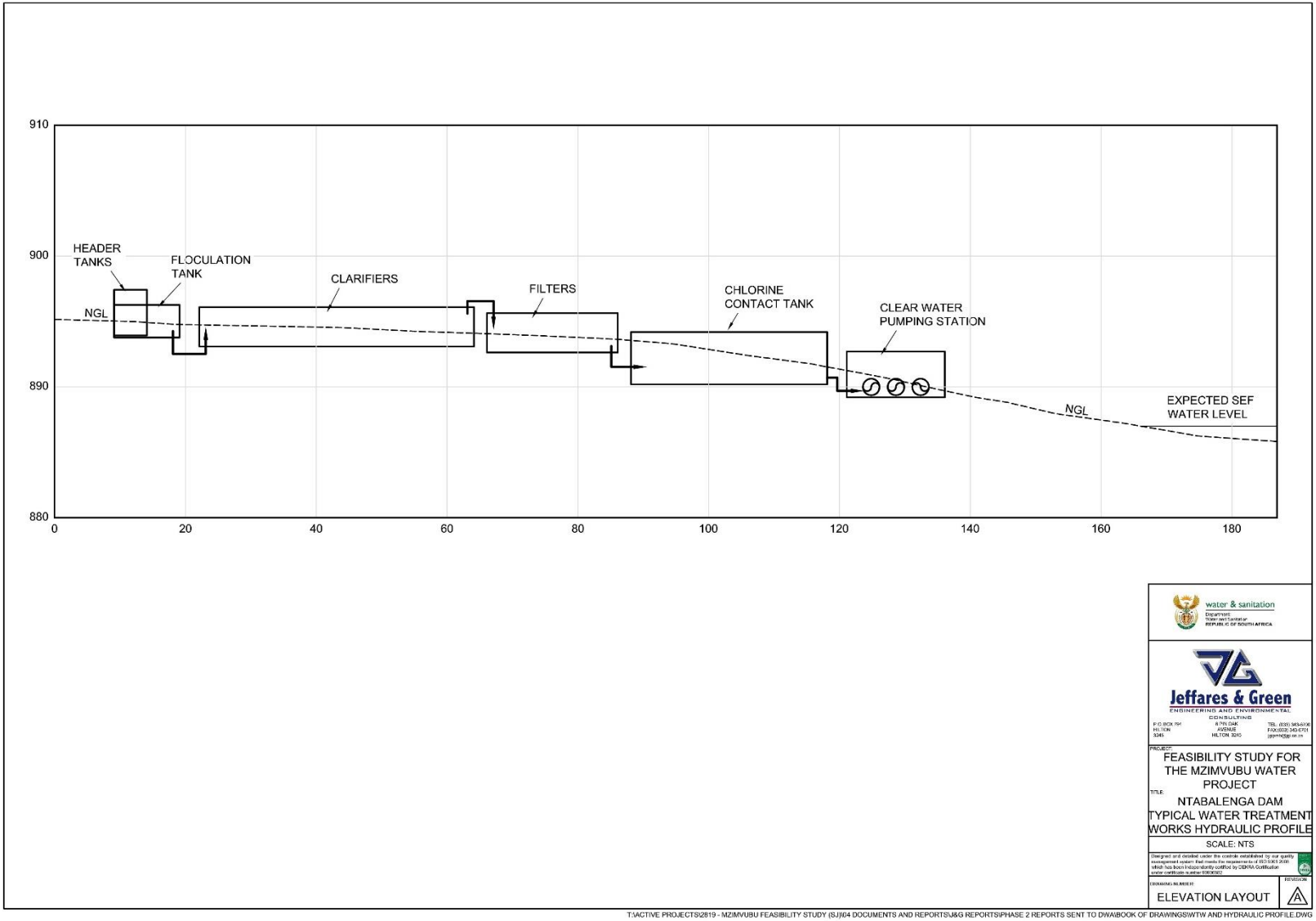

Figure 6: Hydraulic Flow Diagram through Ntabelanga WTW

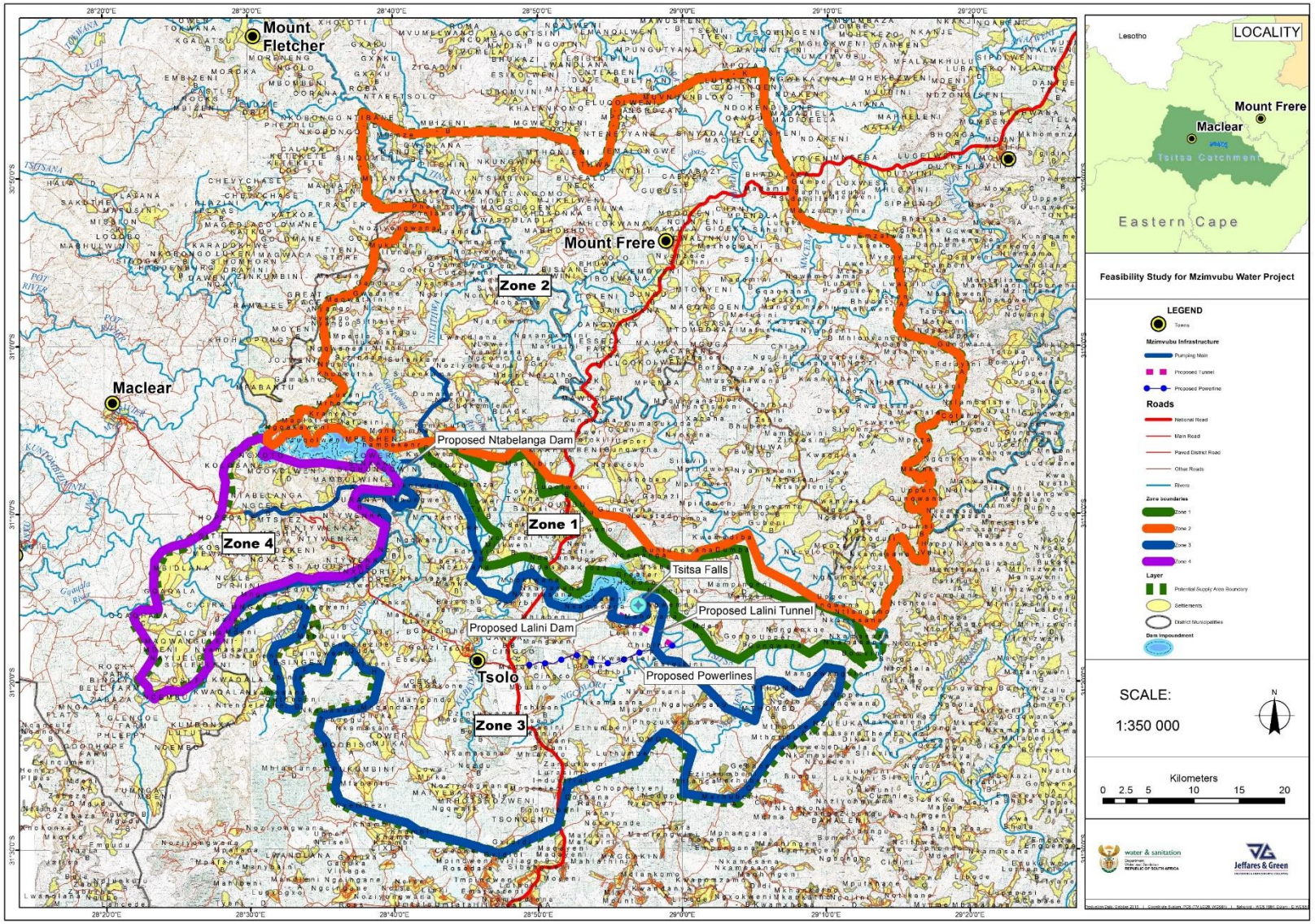

Figure 7: Supply Zones for Infrastructure Planning

The proposed reservoirs range in capacity from 10 m^3 to 750 m^3 in the respective secondary and tertiary systems with the command reservoirs in the primary system being in the order of 2 500 m^3 to 33 000 m^3.

The proposed reservoir construction materials range from pressed steel tanks for capacities less than 500 m^3, modular pre-fabricated systems for the medium sized reservoirs, and conventional reinforced concrete reservoirs for the capacities greater than 2 000 m^3.

The distribution system is divided into three components, viz, Primary, Secondary and Tertiary systems.

The primary bulk water distribution system layout is illustrated diagrammatically in Figure 8, and its layout is shown in Figures 9 and 10. The capacity of these main components is shown on Figure 8, and it can be seen that the configuration has been designed to minimise the pumping of water to the higher elevations as much as possible.

From the water treatment works (WTW), treated water would be pumped from pumping station 1 (PS1) via a rising main going north to primary command reservoir 1 which would then gravity feed the bulk water distribution system designated as Zone 1 in Figure 7. Example details of typical pumping stations and storage reservoirs are given in the main text of this report.

A pumping station (PS2) would lift water from primary command reservoir 1 to primary command reservoir 2 which is located at a higher elevation. From this reservoir, water would be gravity fed to the bulk water supply system in the higher elevations of the Tsitsa valley watershed, as well as supplying some of the neighbouring DM settlements over the watershed and reaching to the southern outskirts of the town of Mount Frere. This is designated as supply Zone 2.

Similarly on the southern side of the river, potable water would be pumped from pumping station PS3 at the WTW to primary command reservoir 3 from where gravity fed bulk mains would transfer water to the settlements in Zone 3.

A pumping station (PS4) at primary command reservoir 3 would pump water in a westerly direction to the higher lying primary command reservoir 4, which would also deliver water by gravity in the direction of Maclear, and to settlements in the Tsitsa River valley adjacent to the flooded area of impoundment once the dam is constructed. This area is shown as Zone 4 in Figure 7.

The secondary bulk water distribution system consists of the main bulk pipelines fed by gravity from the above primary command reservoirs 1, 2, 3 and 4. The secondary systems transfer water in bulk to secondary command reservoirs, which form the second level of strategic storage. The layouts of the secondary bulk potable water distribution pipelines and reservoir locations are shown in Figure 11. In keeping with the planning being undertaken by the DMs, these secondary system command storage sites generally coincide with sites of existing reservoirs that are located at strategic high points, but that can, for the most part, be supplied with potable water by gravity from the primary system, with only a small proportion of the water supplied needing to be boosted to overcome high spots en route. This is achieved by three small booster pumping stations which only operate under peak demand periods.

Figure 12 shows the potential alignments of the tertiary pipelines that would be implemented by the DMs to deliver potable water from the proposed primary and secondary bulk potable water distribution systems. All of these tertiary pipelines would operate under gravity and no additional pumping would be required. The hydraulic capacity, sizing, alignments, and costing of these lines has been undertaken at a feasibility level, and it will be the responsibility of the DMs to undertake the optimisation, detailed design, and implementation of the tertiary lines and storage facilities in each settlement. This process is ongoing and the planning of the overall scheme has taken into account the DM planning and implementation of these systems that is currently underway.

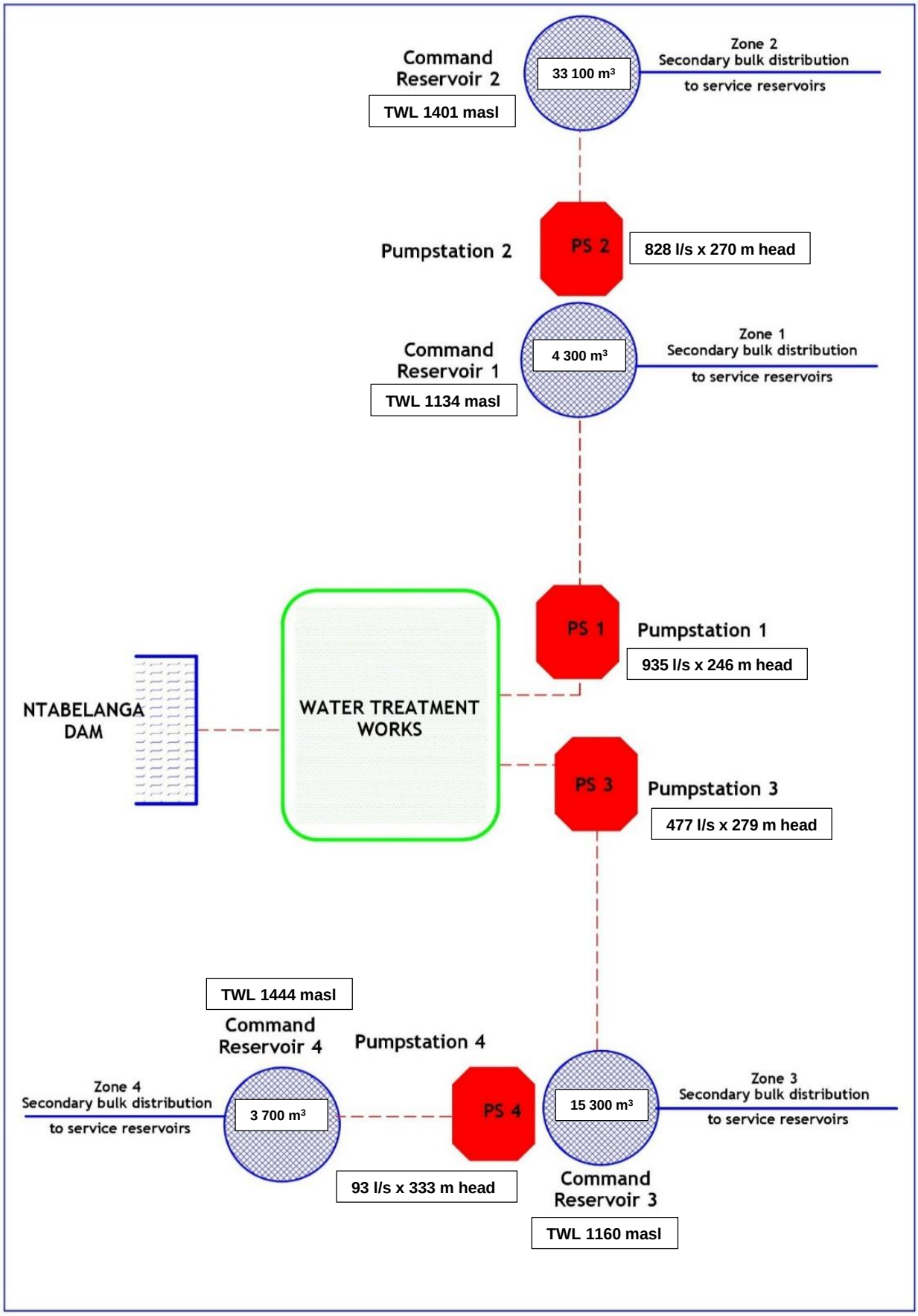

Figure 8: Diagram of Primary Bulk Water Distribution System

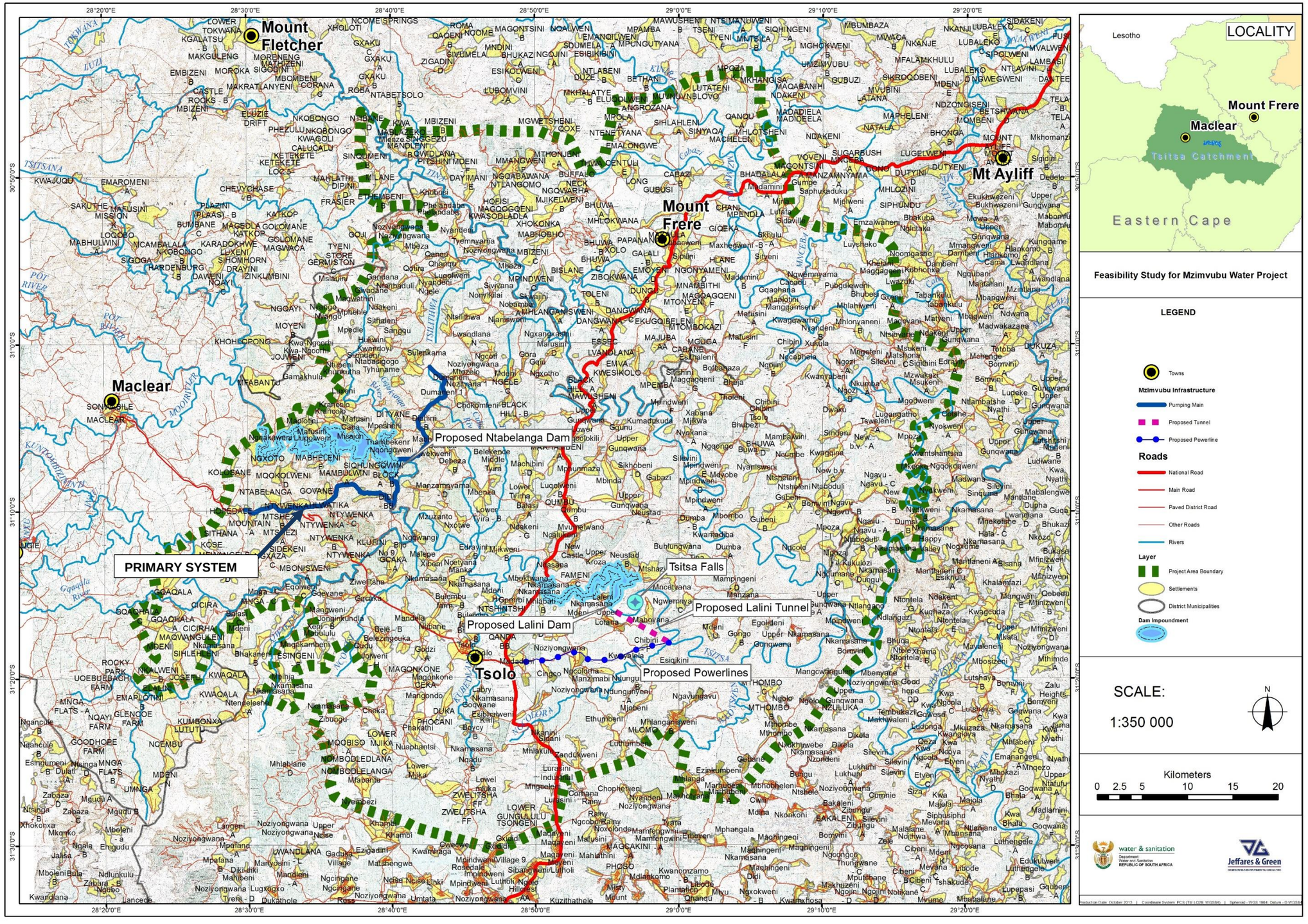

Figure 9: Layout of Scheme and Supply Area

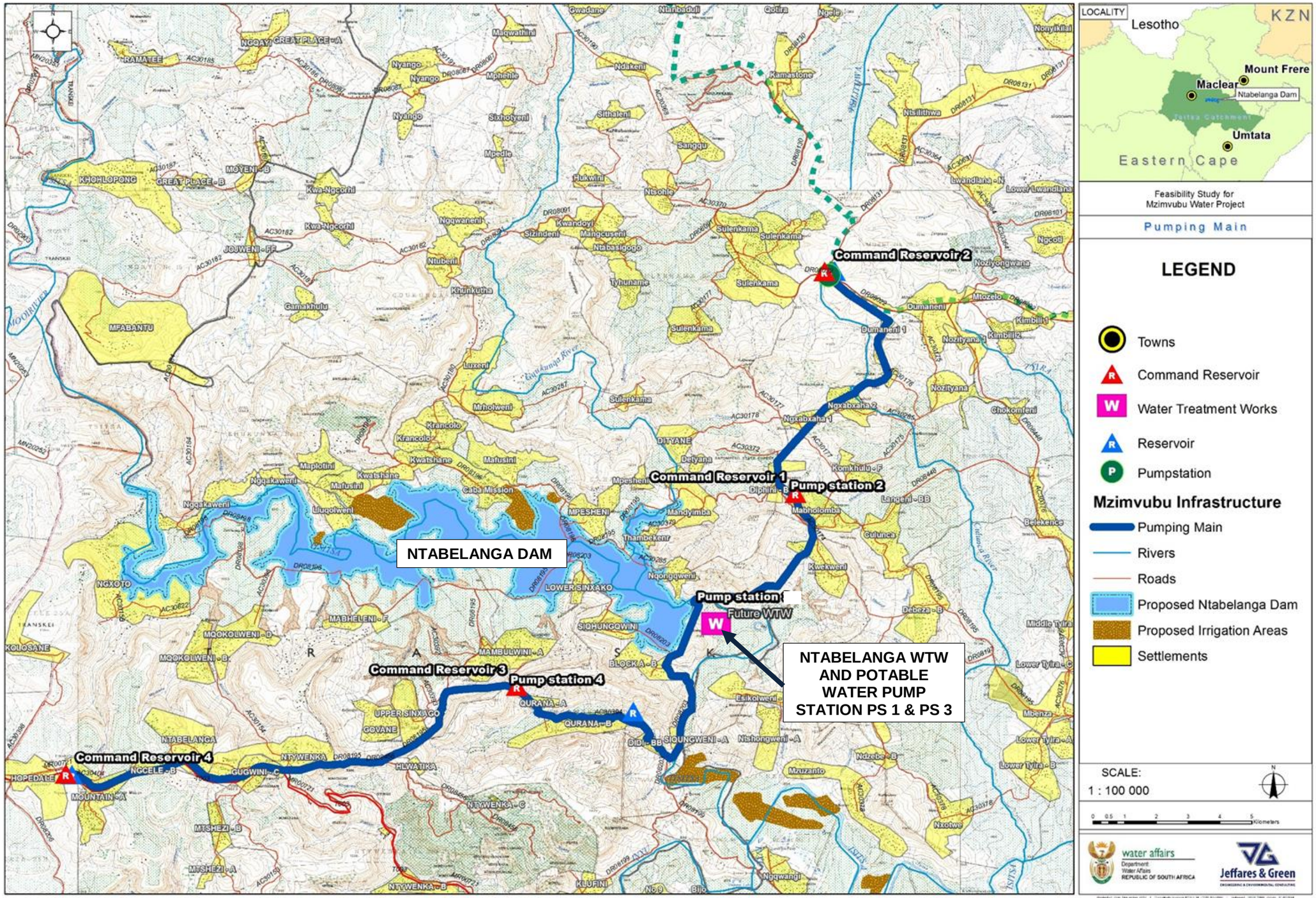

Figure 10: Primary Bulk Potable Water Pipelines, Pumping Stations and Command Reservoirs

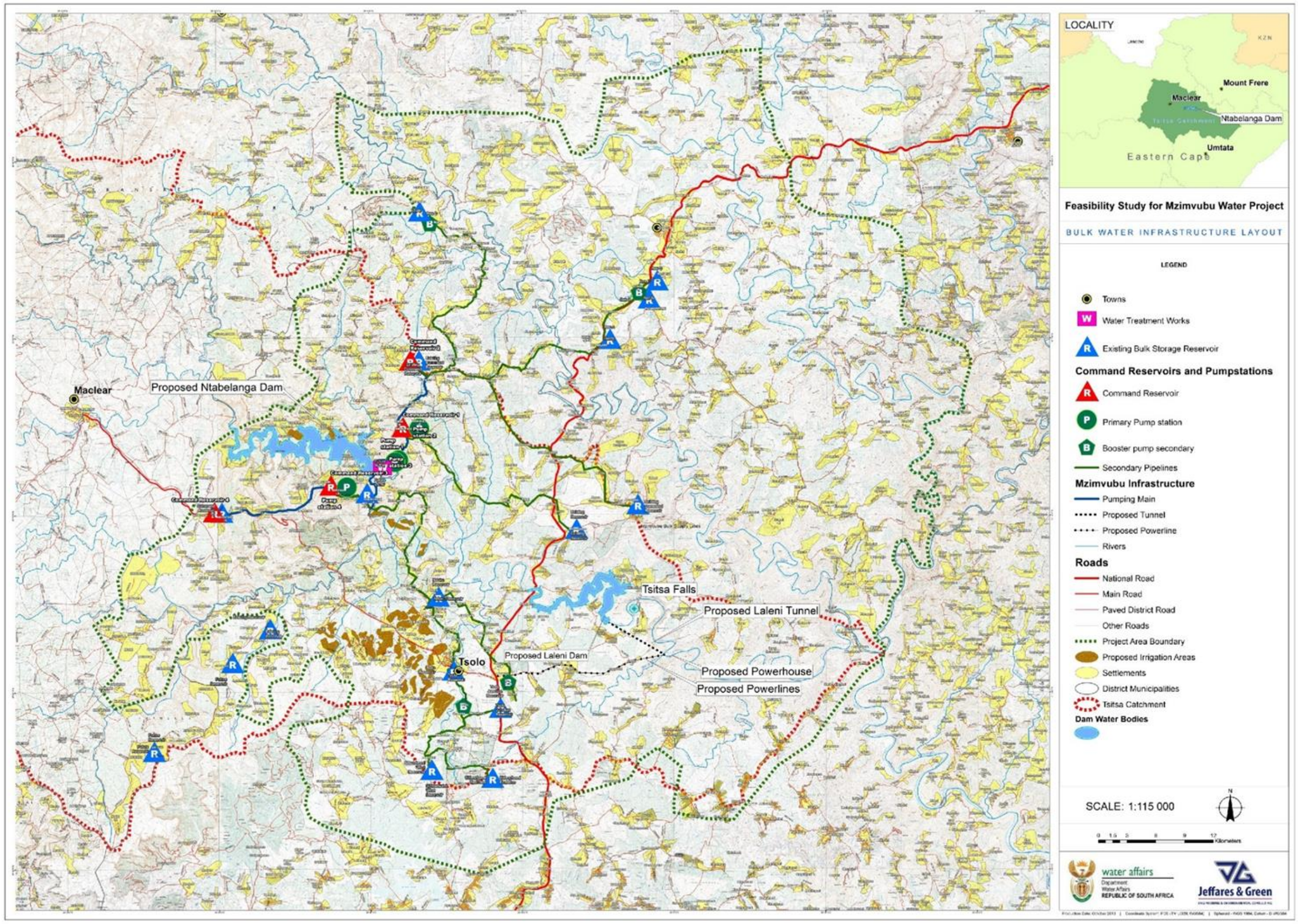

Figure 11: Secondary Bulk Potable Water Distribution Pipelines and Command Reservoirs

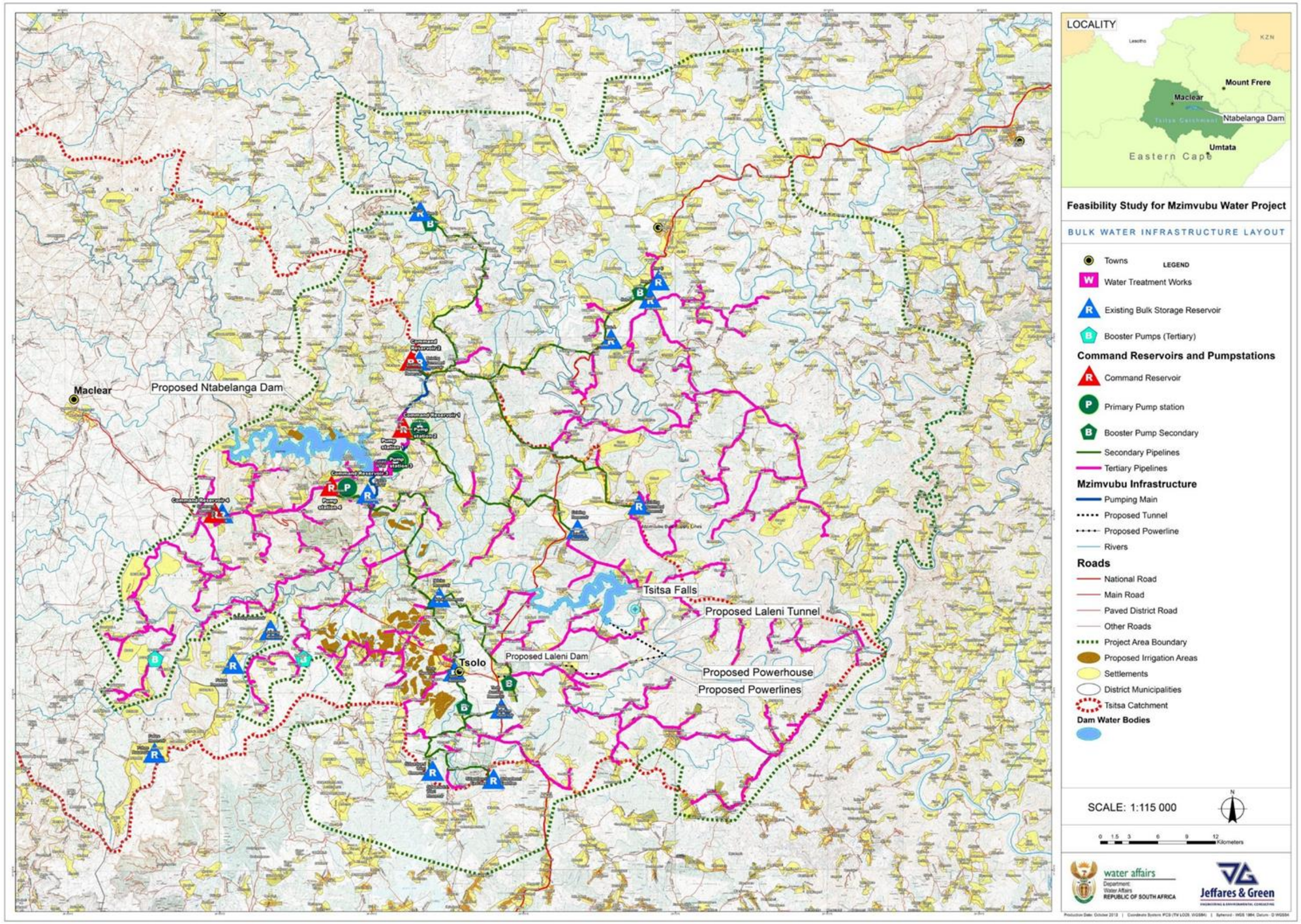

Figure 12: Layout of Potential Tertiary Pipelines

HYDRAULIC MODELLING OF THE BULK WATER DISTRIBUTION SYSTEM

The hydraulic modelling of the bulk water distribution system has been undertaken using the Dynamic Network Analysis Hydraulic Modelling module of Civil Designer software by Knowledge Base.

This simulates the whole system dynamically using the design criteria described above.

The analysis has been run using the 2050 water demands, and has been checked that the system provides the required service levels under a peak summer demand factor of 1.2.

The system is optimised from "bottom up". Each village/settlement end node comprises a village reservoir with 24 hrs x annual average daily demand (AADD) storage capacity, delivering a diurnal water demand profile with an hourly peak factor of 2.

Each of these village tanks would have a top inlet and inlet flow control valve, with a standard flow control characteristic to ensure that the reservoir does not overflow or run dry.

The sizes of tertiary lines feeding all of these tanks from the secondary bulk lines and command reservoirs were optimised using iterative model runs to ensure that they are the smallest size that can still supply the tanks under peak summer flow conditions, with a minimum residual head at each tank inlet valve of 10 m.

Most of these tertiary lines are supplied by gravity, either from branch connections from the secondary bulk distribution pipelines, or directly supplied by the primary and secondary command reservoirs.

The primary command reservoirs have been sized at 16 hrs x AADD, and the secondary command reservoirs at 8 hrs x AADD to ensure that the total requirement of 48 hrs x AADD is provided for the system as a whole.

Similarly, the secondary bulk infrastructure pipelines that are fed by the primary command reservoirs have also been sized using the same iterative modelling process to ensure that adequate residual pressures are available at the inlets of all of the secondary command reservoirs under peak summer flow conditions.

The secondary command reservoir locations include sites where existing reservoirs already supply some existing schemes. As the extent of supply of most of these sites will increase, the storage capacity of existing storage sites would be increased to provide the minimum strategic storage recommended under the DWS Design Guidelines.

In undertaking the design process, it was noted that some sections of the bulk water distribution system will require some additional pumping where gravity flow is not possible due to terrain. Therefore three booster pumping stations have been included in the system.

More detailed layouts and alignments for the primary and secondary systems are given in the Main Report: Volume 2: Book of Drawings Report No. P WMA 12/T30/00/5212/4.

COST ESTIMATES

From the feasibility design process, quantities were taken of the proposed infrastructure and an engineer's estimate was undertaken to establish the capital costs for the implementation of this infrastructure.

These quantities and costing schedules are included herein as Appendix B.

The cost estimates for the primary and secondary bulk potable water distribution systems (including pumping stations, pipelines, and reservoirs) are summarised in Table 1.

These are at current (2014) price levels and allowance must also be made in the project budgeting for price escalation to the date of construction, the quantum of which will be dependent upon the implementation programme and timing of such expenditure. More details of this process are given in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15.

It should be noted that the extent of the DWS-implemented potable water components of the Mzimvubu Water Project is the Ntabelanga dam and associated infrastructure, the water treatment works, and the primary and secondary systems only.

A cost estimate for the Ntabelanga WTW having the daily peak demand output capacity for the water requirement projected in 2050 (101 515 m^3/day) is R817 152 000 including VAT, but this is also at current price levels and excludes escalation to date of construction.

Analysis of the tertiary lines was undertaken purely to ensure that correct budgetary allowance and implementation programme has been made for delivery into these systems. The DM's are responsible for the delivery of water from the secondary reservoirs to the households.

Table 2 summarises the cost estimate of the tertiary potable water distribution system.

Preliminary analysis of the unit reference value of this scheme has been undertaken and will be finalized and reported in the Cost Estimates and Economic Analysis Report.

Discounted cashflow models were used to calculate the URV of potable water supplied, including all costs from the Ntabelanga Dam, water treatment works, pumping stations, primary and secondary bulk water distribution and storage reservoirs, and tertiary lines to local tanks at each of the settlements to be supplied in the three District Municipalities. At a 10% discount rate, the resulting URV of water supplied = R16.71/m^3.

If only operation, maintenance and periodical plant refurbishment costs are included in the discounted cash flow analysis of the same works, the URV = R2.72/m^3.

Given that the latter approach is normally taken with grant funded works, the URV value is within the range normally expected on water supply projects.

Table 1: Capital Costs – Primary and Secondary Bulk Water System

ITEM	COMPONENT	PRIMARY SYSTEM COST (R)				SECONDARY SYSTEM COST (R)				TOTAL (R)
		ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4	
1	Pipelines	60 117 760	99 224 769	80 782 214	44 233 915	97 519 488	200 148 761	227 791 205	0	809 818 112
2	Pumpstations	20 000 000	20 000 000	20 644 000	16 500 000	0	0	8 814 000	0	85 958 000
3	Reservoirs	6 500 000	71 500 000	30 000 000	11 000 000	0	23 500 000	0	0	142 500 000
4	Electrical supply	10 000 000	10 000 000	7 500 000	5 000 000	0	0	2 500 000	0	35 000 000
	Sub-Total	***96 617 760***	***200 724 769***	***138 926 214***	***76 733 915***	***97 519 488***	***223 648 761***	***239 105 205***	***0***	***1 073 276 112***
5	Contingencies (15%)	14 492 664	30 108 715	20 838 932	11 510 087	14 627 923	33 547 314	35 865 781	0	160 991 417
	Sub-Total	***111 110 424***	***230 833 484***	***159 765 147***	***88 244 002***	***112 147 411***	***257 196 075***	***274 970 986***	***0***	***1 234 267 528***
6	Engineering/EMP Costs (12%)	13 333 251	27 700 018	19 171 818	10 589 280	13 457 689	30 863 529	32 996 518	0	148 112 103
	Sub-Total	***124 443 675***	***258 533 502***	***178 936 964***	***98 833 282***	***125 605 100***	***288 059 604***	***307 967 504***	***0***	***1 382 379 632***
	VAT 14%	*17 422 114*	*36 194 690*	*25 051 175*	*13 836 660*	*17 584 714*	*40 328 345*	*43 115 451*	*0*	*193 533 148*
	Total (Rand)	**141 865 789**	**294 728 193**	**203 988 139**	**112 669 942**	**143 189 814**	**328 387 949**	**351 082 954**	**0**	**1 575 912 780**

Note: Current (2014) price levels - Excludes escalation to date of construction

Table 2: Capital Costs – Tertiary Bulk Water System Only

ITEM	COMPONENT	TERTIARY SYSTEM COST (R)				TOTAL (R)
		ZONE 1	ZONE 2	ZONE 3	ZONE 4	
1	Pipelines	164 061 029	439 024 905	413 039 272	108 386 050	1 124 511 256
2	Pumpstations	0	0	4 238 000	2 184 000	6 422 000
3	Reservoirs	13 455 000	46 135 000	30 955 000	12 975 000	103 520 000
4	Electrical supply	0	0	3 750 000	1 250 000	5 000 000
	Sub-Total	***177 516 029***	***485 159 905***	***451 982 272***	***124 795 050***	***1 239 453 256***
5	Contingencies (15%)	26 627 404	72 773 986	67 797 341	18 719 257	185 917 988
	Sub-Total	***204 143 433***	***557 933 891***	***519 779 613***	***143 514 307***	***1 425 371 244***
6	Engineering/EMP Costs (12%)	24 497 212	66 952 067	62 373 554	17 221 717	171 044 549
	Sub-Total	***228 640 645***	***624 885 958***	***582 153 167***	***160 736 024***	***1 596 415 794***
	VAT 14%	*32 009 690*	*87 484 034*	*81 501 443*	*22 503 043*	*223 498 211*
	Total (Rand)	**260 650 336**	**712 369 992**	**663 654 610**	**183 239 067**	**1 819 914 005**

Note: Current (2014) price levels - Excludes escalation to date of construction

Of the R1 820 million cost of the Tertiary lines, the three DMs would need to budget for their particular portions of the system as given in Table 3. The costs again exclude escalation.

Table 3: Split of Budgets Required by DMs to Implement Tertiary Lines

Tertiary Pipelines Funding	Alfed Nzo DM	Joe Gqabi DM	OR Tambo DM	TOTAL
Total cost by DM incl VAT	**R599 861 932**	**R121 298 035**	**R1 098 754 038**	**R1 819 914 005**

RAW WATER FOR IRRIGATION DEVELOPMENT

Some 2 868 ha of high potential irrigable land has been identified, and recommendations have been made to develop commercially run farming units of average size 60 ha.

Some 437 ha of this total are located adjacent to the north shore of the area that would be inundated by the dam, and on each bank of the Tsitsa River downstream of the dam. Irrigation to these areas could be via simple portable abstraction pumps, and quick-coupling systems, and permanent bulk raw water transfer systems would not be needed.

Most of the proposed farming units are located in and around the urbanised centre of Tsolo, at a distance of some 17 km away from the Tsita River and at an elevation of between 130 and 220 m above the river level at that nearest point.

This means that raw water supply to these areas would need to be conveyed via pipeline and pumped from the source.

For these Tsolo irrigation areas totalling 2 451 ha, and allowing for up to 20 hours per day pumping[1] to achieve the required daily application totals for the suggested cropping patterns, this requires the following water transfer pumping rates:

- *Peak daily pumping rate: 1.06 m^3.sec*
- *Average pumping rate: 0.81 m^3/s*

The above are based on net application rates ranging between 619 mm to 1 141 mm per annum, plus allowance for losses, with a "typical" application of 880 mm per annum used for economic analysis purposes.

Two options have been investigated as raw water abstraction locations.

1. *At the Ntabelanga Dam raw water outlet works (Options 1 and 3).*
2. *At an abstraction weir and pumping station located on the Tsitsa River downstream of the dam, and as close to Tsolo as possible (Options 2 and 4)*

For each these two source options, a further two scenarios were investigated:

i. *Pumping from source to a single reservoir located at a high point at the end of the rising main, with the fields irrigated under the residual pressure in the system en route.*
ii. *Pumping from source to an intermediate storage tank (open-topped earth-bunded reservoir) at an elevation that can then supply just over 60% of the farming units by gravity, with the remainder at higher elevations fed by booster pumped pipelines from that gravity system.*

Optimisation of the pipeline size and pumping arrangement resulted in Option 3 being the preferred solution, i.e. being pumped from the Ntabelanga Dam to the intermediate storage arrangement. The general layout of the recommended Option 3 is given in Figure 13.

This resulted in a raw water pumping station at Ntabelanga dam outlet works with 2.7 MW peak power consumption, a 16.4 km x 1 000 mm diameter rising main to intermediate storage, then gravity pipelines and local tanks located at strategic points close to the "edge of fields" of the proposed farming units. In order to reach those farming units that are located at the highest elevations two smaller booster pumping stations of installed capacity 269 kW and 481 kW respectively would be installed.

[1] *Limiting pumping to 20 hours per day avoids peak hour electricity tariffs and significantly reduces energy costs.*

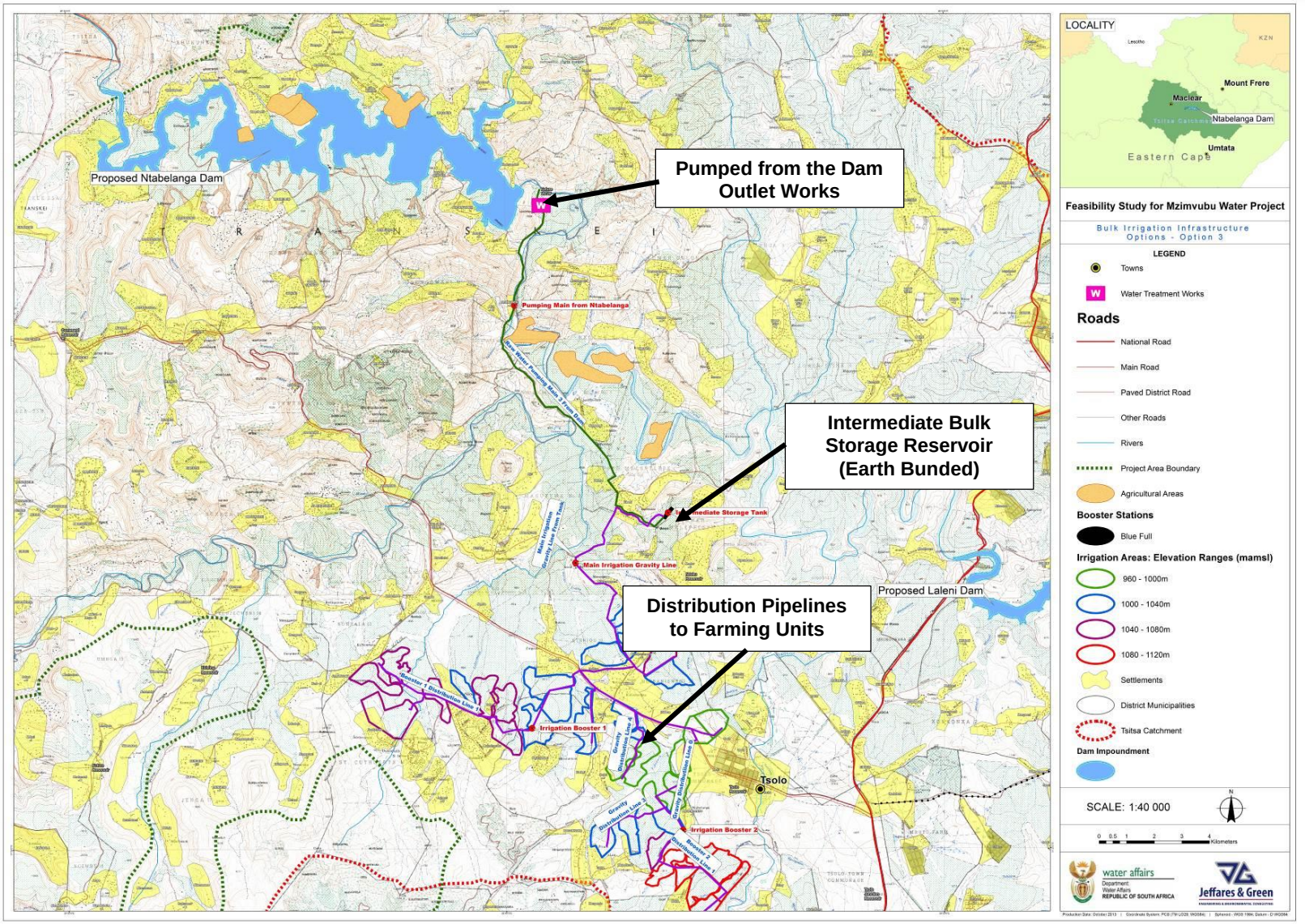

Figure 13: Overall Layout Plan of Option 3

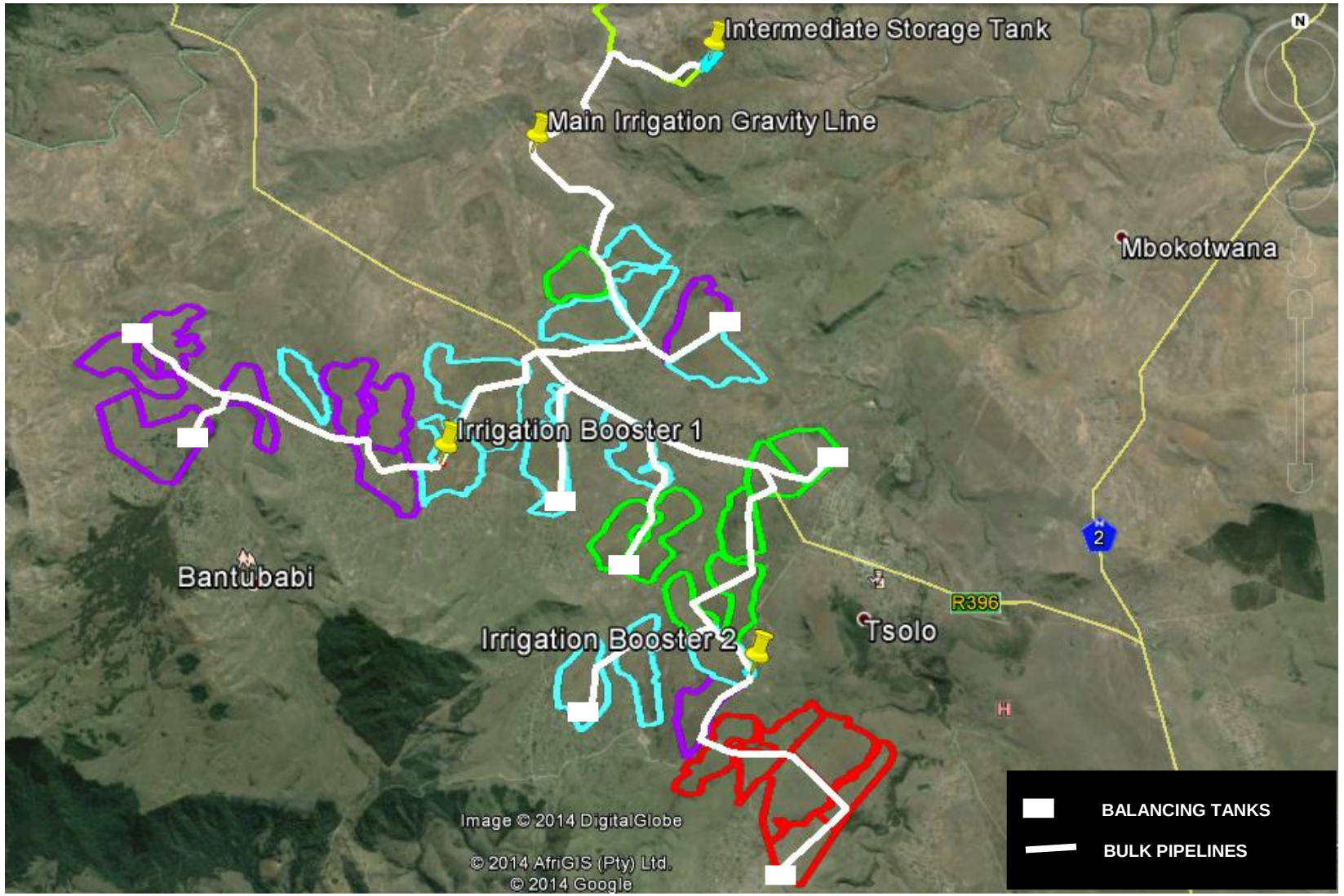

Figure 14: Detail of Bulk Distribution to Edge of Field

The raw water conveyance system capital cost requirement for Option 3 is R661 million incl VAT, at current (2014) price levels and excluding escalation to the construction date. Quantities and costs used to build up the cost estimates are given in Appendix C. In the analyses undertaken, it has been assumed that all capital costs will be grant funded and will not have a capital redemption requirement.

Operation and maintenance costs per annum have been estimated using the percentages of capital cost of the various components of the scheme as recommended in the DWS Technical Guidelines. An additional allowance has been made to fund recurrent depreciation replacement items such a pumps, valves, and similar equipment.

A summary of the capital and recurrent cost estimate for the recommended Option 3 is given in Table 3.

Table 3: Estimated Capital and Recurrent Costs – Option 3

OPTION 3 - IRRIGATION PIPELINE DIRECT FROM DAM					
ITEM	**DESCRIPTION**	**AMOUNT**		**O&M per year**	
1	Pipelines	R 405 636 748	0.50%	R	2 028 184
2	Abstraction works	R 8 000 000	0.25%	R	20 000
3	Pumpstations	R 23 280 152	4%	R	931 206
4	Reservoirs	R 50 000 000	0.25%	R	125 000
5	Electrical supply	R 10 000 000	4%	R	400 000
6	Contingencies	R 49 691 690	1%	R	496 917
7	Engineering fees	R 32 796 515			
	Allowance for M&E depreciation and replacement funding			R	956 515
	Total 1	**R 579 405 105**		**R**	**4 957 822**
	VAT	R 81 116 715		R	694 095
	Total	**R 660 521 820**		**R**	**5 651 917**
			Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power			21 240 366		R 0.27
Power Cost per year		**R 18 559 958**	21 240 366		R 0.87
Cost for supply of raw water to edge of field including power			**R/m^3**		**R 1.14**

Option 3 has the lowest unit cost of raw water supplied at R1.14/m^3.

In the marginal cost analyses undertaken for the Irrigation Development Report No. P WMA 12/T30/00/5212/9, the total unit cost of raw water supplied to each farming unit at "edge of field" was R0.40/m^3. This produced an annual net surplus income of approximately R580 000 per 60 ha farming unit.

Given that such a farming unit would also be estimated to consume water at a rate of some 371 000 m^3/per year, then a R0.74 /m^3 increase in unit cost over the R0.40/m^3 figure used in the above calculation would reduce the net surplus income per annum to R305 460. Such surpluses are required to repay loans, and refurbish equipment etc. and it must be questioned whether a lower surplus income would provide enough return on the investment required on each farming unit.

It should be noted that the power cost forms a high proportion of the overall raw water cost, and it is expected that power tariffs will swiftly increase over the next few years at a rate above inflation. This is a risk to the viability of such farming units.

Clearly some subsidization of this unit cost of raw water as well as capital costs must be made if the potential irrigation schemes are to be viable and sustainable. The Department of Rural Development and Agrarian Reform suggests that a figure of R0.25/m^3 would be a reasonable target to ensure that gross margins are attractive enough to encourage investment into commercial irrigated agriculture. This emphasizes the need to subsidize the Ntabelanga water supply scheme with revenue gained from the energy sales generated by the Lalini Dam and hydropower scheme.

In conclusion, if the effective cost of power supplied to the scheme can be reduced (i.e. cross-subsidized by grant-funded hydropower capital cost) through the benefits gained by generation of hydropower at Ntabelanga and Lalini, then the viability of irrigated agriculture development within the scheme could still be possible. This key issue is discussed in more detail in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15, where the overall viability of the multi-purpose scheme is analysed.

POWER REQUIREMENTS

The power requirements for the complete scheme are described in the Bulk Water Distribution Infrastructure Report No. P WMA 12/T30/00/5212/13. The total required is estimated as 12 572 kVA (circa 13 MW), with the majority of this centralized at the Ntabelanga Dam and WTW sites. Table 4 summarises the duties and power requirements of the various energy consuming infrastructure components in the system.

ESKOM has 132 kV high voltage lines running parallel to the main road from Mount Frere to Mthatha and running through the project supply area from the above alignment to Maclear, passing between the Ntabelanga Dam and Tsolo. ESKOM are also implementing a programme of expansion of both high and medium voltage power supplies in the area, and information received from them indicates that this will eventually result in also complete coverage of power services to all of the settlements in the area.

The Ntabelanga hydropower plant can only produce circa 1 600 kVA (1.6 MW) on average with a maximum of 5 000 kVA (5 MW), and there will therefore be a need to arrange for an ESKOM power supply to meet all of the project's needs in the Ntabelanga area, given that there will be times when the output of the hydropower plant will be very low or off-line.

Significant power will also be required in advance of the start of construction to supply contractor's camps, temporary water supply, site offices, accommodation, wastewater treatment, site lighting, dewatering, cranes and hoists, crushing and batching plants, etc. It is expected that such needs would also be in the order of 10 000 kVA (say 10 MW). The power supply connection from ESKOM to the Ntabelanga Dam site must therefore be implemented as an advance infrastructure component.

The regional grid access department of ESKOM have been consulted and have confirmed that they can provide a connection to the Ntabelanga dam site in order to provide both construction and operational power requirements. It was also confirmed that energy generated by the Ntabelanga Dam mini-hydropower plant could be fed back into the ESKOM grid through the same connection via a switching arrangement, and credits given.

The conjunctive use hydropower scheme (i.e. Ntabelanga Dam in conjunction with the Lalini Dam and hydropower scheme), is expected to produce up to 37.5 MW on a base load basis, and this means that a conjunctive scheme would not only be "self-sufficient" in its energy usage for potable and irrigation water supply needs, but can also supply surplus energy into the local ESKOM grid, thus generating surplus revenue which can be used to effect the subsidisation described above.

This is discussed further in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15, and the Lalini Dam Hydropower Analysis Report No. P WMA 12/T30/00/5212/18.

Table 4: Power Requirements for Scheme

2050 Power Requirements									
Treated Water	***Flow (l/s)***	***Head (m)***	***Duty Water Power (kW)***	***Pump Efficiency (%)***	***Maximum Electricity Demand (kW)***	***Maximum Electricity Demand (kVA)***	***Max hours per day***	***Usage - kWh per year***	***Power cost/year (Rand)****
Pumping station PS1	*935.27*	*246*	*2 257*	*75%*	*3 010*	*3 168*	*20*	*23 128 671*	*19 497 470*
Pumping station PS2	*827.70*	*270*	*2 193*	*75%*	*2 924*	*3 077*	*20*	*22 465 459*	*18 938 382*
Pumping station PS3	*476.66*	*279*	*1 305*	*75%*	*1 740*	*1 831*	*20*	*13 368 771*	*11 269 874*
Pumping station PS4	*92.69*	*333*	*303*	*75%*	*404*	*425*	*20*	*3 102 814*	*2 615 672*
Booster pumping station Z3 PS1	*170*	*94*	*157*	*75%*	*209*	*220*	*20*	*1 606 406*	*1 354 200*
Booster pumping station Z4 PS1	*12.8*	*66*	*8*	*75%*	*11*	*12*	*20*	*84 924*	*71 591*
Booster pumping station Z4 PS2	*3.53*	*195*	*7*	*75%*	*9*	*9*	*20*	*69 197*	*58 333*
Water treatment plant processes	*Estimated*				*500*	*526*	*varies*	*572 998*	*483 038*
Waste water treatment works	*Estimated*				*100*	*105*	*20*	*768 421*	*647 779*
Housing	*Estimated*				*250*	*263*	*12*	*1 152 632*	*971 668*
Other, incl lighting etc	*Estimated*				*250*	*263*	*12*	*1 152 632*	*971 668*
TOTALS EXCL RAW WATER			***6 230***		***9 406***	***9 901***		***67 472 926***	***56 879 676***
Raw Water for Irrigation									
Main pumping station	*1060*	*183*	*1 903*	*75%*	*2 538*	*2 671*	*20*	*19 500 041*	*16 438 535*
Booster pumping station P1	*206*	*100*	*202*	*75%*	*269*	*284*	*20*	*2 070 836*	*1 745 715*
Booster pumping station P2	*223*	*165*	*361*	*75%*	*481*	*507*	*20*	*3 698 856*	*3 118 135*
TOTALS INCL RAW WATER			***8 133***		***11 944***	***12 572***		***86 972 967***	***73 318 211***

**Note: Power costs based upon current average Ruraflex tariffs and are for economic analysis purposes only*

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LIST OF ACRONYMS AND ABBREVIATIONS

ASGISA-EC	Accelerated and Shared Growth Initiative for South Africa – Eastern Cape
CAPEX	Capital Expenditure
CFRD	Concrete-faced rockfill dam
CMA	Catchment Management Agency
CTC	Cost to Company
CV	Coefficient of Variability
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DEA	Department of Environment Affairs
DM	District Municipality
DME	Department of Minerals and Energy
DoE	Department of Energy
DRDAR	Department of Rural Development and Agrarian Reform
DRDLR	Department of Rural Development and Land Reform
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EC	Eastern Cape
ECRD	Earth core rockfill dam
EF	Earthfill (dam)
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPWP	Expanded Public Works Programme
ESIA	Environmental and Social Impact Assessment
EWR	Environmental Water Requirements
FSL	Full Supply Level
GERCC	Grout enriched RCC
GN	Government Notices
GW	Gigawatt
GWh/a	Gigawatt hour per annum
IAPs	Invasive Alien Plants
IB	Irrigation Board
IFC	International Finance Corporation
IPP	Independent Power Producer
IRR	Internal Rate of Return
IVRCC	Internally vibrated RCC
ISO	International Standards Organisation
kW	Kilowatt
LM	Local Municipality
ℓ/s	Litres per second
ℓ/c/d	Litres per capita per day

MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MEC	Member of the Executive Council
MIG	Municipal Infrastructure Grant
million m^3	Million cubic metres
MW	Megawatt
NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act
NOCL	Non-overspill crest level
NWA	National Water Act
NWPR	National Water Policy Review
NWRMS	National Water Resources Management Strategy
O&M	Operations and Maintenance
OPEX	Operational Expenditure
PICC	Presidential Infrastructure Co-Ordinating Committee
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PSC	Project Steering Committee
PSP	Professional Services Provider
RBIG	Regional Bulk Infrastructure Grant
RCC	Roller-compacted concrete
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RWI	Regional Water Institution
RWU	Regional Water Utilities
SAWS	South African Weather Service
SEZ	Special Economic Zone
SIP	Strategic Integrated Project
SMC	Study Management Committee
SPV	Special Purpose Vehicle
TCTA	Trans Caledon Tunnel Authority
ToR	Terms of Reference
UOS	Use of System
URV	Unit Reference Value
WEF	Water Energy Food
WRYM	Water Resources Yield Model
WSA	Water Services Authority
WSP	Water Services Provider
WTE	Water Trade Entity
WUA	Water User Association

LIST OF UNITS

Description	Standard unit
Elevation	m a.s.l.
Height	m
Distance	m, km
Dimension	mm, m
Area	m^2 , ha or km^2
Volume (storage)	m^3
Yield, Mean Annual Runoff	m^3/a
Rotational speed	rpm
Head of Water	m
Pressure	Pa
Diameter	mm or m
Temperature	^oC

Description	Standard unit
Velocity, speed	m/s, km/hr
Discharge	m^3/s
Mass	kg, tonne
Force, weight	N
Gradient (V:H)	%
Slope (H:V) or (V:H)	1:5 (H:V) or 5:1 (V:H)
Volt	V
Power	W
Energy used	kWh
Acceleration	m/s^2
Density	kg/m^3
Frequency	Hz

1. BACKGROUND AND INTRODUCTION

The Mzimvubu River catchment in the Eastern Cape Province of South Africa is situated in one of the poorest and least developed regions of the country. Development of the area to accelerate the social and economic upliftment of the people was therefore identified as one of the priority initiatives of the Eastern Cape Provincial Government.

Harnessing the water resources of the Mzimvubu River, the only major river in the country which is still largely unutilised, is considered by the Eastern Cape Provincial Government as offering one of the best opportunities in the Province to achieve such development. In 2007, a special-purpose vehicle (SPV) called ASGISA-Eastem Cape (Pty) Ltd (ASGISA-EC) was formed in terms of the Companies Act to initiate planning and to facilitate and drive the Mzimvubu River Water Resources Development.

The five pillars on which the Eastern Cape Provincial Government and ASGISA-EC proposed to model the Mzimvubu River Water Resources Development are:

- Forestry;
- Irrigation;
- Hydropower;
- Water transfer; and
- Tourism.

The Department of Water and Sanitation (DWS) commissioned the Mzimvubu Water Project with the overarching aim of developing water resources schemes (dams) that can be multi-purpose reservoirs in order to provide benefits to the surrounding communities and to provide a stimulus for the regional economy, in terms of irrigation, forestry, domestic water supply and the potential for hydropower generation amongst others.

1.1 Study Locality

The Mzimvubu River Catchment is situated in the Eastern Cape (EC) Province of South Africa which consists of six District Municipalities (DM) and two Metropolitan Municipalities (Buffalo City and Nelson Mandela Bay). These include Cacadu DM in the west across to the Alfred Nzo DM in the east with the two Metropolitan Areas being located around the two major centres of the province, East London and Port Elizabeth, both of which border the Indian Ocean.

The Mzimvubu River Catchment is situated within three of the DM's namely the Joe Gqabi DM in the north-west, the OR Tambo DM in the South and the Alfred Nzo DM in the east and north east. A locality map of the whole catchment area and its position in relation to the DM's in the area is provided in Figure 1-1overleaf.

1.2 Study Stages

The study commenced in January 2012 and was completed by October 2014 in three stages as follows:

- Inception;
- Phase 1 – Preliminary Study; and
- Phase 2 – Feasibility Study.

The purpose of the study was not to repeat or restate the research and analyses undertaken on the several key previous studies described below, but to make use of that information previously collected, to update and add to this information, and to undertake more focussed and detailed investigations and feasibility level analyses for the dam site options identified as being the most promising and cost beneficial.

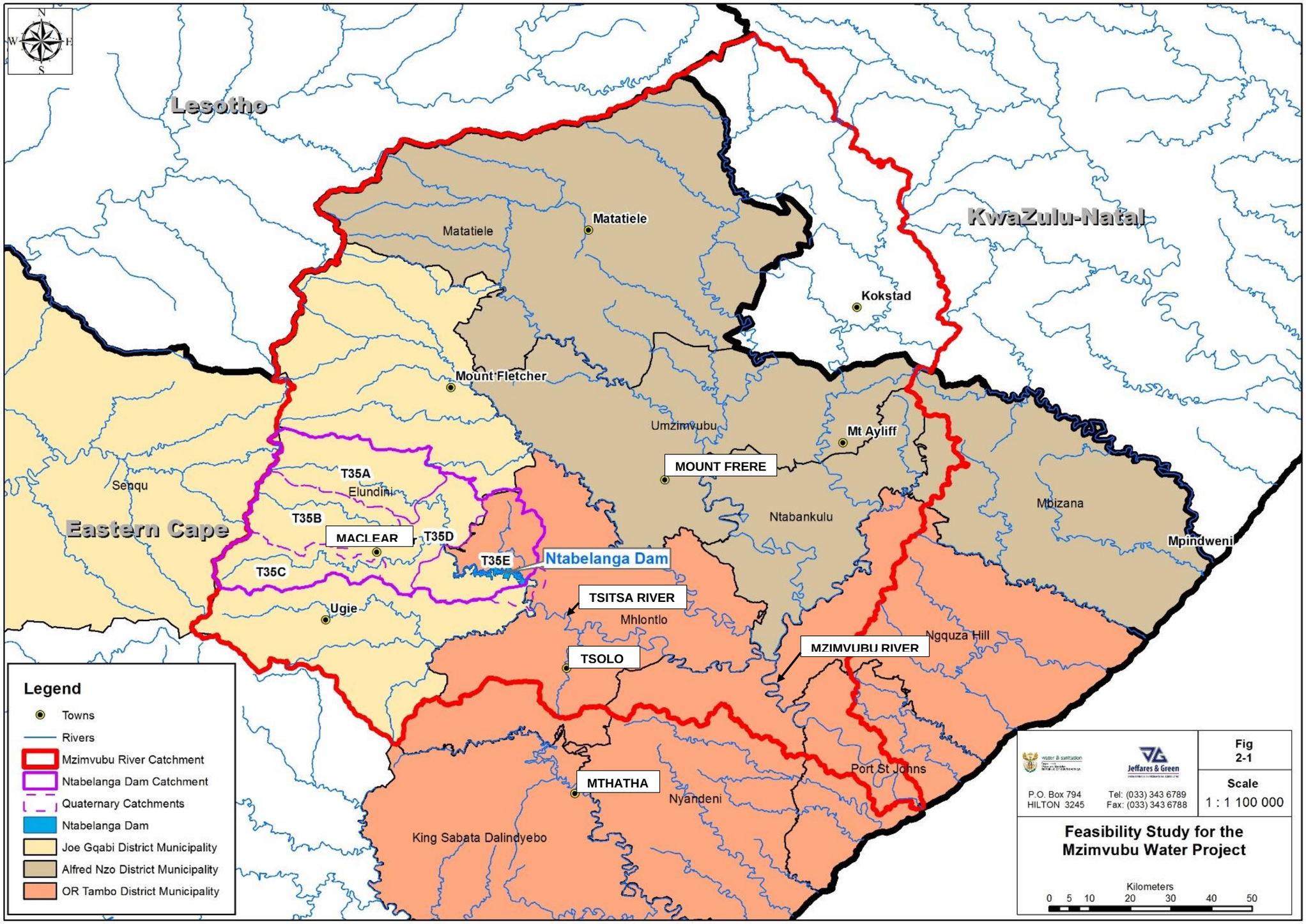


Figure 1-1: Locality Map of Mzimvubu Catchment

1.2.1 Inception Phase

The aim of the inception phase was to finalise the Terms of Reference (TOR) as well as to include, *inter alia*, the following:

- A detailed review of all the data and information sources available for the assignment;
- A revised study methodology and scope of work;
- A detailed review of the proposed project schedule, work plan and work breakdown structure indicating major milestones;
- Provision of an updated organogram and human resources schedule; and
- Provision of an updated project budget and monthly cash flow projections.

The inception phase has been completed and culminated in the production of an inception report (DWS Report Number P WMA 12/T30/00/5212/1) which also constitutes the final TOR for the study.

1.2.2 Preliminary Study Phase

The preliminary report describes the activities undertaken during the preliminary study phase, summarizes the findings and conclusions, and provides recommendations for the way forward and scope of work to be undertaken during the feasibility study phase.

The Preliminary Study Phase was divided into two stages:

- Desktop Study; and
- Preliminary Study.

The aim of the desktop study was, through a process of desktop review, analyses of existing reports and data, and screening, to determine the three best development options from the pre-identified 19 development options (from the previous investigation). This process is described in Section 2 of this report.

The aim of the preliminary study was to gather more information with regard to the three selected development options as well as to involve the Eastern Cape Provincial Government and key stakeholders in the process of selecting the single best development option to be taken forward into Phase 2 of the study.

The main activities undertaken during of the second stage of Phase 1 were as follows:

- Stakeholder involvement;
- Environmental screening;
- Water requirements (including domestic water supply, irrigation and hydropower);
- Hydrological investigations;
- Geotechnical investigations;
- Topographical survey investigations, and
- Selection process.

1.2.3 *Phase 2 – Feasibility Study*

The preliminary study recommended a preferred dam site and scheme development to be taken forward to Feasibility Study level.

The key activities undertaken during the Feasibility Study are as follows:

- Detailed hydrology (over and above that undertaken during the Preliminary Study);
- Reserve determination;
- Water requirements investigation (including agricultural and domestic water supply investigations);
- Topographical survey (over and above that undertaken during the Preliminary Study);
- Geotechnical investigation (more detailed investigations than during the Preliminary Study);
- Dam design;
- Land matters;
- Public participation;
- Regional economics; and
- Legal, institutional and financial arrangements.

An Environmental Impact Assessment was undertaken in a separate study that ran in parallel to this one;

1.2.4 *Additional Detailed Investigations for Lalini Dam and Hydropower Scheme*

Further detailed investigations were undertaken for a second dam on the Tsitsa at Lalini (just above the Tsitsa Falls) which would be operated conjunctively with the Ntabelanga Dam to generate significant hydropower for supply into the national grid. The feasibility design of the Lalini Dam and hydropower scheme is described in Report No. P WMA 12/T30/00/5212/19.

1.3 Purpose of this Report

This report describes the process to undertake the planning and feasibility design of the Bulk Water Distribution Infrastructure for the area of supply that can be serviced from the Ntabelanga Dam at the site that was selected in Phase 1, as described in the Preliminary Study Report No. P WMA 12/T30/00/5212/3.

The planning and sizing of this infrastructure is based upon the Water Requirements Report No. P WMA 12/T30/00/5212/6, and certain extracts from that report are repeated herein for information purposes.

It was confirmed and agreed in Phase 1 that the sizing and modus operandi of the Ntabelanga Dam and its associated works would take into account its multi-purpose role, namely:

i. To supply potable water to some 726 616 people[2] and other water consumers in the region,
ii. To supply raw water for irrigation of some 2 868 ha of high potential agricultural land,
iii. To generate hydropower locally at the dam wall to reduce the environmental impact and cost of energy consumption when pumping water,
iv. To provide flow of water downstream of the Ntabelanga Dam to meet environmental water requirements for an ecological Class C, and
v. To provide additional balancing storage and consistent downstream flow releases to enable a second dam at Lalini (just above the Tsitsa Falls) to generate significant hydropower for supply into the national grid.

[2] *This figure is significantly higher than that used in Phase 1 as much larger areas are to be supplied*

2. DOMESTIC WATER SUPPLY PLANNING CRITERIA

2.1 Domestic Water Supply Area

In Phase 1, the domestic water supply area was initially defined as the area adjacent to and below the Ntabelanga dam wall extending to the watershed crests on either side of the catchment.

This initial study supply area is shown on Figure 2-1, and includes information (shown in blue lines) of the existing water supply infrastructure taken from information gained from the DWS All Towns Study, and from information supplied by the District Municipalities. Many of these schemes are supplied from local sources including small streams, springs, and groundwater, but many do suffer with source unreliability, high maintenance, and limited coverage of the population served. The water resources potential in this study area is described in Report No. P WMA 12/T30/00/5212/5.

2.1.1 Groundwater Potential

The findings from the groundwater potential aspects of the study were that there was a low to moderate water supply potential distributed across the Mzimvubu Catchment that could possibly meet the individual water requirements of selected settlements or very small areas of irrigated agriculture.

The range of potential yield per borehole was estimated to be 0.5 ℓ/s to 5 ℓ/s, with groundwater table depths of up to 50 m. Given that this project seeks to supply a large and widely scattered population it is conceivable that this could require between 500 and 1 500 boreholes, each with its own pumping arrangement and distribution system, which constitutes a huge operation and maintenance requirement, in locations with limited access. Water quality issues and lack of reliability in drought years could add to the problems of sustaining such a system.

The main concerns regarding multiple groundwater sources were:

- Maintaining a scheme with multiple abstraction sites spread across a vast spatial area has practical limitations regarding manpower and logistics when considering the operations and maintenance of the infrastructure;
- Operations and maintenance costs associated with a widespread, multi-abstraction scheme;
- The reliability of groundwater is not always as good as a large-scale surface water supply option, i.e. during the dry years, water tables drop and groundwater schemes can often experience low yields or failures, and, thus, restrictions could be imposed. Such restrictions should not be necessary in a large single-source scheme; and
- Management of groundwater resources is critical in order to ensure the sustainability of the resource. This cannot always be monitored comprehensively in a widely dispersed supply scheme as would be required in this case, thus, the resource is open to misuse, which could have negative impacts for water supply and for the aquifer.

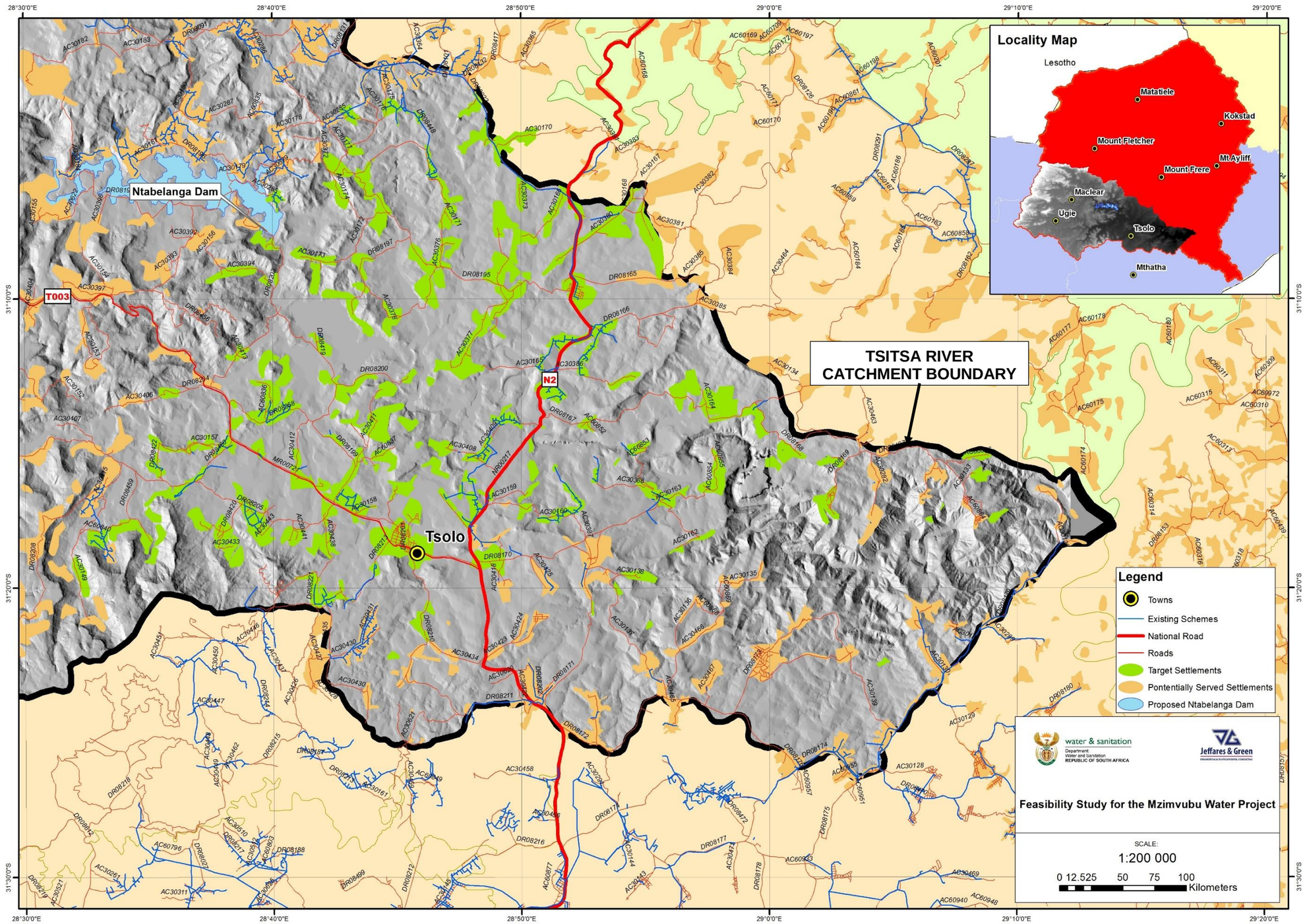


Figure 2-1: Initial Ntabelanga Supply Area

Based on the above, and after discussions with the PSC and DWS, it was decided that there was still a role to be played by groundwater in supplying some of the communities within the study area, and that where such groundwater schemes are considered to be operating reliably and supplying potable water of adequate quantity and quality, then such schemes should be integrated into the overall bulk water supply planning and implementation for the area.

2.1.2 Surface Water Sources

The track record of small dams and river abstraction schemes in this region is also not good. Given the very high sediment loads in the Mzimvubu river catchment, small dams and abstraction weirs would quickly silt up and become inoperable or very difficult to maintain. The water supply dam at Mount Fletcher is an example of this, in that this relatively small dam filled with sediment to about 75% of its capacity within a few years of commissioning. The District Municipalities report the same problems occurring with abstraction weirs, which also suffer from damage under flood conditions.

River abstraction points also rarely meet the EWR requirements as they have no balancing storage, and are often unreliable in the dry season. Off-channel storage dams can be an option to alleviate some of these problems but, given the scale of the proposed scheme, these would need to be substantial dams, each requiring suitable site and impoundment conditions and each off-channel dam normally requires its own river abstraction/pumping facilities. These dams are normally themselves located in tributaries of the main river, and such tributaries would likely also exhibit the same severe sedimentation problems as the main river. Building several river abstraction or off-channel facilities also multiplies the number of water treatment works and associated infrastructure required to be constructed, operated and maintained.

The findings from this study thus highlighted that there was a low to moderate groundwater potential, and vulnerable surface water sources distributed across the Mzimvubu catchment that could possibly meet the individual water requirements of selected settlements. However, this approach would involve many boreholes and multiple abstraction sites spread across a wide geographical area, with very onerous operation and maintenance obligations leading to high risk of failure.

In consultation with the stakeholders during the project steering committee meetings, the water services authorities in the area concurred that they would prefer one single surface water source rather than multiple groundwater and river abstraction sources. The water requirements for the Ntabelanga supply area have therefore been developed on this basis, and cover the demand growth for the whole area.

Despite this approach that the planning for the bulk water distribution systems for this study has been based upon a surface water-sourced system, it is recommended that the detailed design and implementation of the bulk water system takes into account those viable existing groundwater-based schemes, but existing schemes based upon vulnerable river abstraction points could be integrated into the future bulk water distribution system.

2.1.3 Broadening Proposed Area of Supply

In the course of this study, additional settlements located outside the Tsitsa River watershed were also considered in order to maximise the benefit of the proposed water source and treated water supply solution offered by the Ntabelanga Dam and its bulk water infrastructure. These additional potential supply areas were first defined in the *Ntabelanga Dam Potential Supply Area Investigation Study* commissioned by the Amatola Water (as Implementing Agent) and OR Tambo District Municipality and undertaken by Aurecon in 2011.

Meetings and discussions were held with Amatola Water, their PSP, Aurecon, and other DM representatives, to confirm the extent of the domestic water supply area based upon using the Ntabelanga Dam as the main source, and to agree design criteria for assessment of the long-term water requirements through to the planning horizon of 2050.

This significantly increased the area of supply and the number of households to be supplied from that which was used for the Preliminary Study in Phase 1. This extended potential area of supply included settlements in and around the Mount Frere area as well as in the Joe Gqabi DM, towards Maclear. This finally agreed potential supply area is as shown on Figure 2-2.

2.2 Planning Approach

In developing the water requirements for this study area, consideration was made as to how the bulk water delivery infrastructure would be developed and zoned, so that the breakdown of water requirements used for design were matched to the infrastructure to be developed.

Also, for the purposes of identifying the maximum raw water requirements to be supplied by the dam, the water supplied by the existing schemes was not deducted from the total.

This is also justified on the basis that many of the existing smaller schemes would have been designed on the basis of relatively low water demand per capita, some could be reaching their design life, some would have source reliability issues, or might need extensive plant and pipeline replacement. Bulk water supply schemes that have been recently constructed or are in the process of being implemented have been incorporated into the planning of the overall bulk water delivery infrastructure.

The figures derived below therefore represent an upper water requirement scenario. The detailed design and implementation of such infrastructure should include a review of the water requirements and consider the optimum packaging of development stages. Bulk transfer of water into and out of the Tsitsa River catchment has not been considered in this particular planning approach, but this does not preclude such an option in the future.

2.3 Population of Supply Area

As described above, for the purposes of designing bulk infrastructure, the area has been separated into four supply zones based on their geographical location within an elevation band, and the practicalities of building and operating a water supply system within the given terrain. This zoning is as shown on Figure 2-3.

The population figures used in Phase 1 of the study were derived from the GIS database created for this project based on Census 2001 figures (updated in 2006) which have then been escalated at an agreed growth rate of 1% per annum for the design horizon to 2050.

The 2011 census database became available during Phase 2 of the study, and was used as the basis of the population growth projections.

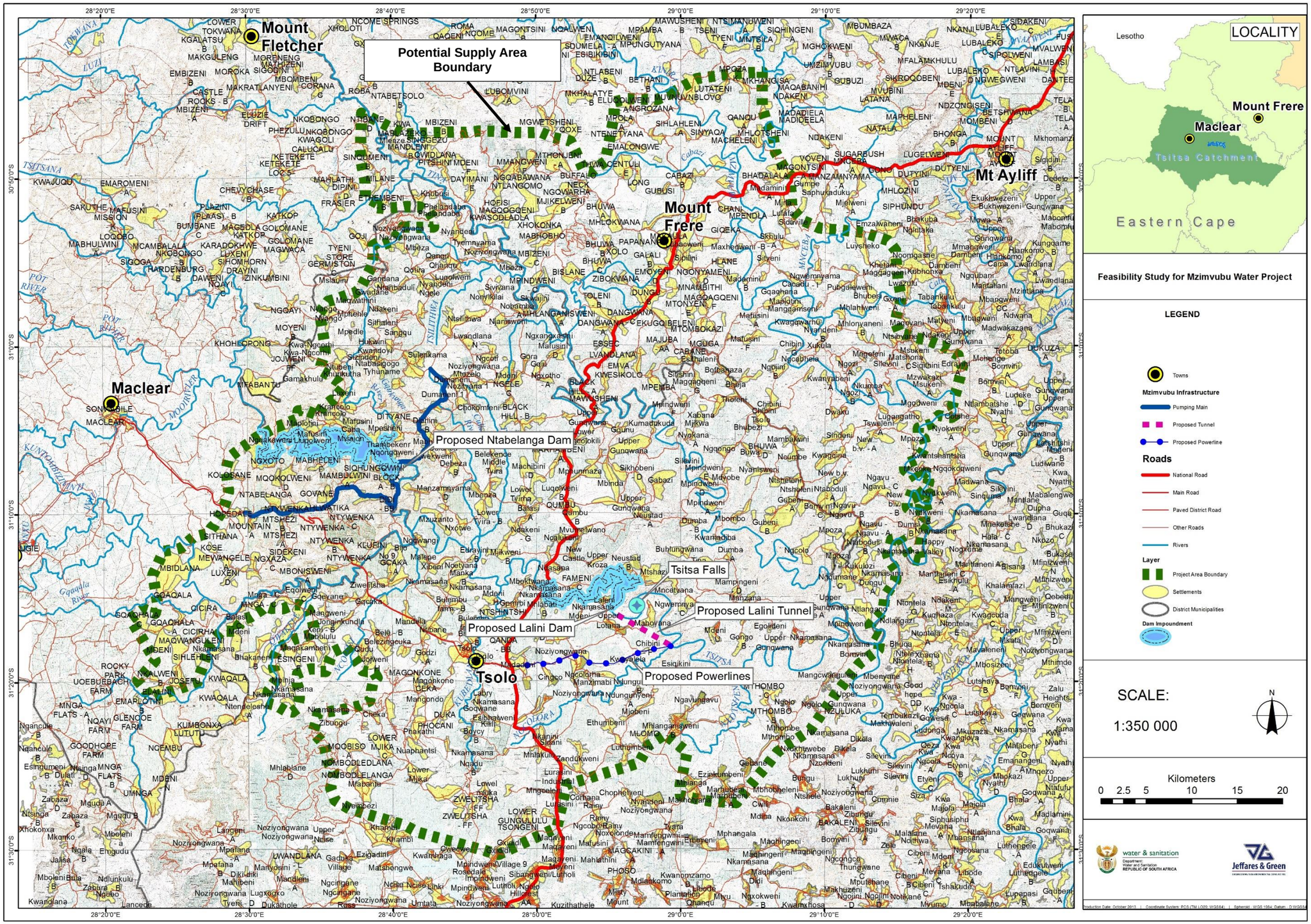


Figure 2-2: Extended Domestic Water Supply Area Boundary

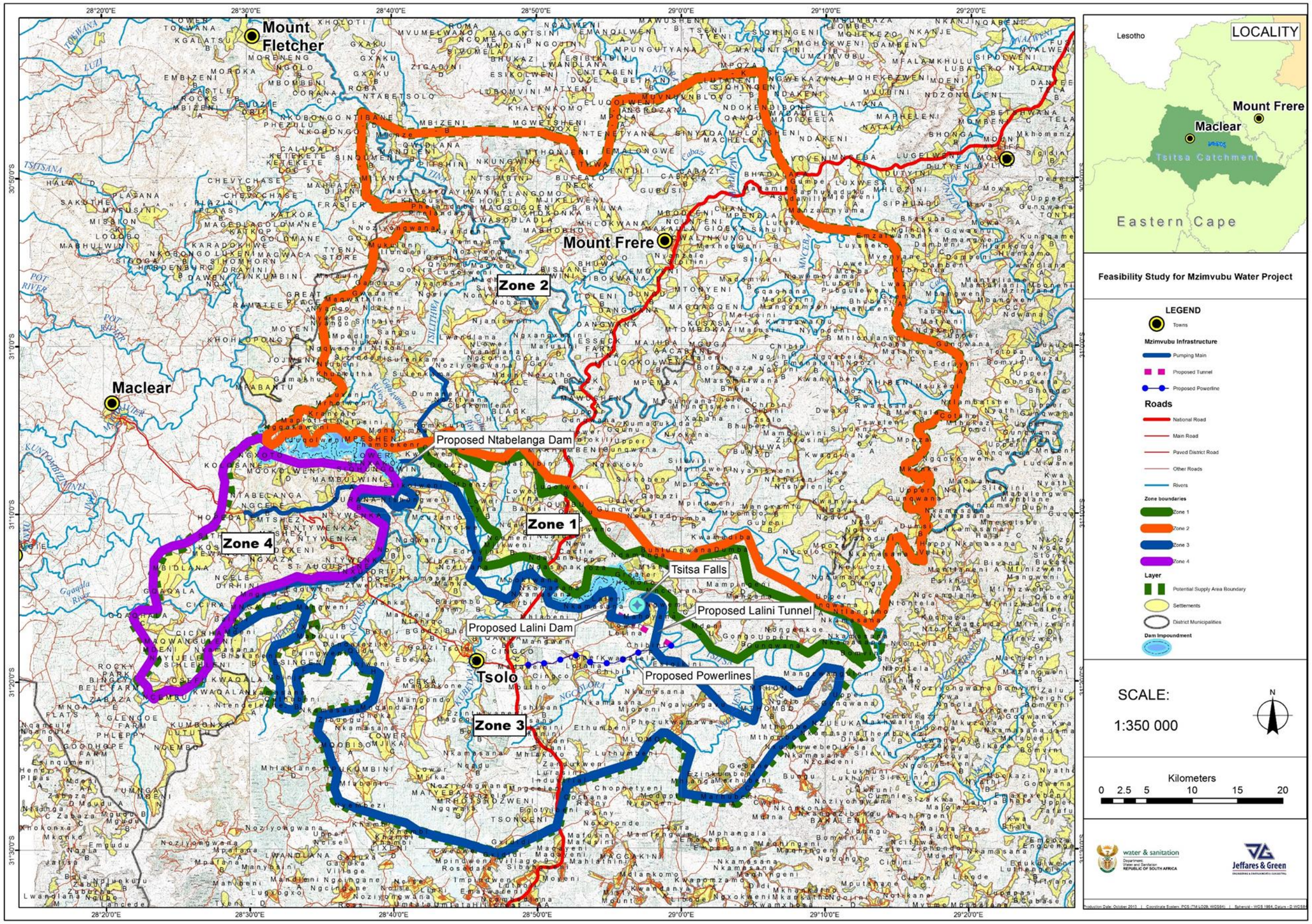


Figure 2-3: Supply Zones for Infrastructure Planning

The projected population to be supplied by the water supply schemes emanating from the construction of the Ntabelanga Dam is depicted in the Table 2-1.

Table 2-1: Population Served by Zone

	Population				
	2013	**2020**	**2030**	**2040**	**2050**
Zone 1	39 404	42 247	46 667	51 549	56 942
Zone 2	288 234	309 026	341 357	377 071	416 521
Zone 3	147 195	157 813	174 324	192 562	212 708
Zone 4	27 988	30 007	33 147	36 615	40 445
Total	**502 822**	**539 094**	**595 495**	**657 797**	**726 616**

2.4 Water Requirement Design Criteria

The design criteria used for the development of the scheme are:

- Domestic water requirement - rural - 60 litres/capita/day (ℓ/c/d)
- Domestic water requirement – urban - 125 ℓ/c/d
- Allowance for transmission losses - 10%
- Allowance for water treatment works losses - 5%
- Summer peak factor for bulk Demand - 1.2 x Annual Average Daily
- Bulk water transfer pipelines peak factor - 1.2 (20 hours pumping per day)
- Population growth rate - 1% per annum

The summer peak factor and bulk water requirement peak factors are standards per the DWS's "Technical Guidelines for the Development of Water and Sanitation Infrastructure" and the "Guidelines for Development of Human Settlements Planning and Design" prepared by the Department of Housing. The summer peak factor is described as a factor to cater for higher water use in the summer period.

This recommended factor of 1.2 is applied to the design of the water treatment works, primary pumping system and reservoirs, while the bulk peak factor of 1.2 is a recommended factor to cater for the inflow into bulk storage as well as gravity flow between one command reservoir to another command reservoir.

This bulk peak factor is applied to the design of the bulk pipelines, but does not change the overall average annual water requirement on source. On pumping mains this can also be achieved by delivering a day's requirement in 20 hours of pumping. This allows adequate spare capacity in the pumping system in order to recover quickly from interruption or failure of the system operation, as well as being able to avoid pumping during the hours when peak energy tariffs apply. The local daily peaks encountered in the reticulation system at settlement level are catered for in local bulk reservoirs which are designed for 48 hours storage, feeding into elevated tanks which themselves balance out hourly peak requirements.

These particular criteria are more relevant to the bulk infrastructure planning as is described in Report No. P WMA 12/T30/00/5212/13, but are included herein as a water requirement criteria guideline.

The choice of unit water requirement and losses are based upon the "Guidelines for Development of Human Settlements Planning and Design" prepared by the Department of Housing. Typically a lower unit requirement is allocated to rural requirements while the urban requirements are of the order of a range between 80 ℓ/c/d and 250 ℓ/c/d depending on the classification of the water use area.

The unit water requirement for rural users of 60 ℓ/c/d is a typical value assigned to rural users in the DWS Guidelines for Water Services Provision. This is an average requirement and caters for the use of water for a yard connection type of water supply system. From experience with past rural schemes, the actual water consumption in these areas ranges from 5 to 25 ℓ/c/d due to the use of water for purely consumption purposes with no use for waterborne sanitation. However, the planning of this project is based upon the assumption that no one should be limited to only basic levels of water supply, and it is expected that standards of living conditions in the region will be increased and that water supply quantity should not be a limitation to such development objectives.

The unit water requirement for urban users are of the order of a range between 80 ℓ/c/d and 250 ℓ/c/d depending on the classification of the water use area as per the Guideline for Development of Human Settlements. In consideration of this being an average requirement, and the nature of the area, the use of 125 ℓ/c/d is deemed to be an appropriate estimate, which was in line with the planning criteria being used by the DMs.

These design criteria are average consumption figures per capita. This allows for cases where larger properties might be built in rural areas, where the water requirement would be that of an urban development. The higher consumption of such properties would be balanced by other rural consumers using less than 60 ℓ/c/d.

Similarly in urban areas, there will be other water requirement such as commercial and institutional organisations that will use more than 125 ℓ/c/d, but again this is balanced by those properties that use less than this figure.

2.5 Domestic Water Demand Projections

A list of all settlements included in the area to be supplied with potable water by the Ntabelanga Dam and its bulk water infrastructure, and population growth projections for these settlements are given in Appendix A. This details the name of each settlement to be supplied, the census category as regards rural and urban settlement type, the location of each settlement as regards the District and Local Municipalities and Water Supply Authority, and the population growth projection from current figures through to the planning horizon year 2050.

The domestic water requirements for the project area are based on the average unit consumptions for these different settlement classifications, using the above per capita and losses allowance criteria. From the GIS database that has been developed for the project, all settlements within the study area have been classified as being either rural or urban in demand type. Applying the design factors to the population projections results in the water requirement for the study area being determined as shown in the Table 2-2.

Table 2-2: Domestic Water Requirement Projections

Projection Year:>	2013	2020	2030	2040	2050
Average daily requirements (m^3/d)	58 541	62 764	69 330	76 583	84 596
Peak daily requirement (m^3/d)	70 248	75 316	83 196	91 900	101 515
Average annual requirements (million m^3/a)	**21.6**	**22.9**	**25.3**	**28.0**	**30.9**

From the above table the average daily water requirements for domestic purposes is expected to range from **22.9 million m³/a** to **30.9 million m³/a**.

Together with an allowance for water treatment works losses, the annual average daily demand figure of **32.4 million m³/a** for 2050 has been applied to the dam yield modelling to determine dam size, with allowances made for EWR purposes.

The peak daily demand figure for 2050 has been used to determine the ultimate sizing of the WTW itself, as well as the treated water pumping plant at these works. These works will be designed in a modular arrangement so that the works can be implemented in stages to match actual demand growth, if the considerations described above are adopted.

The peak daily requirement figure has been used in sizing raw water transfer systems from the dam to the water treatment works (WTW), the ultimate sizing of the WTW itself, as well as the treated water pumping plant at these works.

2.6 Domestic Water Requirements Summary

The Ntabelanga Dam and its bulk water distribution infrastructure must be able to supply the following:

- All existing communities shown on the figures above comprising a total of 502 822 people in 102 723 households; and
- Population growth projections to year 2050 have been undertaken, bringing the total population supplied to 726 616 in 148 443 households.

These populations supplied are distributed between the District Municipalities, as shown in Table 2-3.

Table 2-3: Population and Households Supplied

Population					
	2013	**2020**	**2030**	**2040**	**2050**
Alfred Nzo DM	165 735	177 691	196 281	216 816	239 500
Joe Gqabi DM	33 513	35 931	39 690	43 842	48 429
OR Tambo DM	303 574	325 472	359 524	397 138	438 687
Totals	**502 822**	**539 094**	**595 495**	**657 797**	**726 616**
Households					
	2013	**2020**	**2030**	**2040**	**2050**
Alfred Nzo DM	33 859	36 301	40 099	44 294	48 928
Joe Gqabi DM	6 847	7 340	8 108	8 957	9 894
OR Tambo DM	62 018	66 492	73 448	81 133	89 621
Totals	**102 723**	**110 133**	**121 656**	**134 383**	**148 443**

The breakdown of water volumes to be supplied to the three DMs, and growth to 2050, is as shown in Table 2-4.

Table 2-4: Potable Water Requirements by District Municipality

Projected Average Demands (m^3/d)				
	2020	**2030**	**2040**	**2050**
Alfred Nzo DM	20 687	22 852	25 243	27 884
Joe Gqabi DM	4 183	4 621	5 104	5 638
OR Tambo DM	37 893	41 857	46 236	51 074
Total	**62 764**	**69 330**	**76 583**	**84 596**

Figure 2-4 summarises the growth projection of domestic water requirements, including allowances for conveyance losses.

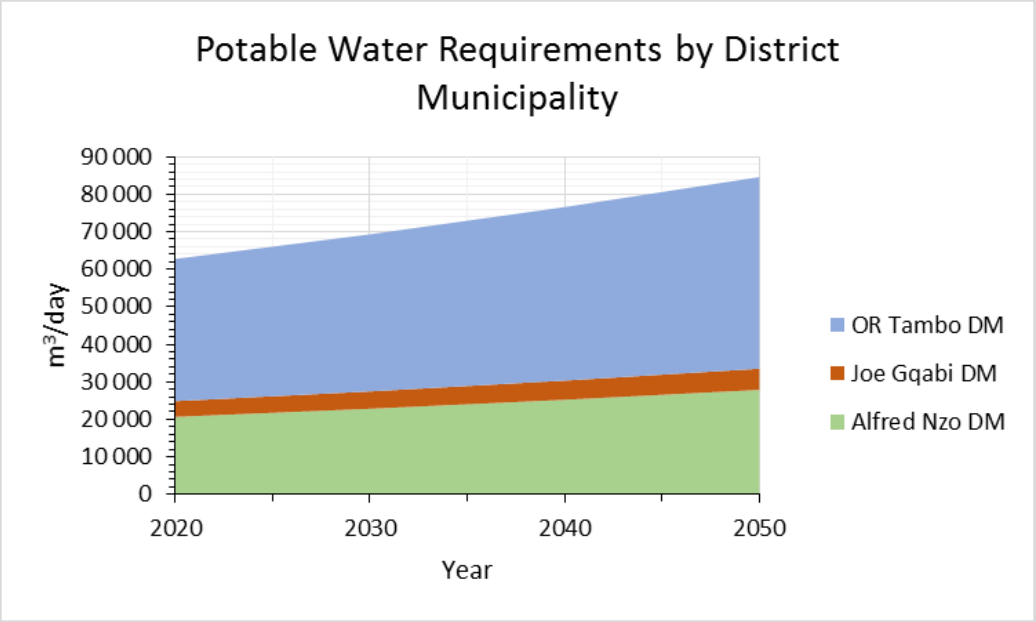


Figure 2-4: Potable Water Requirements by District Municipality

Figure 2-5 summarises the growth projection of raw water requirement on the Ntabelanga Dam to meet domestic water requirements, including allowances for conveyance and treatment losses.

This assumes a fully developed treated water delivery distribution network by the year 2020. If, as is likely, the actual water consumption uptake is slower than projected, and/or the implementation of the tertiary water distribution system is undertaken in stages and over a longer period, then certain works (eg WTW, installed pumping plant, and bulk water storage facilities) could be developed in phases to defer capital expenditure accordingly.

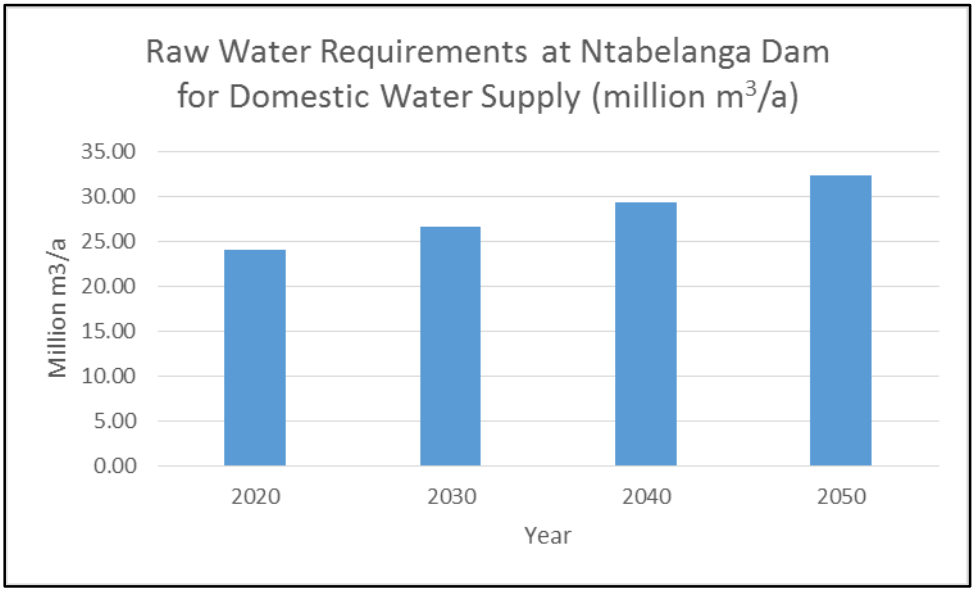


Figure 2-5: Raw Water Requirements: Domestic Supply

2.7 Bulk Water Distribution Infrastructure Zoning

As shown on Figure 2-3, the bulk water distribution infrastructure has been developed in four supply zones.

Table 2-5 summarises the water demand growth projection split into these four zones.

Table 2-5: Water Demand Growth Projection in the Four Supply Zones

Projected Average Demands by Zone (m^3/d)				
	2020	**2030**	**2040**	**2050**
Zone 1	4 789	5 290	5 843	6 455
Zone 2	36 845	40 700	44 958	49 661
Zone 3	17 004	18 783	20 748	22 919
Zone 4	4 126	4 558	5 035	5 561
Total	**62 764**	**69 330**	**76 583**	**84 596**

3. WATER TREATMENT WORKS

3.1 Overview

It is proposed that the scheme would be serviced by a single WTW located at the Ntabelanga Dam site.

This works would be supplied with raw water by a gravity pipeline from the dam outlet works to the WTW inlet works. Water would drawn off from the dam at different levels based upon the monitored limnological conditions, in order to obtain the best quality water given the seasonal and depth variations that occur in normal dam operation.

The normally preferred condition is to draw off water from as near to the dam surface as possible without experiencing vortexing problems at the drawoff point. As described in the Feasibility Design: Ntabelanga Dam Report No. P WMA 12/T30/00/5212/12, the outlet works would be set up with at least seven different drawoff levels, so that a preferred level of abstraction could be selected for the full operating range of dam water levels.

It is recommended that reservoir stratification modelling be undertaken during the detailed design stage so that, in conjunction with reserve determination specialists, a set of operating rules can be established for EWR and optimum drawoff elevation can be established.

3.2 Processes

Based upon the nature and land use of the catchment upstream of the dam, the water treatment processes required to comply with SANS 241:2006 would typically include processes to deal with the following:

- Possibly iron
- Possibly manganese
- Possible nitrates and phosphates
- Turbidity
- Suspended solids
- Microbiological components

Thereafter the treated water would be disinfected.

The catchment area is known to have some of the highest sediment loadings in southern Africa given the soil types, steep topography, eroded nature of the terrain, and the overgrazed, thinly layered soils, contributing a high percentage thereof.

These rivers have been the subject of some recent studies by WRC and Rhodes University, and do exhibit very high sediment loads and turbidity levels. The dam itself would act as a significant sediment trap and settlement basin resulting in a very significant reduction in the suspended solids and turbidity of water entering the water treatment works.

This emphasises the importance of undertaking a concerted catchment restoration and management programme above the dam, both before construction and continuing into the future.

It is expected that, after debris screening and grit removal, conventional settlement processes would be sufficient to deal with the sediment load and turbidity. Selection of the best coagulant would be undertaken after appropriate laboratory testing of water samples.

Removal of iron and manganese (if found to be present) is normally achieve through aeration, but other chemical treatment processes could also be considered.

An aeration cascade is allowed for, to improve taste by introducing oxygen from the atmosphere into the water. In addition this would assist (if required) in the oxidation of iron and manganese, and would also provide for flash mixing the addition of chemicals.

The final choice of coagulant to be used at the WTW would be developed during the final design of the works, (typically procured via a Design and Construct Contract), which process would need to be acceptable to the eventual scheme operator. For feasibility design purposes it has been assumed that aluminium sulphate would be used as the coagulant, in conjunction with a polymer.

The coagulant dose is estimated to be between 5 mg/litre and 50 mg/litre and the polymer dose is expected to be 5 mg/litre. The optimum coagulant dose would need to be confirmed by jar tests undertaken on samples taken during the various seasons (raw water in the rainy season, for example, would have elevated suspended solids and turbidity levels).

The coagulation technique would make use of a serpentine channel arrangement to bring particles into contact with each other and provide low intensity mixing. This would be followed by a clarification system using upflow clarifiers with settled sludge concentrators. An alternative to this would be circular clarifiers with scrapers, but this would depend on the proprietary systems offered by bidders.

Identical modular banks of flocculator/clarifiers operating in parallel should be allowed for, with each bank sized to be a proportion of the total ultimate design flow (2050 peak). Therefore it would be possible to develop the works in stages if deemed to be appropriate.

The size of the clarifiers would be such that they would have an upflow rate of between 1.5 and 1.9 m/hr, depending on the results of water quality and jar testing.

Clarified water would be collected in a peripheral launder (channel) and would flow under gravity to the filtration system. Sludge would be withdrawn from the sludge collection system and fed into a holding tank before being discharged to the backwash recovery tanks along with filter backwash water. Other types of clarifier design might be suitable, but this would depend on the water quality as well as on the proprietary processes that would be proposed by specialist bidders during the design and build tendering process.

After settlement, filtration would typically be via rapid gravity filters with a backwash system. If taste and odour problems are identified through water quality sampling, then this process might also need to be supplemented by using carbon treatment – either Granular Activated Carbon (GAC) or Powder Activated Carbon (PAC). The filters could be developed in a modular pattern to allow for staged development. Cognisance would need to be taken of the number of filters to be backwashed per day and allowance made for the WTW output to be maintained even when these filter beds have been off-line for backwashing. The areas of these filter beds are based on gravity flow rates of between 8 and 12 m/hr.

Sludge produced from the settlement and filtration processes would be stored in sludge settlement tanks and drying beds which would periodically need to be dewatered and de-sludged, in an environmentally acceptable manner.

As an example, South African regulations limit the suspended solids concentration in discharges to the watercourse to a maximum of 25mgTSS/litre. Sludge withdrawn from the clarifiers is expected to be in excess of 5 000mgTSS/litre and could not be legally discharged into the watercourse.

It is, therefore, proposed that all the residuals produced by the works be dried and disposed of off-site. Drying beds have been allowed for dewatering the residuals generated by the plant as the technology is considered appropriate for the plant location. The volume of residuals would be reduced by the incorporation of backwash recovery tanks into the process train.

Disinfection would likely be through a gaseous chlorination process unless the water quality dictates that specific alternative processes might be needed (eg Ozone). However, this latter option is unlikely to be needed.

Whilst the DWS requirements for minimum contact time is 6% of a day, or 1.5 hours, it is proposed that a total contact tank volume equivalent to 3 hours contact time be provided, with the contact tank split into two compartments so that the minimum contact time of 1.5 hrs could still be achieved with one tank off-line for servicing. This would also provide some flexibility of operation by providing more balancing capacity for the plant through-flow rate, and for the treated water pumps.

It is also recommended that the treated water pumping station is integrated into, or close to, the contact tank at the WTW, at an elevation such that the suction of these pumps are continuously drowned.

The detailed design process for the WTW would require as much water quality information as possible. It is recommended that, in addition to a search for water quality information previously accumulated through existing monitoring or various studies undertaken in the region, a continuous water quality sampling programme be commenced, which should take samples at Ntabelanga Dam site at monthly intervals, and be tested for a range of parameters required to inform the water treatment process optimisation. This should commence as soon as possible so that seasonal changes in water quality can be evaluated.

Typical parameters that should be tested include:

- Conductivity
- Turbidity
- pH
- Alkalinity
- Calcium
- Total Hardness
- Ammonia
- Sulphate
- Iron
- Manganese
- Flouride
- Suspended solids
- Phosphates
- Nitrates

3.3 Hydraulics and Capacity

The net output capacity of the works being 84 596 m^3/day average and 101 515 m^3/day peak daily has been determined for the 2050 water demand from the bulk water delivery infrastructure inclusive of allowances for transmission losses, as well as losses within the process stream including backwash.

The WTW would be located close to the river downstream of the dam wall as shown on the layouts in Figure 3-1. The footprint of the works would be located close to the right hand bank of the river but outside the flood line of the river under SEF conditions.

The water treatment works structures would be orientated and located on sloping ground such that the hydraulic flow path from the WTW inlet works, through the settlement tanks, filters, and to the contact tank could be by gravity, as shown in Figure 3-3.

Backwash of the filters would require pumping, and might also include air scour. Treated water would be drawn from the contact tank and pumped into the bulk water infrastructure by the treatment works pumping station.

3.4 Chemical Dosing at the WTW

The chemical dosing requirements would likely include the following systems:

- Pre- and post-chlorination
- Hydrated lime
- Coagulation (aluminium sulphate)
- Flocculation (polymer)

Chemical tanks would need to be installed in bunded areas to contain spills. The chlorination plant would need to be designed to ensure a safe operating environment. All systems would have duty/standby units.

3.5 Post-Chlorination

Given the long transmission distances and retention times of potable water in the bulk water distribution system, provision would need to be made for post-chlorination at strategic bulk water storage reservoirs, in order to maintain sufficient residual chlorine levels in the system and through to the consumer.

3.6 WTW Layouts

Schematics showing a WTW general arrangement, and the hydraulic flow stream through the works are given in Figures 3-2 and 3-3 below.

The ground levels shown in Figure 3-3 are those at the proposed location of the WTW at Ntabelanga Dam.

The 898 m.a.s.l elevation at the WTW inlet works is such that raw water from the Ntabelanga Dam outlet works could be transferred under gravity flow, even at the lowest operating level of the dam.

Space has been allocated for sludge dewatering lagoons, and all works would be located above the river flood line, even under SEF conditions.

The clear water pumping station building containing treated water pumping stations PS1 and PS3 would be located so that the pumps would always operate under drowned suction conditions, from the WTW clear water contact tank.

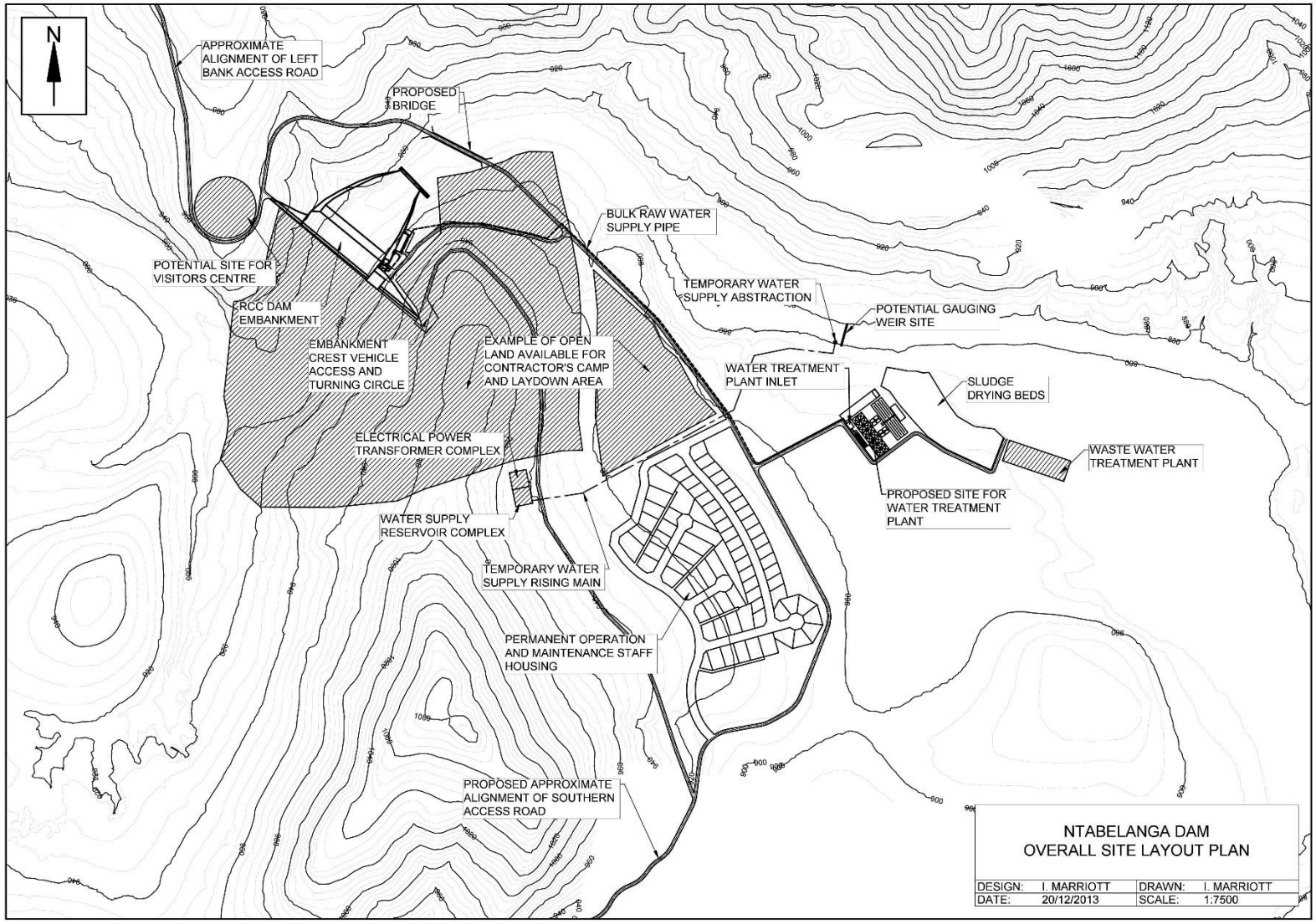


Figure 3-1: Site Layout Plan

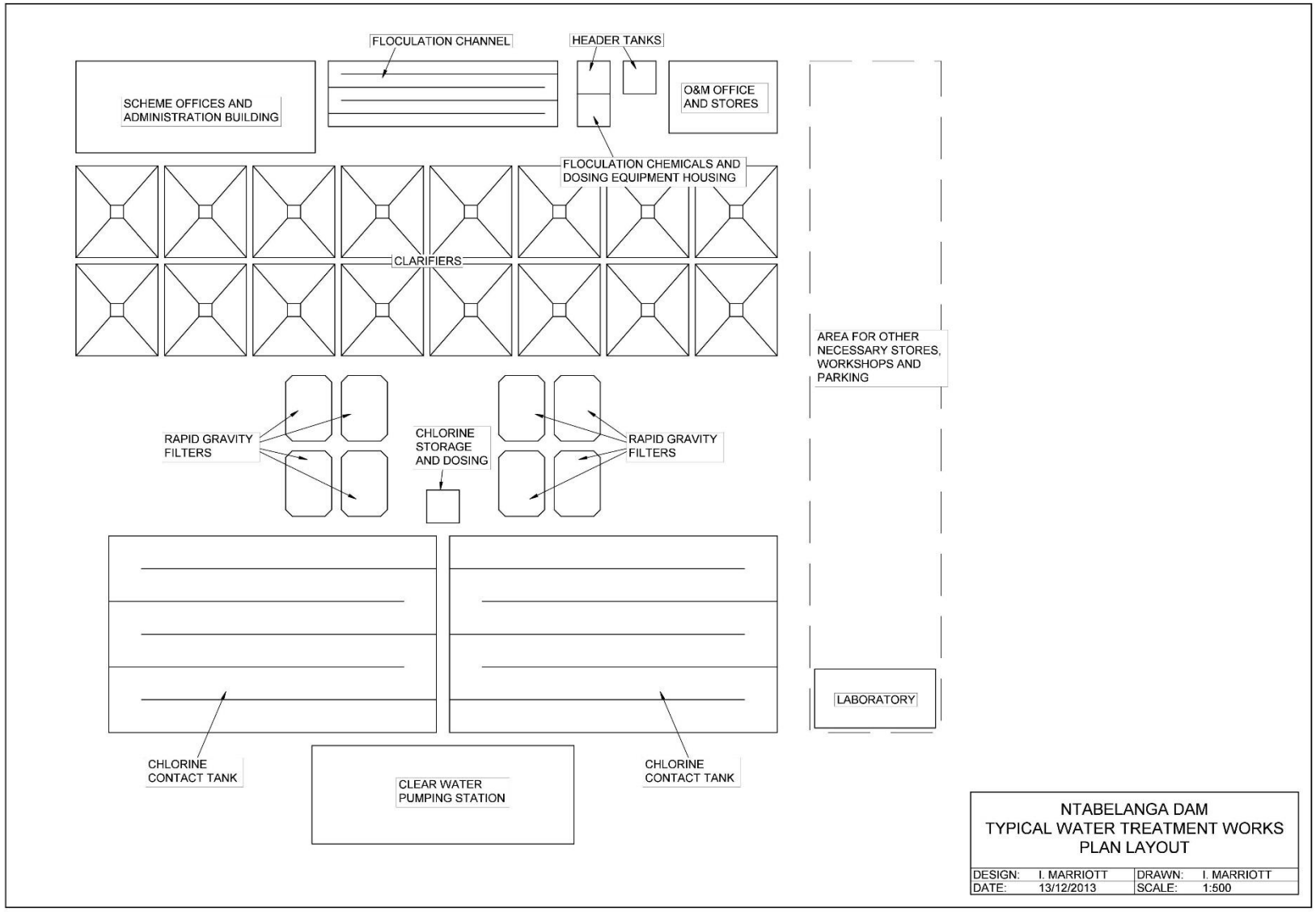


Figure 3-2: Typical Arrangement of the Water Treatment Works

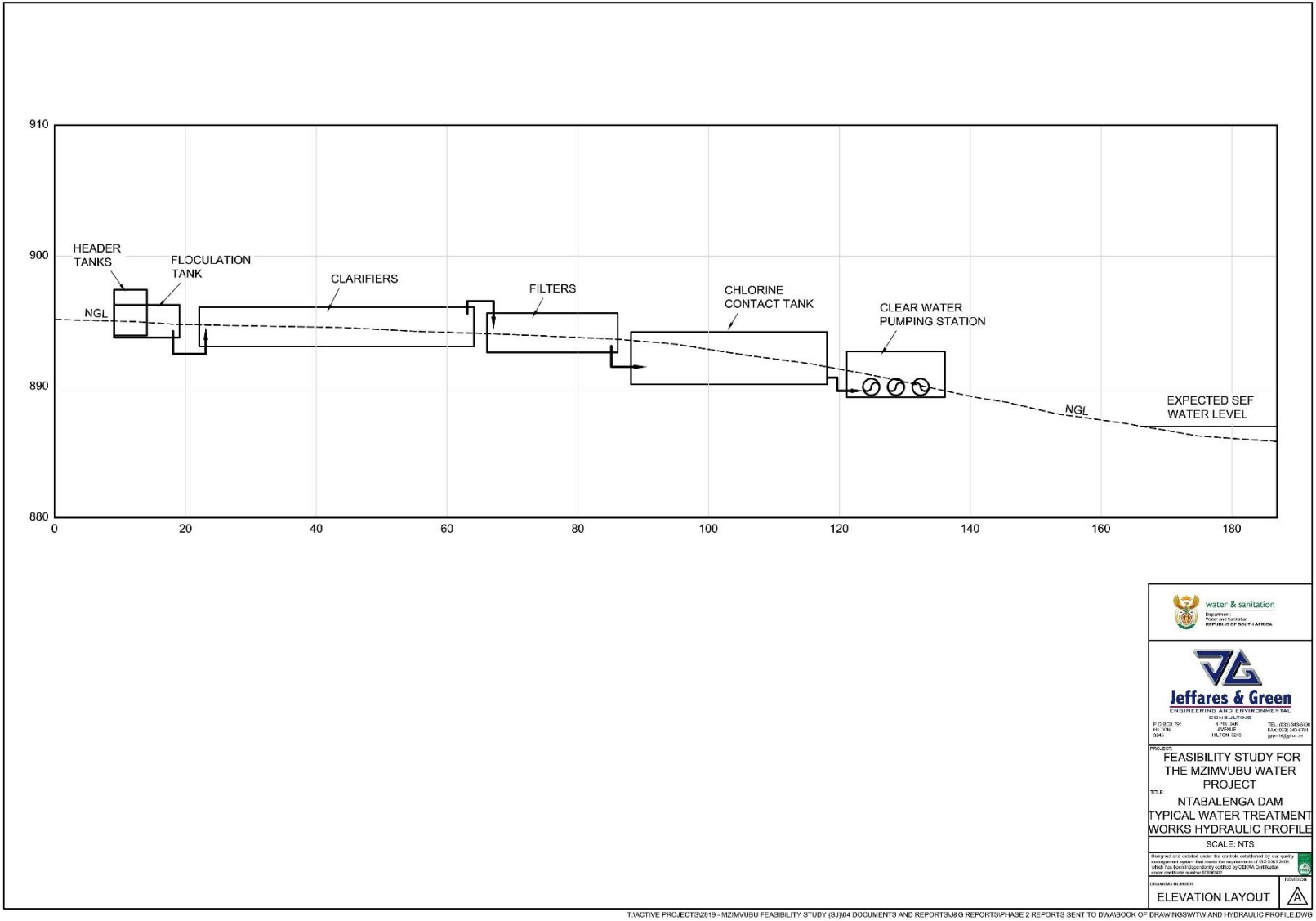


Figure 3-3: Hydraulic Profile through WTW

4. DOMESTIC BULK WATER DISTRIBUTION SYSTEM PLANNING APPROACH

4.1 Matching Solutions to Meet Specific Challenges

The area to be supplied extends over 3 000 km^2, and features a mixture of river valley and floodplain, together with very steep, rugged, eroded and rocky terrain, with elevations ranging from 200 m.a.s.l. at the confluence of the Tsitsa River with the main Mzimvubu River, to 1 475 m.a.s.l., along the crests of the Tsitsa valley watershed. This can be compared with the Full Supply Level of the proposed Ntabelanga Dam of 947.3 m.a.s.l.

Apart from two main national roads, the rest of the area has somewhat basic access, with travel routes comprising a network of formal and informal gravel roads and tracks, footpaths, and bridle paths.

This rugged terrain, the access difficulties, and the very scattered pattern of settlements, makes it relatively difficult and expensive to implement, construct, operate and maintain water supplies of any type.

In planning the proposed scheme, cognisance has been taken of these particular conditions that will be encountered, as well as trying to incorporate as much labour-intensive construction as possible.

4.2 Existing Water Supplies

As discussed in section 2, in the feasibility level planning of these new systems, cognisance has been taken of the existing infrastructure in place, although the detailed integration of existing and new infrastructure will need to be optimised during the detailed design stage.

Figure 2-1 presented in section 2 shows the existing schemes that have been identified in blue. These are a mixture of small tributary river abstraction schemes, as well as spring and groundwater sources, with local reticulations.

The DMs have commented on typical operational problems including difficult access when undertaking operation and maintenance, lack of power in some areas, unreliable river flows at abstraction points, high sediment content, unreliable springs in dry seasons, limited or declining yields from boreholes, borehole collapse and pump failures, water quality and treatment problems, high maintenance and pump replacement requirements, etc.

These are the main reasons why their planners have opted to develop the proposed system as a regional water supply with its benefits of scale, relatively low numbers of pumping installations, and very reliable source and water treatment works.

Where possible, the existing infrastructure will be integrated within the new infrastructure, which includes the integration of the larger existing bulk reservoirs as secondary command reservoirs.

However, each DM would still have the choice of continuing to use existing schemes and sources, or of developing other local water supply solutions in such cases, if these are considered to better local solutions. In such a case, the lesser utilization of the proposed bulk water scheme would extend the proposed system's design horizon date.

4.3 Pipeline Materials

The choice of materials for pipelines takes cognisance of the prevailing conditions, and targets the usage of as much labour-intensive construction as possible. The approach with the smaller diameter pipelines is therefore based, for example, on using HDPE pipe for pipelines of 63 mm and 50 mm diameter

This means that the pipeline materials which will be predominantly used at the tertiary sections of the parts of the system closer to the settlements can be carried or carted along paths and tracks in rolls containing long lengths to speed up construction. Larger diameters are heavier and more difficult to handle.

Pipelines ranging from 75 mm to 350 mm diameter would be uPVC pipes, unless these are required to be built above ground, are high pressure (greater than 16 bar), or are pumping mains. This range of pipe sizes are also more feasible than for other materials types in terms of material costs, handling and jointing etc.

Pipelines larger than 350 mm diameter or which have greater than 16 bar pressure are designed as steel pipelines. This is due to the high pressures that will be encountered on account of the terrain elevation differences, limitations in availability of PVC and HDPE pipes and pressure classes in this range, the resilience of steel pipe when required to be built above ground on plinths, and the suitability of steel pipe for pumping mains.

GRP systems are not recommended given the terrain, and laying conditions anticipated.

HDPE and PVC pipeline materials lend themselves to the use of labour intensive construction methods. This will contribute to the Expanded Public Works Programme initiative to promote local employment generation and boost the local economy.

4.4 Reservoirs

The reservoirs proposed for the system range from very small to large capacity. Pressed steel tanks are recommended for use where the required storage is up to 500 m^3 capacity.

Larger tanks above 500 m^3 and up to 2 000 m^3 capacity can be of the Galaxy Tank or similar type of system which use formed zinc sheets structurally set up with internal storage liners.

These modular systems are very easy to construct in difficult terrain and reduce the construction period and associated costs significantly when compared with conventional reinforced concrete structures.

Larger (> 2000 m^3) capacity tanks will be conventional reinforced concrete type structures.

Figure 4-1 shows a pressed steel tank constructed for a small community water supply scheme. This type of structure is easy to construct for the small volume requirements at village level. Pressed steel plates are assembled and bolted together with rubber gaskets to form a watertight structure.

The panels are supported on dwarf walls constructed of normal masonry bricks which are founded on 15 MPa concrete strip footings. The construction method lends itself to be a labour intensive activity thereby making it more attractive to promote local labour engagement on the projects.

These tanks have been used previously in mountainous terrain with difficult access where materials have been carried by hand or on the back of horses or donkeys.

Where appropriate, these tanks can also be constructed as elevated tanks on stands.

Figure 4-1: Typical Pressed Steel Tank as Reservoir

Figure 4-2 shows a typical example of a "Galaxy" reservoir installation used on a water supply project. This is a zinc sheet structure with structural steel support frames placed on a reinforced concrete ring beam. The actual water retaining material is a polymeric liner contained within the steel tank. The reinforced concrete ring beam is typically 600 mm wide x 350 mm deep with nominal reinforcing that can easily be set out and constructed on site by local labourers. However, this is the only labour intensive part of the construction process as all of the other construction requires skilled manual labour.

Figure 4-2 : Typical "Galaxy" Reservoir

Figure 4-3 shows a reinforced concrete reservoir under construction and Figure 4-4 shows a smaller reinforced concrete reservoir. The typical layout and section through a reinforced concrete reservoir are shown in the figure below.

Depending on the location of the reservoir sites, this type of construction method will require significant foundation excavation and preparation, and the transport of concrete components such as stone, sand and cement to the construction site via access roads that may need to be created especially for the construction activities.

Figure 4-3: Concrete Reservoir under Construction

Figure 4-4: A Smaller Reinforced Concrete Reservoir

Figure 4-5 shows example details of a typical medium sized reservoir site.

Very large reservoirs require particular attention as regards founding conditions and land availability. These are generally more complex structures with more than one compartment, multiple columns, roof panels and floor panels, and with cantilever side walls. Inlet and outlet works are also of large dimensions and are normally quite complex so that multiple chambers or even several reservoirs on one site can be operated in various modes. This also normally involves complex inlet and outlet control systems. In addition, these very large reservoirs will also include post-chlorination facilities and this itself has specific requirements as regards gas storage, dosage control and safety systems. Figures 4-6 and 4-7 illustrate typical arrangements of very large storage reservoirs of capacity greater than 20 000 m^3.

It should be noted that such large sites are often developed in phases matching the water demand growth for the supply area, and the site and pipework therefore needs to be planned for such future extensions.

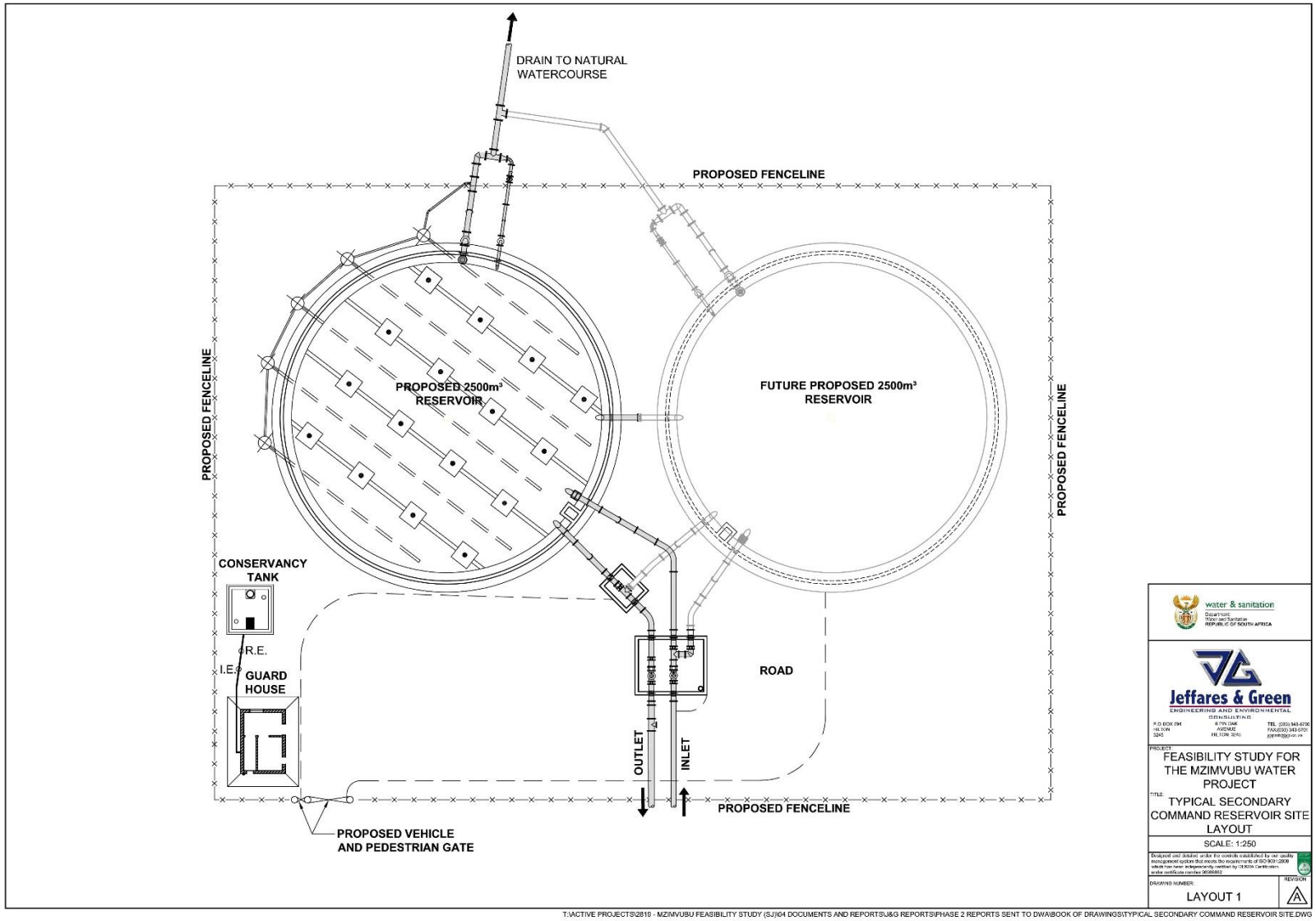


Figure 4-5: Typical Medium Sized Reservoir Site Layout

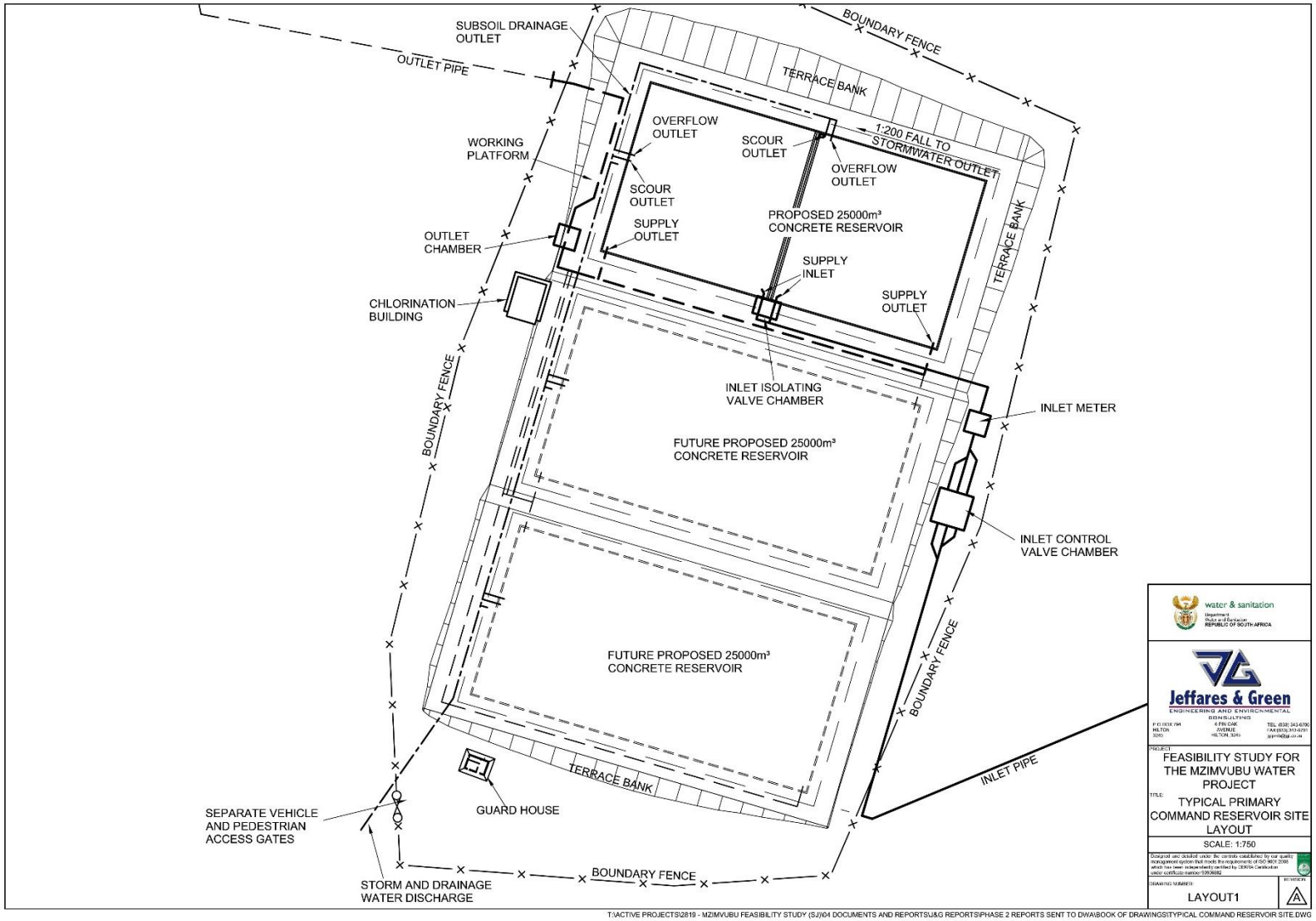


Figure 4-6: Typical Site Layout for a Very Large Command Reservoir Complex

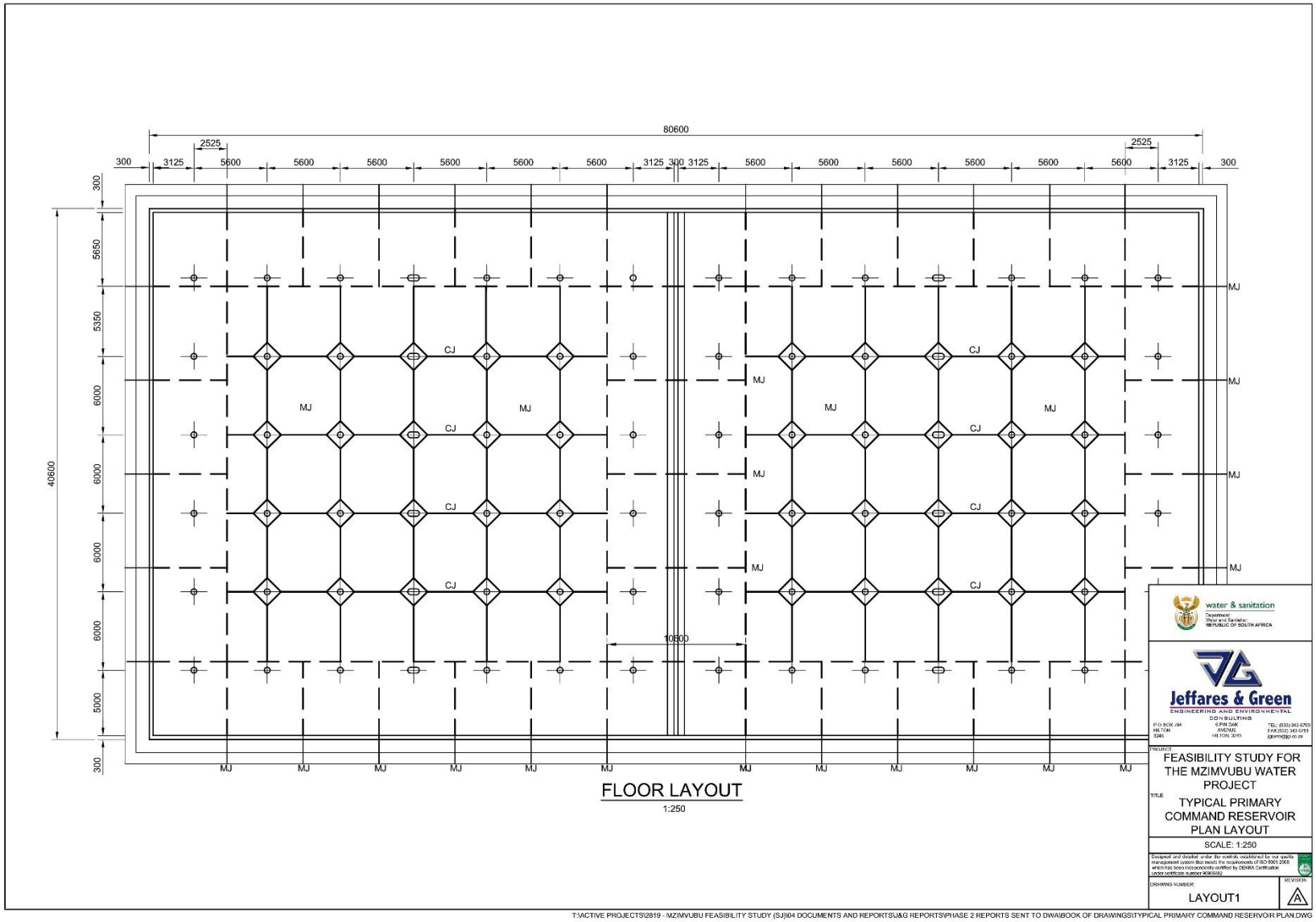


Figure 4-7: Typical Large Reservoir Construction Details

4.5 Pump Stations

Pumping stations are, where possible, designed to be modular in terms of the mechanical and electrical components. The overall structure is designed to cater for the 2050 pumping capacity requirements while the initially installed pumps and the electrical systems will be provided for an appropriate intermediate design horizon capacity (if possible) and then be upgraded in stages as required.

It is recommended that the smaller, more remote pumping station buildings are constructed with a ground level raft slab foundation, and with load-bearing brickwork supporting a reinforced concrete roof slab with the motor control centre housed within the building.

This system provides an economic solution for a secure building in the more remote parts of the area, that can be built using labour-based methods, and is adequate for the "booster" pumping stations required for the project.

The larger pumping stations at the WTW and at the primary command reservoirs, require reinforced concrete basement structures to ensure that the pump suctions are drowned, and have larger roof spans and building dimensions. In such a case the superstructure would normally be designed as a portal frame with steel side panels, ventilation, and roofing.

Typical arrangements (taken from another similar project) of pumping stations are included in Figures 4-8, 4-9 and 4-10, but the layout and design of each pumping station should be revisited again during the detailed design stage, following further site specific investigations, including a detailed topographical survey and geotechnical investigation to determine foundation conditions.

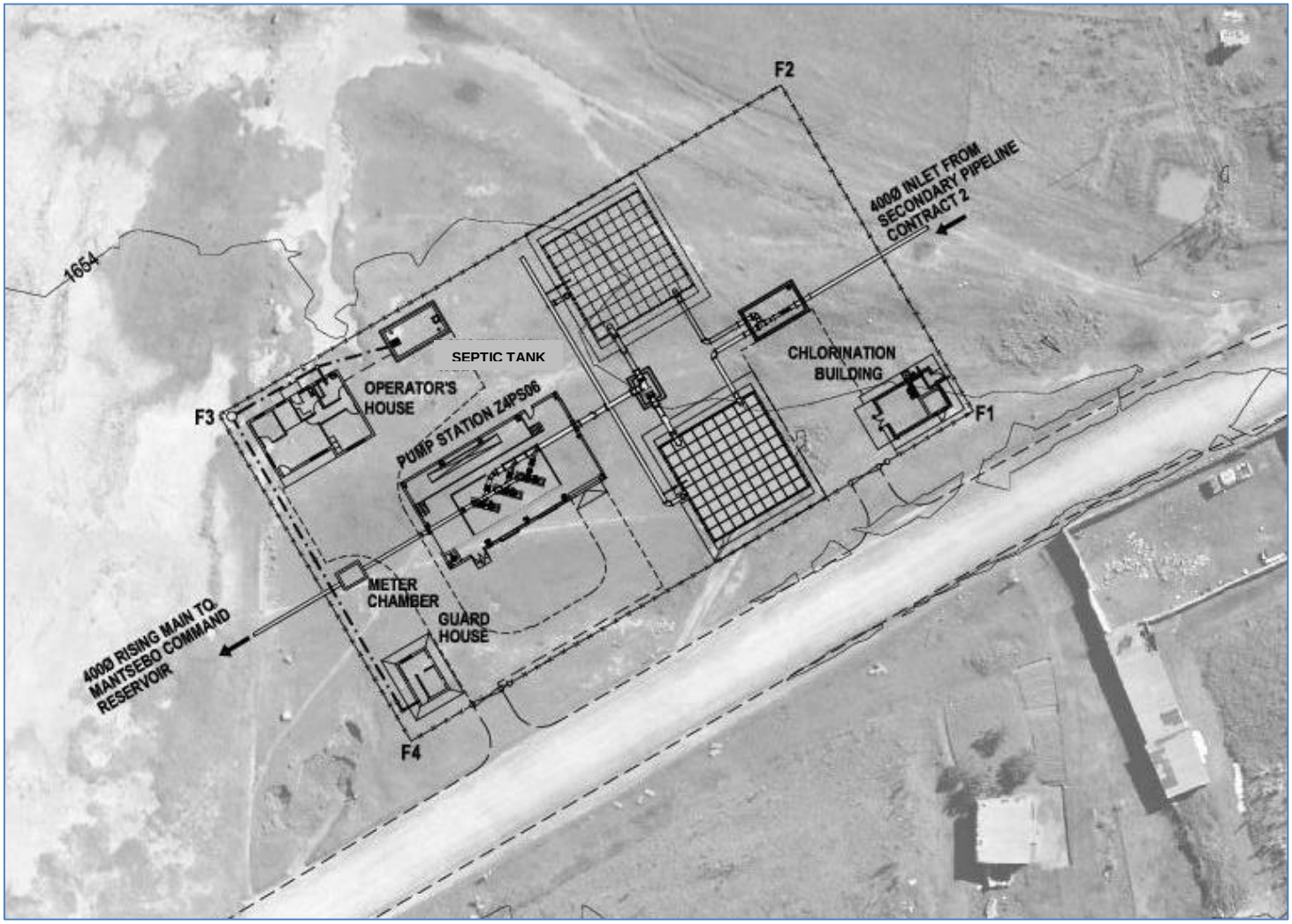


Figure 4-8: Typical Booster Pumping Station Layout. Example Shows Post-Chlorination Option

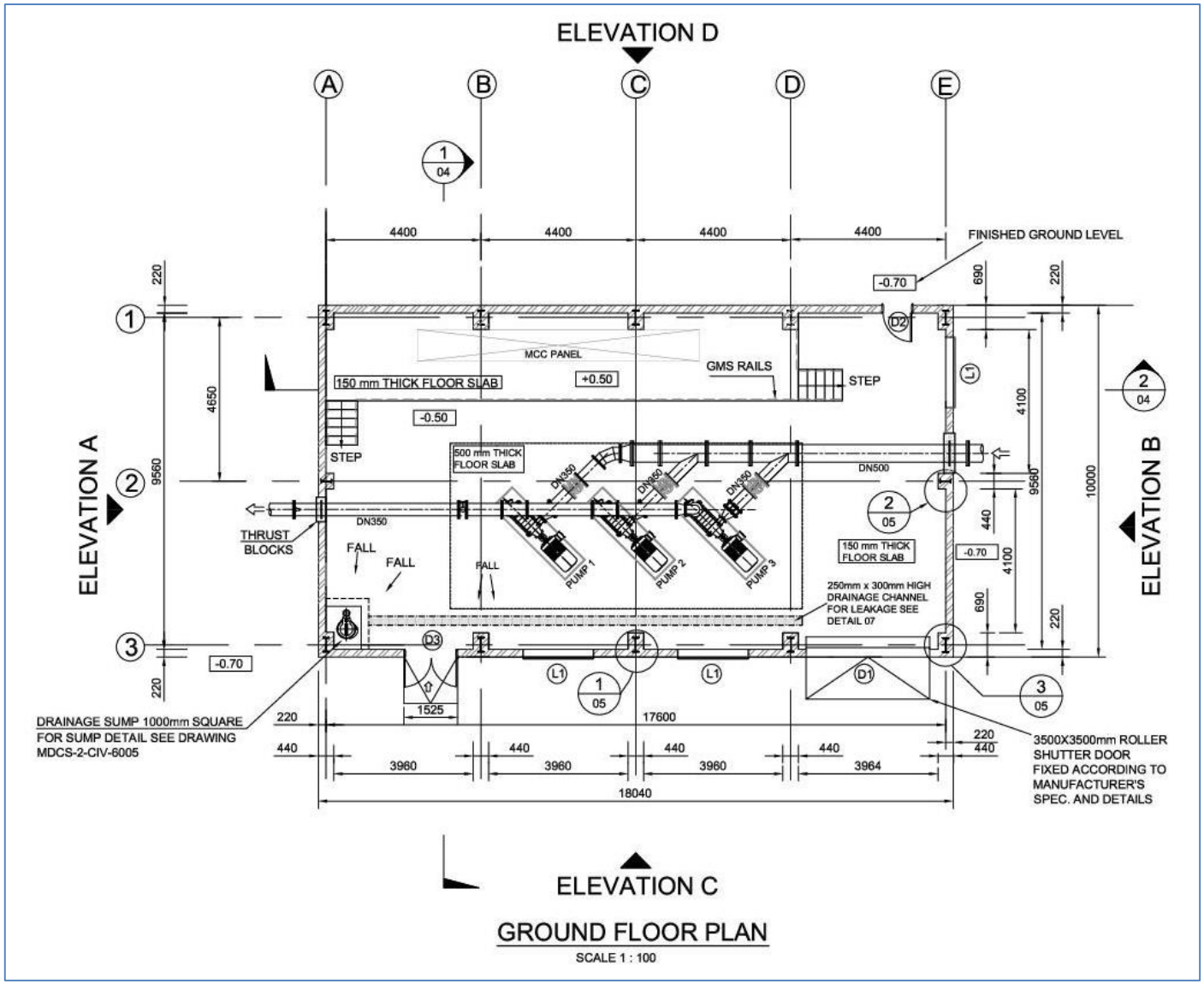


Figure 4-9: Typical Pumping Station Layout

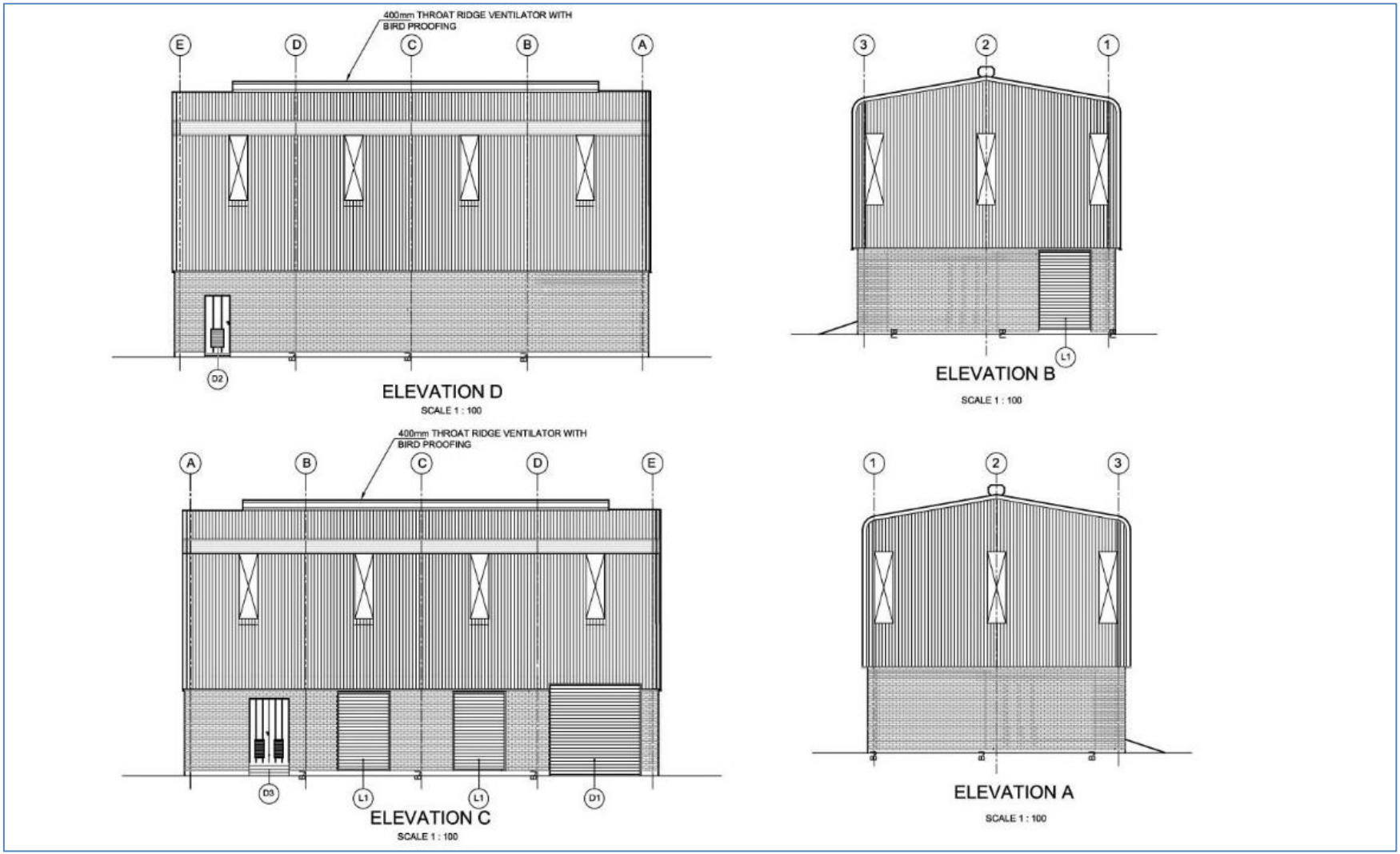


Figure 4-10: Typical Elevations of Larger Pumping Station Building

5. DOMESTIC BULK WATER DISTRIBUTION SYSTEM FEASIBILITY DESIGN

5.1 Overview of Scheme Components

The whole scheme is to be supplied by a proposed new WTW located immediately downstream of the Ntabelanga dam wall, and supplied with raw water from the dam by gravity. For details of this raw water supply arrangement, please see Dam Feasibility Design Report No. P WMA 12/T30/00/5212/12.

The proposed reservoir construction materials range from pressed steel tanks for the small sizes of capacity less than 500 m^3, modular pre-fabricated systems for the medium sized reservoirs, and conventional reinforced concrete reservoirs for the capacities greater than 2 000 m^3.

The distribution system is divided into three components, namely the Primary, Secondary and Tertiary systems.

The primary bulk water distribution system layout is illustrated diagrammatically in Figure 5-1, and its layout is shown in Figures 5-2 and 5-3. The capacity of these main components are shown on Figure 5-1, and it can be seen that the configuration has been designed to minimise the pumping of water to the higher elevations as much as possible.

From the WTW, treated water is pumped from pumping station 1 (PS1) via a rising main going north to primary command reservoir 1 which then gravity feeds the bulk water distribution system designated as Zone 1 in Figure 2-3. Example details of typical pumping stations and storage reservoirs are given in the main text of this report.

A pumping station (PS2) lifts water from primary command reservoir 1 to primary command reservoir 2 which is located at a higher elevation. From this reservoir, water is gravity fed to the bulk water supply system in the higher elevations of the Tsitsa valley watershed, as well as supplying some of the neighbouring DM settlements over the watershed and reaching almost to the southern outskirts of the town of Mount Frere. This is designated as supply Zone 2.

Similarly on the southern side of the river, potable water is pumped from pumping station PS3 at the WTW to primary command reservoir 3 from where gravity fed bulk mains transfer water to the settlements in Zone 3.

A pumping station (PS4) at primary command reservoir 3 lifts water in a westerly direction to the higher lying primary command reservoir 4, which can also deliver water by gravity in the direction of Maclear, and to settlements in the Tsitsa River valley adjacent to the flooded area of impoundment once the dam is constructed. This area is shown as Zone 4 in Figure 2-3.

The secondary bulk water distribution system consists of the main bulk pipelines fed by gravity from the above primary command reservoirs 1, 2, 3 and 4. The secondary systems transfer water in bulk to secondary command reservoirs, which form the second level of strategic storage. The layouts of the secondary bulk potable water distribution pipelines and reservoir locations are shown in Figure 5-4. In keeping with the planning being undertaken by the DMs, these secondary system command storage sites generally coincide with sites of existing reservoirs that are located at strategic high points, but that can, for the most part, be supplied with potable water by gravity from the primary system, with only a small proportion of the water supplied needing to be boosted to overcome high spots en route. This is achieved by three small booster pumping stations which only operate under peak demand periods.

Figure 5-5 shows the potential alignments of the tertiary pipelines that would be implemented by the DMs to deliver potable water from the proposed primary and secondary bulk potable water distribution systems. All of these tertiary pipelines would operate under gravity and no additional pumping would be required. The hydraulic capacity, sizing, alignments, and costing of these lines has been undertaken at a feasibility level, and it will be the responsibility of the DMs to undertake the optimisation, detailed design, and implementation of the tertiary lines and storage facilities in each settlement. This process is ongoing and the planning of the overall scheme has taken into account the DM planning and implementation of these systems that is currently underway.

5.2 Hydraulic Modelling of the Bulk Water Distribution System

The hydraulic modelling of the bulk water distribution system has been undertaken using the Dynamic Network Analysis Hydraulic Modelling module of Civil Designer software by Knowledge Base. This module simulates the whole system dynamically using the design criteria described above.

The analysis was run using the 2050 water demands, to check that the system provides the required service levels under a peak summer demand factor of 1.2.

The system was optimised from “bottom up”. Each village/settlement end node would comprise a village reservoir with 24 hrs x annual average daily demand (AADD) storage capacity, delivering a diurnal water demand profile with an hourly peak factor of 2.

Each of these village tanks would have a top inlet and inlet flow control valve, with a standard flow control characteristic to ensure that the reservoir does not overflow or run dry.

The sizes of tertiary lines feeding all of these tanks from the secondary bulk lines were optimised using iterative model runs to ensure that they are the smallest size that could still supply the tanks under peak summer flow conditions, with a minimum residual head at each tank inlet valve of 10 m.

Most of these tertiary lines would be supplied by gravity from the secondary bulk distribution pipelines, which themselves would be fed by the primary and secondary command reservoirs. The primary command reservoirs were sized at 16 hrs x AADD, and the secondary command reservoirs at 8 hrs x AADD to ensure that the total requirement of 48 hrs x AADD is provided for the system as a whole, which is the requirement given in the DWS Design Guidelines.

Similarly, the secondary bulk infrastructure pipelines that are fed by the primary command reservoirs were also sized using the same iterative modelling process to ensure that adequate residual pressures are available at the inlets of all of the secondary command reservoirs under peak summer flow conditions.

These secondary command reservoirs include existing reservoirs already supplying some schemes, and new reservoirs to be implemented under this project.

In undertaking the design process, it was noted that some sections of the bulk water distribution system would require additional pumping where gravity flow would not possible due to terrain. Therefore three booster pumping stations have been included in the system.

It should be noted that the extent of the Mzimvubu Water Project is the primary and secondary lines only. Analysis of the tertiary lines was undertaken purely to ensure that correct allowance has been made for delivery into these systems. The DM’s are responsible for the delivery of water from the secondary reservoirs to the households.

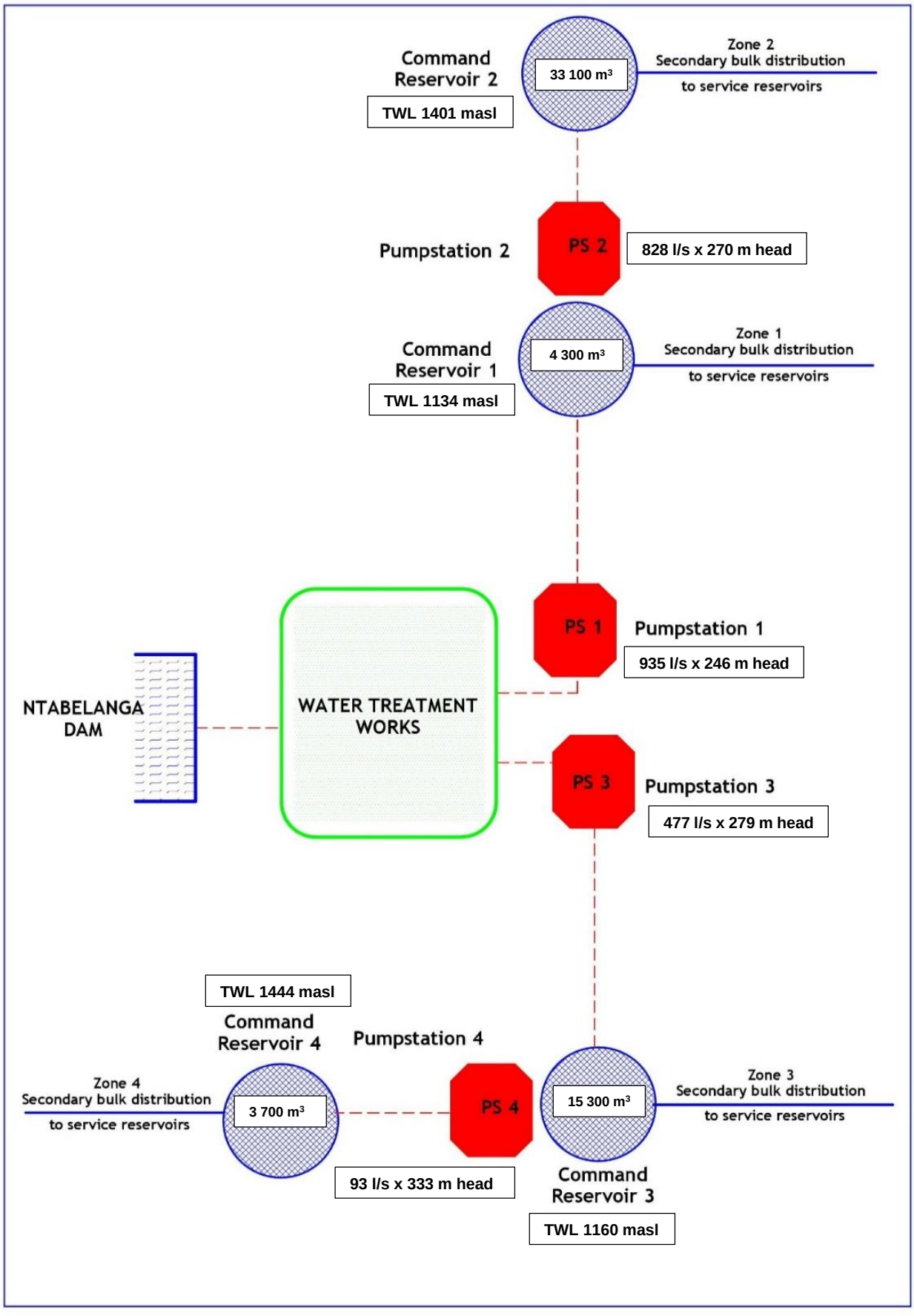


Figure 5-1: Diagram of Primary Bulk Water Distribution System

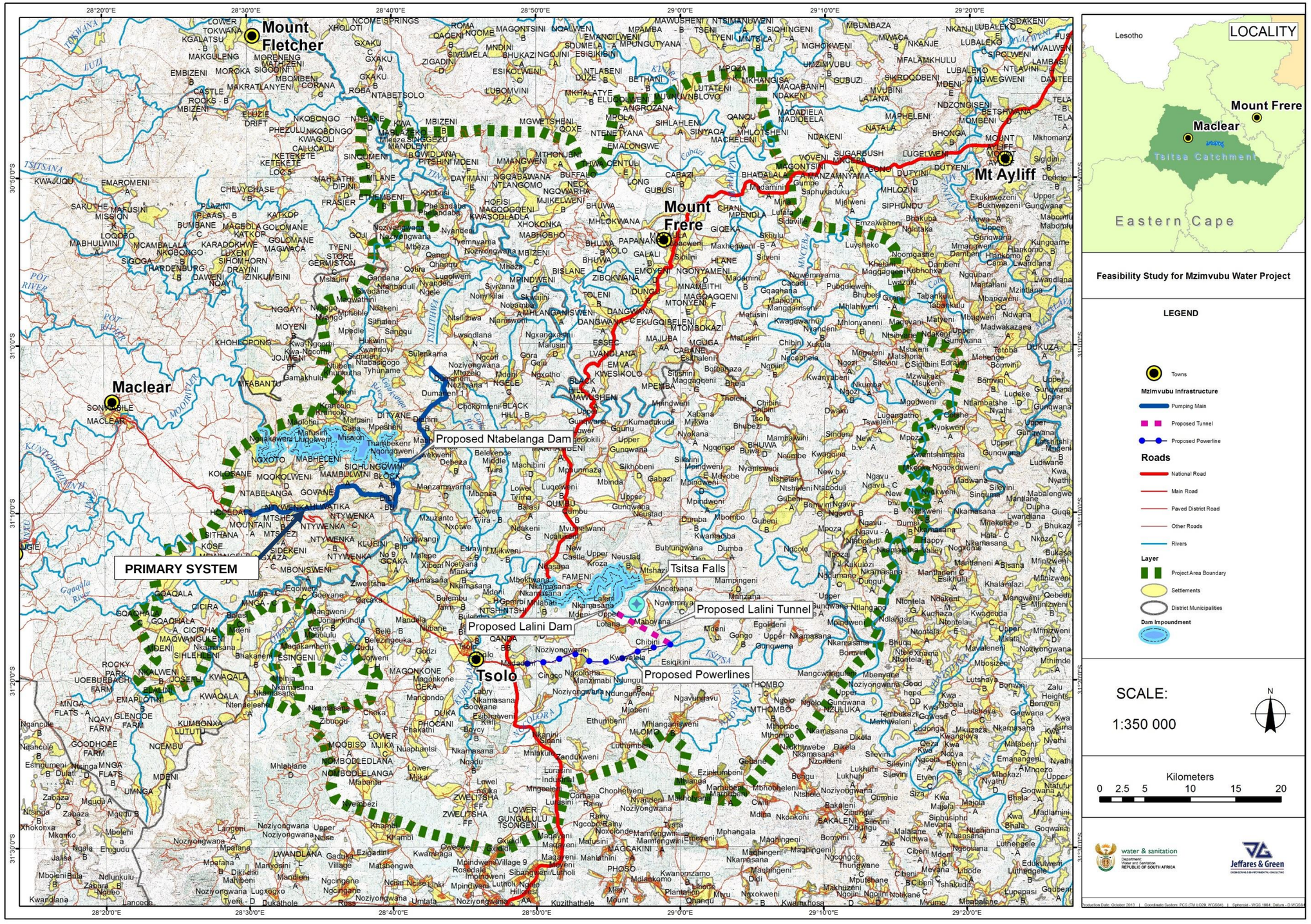


Figure 5-2: Layout of Scheme and Supply Area

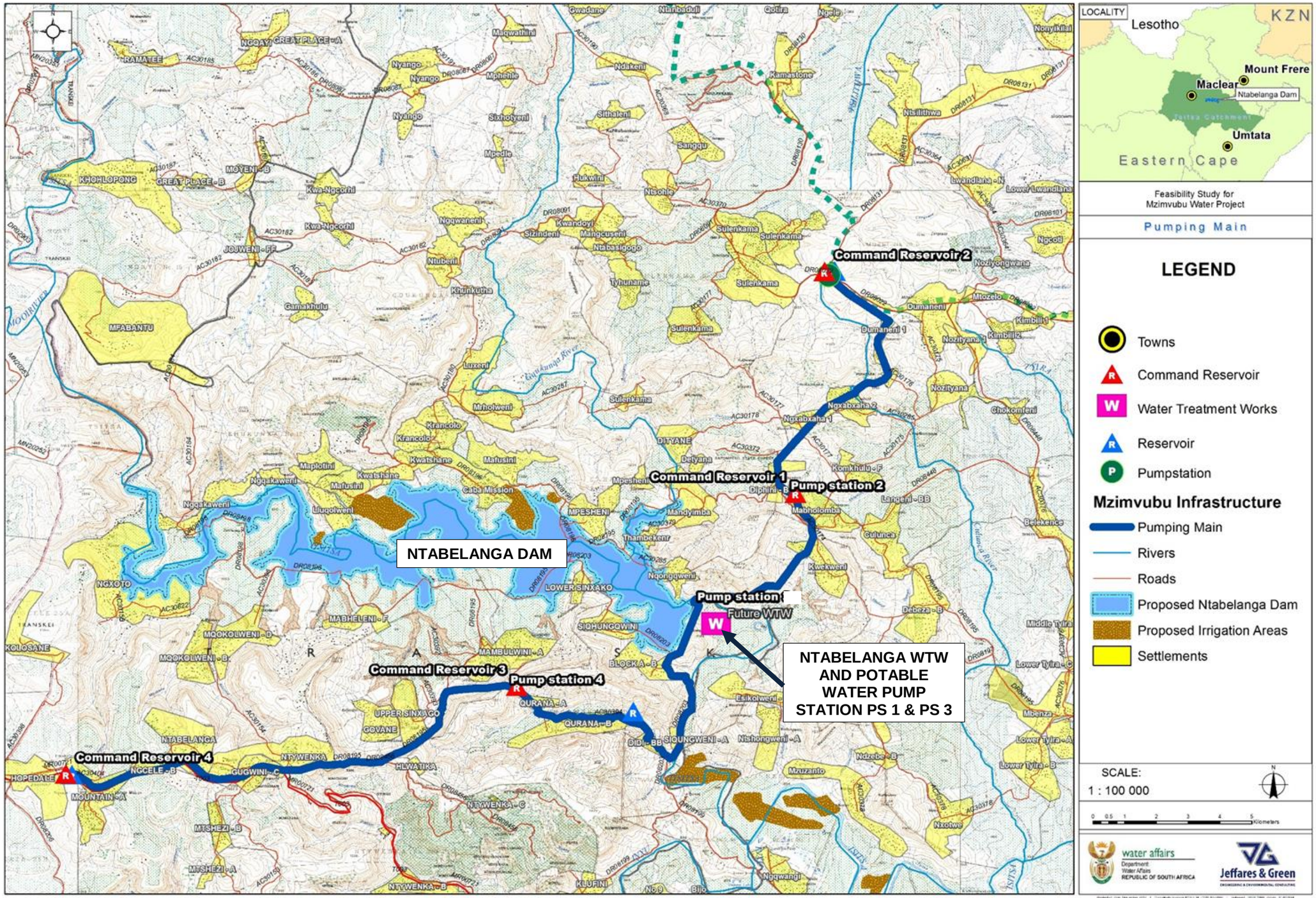


Figure 5-3: Primary Bulk Potable Water Pipelines, Pumping Stations and Command Reservoirs

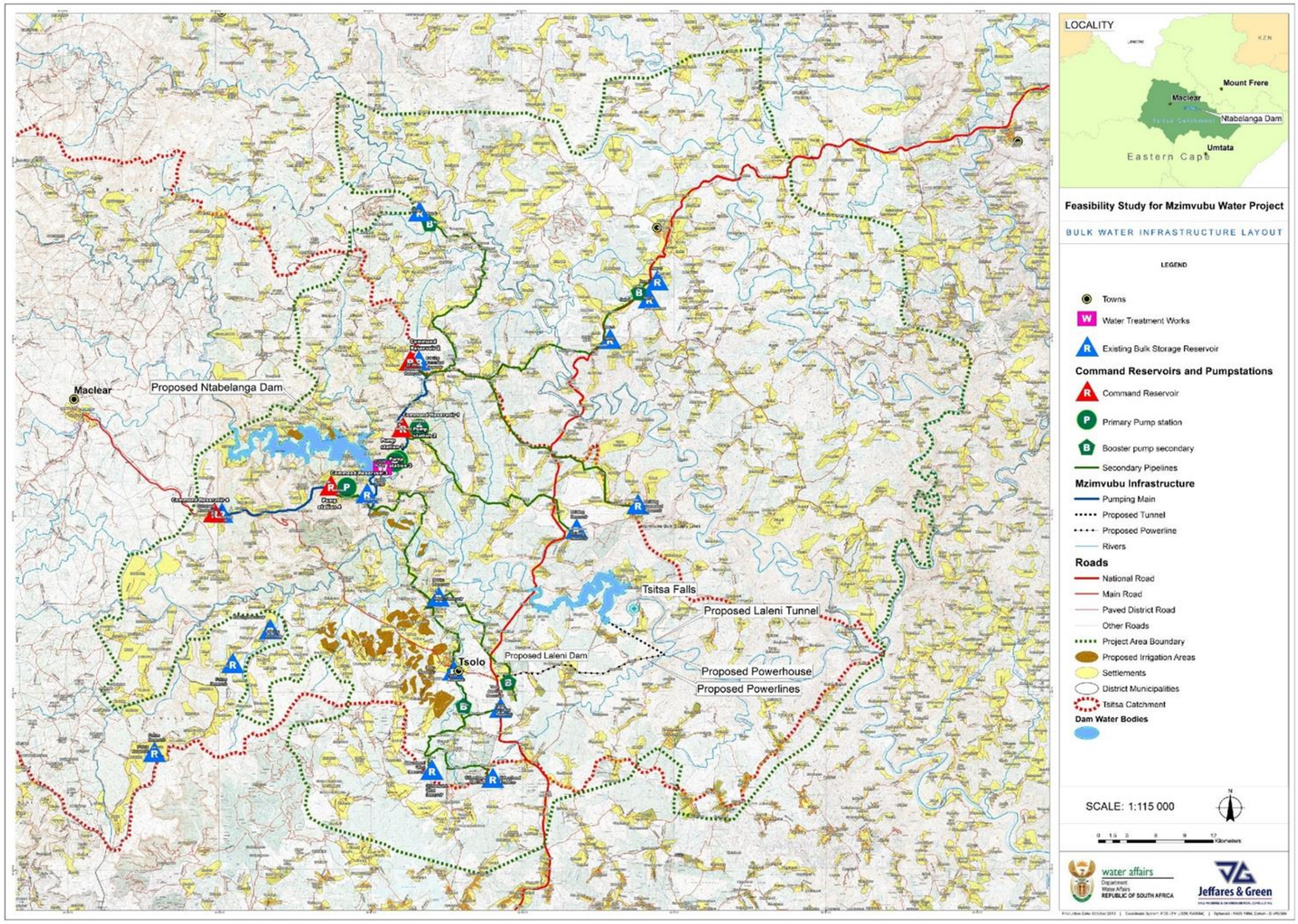


Figure 5-4: Secondary Bulk Potable Water Distribution Pipelines and Command Reservoirs

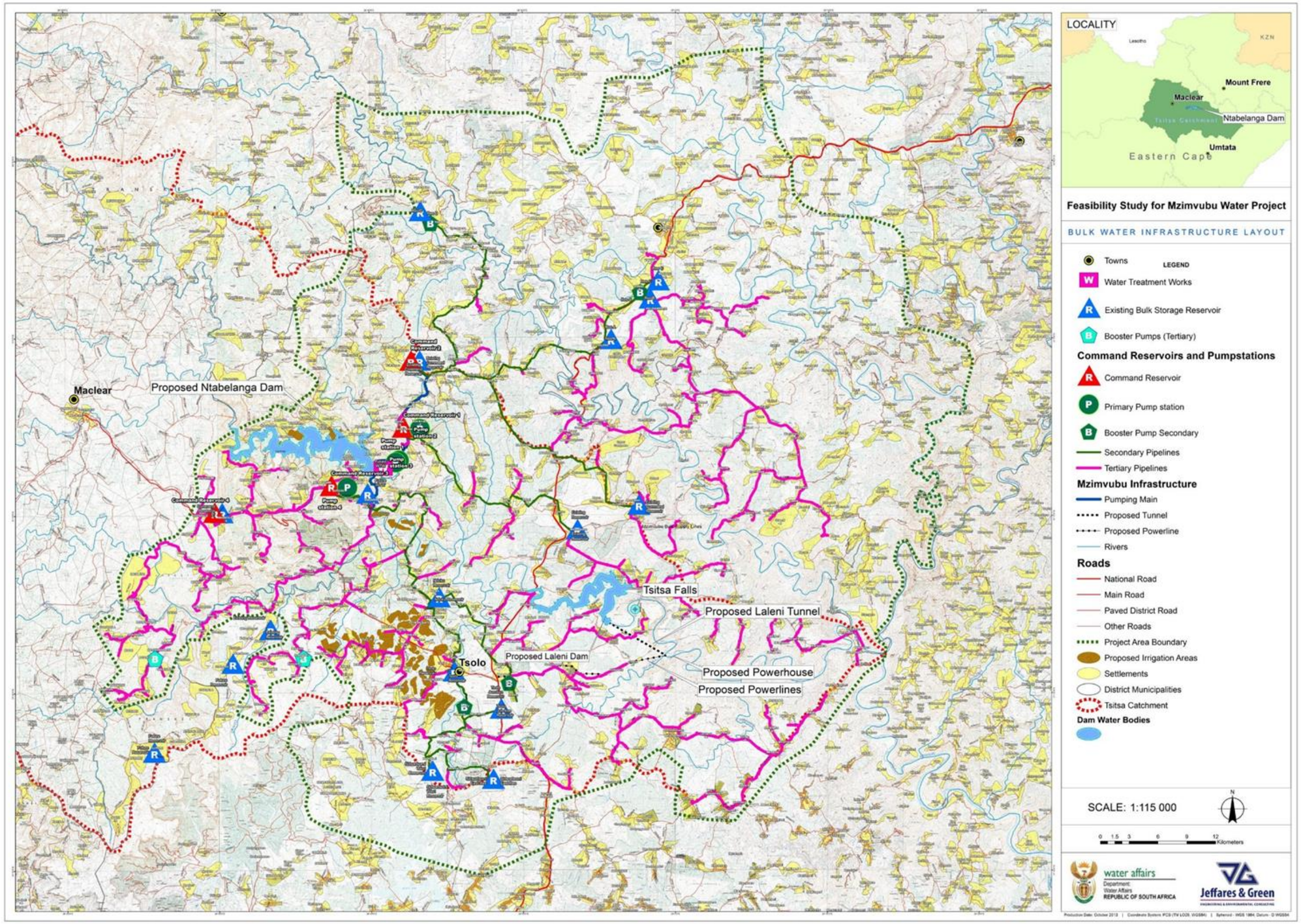


Figure 5-5: Layout of Potential Tertiary Pipelines

5.3 Primary Pump Stations

Please refer to Figures 5-1 and 5-3, and the simplified illustrations of primary, secondary and tertiary parts of the overall distribution system, in Figures 5-6 and 5-7.

These figures what is considered to be the most desirable pumping configuration from an operational perspective, in that it minimises the amount of pumping of the larger portion of potable water supplied into the system from the WTW, thus significantly reducing energy costs. This configuration has been adopted for feasibility design purposes, but this approach would be reviewed again during the detailed design and implementation stages, in conjunction with the planning philosophies then being implemented by the DMs and their Implementing Agent – Amatola Water.

More detailed layout drawings of the primary and secondary bulk potable water distribution system are given in the Main Report Book of Drawings, Report No. P WMA 12/T30/00/5212/4.

Each pumping station design would be integrally linked to the design of the rising main from the pumping station to the receiving reservoir, and the two components will be discussed together for each pumping station. For each pumping station and rising main combination, a unit reference value (URV) of water transferred was calculated using discounted cash flow (net present value or NPV) techniques. These models were run for a 30 year period of operation.

This analysis uses the cost of pumps, power, pipelines, operation and maintenance for a range of pipeline diameter and pumping head combinations to seek the best solution. Other common costs such as the pumping station building structure, and command reservoir were not included, and this analysis is therefore only comparative rather than all-inclusive.

Power costs were based upon an average ESKOM Ruraflex tariff of R0.48/kWh (2014) assuming 20 hours pumping per day, thus avoiding peak hour tariff charges. This tariff is conservative and averages hourly and seasonal tariff changes over each year.

Given that all of the primary and secondary pipelines are high pressure, all of the analysis was undertaken using steel pipeline materials. Various standard outside diameter options were analysed, and maximum working pressures calculated, taking into account the worst case as regard surge pressures are concerned. This, and other required pipe structure criteria were then used to determine the minimum wall thickness required for each option, and this determined the internal diameter to be used for hydraulic velocity and head loss calculation purposes.

Thus, pipeline internal diameters on the tables below are not nominal rounded figures but actuall figures calculated from the process described above.

Further details of these analyses are given in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15.

5.3.1 Pumping Station PS1

Pumping Station 1 (PS1) and PS3 can be housed in the same building as both sets of pumps would draw directly from the WTW contact tank.

The route for the 5.8 km rising main, from the Ntabelanga treatment works to Primary Command Reservoir 1 at Diphini-B, is shown below in Figure 5-8.

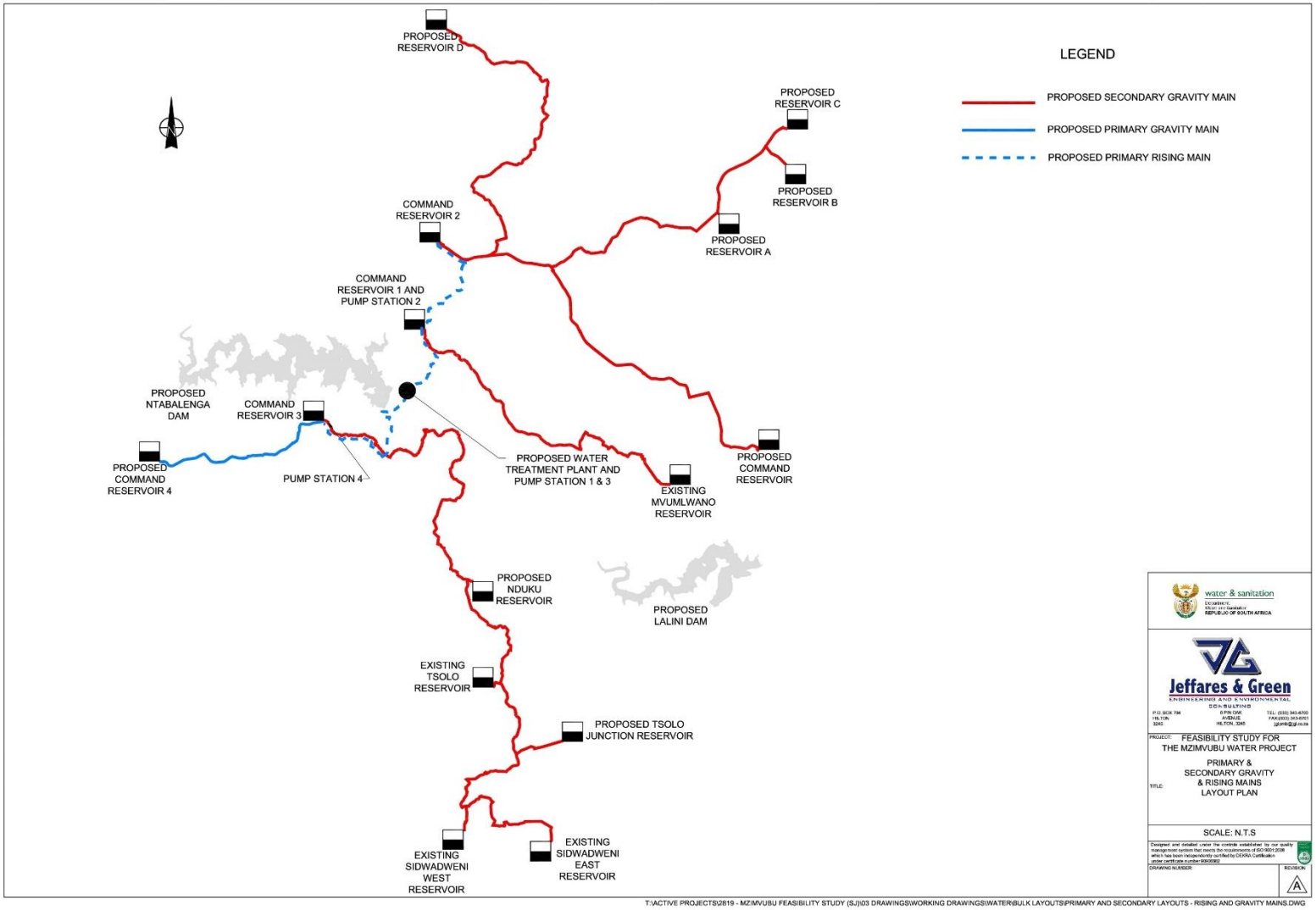


Figure 5-6: Illustration of Primary and Secondary Gravity and Rising Mains Layout

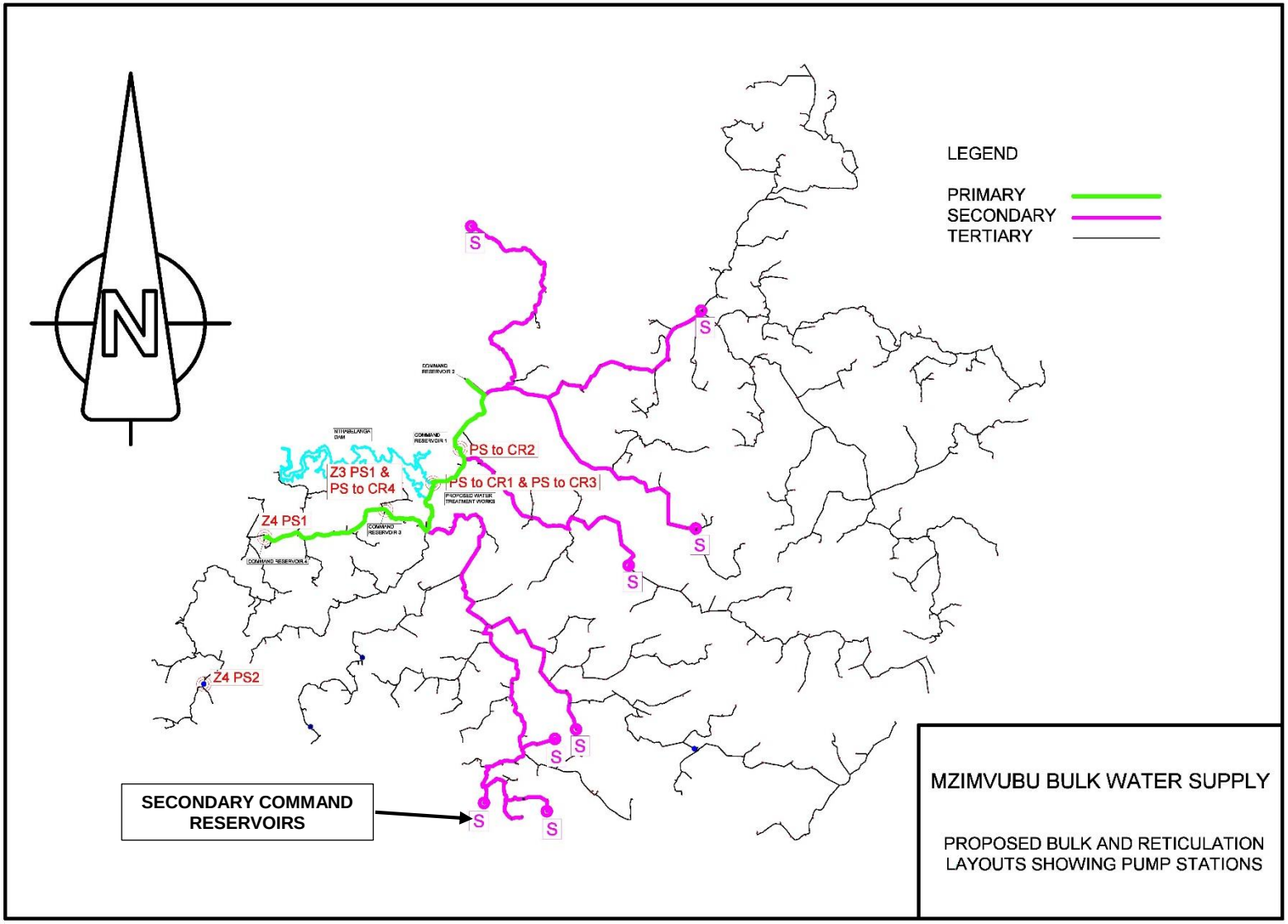


Figure 5-7: Illustration of Primary, Secondary and Tertiary Parts of the Overall Distribution System

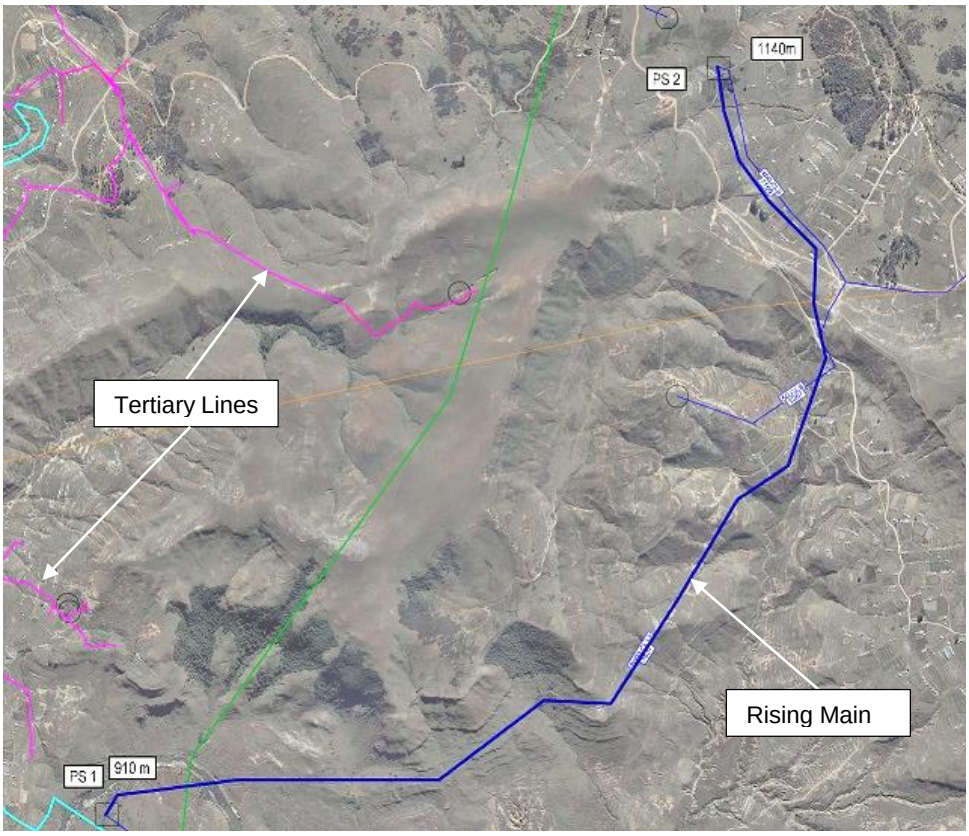


Figure 5-8: Rising Main from PS1 to Primary Command Reservoir 1 at Diphini-B

Note that green lines indicate boundaries only. Purple lines are tertiary lines to settlements.

The pumps for both PS1 and PS3 would be housed in one structure. All pumps would draw directly from the treatment works, minimising the energy losses associated with the use of a collection and distribution manifold. The proposed layout is shown below as Figure 5-9.

The rising main from PS1 to Command Reservoir 1 was sized based on a required flow rate of 0.935 m³/s. The initial target velocity through this pumping main was set at 1.5 m/s. This would require an epoxy-lined steel pipe of 9 mm wall thickness with an outside diameter of 914 mm, and an internal diameter of 896 mm.

This pipeline would be 5 837 m long and would subject to a static head of 230 m. Given this high pressure, it was decided that such rising main pipeline material should be steel.

The URVs were determined for standard pipe diameters above and below the initially chosen diameter, and the results of this analysis are shown in Table 5-1. Wall thickness were calculated as described above. The results are presented in Table 5-1.

Given the results presented in Table 5-1, there is very little difference (circa 1%) in URV between the 799 and 896 mm internal diameter pipe sizes, in which case the lower power cost solution is recommended as being the least affected by future power price rises and thus will have lower operating costs. A summary of the proposed pumping station and rising main characteristics is given in Table 5-2.

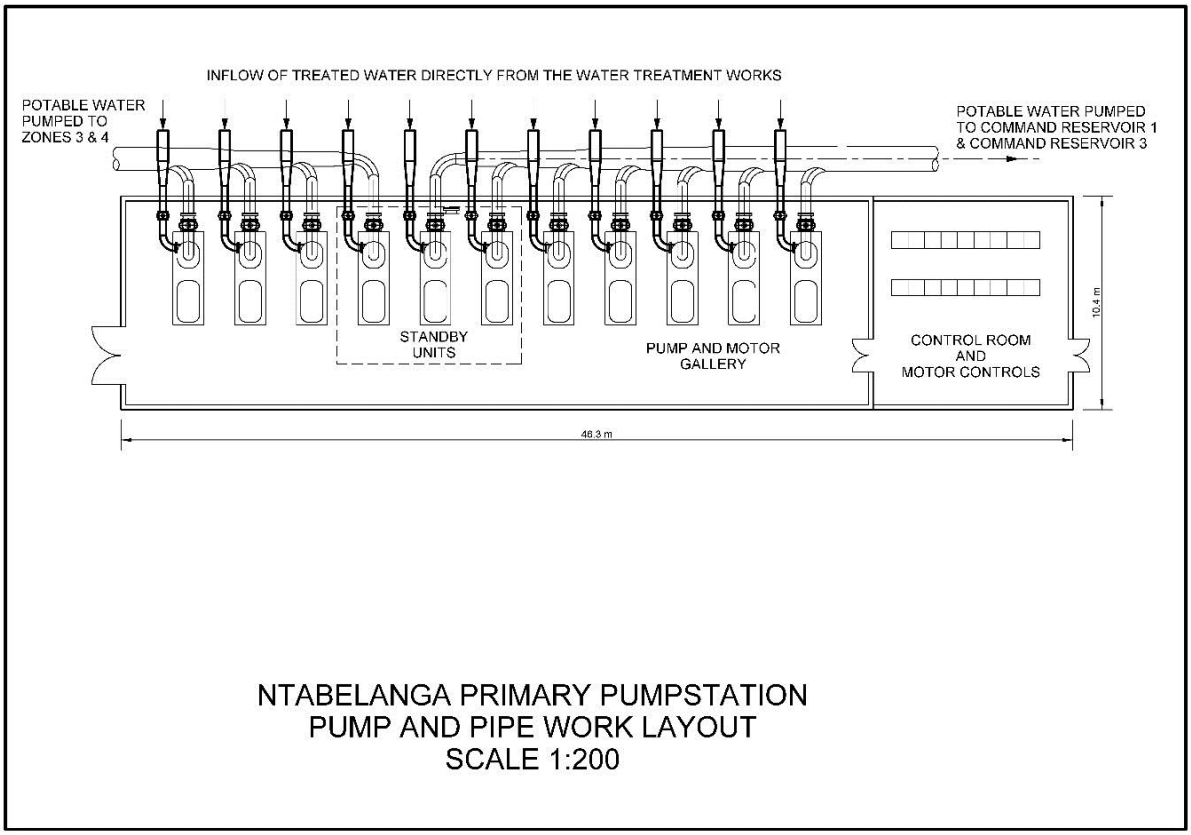


Figure 5-9: Proposed Layout of Combined PS1 and PS3 Pumping Station at Ntabelanga WTW

Table 5-1: URV of the PS1 to Command Reservoir 1 - Pumping Station and Rising Main

PS1 to Command Reservoir 1						
INTERNAL PIPE DIA (mm):>			**695**	**799**	**896**	**1000**
MAX VELOCITY (m/s):			**2.43**	**1.86**	**1.48**	**1.19**
MAX HEAD (m):			**276.64**	**255.55**	**245.78**	**240.28**
MAX POWER (kW):			**4 231**	**3 908**	**3 759**	**3 675**
URV (R/m³)	4%		1.145	1.099	**1.089**	1.107
	6%		1.149	1.112	**1.109**	1.133
	8%		1.155	**1.128**	1.133	1.164
	10%		1.164	**1.147**	1.159	1.197

NB: Lowest URV for each discount rate marked in red

The selection of pump types was dictated by the head and flow characteristics that this system requires.

Not many manufacturers are able to provide pumps in the 250-300 m head range that can lift in excess of 120 l/s.

Local pump manufacturer, Curo, has expanded their LT range of pumps to accommodate these duty points. The provisional sizing has been based on using these pump characteristics, but this is not a recommendation of a proprietary product, which eventually will need to be supplied via an approved competitive procurement process.

Table 5-2: Pumping Station and Rising Main Characteristics for PS1 to CR1

PUMP STATION 1				
2050 capacity	935.27	l/s =	3 367	m³/hr
Rising main				Head (m)
Length	5837	m	Static	230.00
Diameter	914	mm	Dynamic	15.78
Wall thickness	9	mm	**Total**	**245.78**
ID	896	mm		
A	0.631	m²		
V	1.48	m/s		
Pumps				
Duty	Head	245.78		
	1/5 Flow	673.39	m³/hr	
		187.05	l/s	
Pumps	5 x Curo	250/300	4-stages	
Hydraulic power	2.26	MW		
Supplied power	3.17	MW		

Figure 5-10 shows the duty point when using five duty pumps, each delivering 187 l/s. Two additional pumps should be provided as standby/backup. The pump units are likely to be two metres long and one metre wide and high. Motors would be a similar size and a clear distance of 1.5 m between plinths has been allowed in the sizing of the building.

The graph shows the performance of five pumps in parallel as well as four pumps. The delivery that can be achieved with only four pumps running will be in the region of 805 l/s. This would be sufficient to provide for the estimate demand at 2035. The possibility exists of installing five of the seven pumps at this stage (four duty and one standby) until the demand in excess of 800 l/s materialises.

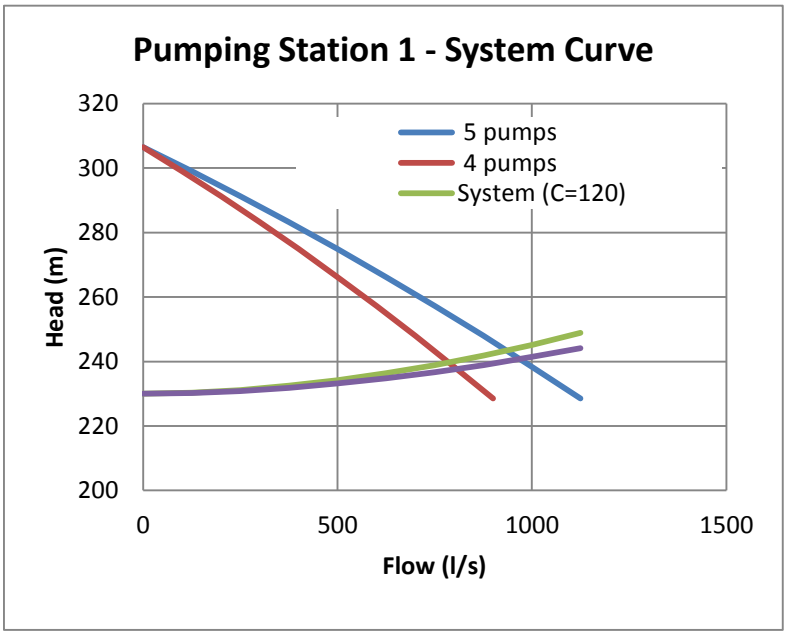


Figure 5-10: Pumping Station 1 System Curves

The possibility exists that the assumption of a Hazen-Williams formula friction factor, Cw, may under- or over-estimate the actual achieved flows. Two system curves are presented, one based on a friction coefficient of 120 (equivalent to 50-year old steel pipes) and one based on 140 (10-year old steel pipes). As can be seen, the differences between the two system curves are minimal.

The power requirements for the pumping station was based on the calculation of the hydraulic power required to lift the required flow to the required total dynamic and static head, adjusted for pump efficiency (75%), motor electrical efficiency (85%) and a power factor (95%).

5.3.2 Pumping Station PS2 at Command Reservoir 1 (Diphini-B)

The route for the pumping main from Primary Command Reservoir 1 at Diphini-B to Primary Command Reservoir 2 at Culunca follows tracks and roads for a total distance of 9.75 km, as shown in Figure 5-11.

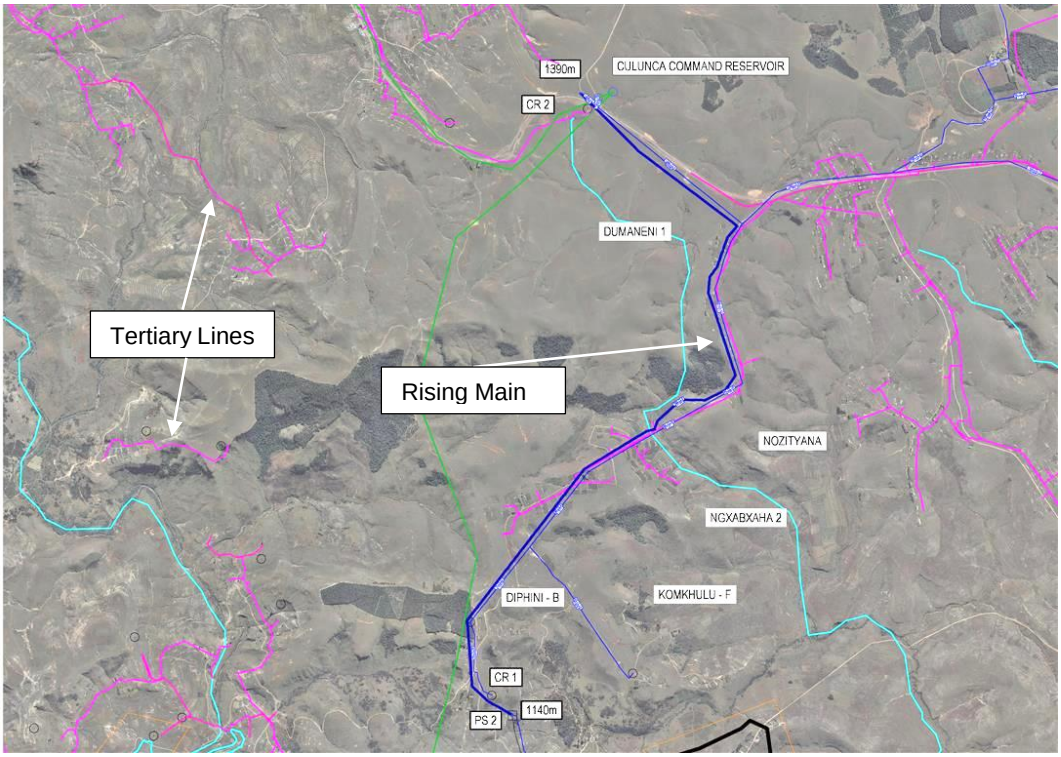


Figure 5-11: Rising Main from Primary Command Reservoir 1 to Primary Reservoir 2

The pumping station would draw water from Primary Command Reservoir 1 via a double-inlet manifold. Each inlet would take off from the two separate chambers that would make up the total capacity of the reservoir. Should the reservoir construction be staged, the manifold would only draw water from the completed section.

The rising main was designed for an ultimate demand in 2050 of 0.83 m³/s. Using a similar target velocity of 1.5 m/s as described above, and a pipe wall thickness of 8 mm outside the pipe outside diameter of 914 mm was arrived at. This epoxy-lined steel pipe would be subject to a maximum pressure of 270.0 m, making steel pipe the most suitable for this application.

The URV range was again tested for standard pipe diameters two sizes above and below the initially chosen diameter, with the results shown in Table 5-3.

Table 5-3: URV of the PS2 to Command Reservoir 2 - Pumping Station and Rising Main

PS2 to Command Reservoir 2					
OUTSIDE PIPE DIA (mm):>			**695**	**799**	**898**	**1000**
MAX VELOCITY (m/s):			**2.18**	**1.65**	**1.31**	**1.05**
MAX HEAD (m):			**313.40**	**283.40**	**270.01**	**262.87**
MAX POWER (kW):			**4 242**	**3 836**	**3 655**	**3 558**
URV (R/m³)	**4%**		**1.362**	**1.313**	**1.320**	**1.366**
	6%		**1.382**	**1.349**	**1.371**	**1.428**
	8%		**1.406**	**1.390**	**1.427**	**1.497**
	10%		**1.432**	**1.436**	**1.489**	**1.571**

NB: lowest URV for each discount rate marked in red

Given the results shown in Table 4-3, there is again very little (circa 3.5%) difference in URV between the 799 and 898 mm internal diameter pipe sizes, in which case the lower power cost solution is recommended as being the least affected by future power price rises and thus will have lower operating costs.

A summary of the proposed pumping station and rising main characteristics is given in Table 5-4.

Table 5-4: Pumping Station and Rising Main Characteristics for PS2 to CR2

PUMP STATION 2				
2050 capacity	827.69	l/s =	2 980	m³/hr
Rising main				Head (m)
Length	9750	m	Static	250.00
Diameter	914	mm	Dynamic	17.67
Wall thickness	8	mm	**Total**	**267.67**
ID	896	mm		
A	0.631	m²		
V	1.31	m/s		
Pumps				
Duty	Head	267.67		
	1/5 Flow	595.54	m³/hr	
		165.54	l/s	
Pumps	5 x Curo	250/300	4-stages	
Hydraulic power	2.19	MW		
Supplied power	3.08	MW		

Due to the pump duty point requirements Curo pumps were again used to give an example of the performance and pump arrangement that can be expected. Figure 5-12 shows a suggested pumping station layout using such pumps

Figure 5-13 shows the duty point when using five duty pumps, each delivering 166 l/s. Two additional pumps should be provided as standby/backup. The pumps are likely to be two metres long and one metre wide and high. Motors would be a similar size and a clear distance of 1.5 m between plinths has been allowed in the sizing of the building.

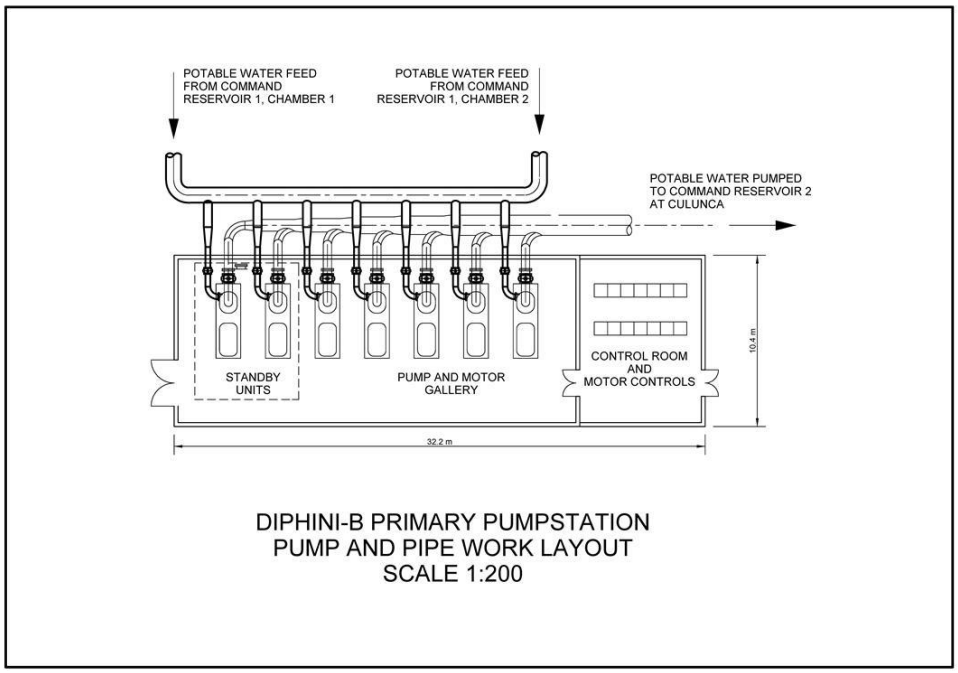


Figure 5-12: Suggested Layout for PS 2

The graph shows the performance of five pumps in parallel as well as four pumps. The delivery that could be achieved with only four pumps running would be 720 l/s. This would be sufficient to provide for the estimated demand at 2035. The possibility exists of installing five of the seven pumps at this stage (four duty and one standby) until the demand in excess of 720 l/s materialises.

The system curves have again been calculated at Cw=120 and Cw=140 to demonstrate the effect of pipe roughness on the end result. The effect is small, with the two duty points being 4.5% apart on flow and 1.5% apart on head.

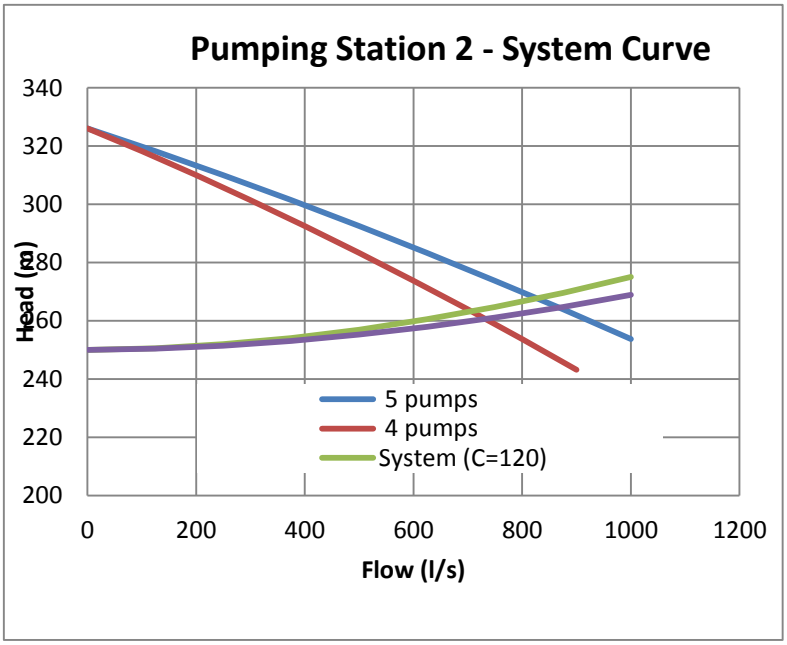


Figure 5-13: Pumping Station 2 System Curves

5.3.3 Pumping Station PS 3 at Ntabelanga Dam WTW

Pumping Station 3 would transfer water from the Ntabelanga WTW to Primary Command Reservoir 3 at Qurana.

The pumps would be housed in the same building at the WTW as the pumps for Pumping Station 1 (see Figure 5-9) and the rising main would need to take a circuitous route to remain close to the roads in the area, and to avoid very steep and rugged ascent routes.

The total length of the rising main would be 11.7 km and the static head 250 m. The layout is presented below as Figure 5-14.

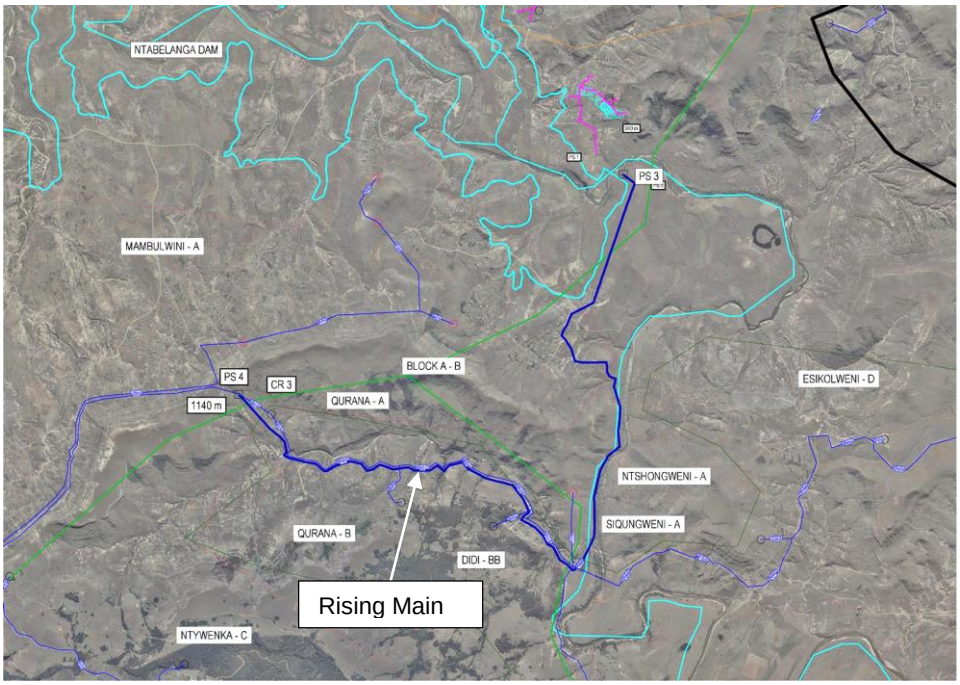


Figure 5-14: Rising Main from PS 3 at WTW to Command Reservoir 3 at Qurana

The sizing of the pumps and rising main to Command Reservoir 3 was based on a flow rate of 474.66 l/s, being the ultimate demand from Zones 3 and 4 for the 2050 horizon.

The choice of pipe size using the target velocity of 1.5 m/s was 711 mm outside diameter and 8 mm wall thickness. Whilst this is not a preferred size for production of pipes at South African manufacturing plants, a length 11.7 km would be considered worthwhile for the pipe manufacturers to undertake a special run to produced pipes of this size since they would roll about 650 pipes of 18 m each. The lack of easy access to the site reinforced the choice of epoxy lining over cement mortar lining, the latter being substantially heavier and more difficult to transport.

The URV range was again tested for standard pipe diameters above and below the initially chosen diameter, and the results of this analysis are presented in Table 5-5.

Table 5-5: URV of the PS3 to Command Reservoir 3 - Pumping Station and Rising Main

PS3 to Command Reservoir 3						
INTERNAL PIPE DIA (mm):>			**614**	**644**	**695**	**799**
MAX VELOCITY (m/s):			**1.60**	**1.46**	**1.25**	**0.95**
MAX HEAD (m):			**300.24**	**290.35**	**278.63**	**265.76**
MAX POWER (kW):			**2 330**	**2 254**	**2 163**	**2 063**
URV (R/m³)	4%		1.445	**1.418**	1.420	1.535
	6%		1.496	**1.472**	1.486	1.631
	8%		1.554	**1.532**	1.559	1.737
	10%		1.616	**1.598**	1.637	1.851

NB: lowest URV for each discount rate marked in red

Given the above result, there is again very little (circa 2.4%) difference in URV between the 644 and 695 internal diameter pipe sizes, in which case the lower power cost solution is recommended as being the least affected by future power price rises and thus will have lower operating costs.

A summary of the proposed pumping station and rising main characteristics is given in Table 5-6.

Table 5-6: Pumping Station and Rising Main Characteristics for PS3 to CR3

PUMP STATION 3				
2050 capacity	476.66	l/s =	1 709	m³/hr
Rising main				Head (m)
Length	11 695	m	Static	250.00
Diameter	711	mm	Dynamic	26.36
Wall thickness	8	mm	**Total**	**276.36**
ID	695	mm		
A	0.379	m²		
V	1.25	m/s		
Pumps				
Duty	Head	276.36		
	1/3 Flow	569.59	m³/hr	
		158.22	l/s	
Pumps	3 x Curo	250/300	4-stages	
Hydraulic power	1.31	MW		
Supplied power	1.83	MW		

Figure 5-15 shows the duty point when using three duty pumps, each delivering 158 l/s. One additional pump should be provided as standby/backup.

The graph shows the duty points for the situation where all three pumps are running and when only two pumps are running. Two pumps can deliver 366 l/s which would be adequate to provide for growth in demand until 2024. It would be feasible to install three pumps (two duty and one standby) until the demand exceeds 366 l/s, at which point the last pump and motor would need to be purchased and installed.

The system curves for C_w values of 120 and 140 were again plotted but these showed that there is no significant difference between the two curves. The design allows for a Cw value of 120, being equivalent to steel pipe condition after 25 years of service.

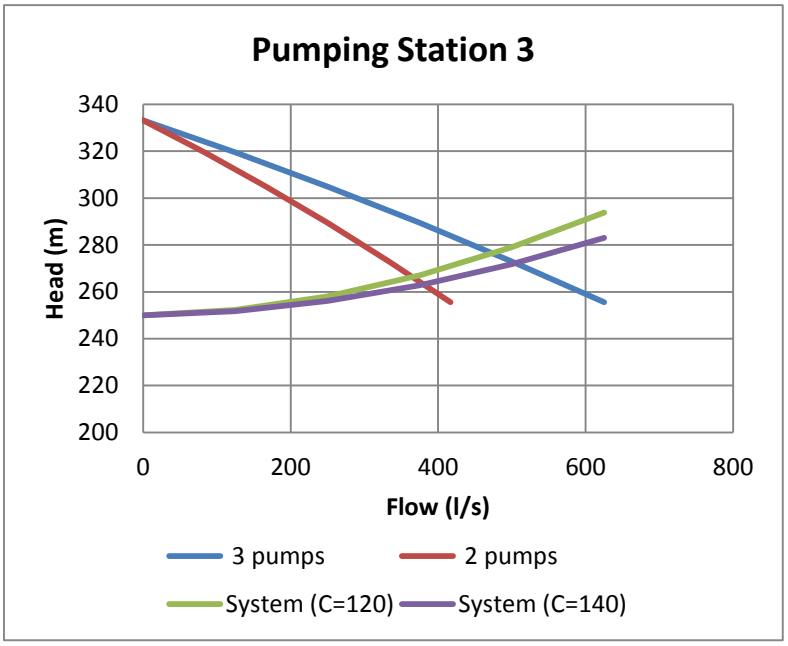


Figure 5-15: Pumping Station 3 System Curves

5.3.4 *Pumping Station PS4 at the Primary Command Reservoir 3 at Qurana*

This pumping station supplies water to Zone 4 only. This is effected by delivering water to Primary Command Reservoir 4 near to Hopedale, which is an existing reservoir "E" supplying the area westwards towards Maclear.

The demand at the 2050 design horizon was established at 92.69 l/s at a static head of 285 m. At a target flow velocity of 1.3 m/s the nominal pipeline size would be 300 mm outside diameter. Due to the length of the pipeline it was found that the friction loss would be too high to allow for the use of locally available pumps. The pipe size was therefore increased from 300 mm to 356 mm outside diameter with a wall thickness of 4.5 mm. This gave an estimated flow velocity of 0.98 m/s in a pipe that can withstand 415 m pumping head.

The route shown follows the alignment of the road up to Hopedale, keeping to the watershed crest for most of its length. At 14.38 km this is the longest of the four rising mains as well as the route with the highest static head (285 m).

The URV analysis was again run and tested for standard pipe diameters above and below the initially chosen diameter, with the results shown in Table 5-7.

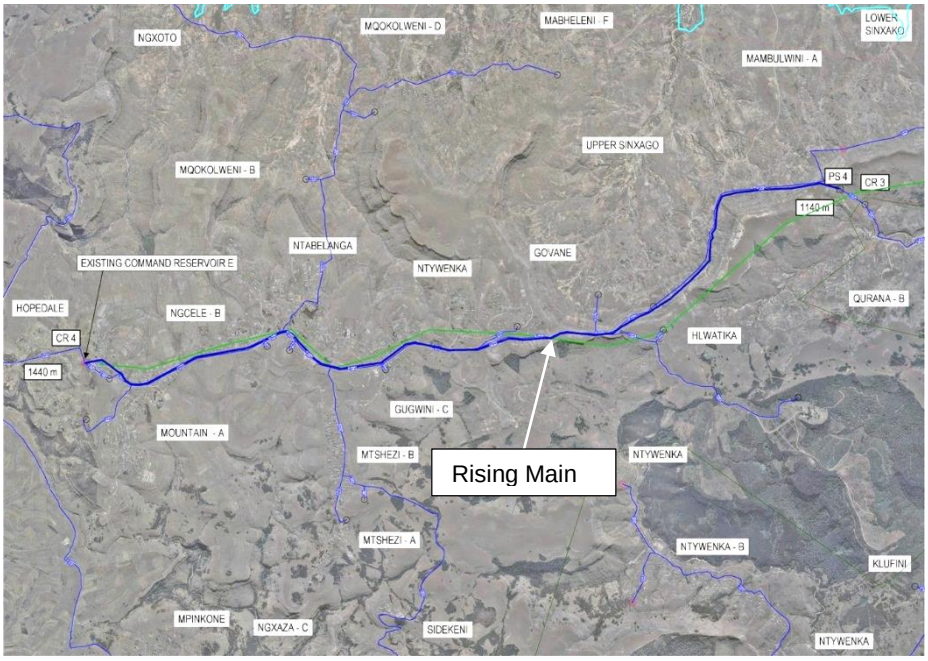


Figure 5-16: Rising Main, PS 4 to Command Reservoir 4/Existing Reservoir E

Table 5-7: URV of the PS4 to Command Reservoir 4 - Pumping Station and Rising Main

PS4 to Command Reservoir 4						
INTERNAL PIPE DIA (mm):>			**315**	**331**	**347**	**368**
MAX VELOCITY (m/s):			**1.19**	**1.08**	**0.98**	**0.87**
MAX HEAD: (m)			**361.00**	**345.26**	**333.41**	**321.99**
MAX POWER (kW):			**547**	**523**	**505**	**488**
URV (R/m³)	4%		2.401	2.399	**2.382**	2.524
	6%		**2.615**	2.626	2.617	2.780
	8%		**2.848**	2.875	2.873	3.059
	10%		**3.095**	3.138	3.145	3.355

NB: lowest URV for each discount rate marked in red

As described above, it was decided to adopt the larger 356 mm pipe diameter rather than what might otherwise be seen as the lowest URV solution. Given the very close URV ranges above, this decision is considered justifiable, and also reduces power requirements by nearly 10%.

A summary of the proposed pumping station and rising main characteristics is given in Table 5-8.

For the high head and the length of the line, the Curo Pump range again provides a possible solution to give as an example of the pump system curve.

The new Primary Command Reservoir 4 would be built adjacent to the existing Reservoir E and the total storage volume at that site would be brought up to the required 16-hour AADD storage volume of 3 700 m³.

Table 5-8: Pumping Station and Rising Main Characteristics from PS4 to CR4

PUMP STATION 4				
2050 capacity	92.69	l/s =	333.7	m³/hr
Rising main				Head (m)
Length	14 380	m	Static	285.00
Diameter	356	mm	Dynamic	46.41
Wall thickness	4.5	mm	**Total**	**331.41**
ID	347	mm		
A	0.095	m²		
V	0.98	m/s		
Pumps				
Duty	Head	331.41		
	Flow	333.68	m³/hr	
		92.69	l/s	
Pumps	1 x Curo	250/300	4-stages	
Hydraulic power	0.30	MW		
Supplied power	0.43	MW		

The pump and system curves are shown in Figure 5-17.

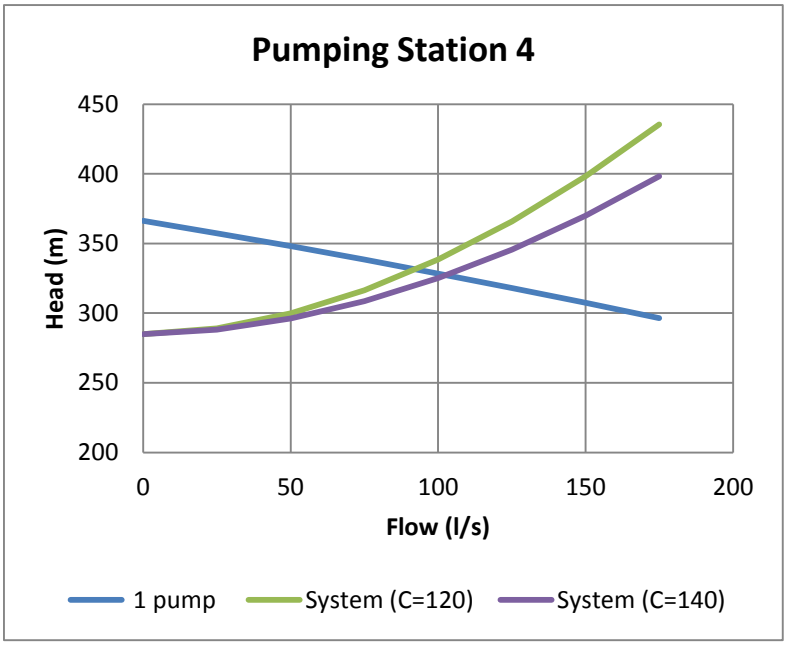


Figure 5-17: Pumping Station PS4 System Curves

For purposes of this feasibility study it proposed that the water could be pumped using one (slightly over-sized w.r.t. flow rate) 250/300 4-stage Curo pump with one pump as standby.

Water would be drawn directly from Command Reservoir 3 and pumped to Command Reservoir 4.

The layout of the building, which would house two sets of pumps, would be along the same principles as applied at the WTW combined pumping station PS1 and PS3 (Figure 5-8), adapted to suit the actual number of pumps required for this site.

5.3.5 *"Booster" Pump Stations*

The undulating terrain downstream of the primary distribution system means that in three locations there will need to be smaller booster pumping stations to provide additional hydraulic head for the water to pass over terrain high points into the secondary and tertiary systems.

All of the remainder of the bulk water distribution system will be fed by gravity.

The locations of these three booster pumping stations in the bulk water distribution system are shown in Figure 5-18 overleaf.

These booster pumping stations are labelled according to the supply zones that they supply.

5.3.6 *Booster Pumping Station Z3 PS1*

This pumping station is located at the same site as Primary Command Reservoir 3 and Primary Pumping Station 4. In order to supply the parts of the system to the south of this command reservoir, the secondary line needs to be boosted in order to keep the hydraulic grade line above an intervening ridge.

For Z3 PS1, the pump duty at the 2050 design horizon is 170 l/s at a static head of 90 m. The relatively short length of the pipeline to keep the hydraulic grade line above the elevation of the intervening hill crest produces low friction losses for a wide range of pipeline diameters. The pipe size range used in the URV calculation was 400 mm to 700 mm internal diameter with a wall thickness of 8 mm.

The URV analysis was again run and tested for pipe diameters above and below an initially chosen diameter, and the results are shown in Table 5-9.

Table 5-9: URV of the Booster Pumping Station Z3 PS1 - Pumping Station and Rising Main

Booster Z3 - PS1						
INTERNAL PIPE DIA (mm):>			**400**	**500**	**559**	**700**
MAX VELOCITY (m/s):			**1.35**	**0.87**	**0.69**	**0.44**
MAX HEAD: (m)			**99.48**	**94.86**	**93.87**	**92.96**
MAX POWER (kW):			**277**	**264**	**261**	**258**
URV (R/m^3)	**4%**		0.479	**0.472**	0.474	0.509
	6%		0.492	**0.488**	0.491	0.533
	8%		0.507	**0.506**	0.510	0.560
	10%		**0.523**	0.525	0.531	0.588

NB: lowest URV for each discount rate marked in red

The optimum pipe diameter and pumping arrangement is for a 500 mm diameter rising main, but given the closeness of the URVs, a larger standard 575 mm outside diameter pipe is recommended given this option's lower power costs. A summary of the proposed pumping station and rising main characteristics is given in Table 5-10.

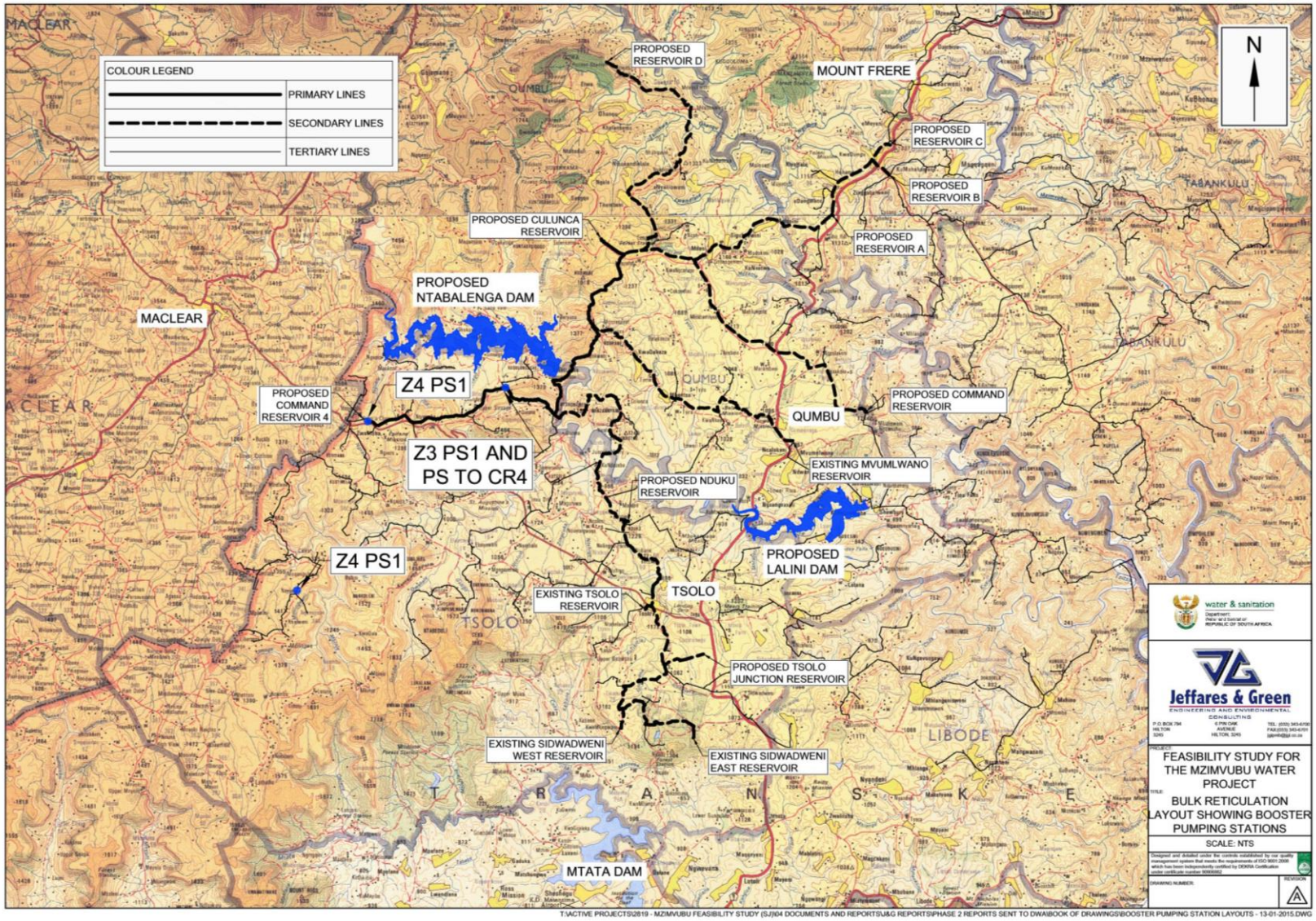


Figure 5-18: Locations of the three Booster Pump Stations in the Bulk Water Distribution System

Table 5-10: Summary of Pumping Station Z3 PS1 and Rising Main Characteristics

BOOSTER PUMP STATION Z3 PS1				
2050 capacity	170.00	l/s =	612	m³/hr
Rising main				Head (m)
Length	1 422	m	Static	90.00
Diameter	559	mm	Dynamic	3.90
Wall thickness	8	mm	**Total**	**93.9**
ID	543	mm		
A	0.232	m²		
V	0.73	m/s		
Pumps				
Duty	Head	93.9		
	Flow	204	m³/hr	
		56	l/s	
Pumps	3xWKLn	125/3	3-stages	
Hydraulic power	0.157	MW		
Supplied power	0.220	MW		

In the case of these small and medium sized booster pumping stations, the KSB range of pumps has been used as an example of pump and system curve requirements. In this case a three duty, one standby arrangement is proposed. The pump and system curves are shown below in Figure 5-19.

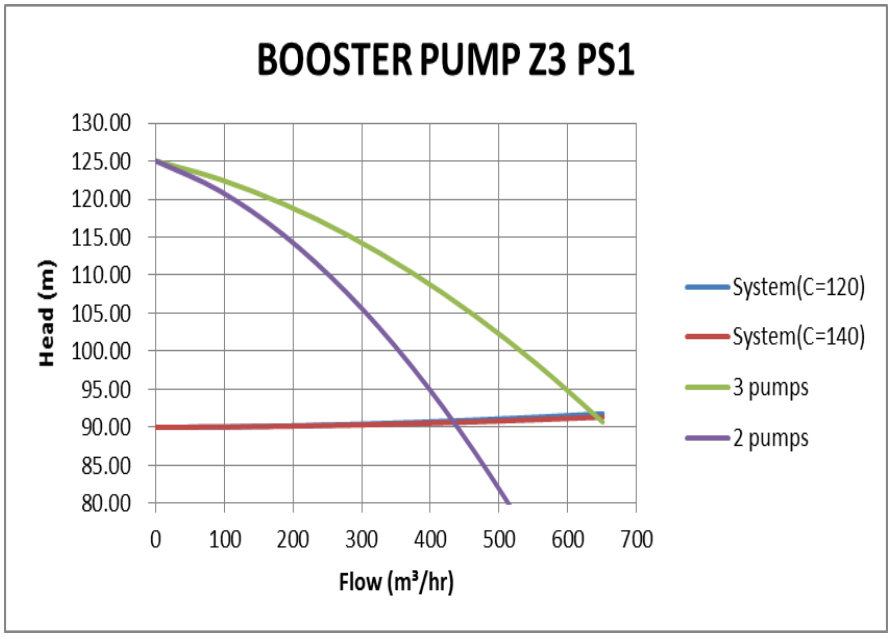


Figure 5-19: Booster Pumping Station Z3 PS1 System Curves

The layout of the building to house two sets of pumps will be along the same principles as applied at the WTW combined pumping station PS1 and PS3 (Figure 5-9), adapted to suit the actual number of pumps required for this site.

5.3.7 *Booster Pumping Station Z4 PS 1*

This pumping station is located at the same site as Primary Command Reservoir 4. In order to supply the parts of the system to the south-west of this command reservoir, the tertiary line needs to be boosted twice in order to keep the hydraulic grade line above intervening ridges. Booster station Z4 PS1 ensures that water can be fed as far as possible, but at a point where the hydraulic grade line peters out, a further small booster is required at Z4 PS2 to reach the remaining settlements located on rising terrain.

The pump duty at the 2050 design horizon was established at 12.80 l/s at a static head of 60 m. The selected pipe size range was from 75 mm to 200 mm diameter with a wall thickness of 3.5 mm. The URV analysis was again run and tested for standard pipe diameters above and below the initially chosen diameter, and the results are shown in Table 5-11.

Table 5-11: URV of the Booster Pumping Station Z3 PS1 - Pumping Station and Rising Main

Booster Z4 - PS1						
INTERNAL PIPE DIA (mm):>			**75**	**100**	**158.1**	**200**
MAX VELOCITY (m/s):			**2.90**	**1.63**	**0.65**	**0.41**
MAX HEAD: (m)			**203.75**	**97.35**	**66.25**	**63.70**
MAX POWER (kW):			**43**	**20**	**14**	**13**
URV (R/m³)	**4%**		1.030	0.651	**0.608**	0.654
	6%		1.067	0.706	**0.683**	0.735
	8%		1.109	0.765	**0.764**	0.823
	10%		1.154	**0.828**	0.850	0.916

NB: lowest URV for each discount rate marked in red

The 158.1 mm inside diameter pipeline option is shown to be the optimum and has been adopted. This saves approximately one-third of the power requirement over a smaller pipe size.

A summary of the proposed pumping station and rising main characteristics is given in Table 5-12.

Table 5-12: Pumping Station Z4 PS1 and Rising Main Characteristics

BOOSTER PUMP STATION Z4 PS1				
2050 capacity	12.8	l/s =	46.08	m³/hr
Rising main				Head (m)
Length	1 000	m	Static	60.00
Diameter	165.1	mm	Dynamic	6.25
Wall thickness	3.5	mm	**Total**	**66.25**
ID	158.1	mm		
A	0.02	m²		
V	0.65	m/s		
Pumps				
Duty	Head	66.25		
	Flow	15.36	m³/hr	
		4.3	l/s	
Pumps	3xWKLn	50/8	8-stages	
Hydraulic power	0.008	MW		
Supplied power	0.012	MW		

The KSB range of pumps has again been used as an example of pump and system curve requirements. In this case a three duty, one standby arrangement is proposed. The pump and system curves are shown below under Figure 5-20.

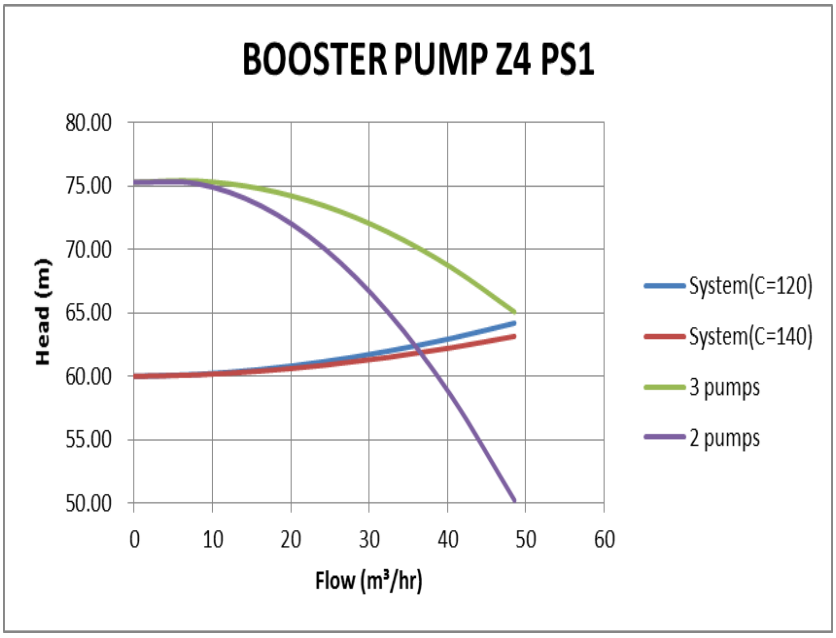


Figure 5-20: Pumping Station Z4 PS1 System Curves

The layout of the building to house these pumps will be on the same principles as applied at PS2 (Figure 5-12).

5.3.8 *Booster Pumping Station Z4 PS 2*

As described above, this boosts water supplied from Z4 PS1 onward to a small number of higher lying settlements

The pump duty at the 2050 design horizon was established at 3.53 l/s at a static head of 184 m. The relatively short length of 520 m for the pipeline produces low friction losses for a wide range of pipeline diameters. The pipe size range used in the URV calculation was 75 mm to 150 mm diameter with a wall thickness of 3.5 mm.

The URV analysis was again run and tested for standard pipe diameters above and below the initially chosen diameter, and the results are shown in Table 5-13.

Table 5-13: URV of the Booster Pumping Station Z4 PS2 - Pumping Station and Rising Main

Booster Z4 - PS2						
INTERNAL PIPE DIA (mm):>			**75**	**100**	**118.9**	**150**
MAX VELOCITY (m/s):			**0.92**	**0.52**	**0.37**	**0.23**
MAX HEAD: (m)			**267.99**	**206.60**	**195.16**	**189.30**
MAX POWER (kW):			**18**	**14**	**13**	**13**
URV (R/m³)	**4%**		**4.294**	4.794	4.997	6.303
	6%		**5.018**	5.693	5.954	7.482
	8%		**5.801**	6.664	6.987	8.756
	10%		**6.627**	7.686	8.075	10.097

NB: lowest URV for each discount rate marked in red

The 75 mm diameter pipeline option was shown to be the lowest URV solution, but with very high pressures in the system. It was decided to bring the pressure head down to below 20 bar, and this required a pipe line of 118.9 mm inside diameter. This again saves approximately one-third of the power requirement over a smaller pipe size.

A summary of the proposed pumping station and rising main characteristics is given in Table 5-14.

Table 5-14: Pumping Station Z4 PS2 and Rising Main Characteristics

BOOSTER PUMP STATION Z4 PS2				
2050 capacity	3.53	l/s =	12.71	m³/hr
Rising main				Head (m)
Length	520	m	Static	184.00
Diameter	113.9	mm	Dynamic	1.22
Wall thickness	3.5	mm	**Total**	**185.22**
ID	106.9	mm		
A	0.009	m²		
V	0.39	m/s		
Pumps				
Duty	Head	185.22		
	Flow	12.71	m³/hr	
		3.53	l/s	
Pumps	1xWKLn	80/11	11-stages	
Hydraulic power	0.007	MW		
Supplied power	0.009	MW		

The KSB range of pumps has been used as an example of pump and system curve requirements. In this case, a one duty, one standby arrangement is proposed. The pump and system curves are shown below under Figure 5-21.

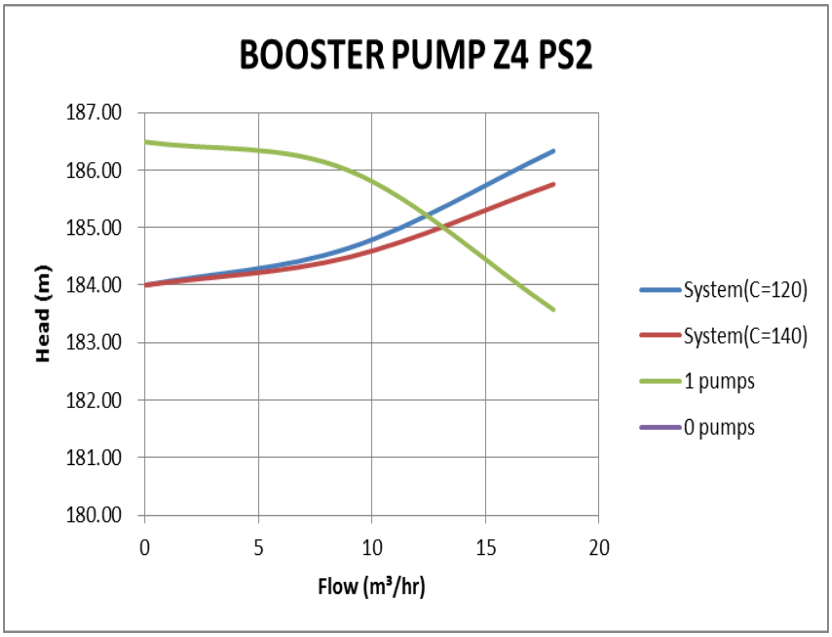


Figure 5-21: Pumping Station Z4 PS2 System Curves

The layout of the building to house these pumps will be on the same principles as applied at PS 2 (Figure 5-12).

Note: The very high URV values for this particular pumping station are due to the small flow rate verses the relatively high capital cost of this section. Being a very small proportion of the whole system this will not significantly affect the overall URV of water supplied by the full system.

6. DOMESTIC BULK WATER DISTRIBUTION INFRASTRUCTURE COMPONENT SUMMARY

From the water demand model and the network analysis of the proposed bulk system, the bulk infrastructure components have been split into the following categories of supply:

- Bulk infrastructure – considers the WTW, pumping stations 1 to 4, command reservoirs and the interlinking pipelines for this primary system
- Zone 1 bulk infrastructure – secondary infrastructure
- Zone 2 bulk infrastructure – secondary infrastructure
- Zone 3 bulk infrastructure – secondary infrastructure
- Zone 4 bulk infrastructure – secondary infrastructure
- Zone 1 bulk infrastructure – tertiary infrastructure
- Zone 2 bulk infrastructure – tertiary infrastructure
- Zone 3 bulk infrastructure – tertiary infrastructure
- Zone 4 bulk infrastructure – tertiary infrastructure

6.1 Primary Infrastructure

Table 6-1 depicts the infrastructure for the bulk system that consists of the water treatment works, bulk pumping stations, command reservoirs and the bulk pipelines interlinking the key components.

Table 6-1: Primary Infrastructure Sizing

Component	2020	2030	2040	2050
	Capacity			
Water treatment works (m^3/d)	75 316	83 196	91 900	101 515
Command Reservoir 1 (m^3)	3 000	4 000	4 000	4 000
Command Reservoir 2 (m^3)	25 000	27 000	30 000	33 000
Command Reservoir 3 (m^3)	11 000	13 000	14 000	15 000
Command Reservoir 4 (m^3)	3 000	3 000	3 000	4 000
Component	**2020**	**2030**	**2040**	**2050**
	Flow in m^3/s			
Pumping station 1 - static head 230m	0.69	0.77	0.85	0.94
Pumping station 2 - static head 250m	0.61	0.68	0.75	0.83
Pumping station 3 - static head 250m	0.35	0.39	0.43	0.47
Pumping station 4 - static head 285m	0.07	0.08	0.08	0.09

	Pipe Details		
	Nominal Diameter (mm)	**Material**	**Length (m)**
Bulk Connector	400	Steel	14 378
Bulk Connector	700	Steel	9 749
Bulk Connector	1000	Steel	17 529

The increment steps in demand growth from 2020 to 2050 start from a relatively high base and increase at a rate of approximately 10% per decade. This situation does not lend itself to modular incremental construction of the infrastructure listed in Table 6-1.

The point of departure demand figures will depend upon the success in meeting the targets of completion of the whole system by 2020, as well as the uptake of water consumption at that same time.

Should the target not be achieved, or the actual per capita consumption be less than the 60 ℓ/c/d and 100 ℓ/c/d used in the water requirements projections, then there may be a case for developing the water treatment works in stages (perhaps 50 000 m^3/d in 2020, 75 000 m^3/d in 2030, and 102 000 m^3/d in 2050) to defer capital and match demand growth. A similar philosophy could be applied to modular development of the larger of the storage reservoirs.

However, such an approach would need to be carefully monitored from the outset and actions taken to bring the next stage of upgrade in at an earlier date if actual demand rapidly starts to outstrip the installed capacity.

6.2 Zone 1 Secondary and Tertiary Infrastructure

The secondary and tertiary infrastructure required for Zone 1 is summarised as:

- 28 536 m of secondary pipelines
- 102 679 m of tertiary pipelines
- 47 reservoirs at tertiary level ranging in size from 10 m^3 to 450 m^3
- Pipeline ancillaries such as isolating valves, scour valves, air valves, break pressure tanks etc. These can only be accurately determined upon conducting a detailed design of the system.

6.3 Zone 2 Secondary and Tertiary Infrastructure

The secondary and tertiary infrastructure required for Zone 2 is summarised as:

- 86 556 m of secondary pipelines
- 483 357 m of tertiary pipelines
- 181 reservoirs at tertiary level ranging in size from 10 m^3 to 750 m^3
- Pipeline ancillaries such as isolating valves, scour valves, air valves, break pressure tanks etc. These can only be accurately determined upon conducting a detailed design of the system.

6.4 Zone 3 Secondary and Tertiary Infrastructure

The secondary and tertiary infrastructure required for Zone 3 is summarised as:

- 91 444 m of secondary pipelines
- 1 booster pumping station in the secondary system
- 319 008 m of tertiary pipelines
- 111 reservoirs at tertiary level ranging in size from 10 m^3 to 750 m^3
- 2 booster pumping stations in the tertiary system
- Pipeline ancillaries such as isolating valves, scour valves, air valves, break pressure tanks etc. These can only be accurately determined upon conducting a detailed design of the system.

6.5 Zone 4 Secondary and Tertiary Infrastructure

The secondary and tertiary infrastructure required for Zone 4 is summarised as:

- 133 324 m of tertiary pipelines
- 49 reservoirs at tertiary level ranging in size from 10 m³ to 450 m³
- 2 booster pumping stations in the tertiary system
- Pipeline ancillaries such as isolating valves, scour valves, air valves, break pressure tanks etc. These can only be accurately determined upon conducting a detailed design of the system.

A schedule of pipelines and reservoirs sizes, capacity and co-ordinates is given in Appendix D. Full details of geometry are available on the hydraulic model files that have been handed over to DWS.

NB: It must be noted that for the purposes of the Mzimvubu Water Project only the primary and secondary lines will be implemented by DWS under this project. The tertiary lines will be the responsibility of the DM's as the Water Services Authorities in the area. However in order to ensure an efficient and effective design of a gravity supply scheme a bottom up approach was required and this is why tertiary lines were considered. The final design of these lines will be undertaken by other consultants working with the DM's.

6.6 Cost Estimates

The cost estimates for the construction of the Domestic Bulk Water Distribution Infrastructure are summarised in the following table. The full breakdown of the costs is given in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15.

The costs are indicated for the 2050 demand scenario with the full infrastructure requirement for that time allowed for in the costing. Works that could be upgraded pending water demands such as reservoirs and pumping stations and the water treatment plant, have been ignored as being incrementally upgraded infrastructure and costs are given for the long term demand sizing.

An allowance for contingencies has been made to counter any significant discrepancies that may arise between this feasibility study stage and the final design. Changes to pipeline routes, more accurate design of pumping systems for surge etc are taken up in this contingency allowance.

Engineering and Environmental Management fees have been allowed for at 12% of construction value. This may also be likely to change depending on how the project is rolled out by the implementing agents.

All cost are at 2014 price levels and no allowance is made for escalation to date of construction at this stage.

The basis for this scenario is to only allow those costs that are directly needed to supply potable water to the domestic water supply system.

From the feasibility design process, quantities were taken of the proposed infrastructure and an engineer's estimate was undertaken to establish the capital costs for the implementation of this infrastructure.

These quantities and costing schedules are included herein as Appendix B.

The cost estimates for the primary and secondary bulk potable water distribution systems (including pumping stations, pipelines, and reservoirs) are summarised in Table 6-2.

These are at current (2014) price levels and allowance must also be made in the project budgeting for price escalation to the date of construction, the quantum of which will be dependent upon the implementation programme and timing of such expenditure. More details of this process are given in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15.

It should be noted that the extent of the DWS-implemented potable water components of the Mzimvubu Water Project is the Ntabelanga dam and associated infrastructure, the water treatment works, and the primary and secondary systems only. Analysis of the tertiary lines was undertaken purely to ensure that correct allowance has been made for delivery into these systems. The DM's are responsible for the delivery of water from the secondary reservoirs to the households.

A cost estimate for the Ntabelanga WTW having the daily peak demand output capacity for the water requirement projected in 2050 (101 515 m^3/day) is R817 152 000 including VAT, but this is also at current price levels and excludes escalation to date of construction.

Analysis of the tertiary lines was undertaken purely to ensure that correct budgetary allowance and implementation programme has been made for delivery into these systems. The DM's are responsible for the delivery of water from the secondary reservoirs to the households.

Table 6-3 summarises the cost estimate of the tertiary potable water distribution system.

Of the R1 819 914 005 (incl. VAT) cost of the Tertiary lines, the three DMs would need to budget for their particular portions of the system as given in Table 6-4. The costs again exclude escalation.

Preliminary analysis of the unit reference value of this scheme has been undertaken and will be finalized and reported in the Cost Estimates and Economic Analysis Report.

The analyses indicate that the URV of water produced by the scheme would be as follows (10% pa discount rate used):

If all capital expenditure listed in Tables 1 and 2 is included in the discounted cashflow analysis, at a 10% discount rate, the resulting URV of water supplied would be R16.71/m^3.

If only operation, maintenance and periodical plant refurbishment costs are included in the discounted cash flow analysis of the same works, the URV = R2.72/m^3.

Given that the latter approach is normally taken with grant funded works, the URV value is considered to be within the range normally expected on water supply projects.

Table 6-2: Capital Costs – Primary and Secondary Bulk Water System

ITEM	COMPONENT	PRIMARY SYSTEM COST (R)				SECONDARY SYSTEM COST (R)				TOTAL (R)
		ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 1	ZONE 2	ZONE 3	ZONE 4	
1	Pipelines	60 117 760	99 224 769	80 782 214	44 233 915	97 519 488	200 148 761	227 791 205	0	809 818 112
2	Pumpstations	20 000 000	20 000 000	20 644 000	16 500 000	0	0	8 814 000	0	85 958 000
3	Reservoirs	6 500 000	71 500 000	30 000 000	11 000 000	0	23 500 000	0	0	142 500 000
4	Electrical supply	10 000 000	10 000 000	7 500 000	5 000 000	0	0	2 500 000	0	35 000 000
	Sub-Total	***96 617 760***	***200 724 769***	***138 926 214***	***76 733 915***	***97 519 488***	***223 648 761***	***239 105 205***	***0***	***1 073 276 112***
5	Contingencies (15%)	14 492 664	30 108 715	20 838 932	11 510 087	14 627 923	33 547 314	35 865 781	0	160 991 417
	Sub-Total	***111 110 424***	***230 833 484***	***159 765 147***	***88 244 002***	***112 147 411***	***257 196 075***	***274 970 986***	***0***	***1 234 267 528***
6	Engineering/EMP Costs (12%)	13 333 251	27 700 018	19 171 818	10 589 280	13 457 689	30 863 529	32 996 518	0	148 112 103
	Sub-Total	***124 443 675***	***258 533 502***	***178 936 964***	***98 833 282***	***125 605 100***	***288 059 604***	***307 967 504***	***0***	***1 382 379 632***
	VAT 14%	*17 422 114*	*36 194 690*	*25 051 175*	*13 836 660*	*17 584 714*	*40 328 345*	*43 115 451*	*0*	*193 533 148*
	Total (Rand)	**141 865 789**	**294 728 193**	**203 988 139**	**112 669 942**	**143 189 814**	**328 387 949**	**351 082 954**	**0**	**1 575 912 780**

Note: Current (2014) price levels - Excludes escalation to date of construction

Table 6-3: Capital Costs – Tertiary Bulk Water System Only

ITEM	COMPONENT	TERTIARY SYSTEM COST (R)				TOTAL (R)
		ZONE 1	ZONE 2	ZONE 3	ZONE 4	
1	Pipelines	164 061 029	439 024 905	413 039 272	108 386 050	1 124 511 256
2	Pumpstations	0	0	4 238 000	2 184 000	6 422 000
3	Reservoirs	13 455 000	46 135 000	30 955 000	12 975 000	103 520 000
4	Electrical supply	0	0	3 750 000	1 250 000	5 000 000
	Sub-Total	***177 516 029***	***485 159 905***	***451 982 272***	***124 795 050***	***1 239 453 256***
5	Contingencies (15%)	26 627 404	72 773 986	67 797 341	18 719 257	185 917 988
	Sub-Total	***204 143 433***	***557 933 891***	***519 779 613***	***143 514 307***	***1 425 371 244***
6	Engineering/EMP Costs (12%)	24 497 212	66 952 067	62 373 554	17 221 717	171 044 549
	Sub-Total	***228 640 645***	***624 885 958***	***582 153 167***	***160 736 024***	***1 596 415 794***
	VAT 14%	*32 009 690*	*87 484 034*	*81 501 443*	*22 503 043*	*223 498 211*
	Total (Rand)	**260 650 336**	**712 369 992**	**663 654 610**	**183 239 067**	**1 819 914 005**

Note: Current (2014) price levels - Excludes escalation to date of construction

Table 6-4: Split of Budgets Required by DMs to Implement Tertiary Lines

Tertiary Pipelines Funding	Alfed Nzo DM	Joe Gqabi DM	OR Tambo DM	TOTAL
Total cost by DM incl VAT	**R 599 861 932**	**R121 298 035**	**R 1 098 754 038**	**R1 819 914 005**

6.7 Conclusion

There is a viable potential to supply treated water from the Ntabelanga Dam to all of the settlements within the watershed adjacent to and downstream of the dam as far as the Tsitsa River's confluence with the main Mzimvubu River, as well as a significant population in settlements outside of the Tsitsa river watershed boundaries.

The total population that can be served is 726 616 at the design horizon of year 2050. The average water demand from this system at the design horizon is estimated at 84 500 m^3/d.

Analysis of the unit reference value of this scheme has been undertaken and will be finalized and reported in the Cost Estimates and Economic Analysis Report.

The preliminary analyses indicate that the URV of water produced by the scheme would be as follows (10% pa discount rate used):

If all capital expenditure is included in the discounted cashflow analysis, the URV of water supplied = R16.71m^3

If only operation, maintenance and periodical plant refurbishment costs are included in the discounted cashflow analysis, the URV = R2.72/m^3

Given that the latter approach is normally taken with grant funded works, the URV value is within the range normally expected on water supply projects.

The assumptions made in this report were:

- The Ntabelanga Dam will be constructed and operational by year 2020,
- The necessary water supply infrastructure will be in place and ready to convey potable water to all settlements in 2020, and
- Village reticulation infrastructure will be in place and functional to receive the bulk water for consumption in 2020.

7. BULK RAW WATER SUPPLY INFRASTRUCTURE FOR IRRIGATION

7.1 Introduction

The planning and water requirements for irrigated agriculture in the area to be supplied by the Ntabelanga Dam are fully described in the Irrigation Development Report No. P WMA 12/T30/00/5212/9, and the Water Requirements Report No. P WMA 12/T30/00/5212/6.

Figure 7-1 shows the locations of high potential land that have been identified as being suitable for irrigation development.

Two remote “outlier” areas 10 and 12 were noted. Area 10 is far from the proposed raw water source and has a low proportion of the higher soil classes. Area 12 has a significant area of high class soils but is at a straight line distance of 12 km, and at an elevation some 440 m above the raw water pumping station. The terrain between the pumping station and area 12 is particularly mountainous and highly problematical for pipeline construction. An intermediate booster pumping station would also be required. This area is not consider viable with regard to being supplied with water from the Ntabelanga Dam.

Areas 1, 8, 9 and 13 are close enough to the dam and river, and could be irrigated directly from source using local “quick-fit” abstraction and distribution infrastructure.

Most of the high potential farming units are located in and around the urbanised centre of Tsolo, at a distance of some 17 km away from the Tsita River, and at an elevation between 130 and 220 m above the river level at that nearest point.

This means that raw water supply to the lands in the Tsolo area would need to be conveyed via pipeline and pumped from the source, which will have significant operation, maintenance and energy cost implications.

This is analysed in detail in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15.

It is proposed that these areas be developed as approximately 45 farming units with sizes ranging from 45 to 65 hectares. The total area of land that would be developed in this way has been estimated as 2 868 ha, of which 2 451 ha is located around the Tsolo area, and the remainder is located adjacent to the river downstream of the dam, and along the shoreline of the inundated area upstream of the dam.

The irrigable areas that have been identified adjacent to the water bodies could be supplied using mobile abstraction pumps, and quick-fit coupling pipeline distribution and irrigation systems.

However, the main potential irrigation areas located around Tsolo are situated at elevations of between 140 m and 220 m above the Tsitsa River elevation, and between 17 and 32 km from the nearest point of the Tsitsa River, and the Ntabelanga Dam, respectively. This will therefore require significant pumping and conveyance systems to deliver raw water in bulk to these lands.

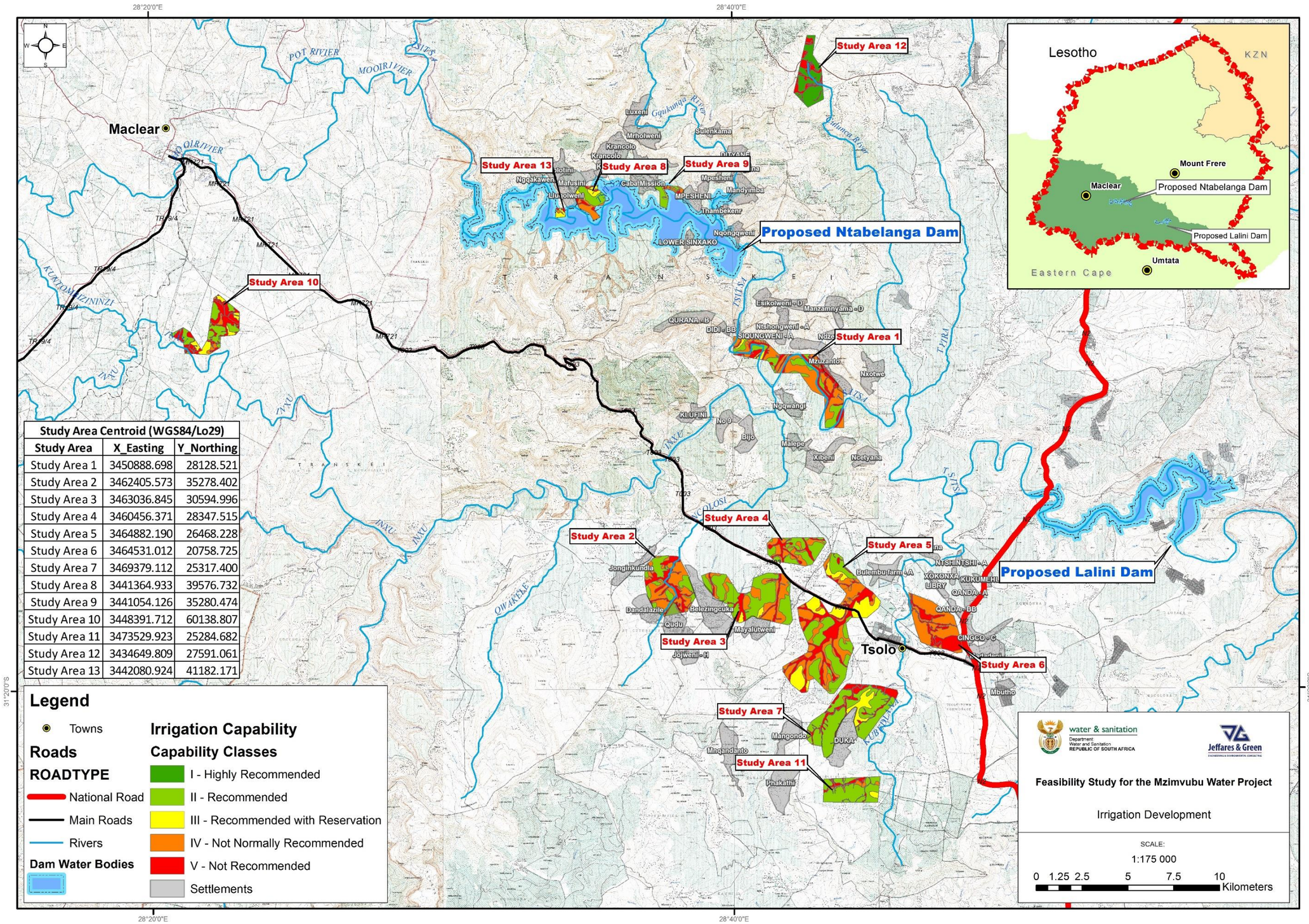


Figure 7-1: Land Identified as Having High Irrigation Potential

7.2 Raw Water Demand to Tsolo Area

The Water Requirements Report concludes that bulk raw water transfer to the Tsolo area irrigation scheme should be planned on the basis of a peak of 11 410 m^3/ha/a, with an average of (say) 8 800 m^3/ha/a (equivalent to 880 mm/yr).

For these Tsolo irrigation areas totalling 2 451 ha, and allowing for up to 20 hours per day pumping to achieve the required daily application totals for the suggested cropping patterns, would require the following water transfer pumping rate:

Peak daily pumping rate: 1.06 m^3/s
Average pumping rate: 0.81 m^3/s

The above equates to net application rates ranging between 619 mm to 1141 mm per annum, and allows for operational losses.

7.3 Bulk Raw Water Transfer Options

The identified potential farming units to be irrigated at Tsolo are located at elevations ranging from 930 to 1 090 m.a.s.l. A minimum residual head of 20 m is required in the bulk water system at the 'edge of field" on each farming unit so that the sprinkler systems on all farms can be supplied by gravity.

Figure 6-2 overleaf shows these areas in more detail. They have been colour coded to show the elevation ranges that they fall within, as well as their available irrigable areas and maximum elevation within each area.

7.3.1 Raw Water Source Alternatives

Two alternatives have been investigated as raw water source locations.

1. Alternative 1: At the Ntabelanga Dam raw water outlet works.
2. Alternative 2: At an abstraction weir and pumping station located on the Tsitsa River downstream of the dam, and as close to Tsolo as possible.

Alternative 1 would have a raw water pumping station located near to the inlet works of the proposed Ntabelanga WTW, and this would have a suction elevation range at a minimum of 915.0 m.a.s.l., and an average of approximately 937.0 m.a.s.l.

Alternative 2 abstracts raw water from the Tsitsa River downstream of the Ntabelanga Dam via an abstraction weir. This may require low lift pumps to transfer water from the river to a large settlement basin prior to high lift pumping onward to the Tsolo area. The river level at this location is 872.0 m.a.s.l., and this alternative therefore has between 43 and 65 m higher pumping head than Alternative 1.

7.4 Irrigation Water Distribution Options

Four options were investigated for irrigation water distribution:

7.4.1 Raw Water Transfer Options 1 and 2

Options 1 and 2 considered pumping raw water directly from the two alternative sources given above to a single command reservoir located at a strategic location, to control flow and maintain pressure along this single rising main. Branches off the rising main are then fed to the edge of fields of the various irrigable land areas described above. Local distribution and sprinkler systems in-field are provided by the farm unit operators. One advantage of these options is the single pumping solution, but a disadvantage is that there will need to be pressure reduction on some branch lines and that all of the raw water is effectively being pumped to the maximum elevation. The end point command reservoir would also need to be an expensive reinforced concrete structure, as there is no suitable location at sufficient elevation for a simpler open, earth-bunded storage structure.

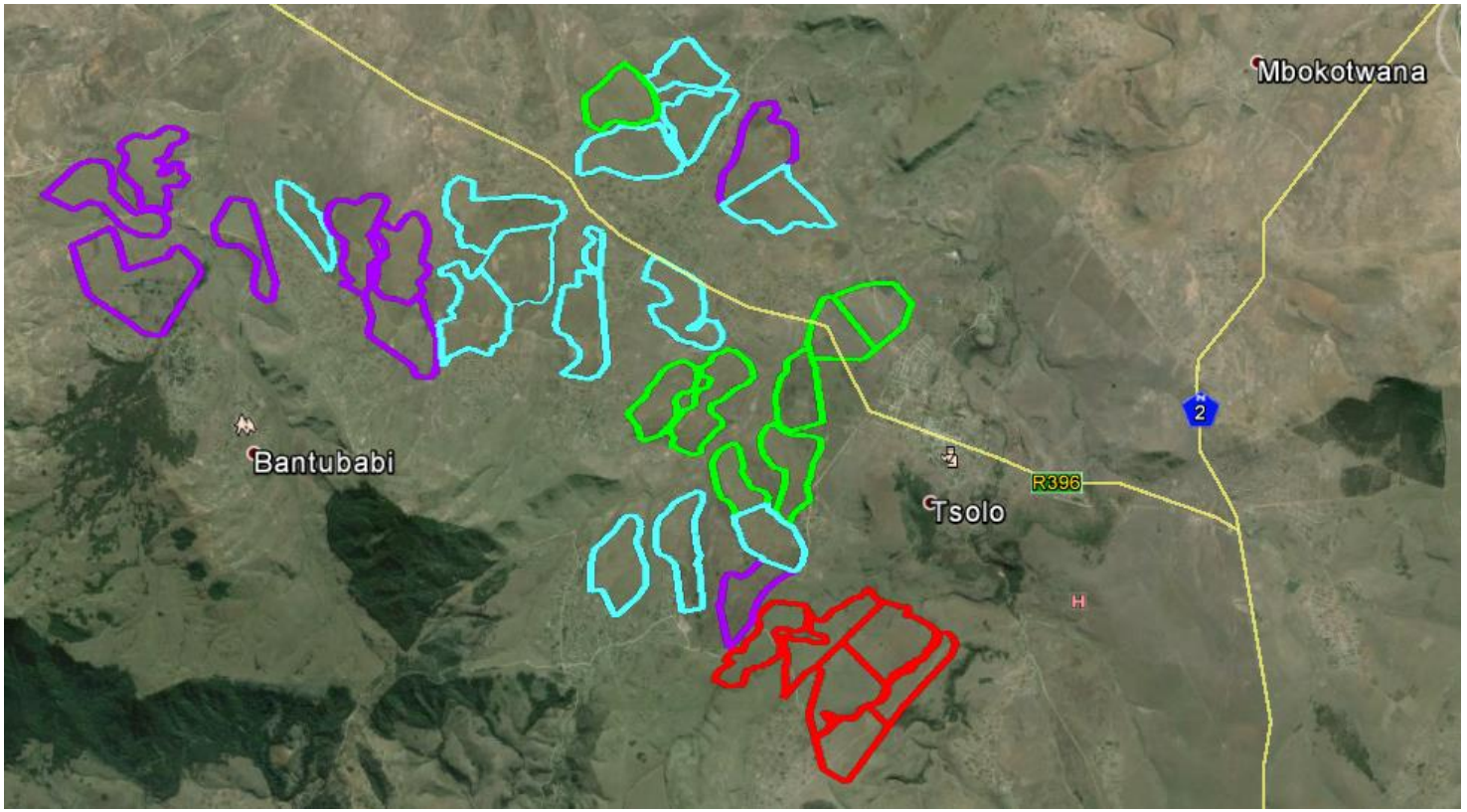


Figure 7-2: Elevations of Land Near to Tsolo with High Irrigation Potential

Key to Farm Unit Elevation Ranges:	
	930 to 1 000 m.a.s.l
	1 000 to 1 040 m.a.s.l
	1 040 to 1 080 m.a.s.l
	1 080 to 1 120 m.a.s.l

7.4.2 Raw Water Transfer Options 3 and 4

Options 3 and 4 considered breaking the delivery of the total bulk water transfer into a shorter rising main to an intermediate open-topped, earth-bunded storage tank, from where it gravitates flow to the distribution system supplying the majority of the land areas at elevations coded in green and blue on Figure 7-2.

The intermediate storage structure will have a volume of one day's storage of the full system demand, allowing for some flexibility in selection of pumping tariff bands, as well as catering for power outages. This storage facility is located on a ridge en route at an elevation of 1 068 m.a.s.l.

Within this distribution system, two smaller booster pumping stations will be required to lift raw water further to the areas at higher elevation, shown in purple and red on Figure 7-2.

Smaller balancing storage tanks will be provided at the end points of the branch lines, which will effect pressure regulation and pump control, and have six hours storage to cater for short power outages.

Figures 7-3 to 7-7 show the proposed alignments and end delivery arrangements of these four options

A discounted cash flow/URV analysis was undertaken to optimally size the rising mains and raw water pumping configurations of Options 1 to 4. The results are summarized in Tables 7-1 to 7-4.

These models were run for a 30 year period of operation.

As with the potable water system, this analysis again uses the cost of pumps, power, pipelines, operation and maintenance for a range of pipeline diameter and pumping head combinations to seek the best solution. Other common costs such as the pumping station building structure, and command reservoir were not included, and this analysis is therefore only comparative rather than all-inclusive.

From the feasibility design process, quantities were taken of the proposed infrastructure and an engineer's estimate was undertaken to establish the capital costs for the implementation of this infrastructure.

These quantities and costing schedules are included herein as Appendix C.

Power costs were based upon an average ESKOM Ruraflex tariff of R0.48/kWh assuming 20 hours pumping per day, thus avoiding peak hour tariff charges. This tariff is conservative and averages hourly and seasonal tariff changes over each year.

Given that all of the primary and secondary pipelines are high pressure, all of the analysis was undertaken using steel pipeline materials. Various standard outside diameter options were analysed, and maximum working pressures calculated, taking into account the worst case as regard surge pressures are concerned. This, and other required pipe structure criteria were then used to determine the minimum wall thickness required for each option, and this determined the internal diameter to be used for hydraulic velocity and head loss calculation purposes.

Thus, pipeline internal diameters on the tables below are not nominal rounded figures but actual figures calculated from the process described above.

Further details of these analyses are given in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15.

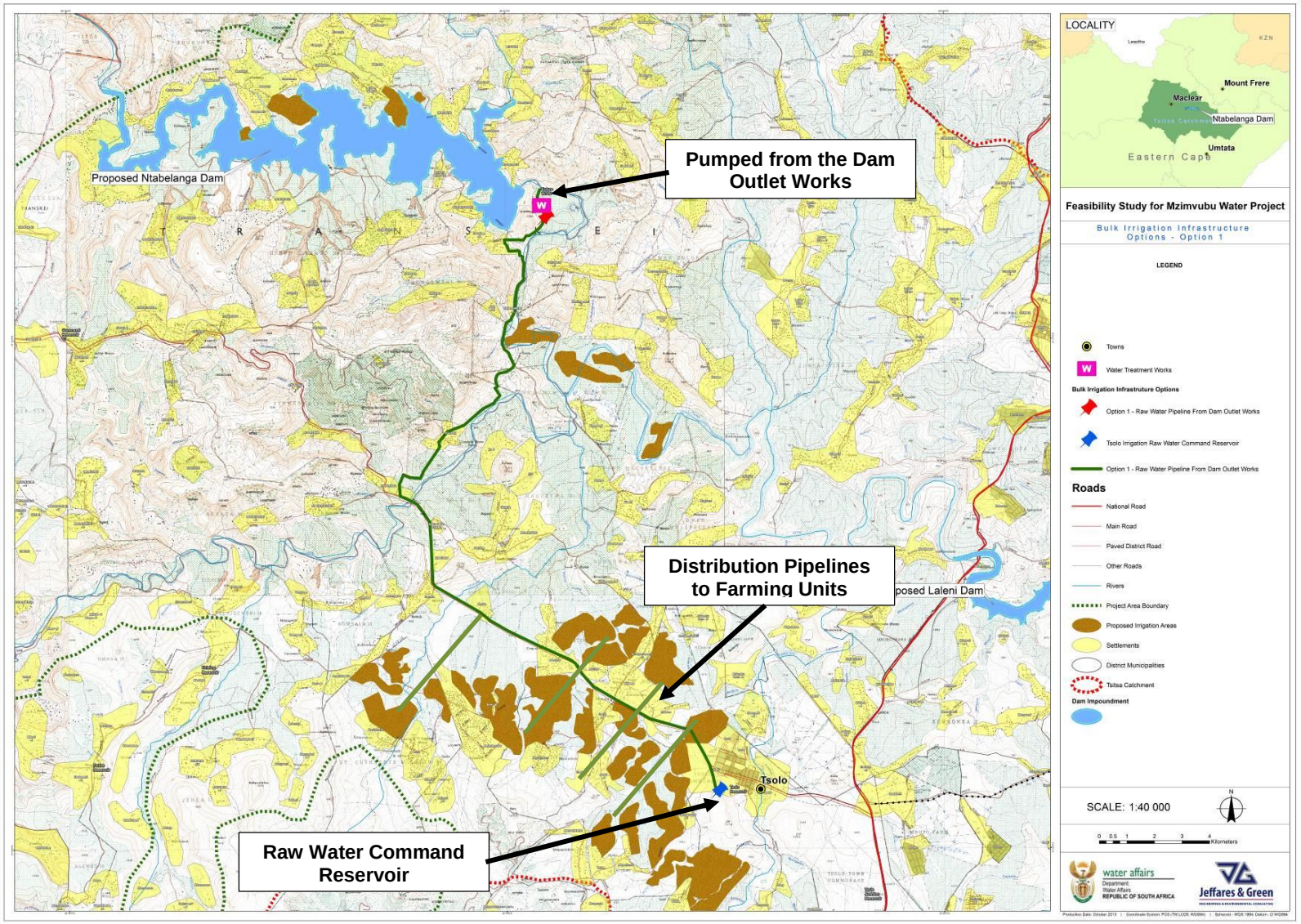


Figure 7-3: Overall Layout Plan of Option 1

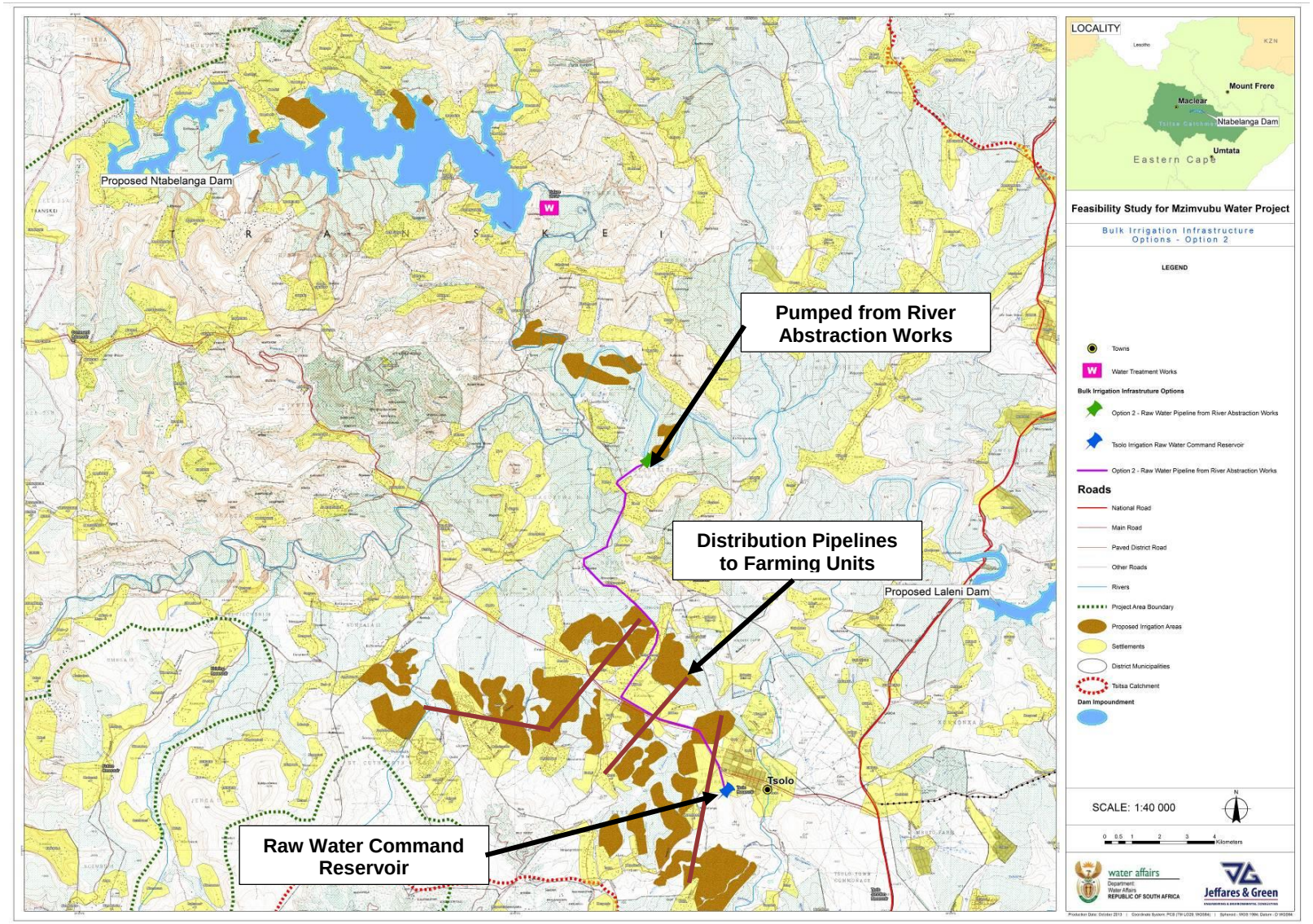


Figure 7-4: Overall Layout Plan of Option 2

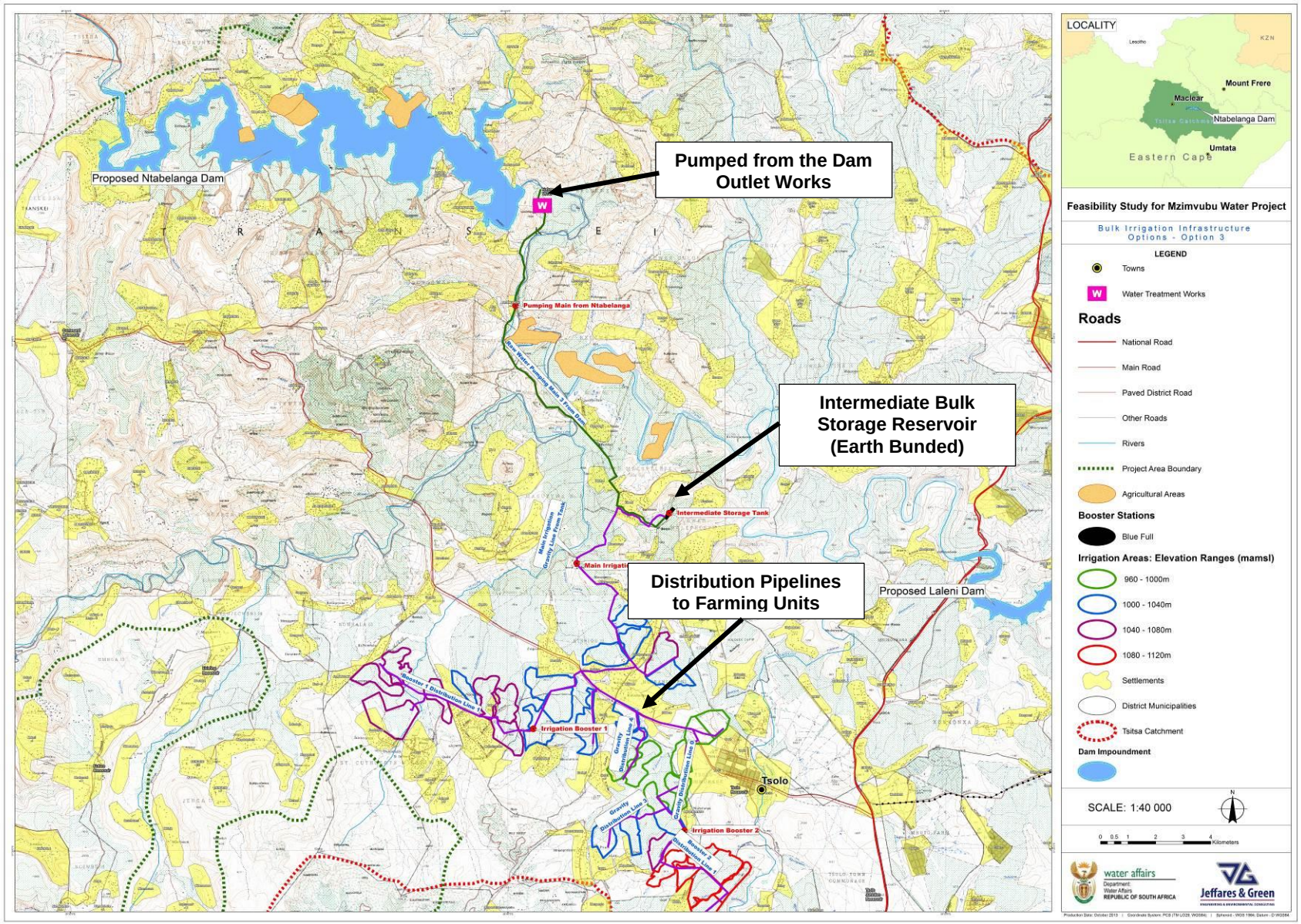


Figure 7-5: Overall Layout Plan of Option 3

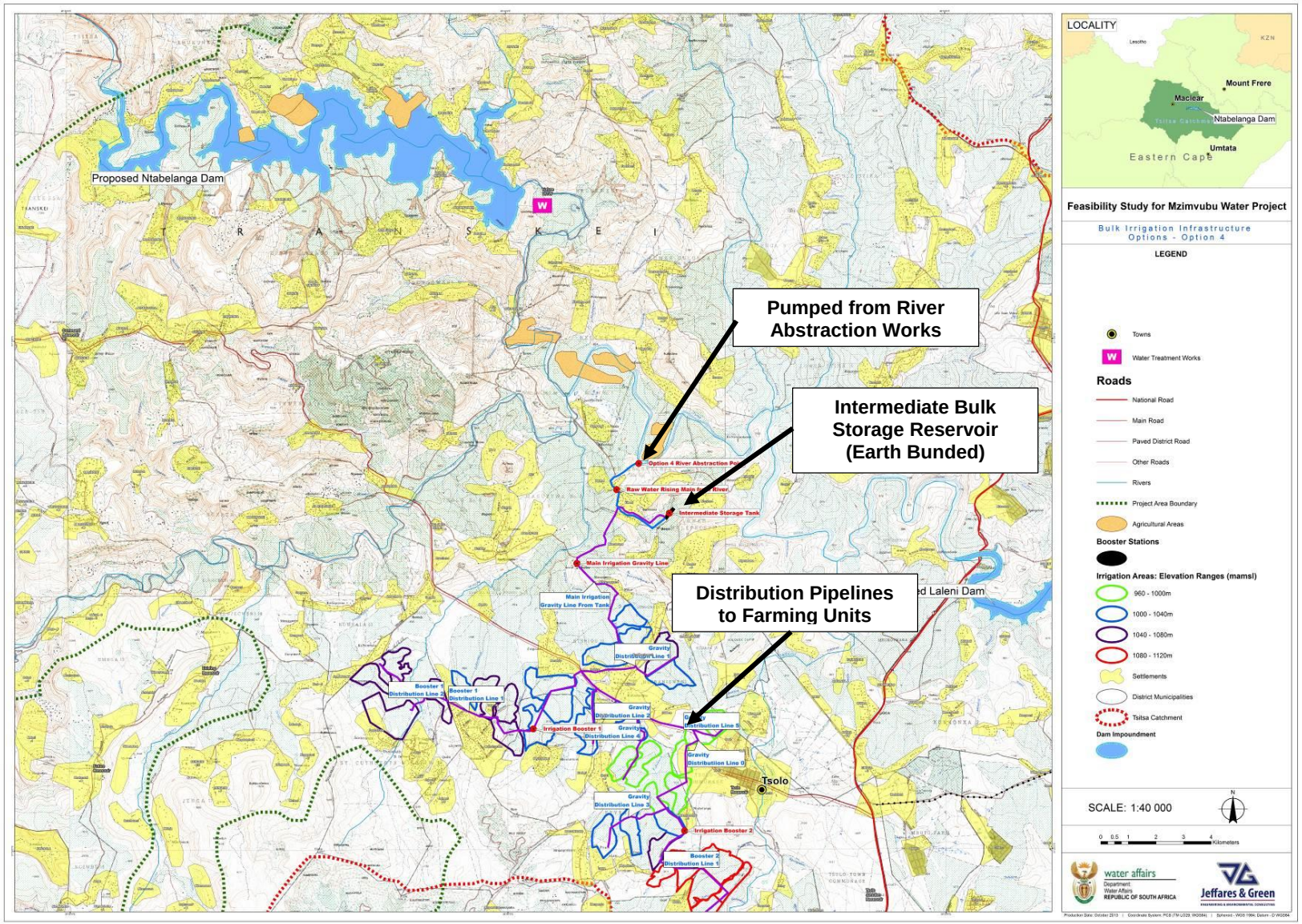


Figure 7-6: Overall Layout Plan of Option 4

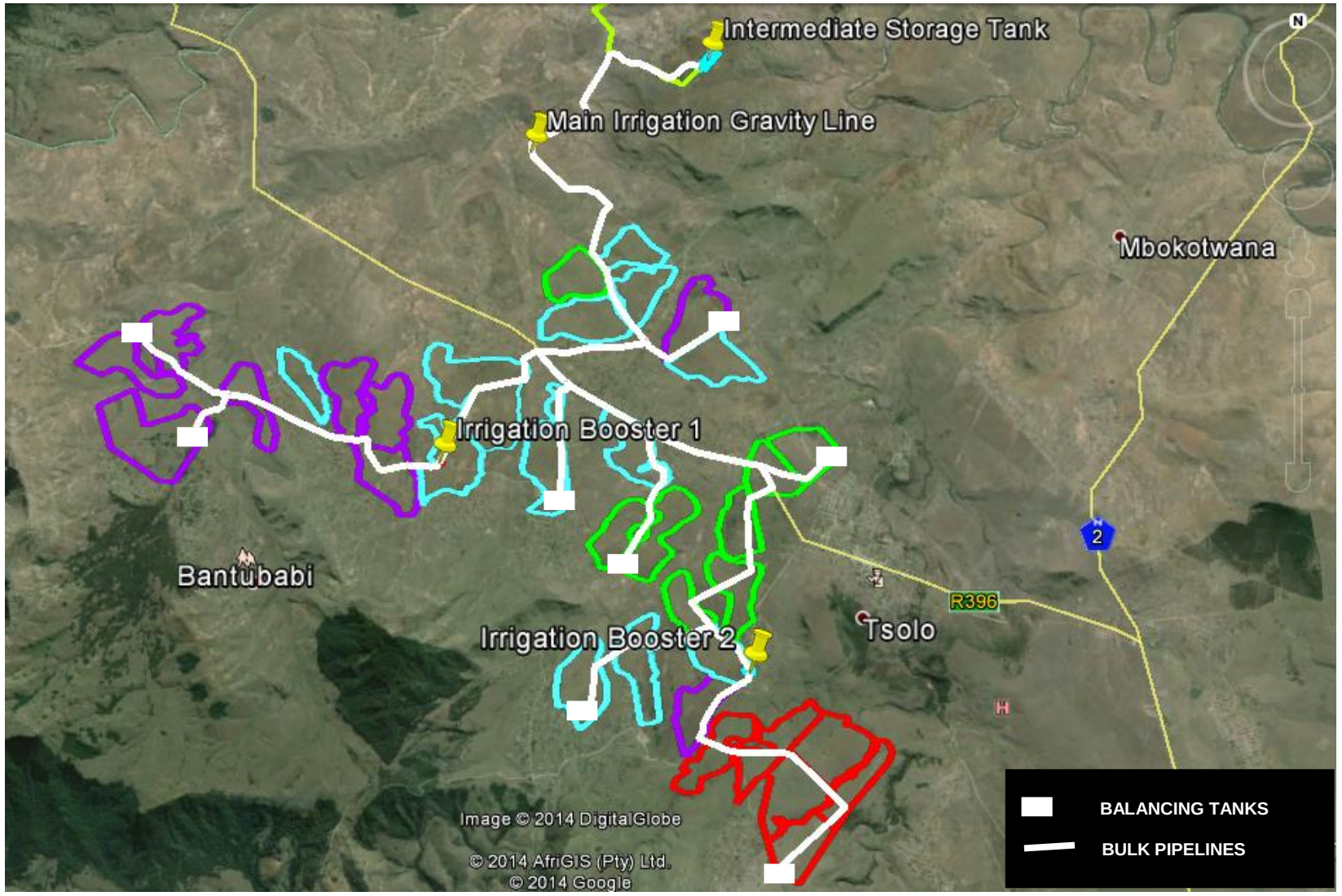


Figure 7-7: Detail of Bulk Irrigation Water Distribution to Edge of Field

Table 7-1: URV Analysis of Raw Water Transfer – Option 1

Raw Water - Option 1						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**349.30**	**277.86**	**237.80**	**218.98**
MAX POWER (kW):			**6 055**	**4 816**	**4 157**	**3 796**
URV (R/m³)	4%		2.012	1.908	**1.906**	2.035
	6%		2.146	**2.085**	2.118	2.277
	8%		2.294	**2.279**	2.350	2.540
	10%		**2.451**	2.484	2.594	2.819

NB: lowest URV for each discount rate marked in red

Table 7-2: URV Analysis of Raw Water Transfer – Option 2

Raw Water - Option 2						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**334.65**	**297.31**	**275.17**	**266.53**
MAX POWER (kW):			**5 801**	**5 153**	**4 809**	**4 620**
URV (R/m³)	4%		1.630	1.576	**1.575**	1.642
	6%		1.690	**1.659**	1.676	1.759
	8%		1.758	**1.751**	1.787	1.887
	10%		**1.832**	1.849	1.907	2.024

NB: lowest URV for each discount rate marked in red

Table 7-3: URV Analysis of Raw Water Transfer – Option 3

Raw Water - Option 3						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**232.65**	**197.04**	**178.07**	**167.69**
MAX POWER (kW):			**4 033**	**3 415**	**3 087**	**2 907**
URV (R/m³)	**4%**		1.225	1.174	**1.173**	1.237
	6%		1.289	**1.258**	1.275	1.354
	8%		1.359	**1.351**	1.386	1.482
	10%		**1.434**	1.450	1.505	1.617

NB: lowest URV for each discount rate marked in red

Table 7-4: URV Analysis of Raw Water Transfer – Option 4

Raw Water - Option 4						
INTERNAL PIPE DIA (mm):>			**799**	**898**	**1000**	**1102**
MAX VELOCITY (m/s):			**2.11**	**1.67**	**1.35**	**1.11**
MAX HEAD: (m)			**230.24**	**220.82**	**215.80**	**213.05**
MAX POWER (kW):			**3 991**	**3 828**	**3 741**	**3 693**
URV (R/m³)	4%		1.105	1.092	**1.091**	1.108
	6%		1.117	**1.109**	1.113	1.134
	8%		1.132	**1.130**	1.139	1.164
	10%		**1.148**	1.153	1.167	1.197

NB: lowest URV for each discount rate marked in red

Optimum pipe sizing lies between 914 mm and 1016 mm diameter and given that these URVs are within a few percent of each other, the recommendation would be made to opt for the larger sized pipeline, in order to reduce power costs and the risk of increased operating costs in the future.

In all options therefore, the 1 016 mm diameter pipeline is recommended.

7.5 Raw Water Pumping Configurations

The raw water pumping configurations for these options are based upon locally-available pumps suitable for the duties required and able to deal with sediment laden water.

7.5.1 Option 1

Table 7-5 summarises the Option 1 pumping station and rising main characteristics.

Table 7-5: Option 1 Pumping Station and Rising Main Characteristics

RAW WATER PUMP STATION OPTION 1				
2050 capacity	1 060	l/s =	3816	m³/hr
Rising main				Head (m)
Length	32 900	m	Static	182.00
Diameter	1 016	mm	Dynamic	55.8
Wall thickness	8	mm	**Total**	**237.80**
ID	1 000	mm		
A	0.785	m²		
V	1.35	m/s		
Pumps				
Duty	Head	237.80		
	1/5 Flow	763.2	m³/hr	
		212	l/s	
Pumps	5 x Curo	250/300	4-stages	
Hydraulic power	3.30	MW		
Supplied power	4.34	MW		

Due to the high lift the Curo pumps were again used to give an example of the performance and pump arrangement that can be expected. This pumping station would be located close to the Ntabelanga Dam WTW, and could either be a stand-alone pumping station with layout as illustrated on other stations above, or could be integrated within the WTW clear water pumping station structure but having a separate inlet and outlet stream.

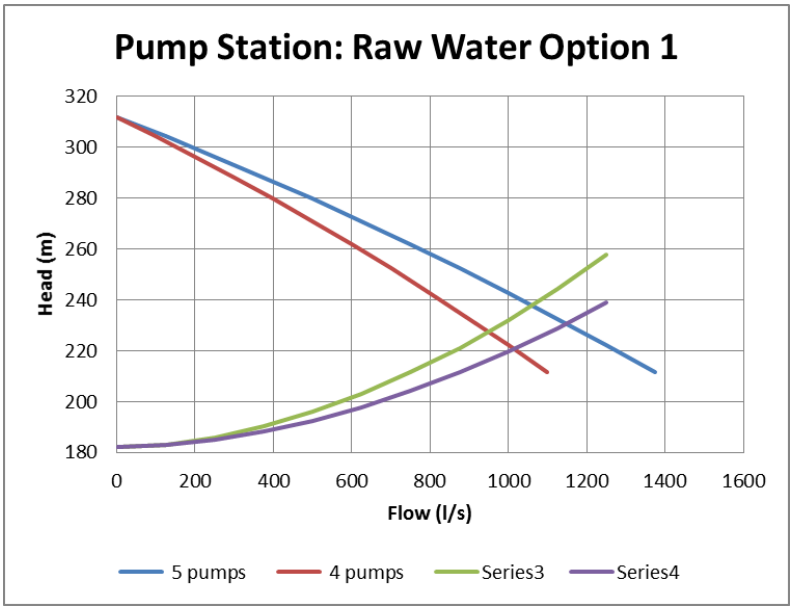


Figure 7-8: Raw Water Pumping Station Option 1 – System Curve

7.5.2 Option 2

Table 7-6 summarises the Option 2 pumping station and rising main characteristics.

Table 7-6: Option 2 Pumping Station and Rising Main Characteristics

RAW WATER PUMP STATION OPTION 2					
2050 capacity	1 060		l/s =	3 816	m³/hr
Rising main					Head (m)
Length		17 200	m	Static	246.00
Diameter		1 016	mm	Dynamic	29.17
Wall thickness		8	mm	**Total**	**275.17**
ID		1 000	mm		
A		0.785	m²		
V		1.35	m/s		
Pumps					
Duty	Head		275.17		
	1/5 Flow		763.20	m³/hr	
			212.00	l/s	
Pumps		5 x Curo	250/300	4-stages	
Hydraulic power	3.82		MW		
Supplied power	5.02		MW		

Due to the high lift the Curo pumps were again used to give an example of the performance and pump arrangement that can be expected. The difference between Option 1 and Option 2 pumps would be the impellor sizes. This pumping station would be located on the bank of the Tsitsa River at a suitable location as near as possible to the proposed Tsolo irrigated farming units. A river weir and intake works will also be required, and should be designed to reject sediment build-up or alternatively two stage pumping and a desilting works may be required.

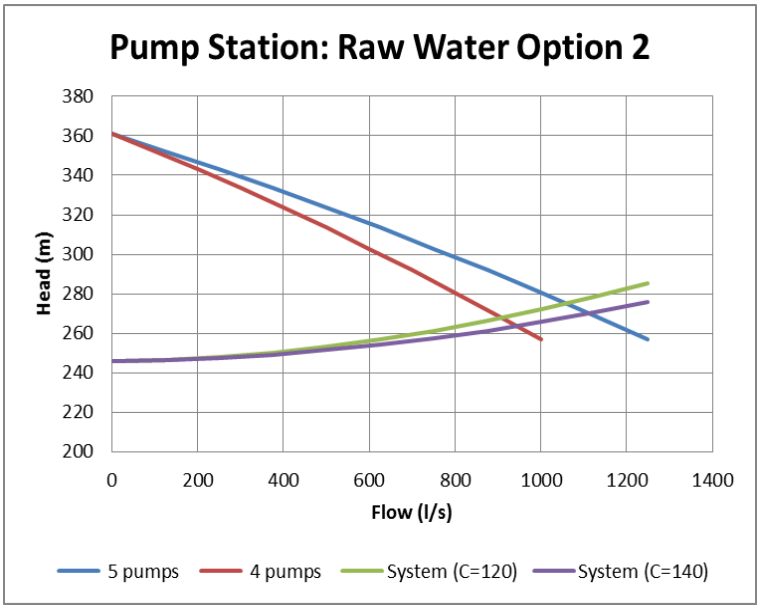


Figure 7-9: Raw Water Pumping Station Option 2 System Curve

7.5.3 Option 3

Table 7-7 summarises the Option 3 pumping station and rising main characteristics.

Table 7-7: Option 3 Pumping Station and Rising Main Characteristics

RAW WATER PUMP STATION OPTION 3					
2050 capacity	1 060		l/s =	3 816	m³/hr
Rising main					Head (m)
Length		16 400	m	Static	151.00
Diameter		1 016	mm	Dynamic	31.80
Wall thickness		8	mm	**Total**	**178.82**
ID		1 000	mm		
A		0.785	m²		
V		1.35	m/s		
Pumps					
Duty	Head		182.80		
	1/5 Flow		763.20	m³/hr	
			212.00	l/s	
Pumps		5 x Curo	250/300	4-stages	
Hydraulic power	1.90		MW		
Supplied power	2.67		MW		

Due to the high lift the Curo pumps were again used to give an example of the performance and pump arrangement that can be expected. The difference between Option 1 and Option 3 pumps would be the impellor sizes.

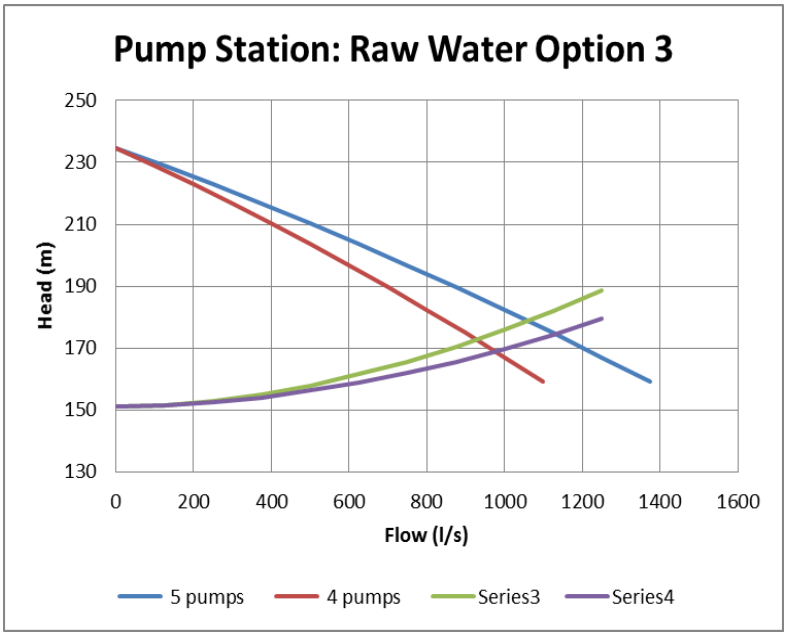


Figure 7-10: Raw Water Pumping Station Option 3 System Curve

7.5.4 Option 4

Table 7-8 summarises the Option 4 pumping station and rising main characteristics.

Table 7-8: Option 4 Pumping Station and Rising Main Characteristics

RAW WATER PUMP STATION OPTION 4					
2050 capacity	1 060		l/s =	3 816	m³/hr
Rising main					Head (m)
Length		16 400	m	Static	208.50
Diameter		1 016	mm	Dynamic	7.36
Wall thickness		8	mm	**Total**	**215.86**
ID		1 000	mm		
A		0.785	m²		
V		1.35	m/s		
Pumps					
Duty	Head		215.86		
	1/5 Flow		763.20	m³/hr	
			212.00	l/s	
Pumps		5 x Curo	250/300	4-stages	
Hydraulic power	2.25		MW		
Supplied power	3.15		MW		

Due to the high lift the Curo pumps were again used to give an example of the performance and pump arrangement that can be expected. The difference between Option 2 and Option 4 pumps would be the impellor sizes.

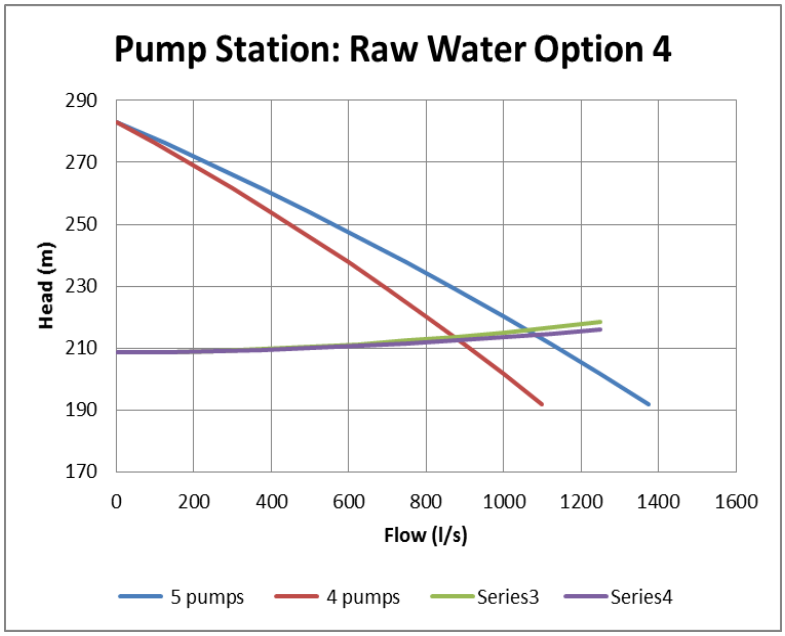


Figure 7-11: Raw Water Pumping Station Option 4 System Curve

In all options the duty point when using five duty pumps, each delivering 212 l/s was considered. Two additional pumps should be provided as standby/backup. The pumps are likely to be 2 m long and 1 m wide and high. Motors will be a similar size and a clear distance of 1.5 m between plinths has been allowed in the sizing of the building.

7.6 Bulk Raw Water System - Capital Works and Operating Costs

Full details of cost estimates for Options 1 to 4 are given in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15.

All costs are based upon 2014 price levels, and this includes power tariffs, based upon an annual average Ruraflex tariff (R0.84/kWh) and avoidance of peak hour tariffs by limiting pumping to up to 20 hours per day.

In each case, the costs of both raw water pumping system and the distribution systems to deliver water to edge of field has been included.

In the case of Options 3 and 4, the distribution systems are identical.

The estimated capital costs, and annual operation and maintenance costs are summarized in Tables 7-9 to 7-12.

Table 7-9: Capital, Operation and Maintenance Costs for Option 1

OPTION 1 - IRRIGATION PIPELINE DIRECT FROM DAM					
ITEM	DESCRIPTION	AMOUNT		O&M per year	
1	Pipelines	R 373 932 964	0.50%	R	1 869 665
2	Abstraction works	R 15 000 000	0.25%	R	37 500
3	Pumpstations	R 19 313 896	4%	R	772 556
4	Reservoirs	R 45 000 000	0.25%	R	112 500
5	Electrical supply	R 30 000 000	4%	R	1 200 000
6	Contingencies	R 48 324 686	1%	R	483 247
7	Engineering fees	R 31 894 293			
	Allowance for M&E depreciation and replacement funding			R	1 931 390
	Total 1	**R 563 465 839**		**R**	**6 406 857**
	VAT	R 78 885 217		R	896 960
	Total	**R 642 351 057**		**R**	**7 303 817**
			Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power			21 240 366		R 0.34
Power Cost per year		**R 20 063 277**	21 240 366		R 0.94
Cost for supply of raw water to edge of field including power			**R/m^3**		**R 1.29**

Table 7-10: Capital, Operation and Maintenance Costs for Option 2

OPTION 2 - IRRIGATION PIPELINE ABSTRACTED FROM RIVER					
ITEM	DESCRIPTION	AMOUNT		O&M per year	
1	Pipelines	R 212 117 272	0.50%	R	1 060 586
2	Abstraction works	R 25 000 000	0.25%	R	62 500
3	Pumpstations	R 21 910 061	4%	R	876 402
4	Reservoirs	R 45 000 000	0.25%	R	112 500
5	Electrical supply	R 30 000 000	4%	R	1 200 000
6	Contingencies	R 33 402 733	1%	R	334 027
7	Engineering fees	R 22 045 804			
	Allowance for M&E depreciation and replacement funding			R	2 191 006
	Total 1	**R 389 475 870**		**R**	**5 837 022**
	VAT	R 54 526 622		R	817 183
	Total	**R 444 002 492**		**R**	**6 654 205**
			Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power			21 240 366		R 0.31
Power Cost per year		**R 22 760 173**	21 240 366		R 1.07
Cost for supply of raw water to edge of field including power			**R/m^3**		**R 1.38**

Table 7-11: Capital, Operation and Maintenance Costs for Option 3

OPTION 3 - IRRIGATION PIPELINE DIRECT FROM DAM					
ITEM	DESCRIPTION	AMOUNT		O&M per year	
1	Pipelines	R 405 636 748	0.50%	R	2 028 184
2	Abstraction works	R 8 000 000	0.25%	R	20 000
3	Pumpstations	R 23 280 152	4%	R	931 206
4	Reservoirs	R 50 000 000	0.25%	R	125 000
5	Electrical supply	R 10 000 000	4%	R	400 000
6	Contingencies	R 49 691 690	1%	R	496 917
7	Engineering fees	R 32 796 515			
	Allowance for M&E depreciation and replacement funding			R	956 515
	Total 1	**R 579 405 105**		**R**	**4 957 822**
	VAT	R 81 116 715		R	694 095
	Total	**R 660 521 820**		**R**	**5 651 917**
			Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power			21 240 366		R 0.27
Power Cost per year		**R 18 559 958**	21 240 366		R 0.87
Cost for supply of raw water to edge of field including power			**R/m^3**		**R 1.14**

Table 7-12: Capital, Operation and Maintenance Costs for Option 4

OPTION 4 - IRRIGATION PIPELINE DIRECT FROM DAM					
ITEM	DESCRIPTION	AMOUNT		O&M per year	
1	Pipelines	R 281 337 560	0.50%	R	1 406 688
2	Abstraction works	R 33 000 000	0.25%	R	82 500
3	Pumpstations	R 25 044 951	4%	R	1 001 798
4	Reservoirs	R 50 000 000	0.25%	R	125 000
5	Electrical supply	R 30 000 000	4%	R	1 200 000
6	Contingencies	R 41 938 251	1%	R	419 383
7	Engineering fees	R 27 679 246			
	Allowance for M&E depreciation and replacement funding			R	1 132 995
	Total 1	**R 489 000 008**		**R**	**5 368 364**
	VAT	R 68 460 001		R	751 571
	Total	**R 557 460 010**		**R**	**6 119 934**
			Tot. Water		
O&M Cost for supply of raw water to edge of field excluding power			21 240 366		R 0.29
Power Cost per year		**R 21 309 869**	21 240 366		R 1.00
Cost for supply of raw water to edge of field including power			**R/m^3**		**R 1.29**

In the analyses undertaken, it has been assumed that all capital costs will be grant funded and will not have a capital redemption requirement. As is shown, the capital cost requirements for Options 2 and 4 are significantly less than for Options 1 and 2. Operation and maintenance costs per annum have been estimated using the percentages of capital cost of the various components of the scheme as recommended in the DWS Technical Guidelines. An additional allowance has been made to set aside funds for recurrent depreciation/replacement on items such a pumps, valves, and similar equipment.

Dividing these annual operation and maintenance costs thus calculated by the average raw water supplied in the same period, produces a unit cost of between R0.27/m^3 and R0.34/m^3 with Option 3 having the lower operation and maintenance cost excluding energy consumption.

Power costs per annum were also calculated using the existing ESKOM Ruraflex tariff at a load factor of 75%, which uses an average tariff of R0.48/kWh.

Using this existing power tariff, and dividing total power cost by the raw water supplied in a year, the unit power cost of water ranges from R0.87/m^3 to R1.07/m^3, with Option 3 having the lowest unit power cost per m^3.

In the analyses undertaken for the Irrigation Development report, the assumed total unit cost of raw water supplied to edge of field was approximately R0.40/m^3. This produced an annual net surplus income of approximately R580 000 per 60 ha farming unit. This compares with the R1.14/m^3 total cost given for Option 3.

Given that a typical farming unit as described in the Irrigation Development Report is estimated to use some 371 000 m^3/per year, then a R0.71/m^3 increase in unit cost over the

R0.40/m^3 figure used in the calculation would reduce the net surplus income per annum to some R405 460. Surpluses are required to repay loans, and refurbish equipment etc. and it must be questioned whether the surplus income would provide enough return on the investment required on each farming unit.

It must also be noted that power tariffs will likely continue to increase at a greater rate than the escalation of prices of the produce sold by these farms, further reducing the surplus income available per farm.

Clearly some subsidization of this unit cost of raw water as well as capital costs must be made if the potential irrigation schemes are to be viable and sustainable. The Department of Rural Development and Agrarian Reform suggests that a figure of R0.25/m^3 would be a reasonable target to ensure that gross margins are attractive enough to encourage investment into commercial irrigated agriculture. This emphasizes the need to subsidize the Ntabelanga scheme with revenue gained from the energy sales generated by the Lalini Dam and hydropower scheme.

Therefore, if the effective cost of power supplied to the scheme can be reduced through the benefits gained by generation of hydropower at Ntabelanga and Lalini, (i.e. cross-subsidized by grant-funding hydropower capital cost), the viability of irrigated agriculture development within the scheme might still be possible.

This key issue is discussed in more detail in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15, where the overall viability of the multi-purpose scheme is analysed.

7.7 Conclusion

The above analyses shows Option 3 to be the preferred solution.

Whilst this has a higher capital cost than other solutions, the lower unit cost of water (assuming grant funding of CAPEX) puts this option as the highest ranked.

In addition, drawing water from the Ntabelanga Dam will produce a pre-settled, lower sediment content raw water that will not require additional settlement basins, and this will also reduce the risk of operation and maintenance problems within the new farming units.

Option 3 has the lowest energy requirement of the four options, with the main pumping station located at the same position as the Ntabelanga WTW, which simplifies the operational management at a single location, and confines the main input and output power supply lines to a common switching and transformer site.

The two smaller booster raw water pumping stations can be supplied with power by connection to the existing grid in the Tsolo Area.

The layout of the proposed raw water pumping station located at the Ntabelanga Dam WTW site is shown overleaf in Figure 7-12.

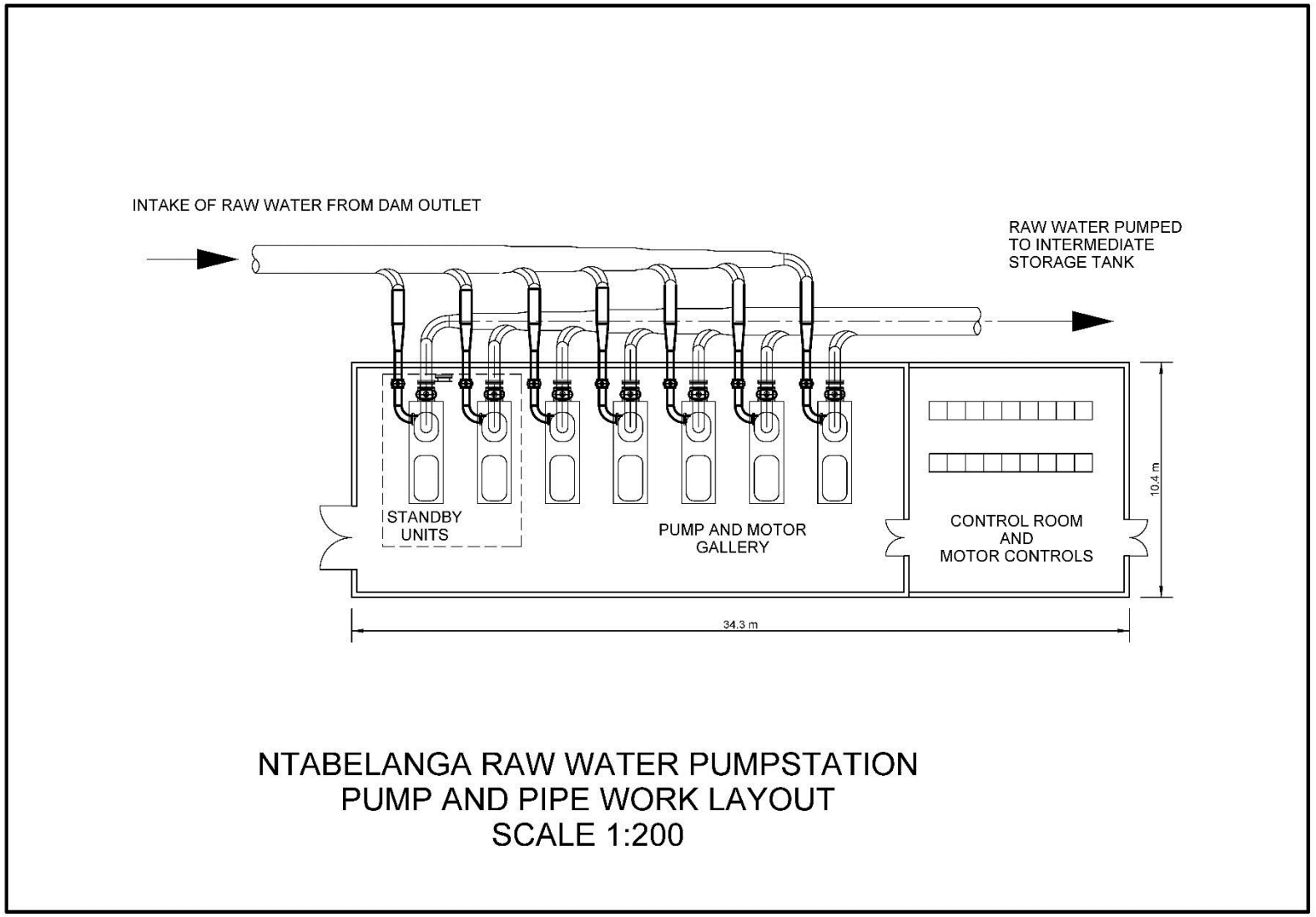


Figure 7-12: Layout of Ntabelanga Raw Water Pumping Station for Irrigation Water Supply

8. OVERALL SCHEME POWER REQUIREMENTS

Table 8-1 summarises the duties and power requirements of the various energy consuming infrastructure components in the system.

Table 8-1 : Power Requirements for Bulk Infrastructure

2050 Power Requirements									
Treated Water	**Flow (l/s)**	**Head (m)**	**Duty Water Power (kW)**	**Pump Efficiency (%)**	**Maximum Electricity Demand (kW)**	**Maximum Electricity Demand (kVA)**	**Max hours per day**	**Usage - kWh per year**	**Power cost/year (Rand)**
Pumping station PS1	935.27	246	2 257	75%	3 010	3 168	20	23 128 671	19 497 470
Pumping station PS2	827.70	270	2 193	75%	2 924	3 077	20	22 465 459	18 938 382
Pumping station PS3	476.66	279	1 305	75%	1 740	1 831	20	13 368 771	11 269 874
Pumping station PS4	92.69	333	303	75%	404	425	20	3 102 814	2 615 672
Booster pumping station Z3 PS1	170	94	157	75%	209	220	20	1 606 406	1 354 200
Booster pumping station Z4 PS1	12.8	66	8	75%	11	12	20	84 924	71 591
Booster pumping station Z4 PS2	3.53	195	7	75%	9	9	20	69 197	58 333
Water treatment plant processes	Estimated				500	526	varies	572 998	483 038
Waste water treatment works	Estimated				100	105	20	768 421	647 779
Housing	Estimated				250	263	12	1 152 632	971 668
Other, incl lighting etc	Estimated				250	263	12	1 152 632	971 668
TOTALS EXCL RAW WATER			**6 230**		**9 406**	**9 901**		**67 472 926**	**56 879 676**
Raw Water for Irrigation									
Main pumping station	1060	183	1 903	75%	2 538	2 671	20	19 500 041	16 438 535
Booster station P1	206	100	202	75%	269	284	20	2 070 836	1 745 715
Booster Station P2	223	165	361	75%	481	507	20	3 698 856	3 118 135
TOTALS INCL RAW WATER			**8 133**		**11 944**	**12 572**		**86 972 967**	**73 318 211**

Further analyses are undertaken in the Cost Estimates and Economic Analysis Report No. P WMA 12/T30/00/5212/15, which compare the energy needs of the project with the hydropower potential at both Ntabelanga and Lalini.

The Legal, Institutional and Financing Arrangements Report No. P WMA 12/T30/00/5212/16, discusses the options for beneficial usage of the hydropower produced by the conjunctive scheme to improve the economic viability of both domestic potable water supply and the raw water supply to the irrigation developments.

APPENDICES

APPENDIX A: STUDY AREA SETTLEMENTS AND POPULATION GROWTH DATA

APPENDIX B: POTABLE BULK WATER DISTRIBUTION SYSTEM: QUANTITIES AND COSTS

APPENDIX C: IRRIGATION BULK WATER DISTRIBUTION SYSTEM: QUANTITIES AND COSTS

APPENDIX D: SCHEDULE OF PIPELINES AND RESERVOIRS SIZES, CAPACITY AND CO-ORDINATES

APPENDIX A

STUDY AREA SETTLEMENTS AND POPULATION GROWTH DATA

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
KWA MANZI	Rural - Small Village <= 5000	Alfred Nzo	481	532	588	649	717
POTE	Rural Scattered	Alfred Nzo	285	314	347	384	424
MAMPOLA - A	Rural Scattered	Alfred Nzo	90	99	110	121	134
KHOHLWENI	Rural Scattered	Alfred Nzo	331	365	403	445	492
BOVINI	Rural Scattered	Alfred Nzo	182	201	222	245	270
EKHOHLWENI	Rural - Small Village <= 5000	Alfred Nzo	491	542	599	661	731
NCWENGANA	Rural Scattered	Alfred Nzo	347	383	423	467	516
SFOLWENI - A	Rural Scattered	Alfred Nzo	459	507	560	619	683
MZONGWANA - B	Rural Scattered	Alfred Nzo	347	383	423	467	516
HILLSIDE - B	Rural - Small Village <= 5000	Alfred Nzo	766	846	935	1 033	1 141
SFOLWENI - B	Rural Scattered	Alfred Nzo	86	95	105	115	128
BOTIN	Rural Scattered	Alfred Nzo	270	299	330	364	402
MAVUNDLENI - A	Rural - Small Village <= 5000	Alfred Nzo	224	248	274	302	334
MATIYASE	Rural Scattered	Alfred Nzo	294	325	358	396	437
PAMLAVILLE - A	Rural - Small Village <= 5000	Alfred Nzo	1 275	1 409	1 556	1 719	1 898
MNGENI - A	Rural - Small Village <= 5000	Alfred Nzo	805	889	982	1 085	1 198
LUFEFEIN	Rural - Small Village <= 5000	Alfred Nzo	994	1 098	1 212	1 339	1 479
MATIASE	Rural Scattered	Alfred Nzo	155	171	189	209	231
MNQAYI - A	Rural Scattered	Alfred Nzo	155	171	189	209	231
KWA MATIAS - A	Rural Scattered	Alfred Nzo	710	784	866	957	1 057
KWA MATIAS - B	Rural Scattered	Alfred Nzo	360	398	439	485	536
KWA MATIAS - C	Rural Scattered	Alfred Nzo	129	142	157	173	191
GOXA	Rural - Small Village <= 5000	Alfred Nzo	770	851	940	1 038	1 147
CIBINI - I	Rural Scattered	Alfred Nzo	507	560	619	683	755
CIBINI - A	Rural Scattered	Alfred Nzo	137	151	167	184	204
CIBINI - B	Rural - Small Village <= 5000	Alfred Nzo	472	522	576	637	703
MDYONE	Rural Scattered	Alfred Nzo	595	657	726	802	885
PAMLAVILLE - C	Rural - Small Village <= 5000	Alfred Nzo	935	1 033	1 141	1 261	1 393
KWA MATIAS - D	Rural Scattered	Alfred Nzo	405	447	494	546	603
CIBINI - CCC	Rural Scattered	Alfred Nzo	405	447	494	546	603
CIBINI - D	Rural Scattered	Alfred Nzo	280	309	341	377	416
PAMLAVILLE - B	Rural Scattered	Alfred Nzo	390	430	475	525	580
CIBINI - E	Rural Scattered	Alfred Nzo	405	447	494	546	603
CIBINI - F	Rural Scattered	Alfred Nzo	558	616	681	752	831
MAGAYAZIDLELE	Rural Scattered	Alfred Nzo	194	214	236	261	289
NEW HOUSE	Rural Scattered	Alfred Nzo	302	334	368	407	450
NO. 7	Rural Scattered	Alfred Nzo	182	201	222	245	270
EDRAYINI - CC	Rural - Small Village <= 5000	Alfred Nzo	718	793	876	968	1 069
D S	Rural Scattered	Alfred Nzo	159	176	194	214	237
KWAMBOMBO	Rural Scattered	Alfred Nzo	80	88	97	107	118
NURESH - A	Rural Scattered	Alfred Nzo	159	176	194	214	237
SIPHO LA	Rural Scattered	Alfred Nzo	198	219	241	267	295
MKOMTHI	Rural Scattered	Alfred Nzo	306	338	373	412	456
MACHANGANENI	Rural Scattered	Alfred Nzo	796	879	971	1 072	1 185
MAKHOBA - A	Rural Scattered	Alfred Nzo	100	110	122	135	149
MAKHOBA - B	Rural - Small Village <= 5000	Alfred Nzo	374	414	457	505	557
MAKGWASENG	Rural - Small Village <= 5000	Alfred Nzo	1 047	1 156	1 277	1 411	1 558
MANDERSTONE	Rural - Small Village <= 5000	Alfred Nzo	452	499	551	609	673
NKALI - A	Rural Scattered	Alfred Nzo	455	503	555	613	677
LUBALEKO - A	Rural Scattered	Alfred Nzo	323	357	395	436	481
MAKOBA	Rural Scattered	Alfred Nzo	117	130	143	158	175
MAKHOBA - C	Rural - Small Village <= 5000	Alfred Nzo	706	780	861	951	1 051
EDRESINI - B	Rural Scattered	Alfred Nzo	186	205	227	250	276
NKALI - B	Rural Scattered	Alfred Nzo	182	201	222	245	270
VIKIINDUKU	Rural Scattered	Alfred Nzo	259	286	316	349	386
VIKINDUKU	Rural Scattered	Alfred Nzo	280	309	341	377	416
MAKOBA - L	Rural Scattered	Alfred Nzo	221	245	270	298	330
MAKOTIKOTING	Rural - Small Village <= 5000	Alfred Nzo	636	702	775	857	946
MOYENI - H	Rural Scattered	Alfred Nzo	428	473	523	577	638
KHASHOLE	Rural - Small Village <= 5000	Alfred Nzo	774	855	945	1 044	1 153
SHENXE	Rural Scattered	Alfred Nzo	230	254	280	309	342
NEW STANCE	Rural Scattered	Alfred Nzo	159	176	194	214	237
DRESINI - A	Rural Scattered	Alfred Nzo	133	146	162	179	197
MOYENI - C	Rural Scattered	Alfred Nzo	79	87	96	106	117
BLACK DIAMOND	Rural Scattered	Alfred Nzo	138	152	168	186	205
GUDLINTABA - E	Rural Scattered	Alfred Nzo	347	383	423	467	516
NQUTHU	Rural - Small Village <= 5000	Alfred Nzo	869	960	1 060	1 171	1 294
NURESH - B	Rural Scattered	Alfred Nzo	327	362	400	441	488
LUBALEKO - B	Rural Scattered	Alfred Nzo	327	362	400	441	488
NKALI - C	Rural Scattered	Alfred Nzo	129	142	157	173	191
MANASE	Rural Scattered	Alfred Nzo	242	267	295	326	360
HLAHLWENI	Rural Scattered	Alfred Nzo	233	257	284	313	346
GOBIZELA	Rural Scattered	Alfred Nzo	198	219	241	267	295
AFZONDERING	Rural Scattered	Alfred Nzo	511	565	624	689	761
NKALI - D	Rural Scattered	Alfred Nzo	447	494	545	602	665

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
EZITALE	Rural - Small Village <= 5000	Alfred Nzo	1 094	1 208	1 334	1 474	1 628
SMALL LOCATION	Rural Scattered	Alfred Nzo	443	489	540	597	659
EPIPHANY - B	Rural Scattered	Alfred Nzo	684	756	835	923	1 019
MADLANGENI - A	Rural - Small Village <= 5000	Alfred Nzo	289	319	352	389	430
NGQUMANE - B	Rural - Small Village <= 5000	Alfred Nzo	495	547	604	667	737
MKIMANE	Rural - Small Village <= 5000	Alfred Nzo	1 654	1 827	2 018	2 229	2 462
TYIWENI	Rural Scattered	Alfred Nzo	794	877	968	1 070	1 182
MDAKENI	Rural - Small Village <= 5000	Alfred Nzo	1 038	1 147	1 267	1 400	1 546
NCQUMANE	Rural Scattered	Alfred Nzo	327	362	400	441	488
EGUBHUZI - B	Rural Scattered	Alfred Nzo	711	785	868	958	1 059
NCINIBA	Rural Scattered	Alfred Nzo	498	550	607	671	741
NOMKHOLOKHONTO - A	Rural - Small Village <= 5000	Alfred Nzo	1 038	1 147	1 267	1 400	1 546
LOWER MVENYANE	Rural Scattered	Alfred Nzo	410	453	500	553	611
NYOSINI	Rural - Small Village <= 5000	Alfred Nzo	1 158	1 279	1 413	1 561	1 724
NOMKHOLOKHONTHO	Rural Scattered	Alfred Nzo	378	418	462	510	563
COLANA - B	Rural - Small Village <= 5000	Alfred Nzo	1 016	1 122	1 240	1 369	1 513
MHLUTA	Rural Scattered	Alfred Nzo	315	348	385	425	469
XHAMENI	Rural - Small Village <= 5000	Alfred Nzo	1 047	1 156	1 277	1 411	1 558
NTSIMANUWENI - A	Rural Scattered	Alfred Nzo	694	766	846	935	1 033
SIQHINGENI - A	Rural - Small Village <= 5000	Alfred Nzo	605	668	738	815	901
MAWUSHENI - B	Rural Scattered	Alfred Nzo	479	530	585	646	714
NTSIMANUWENI - B	Rural Scattered	Alfred Nzo	534	589	651	719	794
TYENI - F	Rural - Small Village <= 5000	Alfred Nzo	1 295	1 430	1 580	1 745	1 927
MPOZA - F	Rural Scattered	Alfred Nzo	392	433	478	528	583
MNTSILA - A	Rural Scattered	Alfred Nzo	475	525	580	641	708
MPOZA - K	Rural - Small Village <= 5000	Alfred Nzo	923	1 020	1 126	1 244	1 375
MVENYANE - A	Rural Scattered	Alfred Nzo	868	959	1 059	1 170	1 292
UPPER MVENYANE	Rural Scattered	Alfred Nzo	468	517	571	631	697
KGOBA	Rural Scattered	Alfred Nzo	1 521	1 680	1 856	2 050	2 265
TINANA - B	Rural - Small Village <= 5000	Alfred Nzo	1 290	1 425	1 575	1 739	1 921
HILLSIDE - BB	Rural - Small Village <= 5000	Alfred Nzo	1 397	1 543	1 704	1 882	2 079
RASHENI	Rural Scattered	Alfred Nzo	994	1 098	1 212	1 339	1 479
GERMISTON - B	Rural Scattered	Alfred Nzo	360	398	439	485	536
KWANDWENGULA	Rural Scattered	Alfred Nzo	912	1 007	1 113	1 229	1 358
NOMKHOLOKHONTO - B	Rural Scattered	Alfred Nzo	690	762	841	929	1 027
SFOLWENI - C	Rural - Small Village <= 5000	Alfred Nzo	432	477	527	582	642
TSENI	Rural Scattered	Alfred Nzo	662	731	808	892	986
MAUONTSINI	Rural Scattered	Alfred Nzo	244	269	297	329	363
MNTSILA - B	Rural Scattered	Alfred Nzo	289	319	352	389	430
NDARHALA	Rural Scattered	Alfred Nzo	186	205	227	250	276
KUMACIBINI	Rural - Small Village <= 5000	Alfred Nzo	485	535	591	653	721
MBUMBAZA	Rural Scattered	Alfred Nzo	229	252	279	308	340
SILINDINI - C	Rural Scattered	Alfred Nzo	167	185	204	225	249
HLOMBE	Rural Scattered	Alfred Nzo	84	92	102	113	125
MQHEKEZO	Rural Scattered	Alfred Nzo	597	659	728	804	888
MQHEKEZWENI - E	Rural Scattered	Alfred Nzo	115	127	141	155	172
NGWEKAZANA - B	Rural Scattered	Alfred Nzo	383	423	467	516	570
MQHEKEZWENI - F	Rural Scattered	Alfred Nzo	231	255	281	311	343
GUBUZI	Rural Scattered	Alfred Nzo	167	185	204	225	249
MAQABANIHI	Rural Scattered	Alfred Nzo	77	85	93	103	114
MVUBINI	Rural Scattered	Alfred Nzo	203	224	248	274	302
PABALLONG	Rural - Small Village <= 5000	Alfred Nzo	1 829	2 020	2 232	2 465	2 723
QHOBONHEQNENG	Rural Scattered	Alfred Nzo	852	941	1 039	1 148	1 268
BUKELA	Rural - Small Village <= 5000	Alfred Nzo	788	870	961	1 061	1 173
SEMONKONG	Rural - Small Village <= 5000	Alfred Nzo	1 428	1 578	1 743	1 925	2 126
KWAMGOBO	Rural - Small Village <= 5000	Alfred Nzo	2 122	2 344	2 589	2 860	3 159
ENKALWENI - A	Rural Scattered	Alfred Nzo	419	463	512	565	624
MHLANGANISWENI - A	Rural Scattered	Alfred Nzo	605	668	738	815	901
MHLOKWANA	Rural Scattered	Alfred Nzo	1 339	1 480	1 634	1 805	1 994
TOLENI - B	Rural - Small Village <= 5000	Alfred Nzo	1 749	1 933	2 135	2 358	2 605
HOFISI	Rural Scattered	Alfred Nzo	511	565	624	689	761
NKUNGWINI - B	Rural Scattered	Alfred Nzo	199	220	243	268	296
MPINDWENI - C	Rural Scattered	Alfred Nzo	485	535	591	653	721
DRAYINI	Rural Scattered	Joe Gqabi	297	328	362	400	442
LUXENI	Rural - Small Village <= 5000	Joe Gqabi	798	881	973	1 075	1 188
SIHOMHORN	Rural - Small Village <= 5000	Joe Gqabi	673	744	822	907	1 002
KATKOP	Rural - Small Village <= 5000	Joe Gqabi	596	658	727	803	887
GOLOMANE	Rural - Small Village <= 5000	Joe Gqabi	895	988	1 092	1 206	1 332
TINANA	Rural - Small Village <= 5000	Joe Gqabi	1 335	1 475	1 629	1 800	1 988
NDAKENI - L	Rural Scattered	Alfred Nzo	410	453	500	553	611
NGOGUDLINTABA	Rural Scattered	Alfred Nzo	225	249	275	304	336
LATANA	Rural Scattered	Alfred Nzo	297	328	362	400	442
MAFUSINI - H	Rural Scattered	Alfred Nzo	274	303	335	370	409
MADIDEELA	Rural Scattered	Alfred Nzo	298	329	363	401	443
NATALA	Rural - Small Village <= 5000	Alfred Nzo	1 380	1 525	1 684	1 860	2 055

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
MHLOTSHENI	Rural Scattered	Alfred Nzo	794	877	968	1 070	1 182
VOVENI	Rural Scattered	Alfred Nzo	822	908	1 003	1 108	1 224
MAGONTSINI - A	Rural - Small Village <= 5000	Alfred Nzo	1 790	1 978	2 184	2 413	2 665
BHADALALA	Rural - Small Village <= 5000	Alfred Nzo	1 939	2 142	2 366	2 614	2 887
MGHOKWENI - B	Rural Scattered	Alfred Nzo	74	82	91	100	111
MQHEKEZWENI - G	Rural Scattered	Alfred Nzo	115	127	141	155	172
NGWEKAZANA - A	Rural Scattered	Alfred Nzo	99	109	121	133	147
NDOKENDIBONE	Rural Scattered	Alfred Nzo	327	362	400	441	488
MADADIELA	Rural Scattered	Alfred Nzo	568	628	693	766	846
NDAKENI - K	Rural Scattered	Alfred Nzo	307	339	375	414	457
DAMBENI - A	Rural Scattered	Alfred Nzo	414	457	505	558	617
NDAKENI - J	Rural Scattered	Alfred Nzo	65	72	80	88	97
NGXAKAXA - A	Rural Scattered	Alfred Nzo	80	88	97	107	118
MWACA - B	Rural Scattered	Alfred Nzo	214	237	261	289	319
NCAWAYI	Rural - Small Village <= 5000	Alfred Nzo	243	268	296	327	361
BROOKS NEK	Rural - Small Village <= 5000	Alfred Nzo	1 186	1 310	1 448	1 599	1 766
SIDAKENI - B	Rural Scattered	Alfred Nzo	399	441	487	538	594
NEW LOOK	Rural - Small Village <= 5000	Alfred Nzo	1 824	2 015	2 226	2 458	2 716
MJIKWENI - A	Rural Scattered	Alfred Nzo	243	268	296	327	361
SIDAKENI - C	Rural Scattered	Alfred Nzo	427	472	522	576	636
CABAZANA	Rural - Small Village <= 5000	Alfred Nzo	1 340	1 481	1 636	1 807	1 996
NQABENI - P	Rural Scattered	Alfred Nzo	458	506	559	617	682
PUTUKEZI	Rural - Small Village <= 5000	Alfred Nzo	3 576	3 951	4 364	4 821	5 325
NKANJI	Rural Scattered	Alfred Nzo	385	425	469	518	573
PEPENI - A	Rural - Small Village <= 5000	Alfred Nzo	1 141	1 261	1 393	1 539	1 700
LUBALEKO - C	Rural Scattered	Alfred Nzo	414	457	505	558	617
FUSI	Rural - Small Village <= 5000	Alfred Nzo	1 406	1 553	1 715	1 895	2 093
SIPOLWENI	Rural - Small Village <= 5000	Alfred Nzo	951	1 050	1 160	1 281	1 416
MFALAMKHULU	Rural Scattered	Alfred Nzo	154	170	188	208	229
LUBALEKO - D	Rural Scattered	Alfred Nzo	682	754	833	920	1 016
NGWEGWENI	Rural - Small Village <= 5000	Alfred Nzo	1 616	1 785	1 972	2 178	2 406
SIKROQOBENI	Rural Scattered	Alfred Nzo	826	913	1 008	1 114	1 230
DANTEE	Rural - Small Village <= 5000	Alfred Nzo	2 147	2 372	2 620	2 894	3 197
BETSHWANA - A	Rural Scattered	Alfred Nzo	676	747	825	912	1 007
NDZONGISENI	Rural - Small Village <= 5000	Alfred Nzo	1 525	1 685	1 861	2 056	2 271
BETSHWANA - B	Rural - Small Village <= 5000	Alfred Nzo	1 093	1 207	1 333	1 473	1 627
BETSHWANA - C	Rural - Small Village <= 5000	Alfred Nzo	1 465	1 618	1 787	1 974	2 181
PEPENI - B	Rural Scattered	Alfred Nzo	477	527	583	643	711
MOMBENI	Rural - Small Village <= 5000	Alfred Nzo	830	917	1 013	1 119	1 236
BHONGA - B	Rural - Small Village <= 5000	Alfred Nzo	1 236	1 366	1 509	1 666	1 841
SINGENI - B	Rural Scattered	Alfred Nzo	463	512	565	624	690
SIGIDINI - A	Rural - Small Village <= 5000	Alfred Nzo	921	1 018	1 124	1 242	1 371
LUBALEKO FARM	Rural Scattered	Alfred Nzo	250	276	305	337	372
LUBALEKO - E	Rural - Small Village <= 5000	Alfred Nzo	826	913	1 008	1 114	1 230
MVALWENI	Rural - Small Village <= 5000	Alfred Nzo	1 411	1 558	1 721	1 902	2 100
NTLAVINI	Rural - Small Village <= 5000	Alfred Nzo	1 008	1 113	1 230	1 358	1 501
LAMBASI - H	Rural - Small Village <= 5000	Alfred Nzo	802	886	978	1 081	1 194
MKHANGISA	Rural Scattered	Alfred Nzo	289	319	352	389	430
MDENI - D	Rural Scattered	Alfred Nzo	494	545	602	665	735
GWADANA - A	Rural - Small Village <= 5000	Alfred Nzo	937	1 036	1 144	1 264	1 396
MVENYANA	Rural - Small Village <= 5000	Alfred Nzo	582	643	711	785	867
MKHALATYE - A	Rural Scattered	Alfred Nzo	365	403	446	492	544
MENYANE	Rural Scattered	Alfred Nzo	315	348	385	425	469
SIQHINGENI - B	Rural Scattered	Alfred Nzo	791	873	965	1 066	1 177
SITHIWENI	Rural Scattered	Alfred Nzo	466	515	569	628	694
COLANA - A	Rural Scattered	Alfred Nzo	194	214	236	261	289
GOGELA	Rural - Small Village <= 5000	Alfred Nzo	648	716	790	873	964
MDUMNDUM	Rural Scattered	Alfred Nzo	494	545	602	665	735
KOKELA	Rural Scattered	Alfred Nzo	489	540	596	659	728
MGHOKWENI - A	Rural Scattered	Alfred Nzo	74	82	91	100	111
SIQINGENI	Rural Scattered	Alfred Nzo	261	288	319	352	389
UMZIMVUBU - E	Rural Scattered	Alfred Nzo	164	181	200	221	245
MQHEKEZWENI - D	Rural Scattered	Alfred Nzo	190	210	232	256	282
MQOKWENI	Rural Scattered	Alfred Nzo	163	180	199	220	243
UMZIMVUBU - B	Rural Scattered	Alfred Nzo	440	486	536	593	655
MDENI - E	Rural Scattered	Alfred Nzo	239	264	291	322	355
BETSHWANA - D	Rural - Small Village <= 5000	Alfred Nzo	1 194	1 318	1 456	1 609	1 777
NKANJE	Rural Scattered	Alfred Nzo	239	264	291	322	355
MAPHELENI	Rural - Small Village <= 5000	Alfred Nzo	1 004	1 109	1 225	1 353	1 494
LUGELWENI	Rural - Small Village <= 5000	Alfred Nzo	1 435	1 585	1 751	1 935	2 137
DUTYINI - D	Rural - Small Village <= 5000	Alfred Nzo	1 411	1 558	1 721	1 902	2 100
NTSHIKAZI	Rural Scattered	Alfred Nzo	364	402	444	491	542
SIKEMANE	Rural Scattered	Alfred Nzo	321	355	392	433	478
ESIKHUMBENI	Rural Scattered	Alfred Nzo	433	478	528	583	644
DUTYENI	Rural - Small Village <= 5000	Alfred Nzo	1 451	1 602	1 770	1 955	2 160

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
LUBHALASI	Rural Scattered	Alfred Nzo	427	472	522	576	636
RIFANTSU	Rural Scattered	Alfred Nzo	140	154	171	188	208
KAPOTLO	Rural Scattered	Alfred Nzo	39	43	47	52	58
AVORIANE FARM - B	Rural Scattered	Alfred Nzo	1 049	1 158	1 280	1 413	1 561
GLADSTONE FARM - B	Rural Scattered	Alfred Nzo	1 049	1 158	1 280	1 413	1 561
MUQUBI	Rural Scattered	Alfred Nzo	491	542	599	661	731
DELAMOTTE FARM	Rural Scattered	Alfred Nzo	1 049	1 158	1 280	1 413	1 561
MGUNGUNDLOVU - D	Rural Scattered	Alfred Nzo	50	55	61	67	74
MFOLOZI - B	Rural Scattered	Alfred Nzo	65	72	80	88	97
LIKHOHLONG	Rural Scattered	Alfred Nzo	82	90	100	110	122
QALABENI	Rural - Small Village <= 5000	Alfred Nzo	448	495	546	604	667
FATIMA	Rural Scattered	Alfred Nzo	502	554	612	676	747
SEQHOBONG - C	Rural Scattered	Alfred Nzo	595	657	726	802	885
CABAZI - A	Rural - Small Village <= 5000	Alfred Nzo	876	968	1 069	1 181	1 305
LONG	Rural Scattered	Alfred Nzo	714	789	871	962	1 063
EKUTSHENI	Rural Scattered	Alfred Nzo	590	651	719	795	878
MAFUSINI - N	Rural Scattered	Alfred Nzo	462	510	564	623	688
NTENETYANA	Rural Scattered	Alfred Nzo	432	477	527	582	642
EMJIKELWENI - H	Rural - Small Village <= 5000	Alfred Nzo	551	608	672	742	820
TELA - A	Rural Scattered	Alfred Nzo	523	578	639	705	779
TELA - B	Rural Scattered	Alfred Nzo	1 033	1 141	1 261	1 393	1 539
DRESINI - B	Rural Scattered	Alfred Nzo	757	836	924	1 020	1 127
GOXE - E	Rural Scattered	Alfred Nzo	313	346	382	422	466
KWAMADLANGALA	Rural Scattered	Alfred Nzo	463	512	565	624	690
TSITSA-MVULA - D	Rural Scattered	Alfred Nzo	802	886	978	1 081	1 194
BRAMWEL	Rural Scattered	Alfred Nzo	304	336	371	410	453
RAMOHLAKOANA	Rural - Small Village <= 5000	Alfred Nzo	5 803	6 411	7 081	7 822	8 640
THUTHANENG	Rural - Small Village <= 5000	Alfred Nzo	710	784	866	957	1 057
MABULA	Rural - Small Village <= 5000	Alfred Nzo	935	1 033	1 141	1 261	1 393
DESCUUR	Rural Scattered	Alfred Nzo	304	336	371	410	453
LEHATA	Rural Scattered	Alfred Nzo	340	375	414	458	506
HILLSIDE - AA	Rural - Small Village <= 5000	Alfred Nzo	1 464	1 617	1 786	1 973	2 179
SKEPANENG	Rural Scattered	Alfred Nzo	529	585	646	714	788
TSITSONG	Rural - Small Village <= 5000	Alfred Nzo	675	746	824	910	1 005
LOKISHINI - E	Rural - Small Village <= 5000	Alfred Nzo	538	594	656	725	800
MAGEME	Rural - Small Village <= 5000	Alfred Nzo	1 266	1 398	1 545	1 706	1 885
TSENULA	Rural - Small Village <= 5000	Alfred Nzo	935	1 033	1 141	1 261	1 393
NKOSANA	Rural Scattered	Alfred Nzo	579	640	707	781	863
MATIMA	Rural - Small Village <= 5000	Alfred Nzo	2 685	2 966	3 276	3 619	3 997
MAGOGOGWENI	Rural - Small Village <= 5000	Alfred Nzo	1 080	1 193	1 318	1 456	1 608
OUTSPAN	Rural - Small Village <= 5000	Alfred Nzo	2 457	2 715	2 999	3 312	3 659
MAZIZINI - E	Rural - Small Village <= 5000	Alfred Nzo	1 701	1 878	2 075	2 292	2 532
GUBUSI	Rural Scattered	Alfred Nzo	244	269	297	329	363
MNCEBA - A	Rural Scattered	Alfred Nzo	1 317	1 455	1 607	1 775	1 961
GONO	Rural - Small Village <= 5000	Alfred Nzo	915	1 011	1 117	1 233	1 362
MHLOZINI	Rural Scattered	Alfred Nzo	1 261	1 393	1 538	1 699	1 877
LUXWESA	Rural Scattered	Alfred Nzo	776	858	947	1 046	1 156
CHANI	Rural Scattered	Alfred Nzo	347	383	423	467	516
MOUNT CURRIE NU 092	Rural Scattered	Alfred Nzo	48	53	59	65	71
MOUNT CURRIE NU 085	Rural Scattered	Alfred Nzo	19	21	24	26	29
MOUNT CURRIE NU 084	Rural Scattered	Alfred Nzo	22	25	27	30	33
MOUNT CURRIE NU 424	Rural Scattered	Alfred Nzo	45	50	55	60	67
MOUNT CURRIE NU 086	Rural Scattered	Alfred Nzo	9	10	11	12	14
MOUNT CURRIE NU 105	Rural Scattered	Alfred Nzo	29	32	35	38	43
MOUNT CURRIE NU 089	Rural Scattered	Alfred Nzo	64	71	78	87	96
MOUNT CURRIE NU 425	Rural Scattered	Alfred Nzo	19	21	24	26	29
MOUNT CURRIE NU 426	Rural Scattered	Alfred Nzo	38	42	46	51	56
MOUNT CURRIE NU 097	Rural Scattered	Alfred Nzo	45	50	55	60	67
NTYWENKA	Rural - Small Village <= 5000	Joe Gqabi	603	666	736	813	898
ST AUGUSTINE	Rural - Small Village <= 5000	Joe Gqabi	802	886	978	1 081	1 194
TSHIKARO	Rural Scattered	Joe Gqabi	252	278	307	340	375
MATUGULU	Rural Scattered	Joe Gqabi	403	445	492	543	600
MFABANTU	Rural Scattered	Joe Gqabi	254	281	310	342	378
UPPER TSITSANA	Rural Scattered	Joe Gqabi	484	534	590	652	720
KHOHLONG	Rural Scattered	Joe Gqabi	120	133	147	162	179
MAKHOTLANA	Rural Scattered	Joe Gqabi	402	444	490	542	598
MATSWANA	Rural - Small Village <= 5000	Joe Gqabi	566	625	691	763	843
VAALHOEK	Rural - Small Village <= 5000	Joe Gqabi	770	851	940	1 038	1 147
NGAPHEZULU - C	Rural Scattered	Joe Gqabi	296	327	361	399	440
VUVU	Rural Scattered	Joe Gqabi	420	464	513	566	626
MAKWATLANE	Rural Scattered	Joe Gqabi	216	239	264	291	322
MADUBOU	Rural Scattered	Joe Gqabi	441	487	538	594	656
DIPHOKONG	Rural Scattered	Joe Gqabi	216	239	264	291	322
SETABATABA	Rural Scattered	Joe Gqabi	282	311	344	379	419
PHIRINTSU - B	Rural Scattered	Joe Gqabi	198	219	241	267	295

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
MATAFENI - C	Rural - Small Village <= 5000	Joe Gqabi	680	752	830	917	1 013
MAXOTSHENI	Rural - Small Village <= 5000	Joe Gqabi	1 224	1 352	1 494	1 650	1 823
THINANA	Rural Scattered	Joe Gqabi	155	171	189	209	231
KWAXHABADIYA	Rural Scattered	Joe Gqabi	270	299	330	364	402
DENGWANE - C	Rural Scattered	Joe Gqabi	296	327	361	399	440
TIPING - A	Rural Scattered	Alfred Nzo	443	489	540	597	659
ST PAUL MISSION	Rural - Small Village <= 5000	Alfred Nzo	1 202	1 327	1 466	1 620	1 789
HEBRON	Rural - Small Village <= 5000	Alfred Nzo	1 136	1 255	1 387	1 532	1 692
GOBIZEMBE	Rural - Small Village <= 5000	Alfred Nzo	749	827	914	1 009	1 115
MAKEMA	Rural - Small Village <= 5000	Alfred Nzo	658	727	803	887	980
DANINI - B	Rural Scattered	Alfred Nzo	502	554	612	676	747
KGWAPHA	Rural - Small Village <= 5000	Alfred Nzo	1 322	1 460	1 613	1 782	1 968
MAGUZEN	Rural - Small Village <= 5000	Alfred Nzo	1 128	1 246	1 377	1 521	1 680
KHOLHONG	Rural Scattered	Alfred Nzo	568	628	693	766	846
TSHISA - C	Rural - Small Village <= 5000	Alfred Nzo	1 464	1 617	1 786	1 973	2 179
DENGWANA - A	Rural - Small Village <= 5000	Alfred Nzo	1 266	1 398	1 545	1 706	1 885
TSHISA - A	Rural - Small Village <= 5000	Alfred Nzo	1 640	1 812	2 002	2 211	2 442
HLONDEDLINI	Rural Scattered	Alfred Nzo	196	216	239	264	292
HLOMENDLINI	Rural - Small Village <= 5000	Alfred Nzo	572	632	698	771	852
MAGADLA - BB	Rural Scattered	Alfred Nzo	196	216	239	264	292
HLOMEDLINI	Rural Scattered	Alfred Nzo	196	216	239	264	292
SILINDINI - B	Rural Scattered	Alfred Nzo	250	276	305	337	372
BETHEL	Rural - Small Village <= 5000	Alfred Nzo	1 397	1 543	1 704	1 882	2 079
TIPING - B	Rural Scattered	Alfred Nzo	1 292	1 428	1 577	1 742	1 924
HARDENBURG - A	Rural Scattered	Alfred Nzo	428	473	523	577	638
BEDFORD - B	Rural Scattered	Alfred Nzo	399	441	487	538	594
MAFUBE - B	Rural Scattered	Alfred Nzo	694	766	846	935	1 033
LOKISHINI - A	Rural - Small Village <= 5000	Alfred Nzo	495	547	604	667	737
MATEWU	Rural Scattered	Alfred Nzo	177	196	217	239	264
JABAVU	Rural - Small Village <= 5000	Alfred Nzo	280	309	341	377	416
TSITA A	Rural - Small Village <= 5000	Alfred Nzo	654	722	798	881	974
ST PAUL-A	Rural Scattered	Alfred Nzo	1 557	1 720	1 899	2 098	2 318
LAGRENGER	Rural Scattered	Alfred Nzo	443	489	540	597	659
JABULANI	Rural - Small Village <= 5000	Alfred Nzo	900	994	1 098	1 213	1 340
KUTWANA	Rural - Small Village <= 5000	Alfred Nzo	311	344	380	419	463
DIKOTOBANG	Rural - Small Village <= 5000	Alfred Nzo	4 086	4 513	4 985	5 507	6 083
BANOYOLO	Rural Scattered	Alfred Nzo	272	301	332	367	406
THAKANELO - A	Rural Scattered	Alfred Nzo	216	239	264	291	322
MOPENG - B	Rural - Small Village <= 5000	Alfred Nzo	1 822	2 013	2 223	2 456	2 713
DIAHOS PONTSENG	Rural - Small Village <= 5000	Alfred Nzo	1 430	1 580	1 745	1 928	2 129
KGUBETSOANA - A	Rural - Small Village <= 5000	Alfred Nzo	1 654	1 827	2 018	2 229	2 462
SPRINGKAAN	Rural Scattered	Alfred Nzo	315	348	385	425	469
MALOTO	Rural - Small Village <= 5000	Alfred Nzo	722	798	881	973	1 075
KGUBETSOANA - B	Rural - Small Village <= 5000	Alfred Nzo	2 892	3 195	3 529	3 898	4 306
GLADSTONE FARM - A	Rural - Small Village <= 5000	Alfred Nzo	1 552	1 714	1 893	2 091	2 310
EZIKAMERENI	Rural - Dense Village > 5000	Alfred Nzo	3 428	3 786	4 182	4 620	5 103
MNGUNGU - I	Rural Scattered	Alfred Nzo	593	655	723	799	882
MNGUNGU - G	Rural - Small Village <= 5000	Alfred Nzo	890	983	1 085	1 199	1 324
KHOLOKWE	Rural - Small Village <= 5000	Alfred Nzo	250	276	305	337	372
DIGHOHLONG	Rural Scattered	Alfred Nzo	194	214	236	261	289
AVORIANE FARM - A	Rural Scattered	Alfred Nzo	1 049	1 158	1 280	1 413	1 561
ESBI FARM	Rural Scattered	Alfred Nzo	1 049	1 158	1 280	1 413	1 561
MGUNGUNDLOVU - F	Rural Scattered	Alfred Nzo	27	29	32	36	39
DENTSA FARM	Rural Scattered	Alfred Nzo	1 049	1 158	1 280	1 413	1 561
MGUNGUNDLOVU - E	Rural Scattered	Alfred Nzo	1 049	1 158	1 280	1 413	1 561
KHAULA - A	Rural - Small Village <= 5000	Alfred Nzo	550	607	671	741	819
HATHAKALELO	Rural Scattered	Alfred Nzo	358	396	437	483	533
KUMETSWENG	Rural Scattered	Alfred Nzo	826	913	1 008	1 114	1 230
MAHARING	Rural - Small Village <= 5000	Alfred Nzo	1 210	1 336	1 476	1 631	1 801
KUNTLOKOVANG	Rural - Small Village <= 5000	Alfred Nzo	2 371	2 619	2 893	3 195	3 530
FRYSTAT	Rural Scattered	Alfred Nzo	275	304	336	371	410
KWAZICWALILE	Rural - Small Village <= 5000	Alfred Nzo	1 547	1 709	1 888	2 086	2 304
KHWARAI	Rural Scattered	Alfred Nzo	429	474	524	579	639
EMHLOLWANENI	Rural Scattered	Alfred Nzo	843	931	1 028	1 136	1 255
MATELENG	Rural Scattered	Alfred Nzo	414	457	505	558	617
KWALUNDA - B	Rural - Small Village <= 5000	Alfred Nzo	1 397	1 543	1 704	1 882	2 079
MUVNUVNBLOVO	Rural - Small Village <= 5000	Alfred Nzo	1 917	2 117	2 339	2 584	2 854
LUTATENI	Rural - Small Village <= 5000	Alfred Nzo	1 631	1 802	1 990	2 199	2 429
MBODLENI	Squatter Camp - Rural	Alfred Nzo	2 490	2 751	3 038	3 356	3 707
MKHALATYE - B	Rural Scattered	Alfred Nzo	167	185	204	225	249
NIYONA - A	Rural - Small Village <= 5000	Alfred Nzo	707	781	863	953	1 053
MATYENI - F	Rural - Small Village <= 5000	Alfred Nzo	750	828	915	1 011	1 116
MGWETSHENI	Rural - Small Village <= 5000	Alfred Nzo	1 155	1 276	1 409	1 556	1 719
MPOLA - B	Rural Scattered	Alfred Nzo	305	337	372	411	454
CABAZI - B	Rural - Small Village <= 5000	Alfred Nzo	1 358	1 500	1 657	1 830	2 022

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
NTIBANE - B	Rural Scattered	Alfred Nzo	387	427	472	521	576
NQALWENI	Rural Scattered	Alfred Nzo	77	85	93	103	114
THWA	Rural Scattered	Alfred Nzo	147	162	179	198	219
SIPHUNDU	Rural Scattered	Alfred Nzo	1 153	1 273	1 407	1 554	1 716
MPENDLA	Rural Scattered	Alfred Nzo	365	403	446	492	544
NCUNTENI	Rural Scattered	Alfred Nzo	773	854	943	1 042	1 151
GIQEKA	Rural Scattered	Alfred Nzo	119	132	146	161	178
CWALINKUNGU	Rural Scattered	Alfred Nzo	235	259	286	316	349
HLANE	Rural Scattered	Alfred Nzo	458	506	559	617	682
MAGQAGQENI - F	Rural Scattered	Alfred Nzo	369	408	451	498	550
QUMRHA	Rural Scattered	Alfred Nzo	640	707	780	862	952
MAGXENI - A	Rural Scattered	Alfred Nzo	789	871	962	1 063	1 174
MTONYENI - D	Rural Scattered	Alfred Nzo	231	255	281	311	343
MAGQAGQENI - A	Rural Scattered	Alfred Nzo	207	229	253	279	308
EKUGQIBELENI	Rural - Small Village <= 5000	Alfred Nzo	723	799	883	975	1 077
MOUNT CURRIE NU 140	Rural Scattered	Alfred Nzo	22	25	27	30	33
MOUNT CURRIE NU 139	Rural Scattered	Alfred Nzo	54	60	66	73	80
MOUNT CURRIE NU 141	Rural Scattered	Alfred Nzo	22	25	27	30	33
MOUNT CURRIE NU 115	Rural Scattered	Alfred Nzo	16	18	20	22	24
MOUNT CURRIE NU 111	Rural Scattered	Alfred Nzo	26	28	31	34	38
MOUNT CURRIE NU 112	Rural Scattered	Alfred Nzo	61	68	75	82	91
KWAMENTI - B	Rural Scattered	Joe Gqabi	224	248	274	302	334
MNGA - A	Rural Scattered	Joe Gqabi	296	327	361	399	440
MNGA FLATS - B	Rural Scattered	Joe Gqabi	296	327	361	399	440
MDENI - N	Rural - Small Village <= 5000	Joe Gqabi	2 119	2 340	2 585	2 856	3 155
MGUDU - C	Rural Scattered	Joe Gqabi	296	327	361	399	440
GLENTHOMSON FARM	Rural Scattered	Joe Gqabi	296	327	361	399	440
GOODHOPE FARM	Rural Scattered	Joe Gqabi	296	327	361	399	440
KWAMKHOVU - B	Rural Scattered	Joe Gqabi	102	113	124	137	152
KWANONKENYANE	Rural Scattered	Joe Gqabi	204	225	249	275	304
PHLEPPY	Rural Scattered	Joe Gqabi	296	327	361	399	440
HARDING	Rural Scattered	Joe Gqabi	296	327	361	399	440
NQAYI FARM	Rural Scattered	Joe Gqabi	296	327	361	399	440
KWEQANA	Rural - Small Village <= 5000	Alfred Nzo	1 101	1 216	1 343	1 484	1 639
MNGUNGU - K	Rural Scattered	Alfred Nzo	711	785	868	958	1 059
BLOCK A - A	Rural - Small Village <= 5000	Alfred Nzo	1 581	1 747	1 929	2 131	2 354
QHITSI	Rural - Small Village <= 5000	Alfred Nzo	669	739	817	902	996
THABA CHICHA	Rural Scattered	Alfred Nzo	940	1 038	1 146	1 266	1 399
MHLOLOANENG - A	Rural Scattered	Alfred Nzo	153	169	187	206	228
MAGOGQOLWENI	Rural - Small Village <= 5000	Alfred Nzo	1 058	1 169	1 291	1 426	1 575
MOPENG - A	Rural Scattered	Alfred Nzo	779	861	951	1 050	1 160
LEKHALONG - A	Rural Scattered	Alfred Nzo	580	641	708	782	864
LEKHALONG - B	Rural Scattered	Alfred Nzo	346	382	422	466	515
MOYANENG	Rural Scattered	Alfred Nzo	169	187	207	228	252
CABA - A	Rural - Small Village <= 5000	Alfred Nzo	1 586	1 752	1 936	2 138	2 362
MAPOLENI	Rural Scattered	Alfred Nzo	297	328	362	400	442
MAPOLISENG	Rural - Small Village <= 5000	Alfred Nzo	1 829	2 020	2 232	2 465	2 723
EZASINI	Rural Scattered	Alfred Nzo	609	673	743	821	907
MAHLOBATHINI	Rural Scattered	Alfred Nzo	609	673	743	821	907
KWANGWE	Rural - Small Village <= 5000	Alfred Nzo	930	1 028	1 135	1 254	1 385
KWAMASHU	Rural - Small Village <= 5000	Alfred Nzo	1 158	1 279	1 413	1 561	1 724
PONTSENG	Rural - Small Village <= 5000	Alfred Nzo	1 063	1 174	1 297	1 433	1 583
EMBIZENI - A	Rural - Small Village <= 5000	Alfred Nzo	869	960	1 060	1 171	1 294
KWAMANGO - A	Rural - Small Village <= 5000	Alfred Nzo	554	612	676	747	825
MAPULENI	Rural Scattered	Alfred Nzo	1 171	1 294	1 429	1 578	1 744
KWAMANGO - B	Rural - Small Village <= 5000	Alfred Nzo	1 876	2 072	2 289	2 529	2 793
KUEGANA	Rural Scattered	Alfred Nzo	919	1 015	1 121	1 239	1 368
MHLOLOANENG - B	Rural - Small Village <= 5000	Alfred Nzo	1 033	1 141	1 261	1 393	1 539
MAYONENG	Rural - Small Village <= 5000	Alfred Nzo	583	645	712	786	869
LOWER MDENI	Rural - Small Village <= 5000	Alfred Nzo	1 202	1 327	1 466	1 620	1 789
MAHHIBI	Rural - Small Village <= 5000	Alfred Nzo	1 612	1 780	1 967	2 172	2 400
NTLAZIBENI - A	Rural - Small Village <= 5000	Alfred Nzo	968	1 069	1 181	1 305	1 441
GOOD HOPE - A	Rural Scattered	Alfred Nzo	99	109	121	133	147
TSHISA - B	Rural - Small Village <= 5000	Alfred Nzo	593	655	723	799	882
BETHESDA	Rural - Small Village <= 5000	Alfred Nzo	1 292	1 428	1 577	1 742	1 924
FUBANE	Rural - Small Village <= 5000	Alfred Nzo	1 220	1 348	1 489	1 644	1 816
BUBESI - A	Rural Scattered	Alfred Nzo	662	731	808	892	986
MANGOLONG	Rural - Small Village <= 5000	Alfred Nzo	1 220	1 348	1 489	1 644	1 816
JAKADU - B	Rural Scattered	Alfred Nzo	457	505	558	616	680
BUBESI - B	Rural - Small Village <= 5000	Alfred Nzo	1 538	1 699	1 877	2 073	2 290
LOWER MTHUMASI	Rural Scattered	Alfred Nzo	613	677	748	826	913
MAQHATSENI	Rural - Small Village <= 5000	Alfred Nzo	771	852	941	1 039	1 148
NYANISO	Rural Scattered	Alfred Nzo	61	68	75	82	91
GOOD HOPE - B	Rural Scattered	Alfred Nzo	358	396	437	483	533
ZINYOSINI	Rural Scattered	Alfred Nzo	600	663	732	808	893

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
MERITING	Rural Scattered	Alfred Nzo	1 033	1 141	1 261	1 393	1 539
SOLWANE	Rural Scattered	Alfred Nzo	271	300	331	366	404
MAHLAKE	Rural - Small Village <= 5000	Alfred Nzo	574	634	701	774	855
ZIMPOFU	Rural Scattered	Alfred Nzo	561	620	685	756	835
TOLENI - A	Rural Scattered	Alfred Nzo	788	870	961	1 061	1 173
MARANJANA - A	Rural Scattered	Alfred Nzo	515	569	629	694	767
LUNDA - A	Rural - Small Village <= 5000	Alfred Nzo	583	645	712	786	869
EMATOLWENI - B	Rural Scattered	Alfred Nzo	1 008	1 113	1 230	1 358	1 501
LUNDA - B	Rural - Small Village <= 5000	Alfred Nzo	740	817	902	997	1 101
FIVA	Rural - Small Village <= 5000	Alfred Nzo	697	770	850	939	1 037
BAMANLI	Rural - Small Village <= 5000	Alfred Nzo	671	741	819	905	999
NKALWENI - E	Rural - Small Village <= 5000	Alfred Nzo	1 016	1 122	1 240	1 369	1 513
EMAXESIBENI	Rural Scattered	Alfred Nzo	628	694	767	847	936
MRWABO	Rural - Small Village <= 5000	Alfred Nzo	374	414	457	505	557
ROLWENI	Rural Scattered	Alfred Nzo	237	261	289	319	352
KWAQILI	Rural Scattered	Alfred Nzo	762	842	930	1 027	1 135
EMNYAMANENI	Rural - Small Village <= 5000	Alfred Nzo	802	886	978	1 081	1 194
UPPER MNYAMANA	Rural Scattered	Alfred Nzo	1 259	1 391	1 536	1 697	1 874
LUKHOLWENI - B	Rural Scattered	Alfred Nzo	1 016	1 122	1 240	1 369	1 513
LOWER MNYANUNA	Rural - Small Village <= 5000	Alfred Nzo	1 828	2 019	2 231	2 464	2 722
NDAKENI - I	Rural Scattered	Alfred Nzo	2 504	2 766	3 056	3 375	3 729
TSHISANE	Rural Scattered	Alfred Nzo	714	789	871	962	1 063
EPIPHANY - A	Rural - Small Village <= 5000	Alfred Nzo	1 374	1 518	1 677	1 852	2 046
LUYENGWENI	Rural - Small Village <= 5000	Alfred Nzo	1 669	1 843	2 036	2 249	2 485
MPOFINI	Rural Scattered	Alfred Nzo	289	319	352	389	430
NCOME SPRINGS	Rural Scattered	Alfred Nzo	816	901	996	1 100	1 215
PHALANE	Rural - Small Village <= 5000	Alfred Nzo	1 417	1 565	1 729	1 910	2 110
MVUMELWANO - B	Rural Scattered	Alfred Nzo	498	550	607	671	741
LIBERTON FARM	Rural Scattered	Joe Gqabi	31	34	37	41	46
JOSEFU	Rural Scattered	Joe Gqabi	316	349	386	426	471
MAQWANGULENI	Rural Scattered	Joe Gqabi	306	338	373	412	456
NGXOTHWANA	Rural Scattered	Joe Gqabi	408	451	498	550	608
MTSHEZI - A	Rural - Small Village <= 5000	Joe Gqabi	1 041	1 149	1 270	1 402	1 549
SITHANA	Rural - Small Village <= 5000	Joe Gqabi	1 389	1 535	1 695	1 873	2 069
MOUNTAIN - A	Rural - Small Village <= 5000	Joe Gqabi	1 173	1 296	1 431	1 581	1 747
MQOKOLWENI - B	Rural - Small Village <= 5000	Joe Gqabi	1 030	1 138	1 257	1 389	1 534
LOWER SINXAKO	Rural - Small Village <= 5000	Joe Gqabi	1 428	1 578	1 743	1 925	2 126
ELALINI	Rural - Small Village <= 5000	Joe Gqabi	528	584	645	712	787
GQAGALA	Rural - Small Village <= 5000	Joe Gqabi	548	605	668	738	816
MDENI	Rural Scattered	Joe Gqabi	463	512	565	624	690
NAYIJELE	Rural - Small Village <= 5000	Joe Gqabi	534	589	651	719	794
MBIDLANA	Rural - Small Village <= 5000	Joe Gqabi	751	829	916	1 012	1 118
GQAQALA	Rural - Small Village <= 5000	Joe Gqabi	572	632	698	771	852
SIHLEHLENI	Rural Scattered	Joe Gqabi	130	143	158	175	193
CICIRA	Rural Scattered	Joe Gqabi	450	497	549	606	670
HOPEDALE	Rural - Small Village <= 5000	Joe Gqabi	1 546	1 708	1 887	2 084	2 302
SIDEKENI	Rural Scattered	Joe Gqabi	211	233	258	285	314
NTABELANGA	Rural - Small Village <= 5000	Joe Gqabi	1 131	1 250	1 380	1 525	1 684
NGXOTO	Rural - Small Village <= 5000	Joe Gqabi	652	720	795	879	971
UPPER SINXAGO	Rural Scattered	Joe Gqabi	451	498	550	608	671
NKALWENI - B	Rural Scattered	Joe Gqabi	347	383	423	467	516
CICIRHA	Rural Scattered	Joe Gqabi	65	72	80	88	97
GQAQHALA - A	Rural Scattered	Joe Gqabi	204	225	249	275	304
GQAQHALA - C	Rural Scattered	Joe Gqabi	357	394	436	481	532
XOLOMBANA	Rural Scattered	Joe Gqabi	80	88	97	107	118
NGXAZA - C	Rural Scattered	Joe Gqabi	248	274	302	334	369
KOSE	Rural Scattered	Joe Gqabi	179	197	218	241	266
MTSHEZI - B	Rural - Small Village <= 5000	Joe Gqabi	1 041	1 149	1 270	1 402	1 549
NTYWENKA - C	Rural - Small Village <= 5000	Joe Gqabi	1 000	1 104	1 220	1 347	1 488
HLWATIKA	Rural - Small Village <= 5000	Joe Gqabi	612	676	747	825	911
GUGWINI - C	Rural - Small Village <= 5000	Joe Gqabi	718	793	876	968	1 069
NGCELE - B	Rural - Small Village <= 5000	Joe Gqabi	765	845	934	1 031	1 139
DIDI - BB	Rural Scattered	Joe Gqabi	343	379	418	462	510
SIQUNGWENI - A	Rural Scattered	Joe Gqabi	296	327	361	399	440
QURANA - B	Rural - Small Village <= 5000	Joe Gqabi	612	676	747	825	911
GOVANE	Rural Scattered	Joe Gqabi	207	229	253	279	308
QURANA - A	Rural - Small Village <= 5000	Joe Gqabi	612	676	747	825	911
BLOCK A - B	Rural Scattered	Joe Gqabi	170	188	208	230	254
MAMBULWINI - A	Rural - Small Village <= 5000	Joe Gqabi	1 162	1 283	1 418	1 566	1 730
SIQHUNGQWINI	Rural Scattered	Joe Gqabi	375	415	458	506	559
MABHELENI - F	Rural Scattered	Joe Gqabi	337	372	411	454	501
MQOKOLWENI - D	Rural - Small Village <= 5000	Joe Gqabi	1 030	1 138	1 257	1 389	1 534
KOLOSANE	Rural Scattered	Joe Gqabi	120	133	147	162	179
DIRHINI	Rural Scattered	Joe Gqabi	190	210	232	256	282
MBONISWEBI - B	Rural Scattered	Joe Gqabi	269	297	329	363	401

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
LUXENI - D	Rural Scattered	Joe Gqabi	289	319	352	389	430
NCELE	Rural Scattered	Joe Gqabi	110	122	134	148	164
MEWANGELE - B	Rural Scattered	Joe Gqabi	110	122	134	148	164
MEWANGELE - A	Rural Scattered	Joe Gqabi	289	319	352	389	430
MPINKONE	Rural - Small Village <= 5000	Joe Gqabi	517	571	631	697	770
Nkamasana	Rural Scattered	Joe Gqabi	102	113	124	137	152
Nkanini	Rural - Small Village <= 5000	O R Tambo	1 149	1 269	1 402	1 548	1 710
Mthombo	Rural - Small Village <= 5000	O R Tambo	933	1 031	1 139	1 258	1 390
Mhlanga	Rural - Small Village <= 5000	O R Tambo	1 097	1 211	1 338	1 478	1 633
MNGA - C	Rural Scattered	O R Tambo	497	549	606	670	740
GCAKA - A	Rural Scattered	O R Tambo	886	979	1 082	1 195	1 320
MALONGWE	Rural Scattered	O R Tambo	595	657	726	802	885
Ngxotho - A	Rural Scattered	O R Tambo	815	900	995	1 099	1 214
Mnqunyana	Rural Scattered	O R Tambo	487	537	594	656	724
Mpindweni - F	Rural Scattered	O R Tambo	129	142	157	173	191
Ngxotho - B	Rural Scattered	O R Tambo	574	634	701	774	855
Mangwaneni - CC	Rural Scattered	O R Tambo	51	56	62	69	76
Gqunu	Rural Scattered	O R Tambo	615	679	751	829	916
Mjikwa	Rural Scattered	O R Tambo	349	385	426	470	519
Kumadukuda	Rural Scattered	O R Tambo	159	176	194	214	237
Mhlangala	Rural Scattered	O R Tambo	174	193	213	235	260
Mbokodwebomvu	Rural Scattered	O R Tambo	271	300	331	366	404
Nyokana - A	Rural Scattered	O R Tambo	625	691	763	843	931
Nkamasana	Rural Scattered	O R Tambo	66	73	81	89	99
Manxiweni - B	Rural Scattered	O R Tambo	344	380	419	463	512
Ngwemnyama - A	Rural Scattered	O R Tambo	420	464	513	566	626
Mpoza - I	Rural Scattered	O R Tambo	205	226	250	276	305
Ngonyameni - C	Rural Scattered	O R Tambo	159	176	194	214	237
Neustad - A	Rural - Small Village <= 5000	O R Tambo	933	1 031	1 139	1 258	1 390
Kwekweni	Rural Scattered	O R Tambo	697	770	850	939	1 037
Mbeza	Rural Scattered	O R Tambo	118	131	144	159	176
Gwali	Rural Scattered	O R Tambo	661	730	807	891	984
Cingco	Rural - Small Village <= 5000	O R Tambo	1 000	1 104	1 220	1 347	1 488
Mangcwanguleni	Rural Scattered	O R Tambo	1 635	1 806	1 995	2 204	2 435
Mbombo	Rural - Small Village <= 5000	O R Tambo	1 086	1 200	1 326	1 464	1 618
Dumba - B	Rural Scattered	O R Tambo	681	753	831	918	1 015
Dumba - B	Rural Scattered	O R Tambo	287	317	350	386	427
Buhlungwana	Rural - Small Village <= 5000	O R Tambo	1 850	2 044	2 258	2 494	2 755
Ngcolo	Rural Scattered	O R Tambo	625	691	763	843	931
Dumba - A	Rural Scattered	O R Tambo	461	509	563	621	686
Tina Falls	Rural - Small Village <= 5000	O R Tambo	1 559	1 722	1 902	2 101	2 321
Mampingeni - D	Rural - Small Village <= 5000	O R Tambo	1 266	1 398	1 545	1 706	1 885
Manzana - A	Rural - Small Village <= 5000	O R Tambo	846	934	1 032	1 140	1 259
Gubeni - B	Rural Scattered	O R Tambo	2 455	2 712	2 996	3 309	3 656
CINGCO - B	Rural Scattered	O R Tambo	61	68	75	82	91
Belekence	Rural - Small Village <= 5000	O R Tambo	1 189	1 314	1 451	1 603	1 771
Nyandeni	Rural Scattered	O R Tambo	933	1 031	1 139	1 258	1 390
DUKA	Rural - Small Village <= 5000	O R Tambo	2 004	2 214	2 446	2 702	2 984
MAGONKONE	Rural - Small Village <= 5000	O R Tambo	805	889	982	1 085	1 198
CEKA	Rural Scattered	O R Tambo	666	736	813	898	992
LIBRY	Rural Scattered	O R Tambo	420	464	513	566	626
XOKONXA	Rural Scattered	O R Tambo	56	62	68	76	84
QANDA - A	Rural Scattered	O R Tambo	754	833	920	1 016	1 122
NTSHINTSHI - A	Rural Scattered	O R Tambo	149	165	182	201	222
MNQANDANTO - C	Rural Scattered	O R Tambo	354	391	432	477	527
PHOCANI	Rural Scattered	O R Tambo	266	294	325	359	396
EMANXIWENI - B	Rural Scattered	O R Tambo	123	136	151	166	184
Lukhuni	Rural - Small Village <= 5000	O R Tambo	318	352	388	429	474
MATHE - D	Rural - Small Village <= 5000	O R Tambo	1 030	1 138	1 257	1 389	1 534
Mukuleni	Rural - Small Village <= 5000	O R Tambo	97	107	118	131	144
Mdabukweni	Rural Scattered	O R Tambo	159	176	194	214	237
Sityeni	Rural Scattered	O R Tambo	379	419	463	511	565
Magqoozini	Rural Scattered	O R Tambo	359	397	438	484	535
Lower Magxemi	Rural Scattered	O R Tambo	113	125	138	153	169
Khetani	Rural - Small Village <= 5000	O R Tambo	656	725	800	884	977
KUKUMEHLO	Rural Scattered	O R Tambo	225	249	275	304	336
QANDA - BB	Rural Scattered	O R Tambo	236	260	288	318	351
CINGCO - C	Rural Scattered	O R Tambo	754	833	920	1 016	1 122
Nkamasana	Rural Scattered	O R Tambo	71	79	87	96	106
Nkamasana	Rural Scattered	O R Tambo	31	34	37	41	46
Nkamasana	Rural Scattered	O R Tambo	56	62	68	76	84
Nkamasana	Rural Scattered	O R Tambo	113	125	138	153	169
Nkamasana	Rural Scattered	O R Tambo	36	39	44	48	53
Nkamasana	Rural Scattered	O R Tambo	46	51	56	62	68
Ndasana	Rural - Small Village <= 5000	O R Tambo	1 554	1 716	1 896	2 094	2 313

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Mncetvana	Rural Scattered	O R Tambo	728	805	889	982	1 084
Mboktwana	Rural - Small Village <= 5000	O R Tambo	1 189	1 314	1 451	1 603	1 771
Kuhleke	Rural Scattered	O R Tambo	395	436	482	532	588
Manzamnyama	Rural Scattered	O R Tambo	410	453	500	553	611
Phelandaba	Rural Scattered	O R Tambo	271	300	331	366	404
Sidaville	Rural Scattered	O R Tambo	969	1 070	1 182	1 306	1 443
Phelandaba	Rural Scattered	O R Tambo	185	204	225	249	275
Empoza	Rural Scattered	O R Tambo	185	204	225	249	275
Lwandlana - F	Rural Scattered	O R Tambo	374	414	457	505	557
Majola Tea Factory	Rural Scattered	O R Tambo	702	775	856	946	1 045
Goqwana - F	Rural Scattered	O R Tambo	420	464	513	566	626
Mvukazi	Rural Scattered	O R Tambo	56	62	68	76	84
Enkweza	Rural Scattered	O R Tambo	118	131	144	159	176
Goqwana - E	Rural Scattered	O R Tambo	139	153	169	187	207
Madlamini	Rural Scattered	O R Tambo	251	277	306	338	374
Ziputhe	Rural - Small Village <= 5000	O R Tambo	487	537	594	656	724
Mukuleni	Rural - Small Village <= 5000	O R Tambo	108	119	132	146	161
Mngazana	Rural Scattered	O R Tambo	200	221	244	269	298
Magqabasini	Rural Scattered	O R Tambo	410	453	500	553	611
Makelweni	Rural - Small Village <= 5000	O R Tambo	113	125	138	153	169
Upper Magxeni	Rural Scattered	O R Tambo	287	317	350	386	427
Lower Mceba	Rural - Small Village <= 5000	O R Tambo	974	1 076	1 189	1 313	1 450
Qotira	Rural - Small Village <= 5000	O R Tambo	1 707	1 885	2 082	2 300	2 541
Mbeza	Rural Scattered	O R Tambo	134	148	163	180	199
Magqagqeni	Rural Scattered	O R Tambo	308	340	376	415	459
Cacadu	Rural - Small Village <= 5000	O R Tambo	1 046	1 155	1 276	1 409	1 557
Ngqubani	Rural Scattered	O R Tambo	164	181	200	221	245
Luqolweni	Rural Scattered	O R Tambo	123	136	151	166	184
Mslauini	Rural Scattered	O R Tambo	415	459	507	560	618
Luqolweni	Rural Scattered	O R Tambo	61	68	75	82	91
Pubguleweni	Rural - Small Village <= 5000	O R Tambo	964	1 065	1 176	1 299	1 435
Luqolwenu	Rural Scattered	O R Tambo	134	148	163	180	199
Ntanbaduli	Rural - Small Village <= 5000	O R Tambo	805	889	982	1 085	1 198
Nyandeni	Rural Scattered	O R Tambo	661	730	807	891	984
Gandana	Rural - Small Village <= 5000	O R Tambo	441	487	538	594	656
Mantaliani	Rural Scattered	O R Tambo	36	39	44	48	53
Lubala	Rural Scattered	O R Tambo	471	521	575	635	702
Lwazulu	Rural - Small Village <= 5000	O R Tambo	1 061	1 172	1 295	1 430	1 580
Rwantswana	Rural Scattered	O R Tambo	323	357	395	436	481
Bhubesi	Rural - Small Village <= 5000	O R Tambo	974	1 076	1 189	1 313	1 450
Ngele	Rural - Small Village <= 5000	O R Tambo	190	210	232	256	282
Maqwathini	Rural Scattered	O R Tambo	66	73	81	89	99
Nyango	Rural Scattered	O R Tambo	174	193	213	235	260
Ndakeni	Rural Scattered	O R Tambo	302	334	368	407	450
Ntsilithwa	Rural - Small Village <= 5000	O R Tambo	2 342	2 587	2 858	3 157	3 487
Mhlahlweni	Rural Scattered	O R Tambo	292	322	356	393	434
Mphehle	Rural Scattered	O R Tambo	108	119	132	146	161
Nyango	Rural Scattered	O R Tambo	10	11	12	14	15
Caba	Rural - Small Village <= 5000	O R Tambo	636	702	775	857	946
Ntsibyane	Rural - Small Village <= 5000	O R Tambo	610	674	744	822	908
Hukwini	Rural Scattered	O R Tambo	174	193	213	235	260
Ntsohle	Rural Scattered	O R Tambo	415	459	507	560	618
Kwa-Ngcorhi	Rural Scattered	O R Tambo	164	181	200	221	245
Luthulini	Rural - Small Village <= 5000	O R Tambo	61	68	75	82	91
Dukuza	Rural - Small Village <= 5000	O R Tambo	502	554	612	676	747
Lower Lwandlana	Rural - Small Village <= 5000	O R Tambo	497	549	606	670	740
Dukuza	Rural - Small Village <= 5000	O R Tambo	144	159	176	194	214
Ngqwaneni	Rural Scattered	O R Tambo	266	294	325	359	396
Luthulini	Rural - Small Village <= 5000	O R Tambo	579	640	707	781	863
Kwa-Ngcorhi	Rural Scattered	O R Tambo	144	159	176	194	214
Kwandoyi	Rural - Small Village <= 5000	O R Tambo	185	204	225	249	275
Mangcuseni	Rural - Small Village <= 5000	O R Tambo	364	402	444	491	542
Sulenkama	Rural - Small Village <= 5000	O R Tambo	944	1 042	1 151	1 272	1 405
Sulenkama	Rural - Small Village <= 5000	O R Tambo	974	1 076	1 189	1 313	1 450
Mkhumbi	Rural - Small Village <= 5000	O R Tambo	707	781	863	953	1 053
Sizindeni	Rural Scattered	O R Tambo	77	85	93	103	114
Ngcoti	Rural - Small Village <= 5000	O R Tambo	1 030	1 138	1 257	1 389	1 534
Mdudwa	Rural Scattered	O R Tambo	297	328	362	400	442
Bofbanaza	Rural - Small Village <= 5000	O R Tambo	1 405	1 552	1 714	1 893	2 091
Ntabasigogo	Rural - Small Village <= 5000	O R Tambo	364	402	444	491	542
Ntubeni	Rural Scattered	O R Tambo	334	368	407	450	497
Sulenkama	Rural - Small Village <= 5000	O R Tambo	764	844	932	1 030	1 138
Mdudwa	Rural Scattered	O R Tambo	123	136	151	166	184
Tyhuname	Rural - Small Village <= 5000	O R Tambo	625	691	763	843	931
Mdeni	Rural Scattered	O R Tambo	1 420	1 569	1 733	1 914	2 114

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Masomntwana	Rural - Small Village <= 5000	O R Tambo	984	1 087	1 201	1 327	1 466
Dumaneni	Rural - Small Village <= 5000	O R Tambo	656	725	800	884	977
Khunkutha	Rural Scattered	O R Tambo	56	62	68	76	84
Mtozelo	Rural Scattered	O R Tambo	236	260	288	318	351
Sulenkama	Rural - Small Village <= 5000	O R Tambo	779	861	951	1 050	1 160
Kimbili 1	Rural - Small Village <= 5000	O R Tambo	625	691	763	843	931
Dumaneni 1	Rural Scattered	O R Tambo	220	243	269	297	328
Kwatshane	Rural Scattered	O R Tambo	308	340	376	415	459
Detyana	Rural Scattered	O R Tambo	61	68	75	82	91
Gabajana	Squatter Camp - Rural	O R Tambo	2 957	3 267	3 608	3 986	4 403
Mpesheni	Rural Scattered	O R Tambo	71	79	87	96	106
Caba Mission	Rural Scattered	O R Tambo	564	623	688	760	840
Sindeni	Rural - Small Village <= 5000	O R Tambo	2 276	2 514	2 777	3 067	3 388
Lluqolwenl	Rural - Small Village <= 5000	O R Tambo	518	572	632	698	772
Mandyimba	Rural Scattered	O R Tambo	544	601	663	733	810
Natal	Rural Scattered	O R Tambo	287	317	350	386	427
Lower Ngcolokili	Rural Scattered	O R Tambo	97	107	118	131	144
Zinyosimi	Rural - Small Village <= 5000	O R Tambo	749	827	914	1 009	1 115
Ndakeni	Rural - Small Village <= 5000	O R Tambo	651	719	794	877	969
Thambekenr	Rural Scattered	O R Tambo	159	176	194	214	237
Ngqongo	Rural - Small Village <= 5000	O R Tambo	1 312	1 449	1 601	1 768	1 953
Buwa	Rural Scattered	O R Tambo	830	917	1 013	1 119	1 236
Ncumbe	Rural Scattered	O R Tambo	1 215	1 342	1 482	1 638	1 809
Mtwaku	Rural - Small Village <= 5000	O R Tambo	1 302	1 438	1 588	1 754	1 938
Bisi	Rural - Small Village <= 5000	O R Tambo	1 128	1 246	1 377	1 521	1 680
Ntsheleni	Rural - Small Village <= 5000	O R Tambo	2 235	2 469	2 727	3 012	3 328
Kwa Nyathi	Rural Scattered	O R Tambo	610	674	744	822	908
Ngqwangi	Rural - Small Village <= 5000	O R Tambo	928	1 025	1 133	1 251	1 382
Ncalukeni	Squatter Camp - Rural	O R Tambo	1 349	1 490	1 646	1 818	2 008
New Castle	Squatter Camp - Rural	O R Tambo	2 379	2 628	2 903	3 206	3 542
Ndasana	Rural Scattered	O R Tambo	723	799	883	975	1 077
Gqcaka	Rural Scattered	O R Tambo	646	713	788	870	961
Noziyongwana	Rural Scattered	O R Tambo	308	340	376	415	459
Ngolo	Rural Scattered	O R Tambo	487	537	594	656	724
Upper Tafufu	Rural Scattered	O R Tambo	185	204	225	249	275
Zele	Rural - Small Village <= 5000	O R Tambo	1 349	1 490	1 646	1 818	2 008
Lufafa	Rural - Small Village <= 5000	O R Tambo	769	850	939	1 037	1 145
Nglntaka	Rural - Small Village <= 5000	O R Tambo	1 138	1 258	1 389	1 534	1 695
Emzalwaneni	Rural - Small Village <= 5000	O R Tambo	759	838	926	1 023	1 130
Emzalwaneni	Rural - Small Village <= 5000	O R Tambo	1 538	1 699	1 877	2 073	2 290
Mhlabeniomhlophe	Rural Scattered	O R Tambo	425	470	519	573	633
Dumsi	Rural - Small Village <= 5000	O R Tambo	1 261	1 393	1 538	1 699	1 877
Gumpe	Rural - Small Village <= 5000	O R Tambo	1 000	1 104	1 220	1 347	1 488
Dandalazile	Rural Scattered	O R Tambo	661	730	807	891	984
Qudu	Rural - Small Village <= 5000	O R Tambo	1 384	1 529	1 689	1 866	2 061
Mayalutweni	Rural - Small Village <= 5000	O R Tambo	1 502	1 659	1 832	2 024	2 236
Jojweni - K	Rural Scattered	O R Tambo	651	719	794	877	969
Jojweni - H	Rural Scattered	O R Tambo	374	414	457	505	557
Bele - B	Rural Scattered	O R Tambo	36	39	44	48	53
Malepe	Rural - Small Village <= 5000	O R Tambo	676	747	825	912	1 007
Ntshiqo	Rural Scattered	O R Tambo	292	322	356	393	434
Bijo	Rural Scattered	O R Tambo	231	255	281	311	343
No 9	Rural Scattered	O R Tambo	149	165	182	201	222
Goqwana - G	Rural Scattered	O R Tambo	246	272	300	331	366
Malonggwe	Rural Scattered	O R Tambo	276	305	337	373	412
Mnga - C	Rural Scattered	O R Tambo	497	549	606	670	740
Mcheni	Rural Scattered	O R Tambo	159	176	194	214	237
Esidwadweni - A	Rural Scattered	O R Tambo	164	181	200	221	245
Waterfall	Rural Scattered	O R Tambo	102	113	124	137	152
Emdibanisweni - B	Rural Scattered	O R Tambo	26	28	31	34	38
Xibeni	Rural - Small Village <= 5000	O R Tambo	820	906	1 001	1 105	1 221
Tshisani - A	Rural Scattered	O R Tambo	502	554	612	676	747
Lower Tyira - A	Rural Scattered	O R Tambo	364	402	444	491	542
Ndamanga	Rural - Small Village <= 5000	O R Tambo	881	974	1 075	1 188	1 312
Bhayi	Rural - Small Village <= 5000	O R Tambo	1 174	1 297	1 433	1 583	1 748
Mdeni - U	Rural - Small Village <= 5000	O R Tambo	1 364	1 507	1 664	1 838	2 031
Mpindweni - I	Rural Scattered	O R Tambo	92	101	112	124	137
Egolideni	Rural Scattered	O R Tambo	395	436	482	532	588
Nongenkqe	Rural Scattered	O R Tambo	349	385	426	470	519
Gongo - B	Rural Scattered	O R Tambo	754	833	920	1 016	1 122
Esiqikini - D	Rural Scattered	O R Tambo	210	232	256	283	313
Ngavungavu	Rural - Small Village <= 5000	O R Tambo	1 154	1 274	1 408	1 555	1 718
Phezukwamawa	Rural - Small Village <= 5000	O R Tambo	933	1 031	1 139	1 258	1 390
Dokodela	Rural Scattered	O R Tambo	559	618	682	753	832
Mhlanganisweni - B	Rural - Small Village <= 5000	O R Tambo	2 184	2 413	2 665	2 944	3 252

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Endwe B	Rural - Small Village <= 5000	O R Tambo	1 061	1 172	1 295	1 430	1 580
Gongo - A	Rural Scattered	O R Tambo	144	159	176	194	214
Lutubeni - A	Rural Scattered	O R Tambo	169	187	207	228	252
Mkuzaza	Rural - Small Village <= 5000	O R Tambo	1 046	1 155	1 276	1 409	1 557
Nyathi - D	Rural Scattered	O R Tambo	51	56	62	69	76
Gqaqhana	Rural Scattered	O R Tambo	625	691	763	843	931
Emthojeni	Rural Scattered	O R Tambo	139	153	169	187	207
Gxeni - A	Rural Scattered	O R Tambo	149	165	182	201	222
Mangqamseni	Rural Scattered	O R Tambo	415	459	507	560	618
Nqalo	Rural Scattered	O R Tambo	271	300	331	366	404
Kunyingweni	Rural Scattered	O R Tambo	82	90	100	110	122
Ngqalo	Rural Scattered	O R Tambo	210	232	256	283	313
Mzwakazi	Rural Scattered	O R Tambo	318	352	388	429	474
Chibini	Rural Scattered	O R Tambo	287	317	350	386	427
Krancolo	Rural - Small Village <= 5000	O R Tambo	241	266	294	324	358
Tsolo	Rural Scattered	O R Tambo	933	1 031	1 139	1 258	1 390
Goqwana - H	Rural Scattered	O R Tambo	231	255	281	311	343
Mmangweni - A	Rural Scattered	O R Tambo	436	481	531	587	649
Qomo Plantation	Rural Scattered	O R Tambo	256	283	312	345	381
Nkumba - A	Rural Scattered	O R Tambo	420	464	513	566	626
Msukeni - A	Rural Scattered	O R Tambo	451	498	550	608	671
Ngozi - B	Rural Scattered	O R Tambo	569	629	695	767	847
Nkamasana	Rural Scattered	O R Tambo	129	142	157	173	191
Nkamasana	Rural Scattered	O R Tambo	61	68	75	82	91
Nkamasana	Rural Scattered	O R Tambo	46	51	56	62	68
Nzondeni	Rural Scattered	O R Tambo	190	210	232	256	282
Ezinkumbeni	Rural - Small Village <= 5000	O R Tambo	1 881	2 078	2 295	2 535	2 801
Bungu	Rural - Small Village <= 5000	O R Tambo	1 456	1 608	1 776	1 962	2 167
Dumsi - B	Rural Scattered	O R Tambo	220	243	269	297	328
Ntaboduli - B	Rural Scattered	O R Tambo	754	833	920	1 016	1 122
Kukulozi	Rural - Small Village <= 5000	O R Tambo	964	1 065	1 176	1 299	1 435
Mantlaneni C	Rural - Small Village <= 5000	O R Tambo	1 317	1 455	1 607	1 775	1 961
Dungu - A	Rural Scattered	O R Tambo	549	606	670	740	817
Mantlaneni B	Rural - Small Village <= 5000	O R Tambo	1 527	1 687	1 863	2 058	2 274
Ethumbeni	Rural - Small Village <= 5000	O R Tambo	1 651	1 823	2 014	2 225	2 457
Mthombe	Rural - Small Village <= 5000	O R Tambo	759	838	926	1 023	1 130
Nkanini	Rural - Small Village <= 5000	O R Tambo	502	554	612	676	747
Dikela	Rural Scattered	O R Tambo	271	300	331	366	404
Lukhuni	Rural - Small Village <= 5000	O R Tambo	620	685	757	836	923
Mhlanga	Rural - Small Village <= 5000	O R Tambo	1 759	1 943	2 146	2 370	2 618
Marhubeni	Rural - Small Village <= 5000	O R Tambo	2 025	2 237	2 471	2 729	3 015
Upper Tafufu	Rural - Small Village <= 5000	O R Tambo	2 671	2 950	3 259	3 600	3 976
Ntshele	Rural - Small Village <= 5000	O R Tambo	922	1 019	1 125	1 243	1 373
Lukhuni	Rural - Small Village <= 5000	O R Tambo	461	509	563	621	686
Lukhuni	Rural - Small Village <= 5000	O R Tambo	276	305	337	373	412
Bakaleni	Rural - Small Village <= 5000	O R Tambo	430	476	525	580	641
Nkanga	Rural - Small Village <= 5000	O R Tambo	1 764	1 948	2 152	2 377	2 626
Mpendlamoya	Rural Scattered	O R Tambo	220	243	269	297	328
Gqwashu	Rural Scattered	O R Tambo	225	249	275	304	336
Makelweni	Rural - Small Village <= 5000	O R Tambo	487	537	594	656	724
Luysheko	Rural - Small Village <= 5000	O R Tambo	2 973	3 284	3 627	4 007	4 426
Mabhudu	Rural - Small Village <= 5000	O R Tambo	323	357	395	436	481
Mmangweni	Rural - Small Village <= 5000	O R Tambo	707	781	863	953	1 053
Hlankomo	Rural Scattered	O R Tambo	579	640	707	781	863
Tyemnyama	Rural Scattered	O R Tambo	77	85	93	103	114
Ntibane	Rural Scattered	O R Tambo	671	741	819	905	999
Bomvini	Rural Scattered	O R Tambo	220	243	269	297	328
Kimbili 2	Rural Scattered	O R Tambo	774	855	945	1 044	1 153
Luxeni	Rural Scattered	O R Tambo	364	402	444	491	542
Chibini	Rural - Small Village <= 5000	O R Tambo	1 696	1 874	2 070	2 287	2 526
Sipaqeni	Rural - Small Village <= 5000	O R Tambo	5 060	5 589	6 174	6 820	7 533
Tholeni	Rural - Small Village <= 5000	O R Tambo	2 579	2 849	3 147	3 476	3 840
Nkamasana	Rural Scattered	O R Tambo	61	68	75	82	91
Nkamasana	Rural Scattered	O R Tambo	26	28	31	34	38
Nkamasana	Rural Scattered	O R Tambo	308	340	376	415	459
Nkamasana	Rural Scattered	O R Tambo	282	311	344	379	419
Mataleni	Rural Scattered	O R Tambo	185	204	225	249	275
Gpmrbi	Rural - Small Village <= 5000	O R Tambo	1 000	1 104	1 220	1 347	1 488
Gqeyana	Rural Scattered	O R Tambo	339	374	413	456	504
Laleni	Rural - Small Village <= 5000	O R Tambo	928	1 025	1 133	1 251	1 382
Manka	Rural Scattered	O R Tambo	441	487	538	594	656
Mandela	Rural - Small Village <= 5000	O R Tambo	1 569	1 733	1 914	2 115	2 336
Mangweni	Rural Scattered	O R Tambo	620	685	757	836	923
Mdeni	Rural Scattered	O R Tambo	174	193	213	235	260
Jonginkundla	Rural Scattered	O R Tambo	1 005	1 110	1 226	1 354	1 496

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Kwam	Rural - Small Village <= 5000	O R Tambo	1 332	1 472	1 626	1 796	1 984
Upper Lotana	Squatter Camp - Rural	O R Tambo	1 451	1 602	1 770	1 955	2 160
Belezingcuka	Rural - Small Village <= 5000	O R Tambo	2 835	3 131	3 459	3 821	4 221
Mangweni	Rural Scattered	O R Tambo	866	957	1 057	1 167	1 289
Ntibane	Rural Scattered	O R Tambo	1 959	2 164	2 390	2 640	2 916
Lower Lotina	Squatter Camp - Rural	O R Tambo	902	996	1 100	1 215	1 343
Ngolo	Rural Scattered	O R Tambo	585	646	713	788	870
Sidani	Rural - Small Village <= 5000	O R Tambo	502	554	612	676	747
Zandukweni	Rural - Small Village <= 5000	O R Tambo	3 516	3 884	4 291	4 739	5 235
Luthumbeni	Rural - Small Village <= 5000	O R Tambo	1 702	1 880	2 076	2 293	2 533
Dikela	Rural Scattered	O R Tambo	574	634	701	774	855
Sidani	Rural - Small Village <= 5000	O R Tambo	302	334	368	407	450
Mhlakulo	Rural - Small Village <= 5000	O R Tambo	1 481	1 636	1 807	1 996	2 205
Nxukhuwebe	Rural Scattered	O R Tambo	671	741	819	905	999
Gebane	Rural - Small Village <= 5000	O R Tambo	1 549	1 711	1 889	2 087	2 306
XHIBENI	Rural Scattered	O R Tambo	687	758	838	925	1 022
DUKUZA - A	Rural Scattered	O R Tambo	180	198	219	242	267
Ngcosana	Rural Scattered	O R Tambo	579	640	707	781	863
Emanaleni - C	Rural Scattered	O R Tambo	271	300	331	366	404
Elusibeni	Rural Scattered	O R Tambo	236	260	288	318	351
Lower ntafufu - A	Rural Scattered	O R Tambo	415	459	507	560	618
Mthambalala - C	Rural Scattered	O R Tambo	318	352	388	429	474
Emanaleni - A	Rural Scattered	O R Tambo	256	283	312	345	381
Siphusiphu	Rural Scattered	O R Tambo	123	136	151	166	184
Goqwana - D	Rural - Small Village <= 5000	O R Tambo	334	368	407	450	497
Goqwana - A	Rural - Small Village <= 5000	O R Tambo	425	470	519	573	633
Dedelo - AA	Rural - Small Village <= 5000	O R Tambo	174	193	213	235	260
Kwabipha - A	Rural Scattered	O R Tambo	369	408	451	498	550
Dedelo - B	Rural - Small Village <= 5000	O R Tambo	1 015	1 121	1 238	1 368	1 511
Dedelo - C	Rural Scattered	O R Tambo	481	532	588	649	717
Lutswana	Rural Scattered	O R Tambo	225	249	275	304	336
Kwabipha - B	Rural Scattered	O R Tambo	456	504	556	615	679
Kwantshangase	Rural Scattered	O R Tambo	87	96	106	117	129
Thuntu	Rural Scattered	O R Tambo	200	221	244	269	298
Elhibini	Rural Scattered	O R Tambo	164	181	200	221	245
Mathe - A	Rural - Small Village <= 5000	O R Tambo	774	855	945	1 044	1 153
Gqina	Rural Scattered	O R Tambo	215	238	263	290	320
Dumsi - A	Rural - Small Village <= 5000	O R Tambo	564	623	688	760	840
Eqabangeni	Rural Scattered	O R Tambo	641	708	782	863	954
Esithukuthezi	Rural - Small Village <= 5000	O R Tambo	1 174	1 297	1 433	1 583	1 748
Emarambeni	Rural Scattered	O R Tambo	15	17	19	21	23
Emagusheni	Rural Scattered	O R Tambo	97	107	118	131	144
Ntshangase	Rural Scattered	O R Tambo	497	549	606	670	740
Emabusheni	Rural Scattered	O R Tambo	26	28	31	34	38
Xopozo	Rural Scattered	O R Tambo	1 133	1 252	1 383	1 528	1 687
Lwandlana - G	Rural Scattered	O R Tambo	656	725	800	884	977
Thonti - A	Rural Scattered	O R Tambo	77	85	93	103	114
Cetshe	Rural - Small Village <= 5000	O R Tambo	1 481	1 636	1 807	1 996	2 205
Magonkone	Rural Scattered	O R Tambo	476	526	581	642	709
Nkamasana	Rural Scattered	O R Tambo	41	45	50	55	61
Nkamasana	Rural Scattered	O R Tambo	66	73	81	89	99
Nkamasana	Rural Scattered	O R Tambo	154	170	188	208	229
Nkamasana	Rural Scattered	O R Tambo	123	136	151	166	184
MPETSHWA	Rural Scattered	O R Tambo	1 071	1 183	1 307	1 444	1 595
TONTI - A	Rural - Small Village <= 5000	O R Tambo	666	736	813	898	992
MARAMZENI - B	Rural - Small Village <= 5000	O R Tambo	261	288	319	352	389
MARAMZENI - A	Rural Scattered	O R Tambo	149	165	182	201	222
MARA	Rural Scattered	O R Tambo	641	708	782	863	954
Nkamasana	Rural Scattered	O R Tambo	46	51	56	62	68
Nkamasana	Rural Scattered	O R Tambo	66	73	81	89	99
Nkamasana	Rural Scattered	O R Tambo	87	96	106	117	129
Nkamasana	Rural Scattered	O R Tambo	71	79	87	96	106
Nkamasana	Rural Scattered	O R Tambo	36	39	44	48	53
Nkamasana	Rural Scattered	O R Tambo	26	28	31	34	38
Nkamasana	Rural Scattered	O R Tambo	36	39	44	48	53
Nkamasana	Rural Scattered	O R Tambo	102	113	124	137	152
Nkamasana	Rural Scattered	O R Tambo	200	221	244	269	298
Nkamasana	Rural Scattered	O R Tambo	164	181	200	221	245
GXWALENI - E	Rural - Small Village <= 5000	O R Tambo	1 559	1 722	1 902	2 101	2 321
SIPHOLWENI	Rural - Small Village <= 5000	O R Tambo	5	6	6	7	8
GXWALENI - C	Rural Scattered	O R Tambo	149	165	182	201	222
GXWALENI - G	Rural Scattered	O R Tambo	302	334	368	407	450
GXWALENI - F	Rural - Small Village <= 5000	O R Tambo	1 189	1 314	1 451	1 603	1 771
MAJABA	Rural - Small Village <= 5000	O R Tambo	1 056	1 166	1 288	1 423	1 572
ESINGENI - F	Rural Scattered	O R Tambo	231	255	281	311	343

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
ESINGENI - EE	Rural Scattered	O R Tambo	523	578	639	705	779
MARHAMBENI - A	Rural - Small Village <= 5000	O R Tambo	1 291	1 427	1 576	1 741	1 923
ZILANDAME	Rural - Small Village <= 5000	O R Tambo	1 015	1 121	1 238	1 368	1 511
MAHLUNGELA	Rural - Small Village <= 5000	O R Tambo	2 404	2 656	2 934	3 241	3 580
BLACK HILL - B	Rural - Small Village <= 5000	O R Tambo	1 338	1 478	1 633	1 804	1 993
MAHLUNGUU	Rural Scattered	O R Tambo	702	775	856	946	1 045
NGELE - C	Rural Scattered	O R Tambo	605	668	738	815	901
GQILI - B	Rural Scattered	O R Tambo	795	878	970	1 071	1 183
DITYANE	Rural Scattered	O R Tambo	205	226	250	276	305
MPESHENI	Rural Scattered	O R Tambo	610	674	744	822	908
BHUWA - D	Rural Scattered	O R Tambo	625	691	763	843	931
NZULUKA	Rural Scattered	O R Tambo	466	515	569	628	694
MTHOMBO - C	Rural - Small Village <= 5000	O R Tambo	769	850	939	1 037	1 145
MTHOMBO - B	Rural - Small Village <= 5000	O R Tambo	630	696	769	850	939
MLOMO	Rural - Small Village <= 5000	O R Tambo	1 907	2 106	2 326	2 570	2 839
Saphukaduku	Rural Scattered	O R Tambo	518	572	632	698	772
Hayiheke	Rural Scattered	O R Tambo	82	90	100	110	122
Khubusi	Rural Scattered	O R Tambo	200	221	244	269	298
Mjrla	Rural - Small Village <= 5000	O R Tambo	744	821	907	1 002	1 107
Khubusi	Rural Scattered	O R Tambo	390	430	475	525	580
Mswakazi	Rural - Small Village <= 5000	O R Tambo	1 159	1 280	1 414	1 562	1 725
Qhaka	Rural - Small Village <= 5000	O R Tambo	3 260	3 601	3 978	4 394	4 854
Caguba	Rural - Small Village <= 5000	O R Tambo	1 349	1 490	1 646	1 818	2 008
Caguba	Rural - Small Village <= 5000	O R Tambo	5 716	6 314	6 974	7 704	8 510
Goqwana - B	Rural Scattered	O R Tambo	318	352	388	429	474
Dlankomo	Rural Scattered	O R Tambo	61	68	75	82	91
Lwandlana - A	Rural Scattered	O R Tambo	149	165	182	201	222
Hlankomo - B	Rural Scattered	O R Tambo	31	34	37	41	46
Bukhwezeni	Rural Scattered	O R Tambo	66	73	81	89	99
Sihlonyaneni	Rural Scattered	O R Tambo	169	187	207	228	252
Kungqame - A	Rural Scattered	O R Tambo	313	346	382	422	466
Mowa - C	Rural Scattered	O R Tambo	231	255	281	311	343
Ndwana	Rural Scattered	O R Tambo	297	328	362	400	442
Hlankomo - C	Rural Scattered	O R Tambo	318	352	388	429	474
Ngqame	Rural Scattered	O R Tambo	51	56	62	69	76
Ekukhwezeni	Rural Scattered	O R Tambo	220	243	269	297	328
Mbongwenimowa - B	Rural Scattered	O R Tambo	118	131	144	159	176
Mantaliame	Rural Scattered	O R Tambo	41	45	50	55	61
Mowa - D	Rural Scattered	O R Tambo	51	56	62	69	76
Mowa - E	Rural Scattered	O R Tambo	149	165	182	201	222
Kungqame - B	Rural Scattered	O R Tambo	481	532	588	649	717
Mboneni	Rural Scattered	O R Tambo	97	107	118	131	144
Bhungeni - A	Rural Scattered	O R Tambo	97	107	118	131	144
Madlokoza	Rural - Small Village <= 5000	O R Tambo	585	646	713	788	870
Manxontseni	Rural Scattered	O R Tambo	881	974	1 075	1 188	1 312
Mqebeleleni	Rural Scattered	O R Tambo	554	612	676	747	825
Mbongweni - A	Rural - Small Village <= 5000	O R Tambo	2 061	2 276	2 514	2 777	3 068
Dedelo - A	Rural Scattered	O R Tambo	471	521	575	635	702
Ezibanzini - A	Rural Scattered	O R Tambo	236	260	288	318	351
Ludeke - G	Rural Scattered	O R Tambo	71	79	87	96	106
Ludeke - E	Rural Scattered	O R Tambo	600	663	732	808	893
Latshitshi	Rural Scattered	O R Tambo	144	159	176	194	214
Mngeni - B	Rural Scattered	O R Tambo	287	317	350	386	427
Ngcwamane	Rural Scattered	O R Tambo	754	833	920	1 016	1 122
Madwakazana - A	Rural - Small Village <= 5000	O R Tambo	574	634	701	774	855
Nogxume	Rural Scattered	O R Tambo	123	136	151	166	184
Ludiwane	Rural Scattered	O R Tambo	395	436	482	532	588
Madwana	Rural Scattered	O R Tambo	712	787	869	960	1 060
Ndile	Rural Scattered	O R Tambo	425	470	519	573	633
Sikitini	Rural Scattered	O R Tambo	497	549	606	670	740
Mabalengwe	Rural - Small Village <= 5000	O R Tambo	1 066	1 178	1 301	1 437	1 587
Mantlaneni - A	Rural Scattered	O R Tambo	497	549	606	670	740
Dupha	Rural Scattered	O R Tambo	359	397	438	484	535
Lwandlana - D	Rural - Small Village <= 5000	O R Tambo	754	833	920	1 016	1 122
Guqa	Rural - Small Village <= 5000	O R Tambo	539	595	657	726	802
Hala - C	Rural Scattered	O R Tambo	276	305	337	373	412
Mneketshe	Rural Scattered	O R Tambo	425	470	519	573	633
Dwakazana	Rural Scattered	O R Tambo	92	101	112	124	137
Sinquma	Rural Scattered	O R Tambo	169	187	207	228	252
Mchenge	Rural Scattered	O R Tambo	66	73	81	89	99
Mantlaneni A	Rural - Small Village <= 5000	O R Tambo	825	912	1 007	1 112	1 229
Bisana	Rural Scattered	O R Tambo	456	504	556	615	679
Khalamfazi	Rural Scattered	O R Tambo	56	62	68	76	84
Mfinizweni - C	Rural Scattered	O R Tambo	569	629	695	767	847
Mfinizweni - C	Rural Scattered	O R Tambo	246	272	300	331	366

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Ziwelitsha	Rural Scattered	O R Tambo	180	198	219	242	267
Nogqadasi - B	Rural Scattered	O R Tambo	129	142	157	173	191
Mdeni - I	Rural Scattered	O R Tambo	261	288	319	352	389
Mnga - B	Rural Scattered	O R Tambo	129	142	157	173	191
INXU-DRIFT STORE	Rural Scattered	O R Tambo	36	39	44	48	53
Mabululu	Rural Scattered	O R Tambo	159	176	194	214	237
Xeni - B	Rural Scattered	O R Tambo	282	311	344	379	419
Enkameni	Rural Scattered	O R Tambo	66	73	81	89	99
Maqakambeni	Rural Scattered	O R Tambo	600	663	732	808	893
Cikade	Rural Scattered	O R Tambo	36	39	44	48	53
Lukhuni - A	Rural Scattered	O R Tambo	56	62	68	76	84
Kwa - Ngcola - B	Rural Scattered	O R Tambo	56	62	68	76	84
Kwa Ncoya	Rural Scattered	O R Tambo	20	23	25	27	30
Cumnie	Rural Scattered	O R Tambo	190	210	232	256	282
Kwa - Ngcova	Rural Scattered	O R Tambo	256	283	312	345	381
Mbeza	Rural Scattered	O R Tambo	502	554	612	676	747
Nobamba - A	Rural Scattered	O R Tambo	954	1 054	1 164	1 286	1 420
Sivivana	Rural Scattered	O R Tambo	102	113	124	137	152
Upper Gunqwana	Rural Scattered	O R Tambo	56	62	68	76	84
Upper Gunqwana	Rural Scattered	O R Tambo	118	131	144	159	176
Upper Gunqwana	Rural Scattered	O R Tambo	97	107	118	131	144
Upper Gunqwana	Rural Scattered	O R Tambo	82	90	100	110	122
Upper Gunqwana	Rural Scattered	O R Tambo	46	51	56	62	68
Upper Gunqwana	Rural Scattered	O R Tambo	51	56	62	69	76
Upper Gunqwana	Rural Scattered	O R Tambo	113	125	138	153	169
Upper Gunqwana	Rural Scattered	O R Tambo	159	176	194	214	237
Upper Gunqwana	Rural Scattered	O R Tambo	77	85	93	103	114
Upper Gunqwana	Rural Scattered	O R Tambo	139	153	169	187	207
Upper Gunqwana	Rural Scattered	O R Tambo	51	56	62	69	76
Komkhulu - F	Rural Scattered	O R Tambo	246	272	300	331	366
Mabholomba	Rural Scattered	O R Tambo	646	713	788	870	961
Madwaleni - D	Rural Scattered	O R Tambo	651	719	794	877	969
Nqadu - C	Rural Scattered	O R Tambo	236	260	288	318	351
Nqadu - B	Rural Scattered	O R Tambo	113	125	138	153	169
Ncemeni	Rural - Small Village <= 5000	O R Tambo	886	979	1 082	1 195	1 320
Balasi - A	Rural - Small Village <= 5000	O R Tambo	1 205	1 331	1 470	1 624	1 794
Ebelezi	Rural Scattered	O R Tambo	481	532	588	649	717
Erayini	Rural Scattered	O R Tambo	118	131	144	159	176
Bulembu farm - A	Rural Scattered	O R Tambo	271	300	331	366	404
Lower Tyira - C	Rural Scattered	O R Tambo	487	537	594	656	724
Goqwane	Rural Scattered	O R Tambo	559	618	682	753	832
Ndzebe - B	Rural Scattered	O R Tambo	256	283	312	345	381
Labry	Rural Scattered	O R Tambo	292	322	356	393	434
Emdibanisweni - C	Rural - Small Village <= 5000	O R Tambo	795	878	970	1 071	1 183
Ezintutyaneni	Rural Scattered	O R Tambo	190	210	232	256	282
Esibhalweni	Rural Scattered	O R Tambo	436	481	531	587	649
Balasi - B	Rural Scattered	O R Tambo	102	113	124	137	152
Diphini - B	Rural Scattered	O R Tambo	256	283	312	345	381
Magoqoza	Rural Scattered	O R Tambo	200	221	244	269	298
Kilili	Rural Scattered	O R Tambo	492	543	600	663	732
Bulembu farm - B	Rural Scattered	O R Tambo	215	238	263	290	320
Godzi - B	Rural Scattered	O R Tambo	615	679	751	829	916
Bhungeni - B	Rural - Small Village <= 5000	O R Tambo	554	612	676	747	825
Madadeni	Rural Scattered	O R Tambo	1 435	1 585	1 751	1 935	2 137
Mngwnvbeni	Rural Scattered	O R Tambo	344	380	419	463	512
Xhama - B	Rural Scattered	O R Tambo	261	288	319	352	389
Magungululu	Rural - Small Village <= 5000	O R Tambo	169	187	207	228	252
Nkamasana	Rural Scattered	O R Tambo	154	170	188	208	229
Nkamasana	Rural Scattered	O R Tambo	71	79	87	96	106
Mbosizeni	Rural - Small Village <= 5000	O R Tambo	2 142	2 366	2 614	2 887	3 189
Tshaya	Rural Scattered	O R Tambo	113	125	138	153	169
Ngqubungweni	Rural Scattered	O R Tambo	251	277	306	338	374
Mbenyane	Rural Scattered	O R Tambo	446	492	544	601	664
Lutshaya - B	Rural - Small Village <= 5000	O R Tambo	1 681	1 857	2 051	2 266	2 503
Makhwaleni	Rural Scattered	O R Tambo	139	153	169	187	207
Ntontela - D	Rural Scattered	O R Tambo	10	11	12	14	15
Ntontela - C	Rural Scattered	O R Tambo	87	96	106	117	129
Upper Mkata	Rural Scattered	O R Tambo	66	73	81	89	99
Makhwalweni - D	Rural Scattered	O R Tambo	56	62	68	76	84
Kwabela	Rural Scattered	O R Tambo	15	17	19	21	23
Makhwalini - A	Rural Scattered	O R Tambo	26	28	31	34	38
Mtshiso - A	Rural Scattered	O R Tambo	164	181	200	221	245
Ntlembini	Rural Scattered	O R Tambo	287	317	350	386	427
Thembukazi - A	Rural Scattered	O R Tambo	139	153	169	187	207
Mavaleleni	Rural Scattered	O R Tambo	385	425	469	518	573

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Makhwalini - B	Rural Scattered	O R Tambo	36	39	44	48	53
Good hope - DD	Rural Scattered	O R Tambo	56	62	68	76	84
Mavaleneni	Rural Scattered	O R Tambo	41	45	50	55	61
Mtshiso - B	Rural Scattered	O R Tambo	154	170	188	208	229
Mbandane	Rural Scattered	O R Tambo	328	363	401	443	489
Tonti - B	Rural Scattered	O R Tambo	180	198	219	242	267
Lunzwane	Rural Scattered	O R Tambo	77	85	93	103	114
Nkamasana	Rural Scattered	O R Tambo	51	56	62	69	76
Upper Gunqwana	Rural - Small Village <= 5000	O R Tambo	518	572	632	698	772
Upper Gunqwana	Rural Scattered	O R Tambo	129	142	157	173	191
Upper Gunqwana	Rural Scattered	O R Tambo	77	85	93	103	114
Kwabipha - D	Rural Scattered	O R Tambo	61	68	75	82	91
Kwabipha - E	Rural Scattered	O R Tambo	185	204	225	249	275
Mbhongweni - A	Rural Scattered	O R Tambo	195	215	238	263	290
Mkhomanzi	Rural Scattered	O R Tambo	456	504	556	615	679
Mbongweni - B	Rural Scattered	O R Tambo	118	131	144	159	176
Lusuthu - A	Rural Scattered	O R Tambo	190	210	232	256	282
Mathe - C	Rural - Small Village <= 5000	O R Tambo	1 240	1 370	1 514	1 672	1 847
Mbangula	Rural - Small Village <= 5000	O R Tambo	502	554	612	676	747
Totoba	Rural - Small Village <= 5000	O R Tambo	466	515	569	628	694
Mfinizweni - N	Rural Scattered	O R Tambo	718	793	876	968	1 069
Bomvini - A	Rural - Small Village <= 5000	O R Tambo	1 189	1 314	1 451	1 603	1 771
Luthulini - B	Rural Scattered	O R Tambo	51	56	62	69	76
Kwabala - A	Rural Scattered	O R Tambo	164	181	200	221	245
Xhophozo	Rural - Small Village <= 5000	O R Tambo	476	526	581	642	709
Bomvini - B	Rural Scattered	O R Tambo	590	651	719	795	878
Bhonga - C	Rural - Small Village <= 5000	O R Tambo	876	968	1 069	1 181	1 305
Ludeke - D	Rural Scattered	O R Tambo	610	674	744	822	908
Ntlambatshe	Rural Scattered	O R Tambo	1 343	1 484	1 639	1 811	2 000
Ludeke - F	Rural Scattered	O R Tambo	487	537	594	656	724
Mthukazi	Rural Scattered	O R Tambo	759	838	926	1 023	1 130
Dambeni - B	Rural Scattered	O R Tambo	441	487	538	594	656
Mbango	Rural - Small Village <= 5000	O R Tambo	308	340	376	415	459
Nyathi - C	Rural Scattered	O R Tambo	492	543	600	663	732
Nkozo Store	Rural Scattered	O R Tambo	26	28	31	34	38
Mantlane	Rural Scattered	O R Tambo	36	39	44	48	53
Mqatyeni	Rural Scattered	O R Tambo	97	107	118	131	144
Nyukhweni	Rural Scattered	O R Tambo	31	34	37	41	46
Mangweni - E	Rural Scattered	O R Tambo	210	232	256	283	313
Madwakazana - B	Rural - Small Village <= 5000	O R Tambo	149	165	182	201	222
Dondi	Rural Scattered	O R Tambo	174	193	213	235	260
Zadungeni	Rural Scattered	O R Tambo	476	526	581	642	709
Baleni	Rural Scattered	O R Tambo	169	187	207	228	252
Lufankomo	Rural Scattered	O R Tambo	149	165	182	201	222
Happy Valley	Rural Scattered	O R Tambo	180	198	219	242	267
Kwaveni	Rural Scattered	O R Tambo	185	204	225	249	275
Madamini - A	Rural Scattered	O R Tambo	476	526	581	642	709
Mjelweni - A	Rural Scattered	O R Tambo	512	566	625	690	762
Skhulu - A	Rural Scattered	O R Tambo	534	589	651	719	794
Ngwemnyama - E	Rural Scattered	O R Tambo	549	606	670	740	817
Maxhegweni -B	Rural Scattered	O R Tambo	147	162	179	198	219
Lugalakaxa	Rural Scattered	O R Tambo	220	243	269	297	328
Madamini - B	Rural Scattered	O R Tambo	71	79	87	96	106
Ngwemnyama - I	Rural Scattered	O R Tambo	282	311	344	379	419
Mpoza - L	Rural Scattered	O R Tambo	154	170	188	208	229
Ngqokoqweni	Rural - Small Village <= 5000	O R Tambo	1 456	1 608	1 776	1 962	2 167
Mkenke	Rural Scattered	O R Tambo	66	73	81	89	99
New b.v. - C	Rural Scattered	O R Tambo	1 076	1 189	1 313	1 451	1 602
Ntaboduli - A	Rural - Small Village <= 5000	O R Tambo	2 845	3 143	3 472	3 835	4 236
Nydkweni - A	Rural Scattered	O R Tambo	415	459	507	560	618
Nydkweni - B	Rural Scattered	O R Tambo	87	96	106	117	129
Ngozi - C	Rural Scattered	O R Tambo	139	153	169	187	207
Lugangatho	Rural Scattered	O R Tambo	585	646	713	788	870
Tsweleni - A	Rural Scattered	O R Tambo	51	56	62	69	76
New b.v. - B	Rural Scattered	O R Tambo	236	260	288	318	351
Ngavu - Ngavu - B	Rural Scattered	O R Tambo	302	334	368	407	450
Kwanyasa	Rural Scattered	O R Tambo	523	578	639	705	779
Ngojini - C	Rural Scattered	O R Tambo	185	204	225	249	275
Ngavu - Ngavu - C	Rural - Small Village <= 5000	O R Tambo	2 615	2 888	3 190	3 524	3 893
Xukula	Rural Scattered	O R Tambo	261	288	319	352	389
Ngavu - Ngavu - A	Rural - Small Village <= 5000	O R Tambo	907	1 002	1 107	1 222	1 350
Ntontela - G	Rural Scattered	O R Tambo	354	391	432	477	527
Ntlangano	Rural Scattered	O R Tambo	446	492	544	601	664
Kwagcuda - A	Rural - Small Village <= 5000	O R Tambo	995	1 099	1 214	1 341	1 481
Ntontela - F	Rural Scattered	O R Tambo	139	153	169	187	207

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Ngcenglane	Rural - Small Village <= 5000	O R Tambo	656	725	800	884	977
Kuqhaza	Rural Scattered	O R Tambo	641	708	782	863	954
Ntontela - E	Rural - Small Village <= 5000	O R Tambo	928	1 025	1 133	1 251	1 382
Makhwalweni - C	Rural - Small Village <= 5000	O R Tambo	1 005	1 110	1 226	1 354	1 496
Ntontela - I	Rural Scattered	O R Tambo	564	623	688	760	840
Sawulana - C	Rural Scattered	O R Tambo	113	125	138	153	169
Esikhulu - A	Rural Scattered	O R Tambo	123	136	151	166	184
Cikolo	Rural Scattered	O R Tambo	118	131	144	159	176
Ndakeni - M	Rural Scattered	O R Tambo	97	107	118	131	144
Mantlaneni - B	Rural - Small Village <= 5000	O R Tambo	1 133	1 252	1 383	1 528	1 687
Kwagcuda - B	Rural - Small Village <= 5000	O R Tambo	585	646	713	788	870
Kwagcuda - C	Rural - Small Village <= 5000	O R Tambo	1 205	1 331	1 470	1 624	1 794
Ntontela - A	Rural - Small Village <= 5000	O R Tambo	425	470	519	573	633
Ngqandulwana	Rural Scattered	O R Tambo	66	73	81	89	99
Ndlangazi	Rural Scattered	O R Tambo	308	340	376	415	459
Nonyikilai	Rural - Small Village <= 5000	O R Tambo	1 000	1 104	1 220	1 347	1 488
Skwajini	Rural - Small Village <= 5000	O R Tambo	1 133	1 252	1 383	1 528	1 687
Njanisweni	Rural - Small Village <= 5000	O R Tambo	820	906	1 001	1 105	1 221
Lwandlana - N	Rural - Small Village <= 5000	O R Tambo	922	1 019	1 125	1 243	1 373
Mafusini - D	Rural - Small Village <= 5000	O R Tambo	1 400	1 546	1 708	1 886	2 084
Gqili - A	Rural Scattered	O R Tambo	66	73	81	89	99
Mfundisweni - C	Rural Scattered	O R Tambo	430	476	525	580	641
Mampola - B	Rural - Small Village <= 5000	O R Tambo	1 000	1 104	1 220	1 347	1 488
Mdyobe	Rural Scattered	O R Tambo	415	459	507	560	618
Mpindweni - E	Rural Scattered	O R Tambo	328	363	401	443	489
Mpindweni - D	Rural Scattered	O R Tambo	430	476	525	580	641
Gabazi	Rural - Small Village <= 5000	O R Tambo	2 245	2 480	2 740	3 026	3 343
Mpindweni - A	Rural Scattered	O R Tambo	390	430	475	525	580
Mangxamfu - B	Rural Scattered	O R Tambo	369	408	451	498	550
Esikolweni - D	Rural Scattered	O R Tambo	446	492	544	601	664
Gwadane	Rural Scattered	O R Tambo	41	45	50	55	61
Emagqubeni	Rural Scattered	O R Tambo	497	549	606	670	740
Eqolweni - C	Rural Scattered	O R Tambo	512	566	625	690	762
Gqeyane	Rural Scattered	O R Tambo	154	170	188	208	229
Balasi - C	Rural - Small Village <= 5000	O R Tambo	129	142	157	173	191
Mthonyameni	Rural Scattered	O R Tambo	195	215	238	263	290
Rhatyela	Rural Scattered	O R Tambo	590	651	719	795	878
Esingweni	Rural Scattered	O R Tambo	313	346	382	422	466
Bhakaneni - B	Rural Scattered	O R Tambo	825	912	1 007	1 112	1 229
Qutshubeni	Rural Scattered	O R Tambo	205	226	250	276	305
Jenee	Rural Scattered	O R Tambo	549	606	670	740	817
Quthubeni - B	Rural Scattered	O R Tambo	200	221	244	269	298
Ntendeleshe - A	Rural Scattered	O R Tambo	754	833	920	1 016	1 122
Mahakatini	Rural Scattered	O R Tambo	549	606	670	740	817
Swazini - A	Rural Scattered	O R Tambo	825	912	1 007	1 112	1 229
Malalane	Rural Scattered	O R Tambo	61	68	75	82	91
Makhwalweni - A	Rural Scattered	O R Tambo	61	68	75	82	91
Maqhubini	Rural Scattered	O R Tambo	118	131	144	159	176
Ngxangxasini	Rural Scattered	O R Tambo	129	142	157	173	191
Gora	Rural - Small Village <= 5000	O R Tambo	559	618	682	753	832
Esithaleni	Rural Scattered	O R Tambo	308	340	376	415	459
Sitishini	Rural Scattered	O R Tambo	344	380	419	463	512
Mbinda	Squatter Camp - Rural	O R Tambo	917	1 013	1 119	1 236	1 365
Sikhobeni - D	Rural - Small Village <= 5000	O R Tambo	902	996	1 100	1 215	1 343
Xabana	Rural Scattered	O R Tambo	425	470	519	573	633
Ngxakoko	Rural Scattered	O R Tambo	544	601	663	733	810
Ntamonde	Rural Scattered	O R Tambo	405	447	494	546	603
Tyeni - G	Rural Scattered	O R Tambo	271	300	331	366	404
Ntele	Rural - Small Village <= 5000	O R Tambo	574	634	701	774	855
Eluxolweni	Rural - Small Village <= 5000	O R Tambo	974	1 076	1 189	1 313	1 450
Kwa Majola	Rural Scattered	O R Tambo	66	73	81	89	99
Ntontela - H	Rural - Small Village <= 5000	O R Tambo	681	753	831	918	1 015
Bhuqa	Rural Scattered	O R Tambo	415	459	507	560	618
Bhala	Rural Scattered	O R Tambo	313	346	382	422	466
Ntlanjana	Rural Scattered	O R Tambo	113	125	138	153	169
Mbansana	Rural - Small Village <= 5000	O R Tambo	1 041	1 149	1 270	1 402	1 549
Luthengele - A	Rural Scattered	O R Tambo	20	23	25	27	30
Edukulweni	Rural Scattered	O R Tambo	574	634	701	774	855
Magcakeni - B	Rural - Small Village <= 5000	O R Tambo	810	895	988	1 092	1 206
Tafufu - A	Rural - Small Village <= 5000	O R Tambo	825	912	1 007	1 112	1 229
Tyityane	Rural Scattered	O R Tambo	1 041	1 149	1 270	1 402	1 549
Cabase	Rural Scattered	O R Tambo	149	165	182	201	222
Gqubeni - A	Rural Scattered	O R Tambo	425	470	519	573	633
Langeni - BB	Rural Scattered	O R Tambo	10	11	12	14	15
Culunca	Rural Scattered	O R Tambo	692	764	844	932	1 030

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Debeza - B	Rural - Small Village <= 5000	O R Tambo	1 579	1 744	1 927	2 128	2 351
Middle Tyira	Rural Scattered	O R Tambo	871	962	1 063	1 174	1 297
Machibini - D	Rural - Small Village <= 5000	O R Tambo	1 384	1 529	1 689	1 866	2 061
Marhambeni - B	Rural - Small Village <= 5000	O R Tambo	1 205	1 331	1 470	1 624	1 794
Mbenza	Rural - Small Village <= 5000	O R Tambo	2 045	2 259	2 496	2 757	3 045
Manzamnyama - D	Rural - Small Village <= 5000	O R Tambo	928	1 025	1 133	1 251	1 382
Ntshongweni - A	Rural Scattered	O R Tambo	646	713	788	870	961
Luqolweni - B	Squatter Camp - Rural	O R Tambo	718	793	876	968	1 069
Lower Tyira - B	Rural Scattered	O R Tambo	661	730	807	891	984
Lower Tyirha	Rural - Small Village <= 5000	O R Tambo	1 774	1 960	2 165	2 391	2 641
Nxotwe	Rural - Small Village <= 5000	O R Tambo	944	1 042	1 151	1 272	1 405
Mzuzanto	Rural Scattered	O R Tambo	681	753	831	918	1 015
Ndakeni - G	Rural Scattered	O R Tambo	180	198	219	242	267
Mjikweni - B	Rural - Small Village <= 5000	O R Tambo	1 712	1 891	2 089	2 307	2 549
Edrayini - B	Rural Scattered	O R Tambo	236	260	288	318	351
Upper Kroza	Rural Scattered	O R Tambo	764	844	932	1 030	1 138
Ncetyana	Rural Scattered	O R Tambo	282	311	344	379	419
Manka - B	Rural Scattered	O R Tambo	830	917	1 013	1 119	1 236
Mdeni - H	Rural Scattered	O R Tambo	585	646	713	788	870
Godzi - A	Rural Scattered	O R Tambo	712	787	869	960	1 060
Mbutho	Rural - Small Village <= 5000	O R Tambo	964	1 065	1 176	1 299	1 435
Boycy - A	Rural Scattered	O R Tambo	554	612	676	747	825
Hlangani - C	Rural Scattered	O R Tambo	185	204	225	249	275
Boycy - B	Rural Scattered	O R Tambo	36	39	44	48	53
Jiminxeni	Rural - Small Village <= 5000	O R Tambo	1 845	2 038	2 252	2 487	2 747
Ezibanzini - B	Rural Scattered	O R Tambo	185	204	225	249	275
Maxaxibeni	Rural - Small Village <= 5000	O R Tambo	1 532	1 692	1 870	2 065	2 281
Mbhadango	Rural - Small Village <= 5000	O R Tambo	949	1 048	1 158	1 279	1 412
Bhukazi - C	Rural - Small Village <= 5000	O R Tambo	1 810	1 999	2 208	2 439	2 694
Luqumbeni	Rural - Small Village <= 5000	O R Tambo	790	872	963	1 064	1 176
Thaleni - H	Rural - Small Village <= 5000	O R Tambo	1 327	1 466	1 619	1 789	1 976
Emanangeni - A	Rural - Small Village <= 5000	O R Tambo	1 343	1 484	1 639	1 811	2 000
Mnqezo	Rural - Small Village <= 5000	O R Tambo	917	1 013	1 119	1 236	1 365
Emaxexebeni	Rural - Small Village <= 5000	O R Tambo	764	844	932	1 030	1 138
Dedeni	Rural - Small Village <= 5000	O R Tambo	1 276	1 410	1 557	1 720	1 900
Engcenga	Rural Scattered	O R Tambo	497	549	606	670	740
Gemvale	Rural - Small Village <= 5000	O R Tambo	2 004	2 214	2 446	2 702	2 984
Mevana - B	Rural Scattered	O R Tambo	46	51	56	62	68
Marhubeni - C	Rural Scattered	O R Tambo	339	374	413	456	504
Qukuswayo	Rural - Small Village <= 5000	O R Tambo	1 774	1 960	2 165	2 391	2 641
Swazini - C	Rural - Small Village <= 5000	O R Tambo	1 010	1 116	1 232	1 361	1 504
Mdeni - K	Rural - Small Village <= 5000	O R Tambo	487	537	594	656	724
Cibeni - A	Rural Scattered	O R Tambo	15	17	19	21	23
Lupapasi - A	Rural Scattered	O R Tambo	636	702	775	857	946
Lupapasi - B	Rural - Small Village <= 5000	O R Tambo	1 276	1 410	1 557	1 720	1 900
Noziyongwana	Rural Scattered	O R Tambo	71	79	87	96	106
Noziyongwana	Rural Scattered	O R Tambo	92	101	112	124	137
Noziyongwana	Rural Scattered	O R Tambo	41	45	50	55	61
Noziyongwana	Rural Scattered	O R Tambo	164	181	200	221	245
Noziyongwana	Rural Scattered	O R Tambo	26	28	31	34	38
Noziyongwana	Rural Scattered	O R Tambo	82	90	100	110	122
Noziyongwana	Rural Scattered	O R Tambo	56	62	68	76	84
Noziyongwana	Rural Scattered	O R Tambo	61	68	75	82	91
Noziyongwana	Rural Scattered	O R Tambo	256	283	312	345	381
Noziyongwana	Rural Scattered	O R Tambo	26	28	31	34	38
Noziyongwana	Rural Scattered	O R Tambo	339	374	413	456	504
Noziyongwana	Rural Scattered	O R Tambo	108	119	132	146	161
Noziyongwana	Rural Scattered	O R Tambo	374	414	457	505	557
Noziyongwana	Rural - Small Village <= 5000	O R Tambo	534	589	651	719	794
Noziyongwana	Rural - Small Village <= 5000	O R Tambo	886	979	1 082	1 195	1 320
Tembukazi	Rural Scattered	O R Tambo	692	764	844	932	1 030
Kwa - Ngcola - C	Rural Scattered	O R Tambo	159	176	194	214	237
Esingeni - A	Rural Scattered	O R Tambo	769	850	939	1 037	1 145
Dlelengana	Rural Scattered	O R Tambo	544	601	663	733	810
Lutshaya - C	Rural Scattered	O R Tambo	149	165	182	201	222
Ludonga	Rural Scattered	O R Tambo	210	232	256	283	313
Phakathi	Rural Scattered	O R Tambo	728	805	889	982	1 084
Mangondo	Rural Scattered	O R Tambo	251	277	306	338	374
Sigidini - B	Rural - Small Village <= 5000	O R Tambo	400	442	488	539	595
Mava	Rural Scattered	O R Tambo	215	238	263	290	320
Mbongwenimowa - A	Rural Scattered	O R Tambo	82	90	100	110	122
Ndakeni - A	Rural Scattered	O R Tambo	559	618	682	753	832
Mowa - A	Rural Scattered	O R Tambo	215	238	263	290	320
Gqiu	Rural Scattered	O R Tambo	534	589	651	719	794
Machibini	Rural - Small Village <= 5000	O R Tambo	2 527	2 791	3 083	3 406	3 762

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Embane	Rural Scattered	O R Tambo	339	374	413	456	504
Mazeni - A	Rural Scattered	O R Tambo	276	305	337	373	412
Luphilisweni - A	Rural Scattered	O R Tambo	866	957	1 057	1 167	1 289
Mabomfu	Rural Scattered	O R Tambo	369	408	451	498	550
Mbiba	Rural Scattered	O R Tambo	851	940	1 038	1 147	1 267
Mazeni - B	Rural - Small Village <= 5000	O R Tambo	969	1 070	1 182	1 306	1 443
Kubha	Rural Scattered	O R Tambo	749	827	914	1 009	1 115
Magcakeni - A	Rural - Small Village <= 5000	O R Tambo	1 369	1 512	1 670	1 845	2 038
Bhukuva	Rural Scattered	O R Tambo	1 128	1 246	1 377	1 521	1 680
Mabomvu - A	Rural Scattered	O R Tambo	1 184	1 308	1 445	1 596	1 763
Mfundisweni - A	Rural - Small Village <= 5000	O R Tambo	1 681	1 857	2 051	2 266	2 503
Mabomvu - B	Rural Scattered	O R Tambo	430	476	525	580	641
Magqabesi	Rural Scattered	O R Tambo	241	266	294	324	358
Kwabipha - C	Rural Scattered	O R Tambo	276	305	337	373	412
Mbofu	Rural Scattered	O R Tambo	590	651	719	795	878
Maplotini	Rural Scattered	O R Tambo	174	193	213	235	260
Mhlonyaneni - A	Rural Scattered	O R Tambo	313	346	382	422	466
Mhlonyaneni - B	Rural Scattered	O R Tambo	733	810	895	989	1 092
Mafusini - A	Rural Scattered	O R Tambo	174	193	213	235	260
Kwagqwarhu	Rural Scattered	O R Tambo	236	260	288	318	351
Mafusini - F	Rural - Small Village <= 5000	O R Tambo	1 702	1 880	2 076	2 293	2 533
Mangqamzeni - A	Rural Scattered	O R Tambo	271	300	331	366	404
Nyandeni - B	Rural Scattered	O R Tambo	241	266	294	324	358
Chibini - G	Rural Scattered	O R Tambo	236	260	288	318	351
Mngeni - C	Rural Scattered	O R Tambo	313	346	382	422	466
Ngcabhela	Rural Scattered	O R Tambo	200	221	244	269	298
Mngefeni	Rural Scattered	O R Tambo	739	816	901	995	1 100
Siqithini	Rural Scattered	O R Tambo	241	266	294	324	358
Ngcabeia	Rural Scattered	O R Tambo	385	425	469	518	573
Matshona - C	Rural Scattered	O R Tambo	518	572	632	698	772
Ngojini - B	Rural Scattered	O R Tambo	692	764	844	932	1 030
Ngozi - A	Rural Scattered	O R Tambo	492	543	600	663	732
Edrayini - A	Rural Scattered	O R Tambo	487	537	594	656	724
Emanaleni - B	Rural Scattered	O R Tambo	512	566	625	690	762
Kwanyabeni - A	Rural Scattered	O R Tambo	718	793	876	968	1 069
Neustad - B	Rural - Small Village <= 5000	O R Tambo	779	861	951	1 050	1 160
Mtshazi	Rural - Small Village <= 5000	O R Tambo	2 066	2 282	2 521	2 784	3 076
Mkhotshozweni - A	Rural Scattered	O R Tambo	313	346	382	422	466
Ngwemnyama - B	Rural Scattered	O R Tambo	800	883	976	1 078	1 191
Gandana	Rural Scattered	O R Tambo	585	646	713	788	870
Mahoyana	Rural - Small Village <= 5000	O R Tambo	1 261	1 393	1 538	1 699	1 877
Mhlabati - B	Rural Scattered	O R Tambo	174	193	213	235	260
Kwayalela	Rural Scattered	O R Tambo	174	193	213	235	260
Upper Lotana	Rural Scattered	O R Tambo	1 559	1 722	1 902	2 101	2 321
Chibini - B	Rural Scattered	O R Tambo	554	612	676	747	825
Esiqikini - C	Rural - Small Village <= 5000	O R Tambo	815	900	995	1 099	1 214
Ngcolorha	Rural Scattered	O R Tambo	707	781	863	953	1 053
Manzimabi	Rural Scattered	O R Tambo	195	215	238	263	290
Ndungunyeni - A	Rural Scattered	O R Tambo	97	107	118	131	144
Tshisani - B	Rural - Small Village <= 5000	O R Tambo	1 015	1 121	1 238	1 368	1 511
Mjobeni	Rural Scattered	O R Tambo	1 056	1 166	1 288	1 423	1 572
Ngwemnyama - C	Rural Scattered	O R Tambo	297	328	362	400	442
Mhlabeni - E	Rural Scattered	O R Tambo	185	204	225	249	275
Chibini - F	Rural Scattered	O R Tambo	318	352	388	429	474
Ndungunyeni - B	Rural Scattered	O R Tambo	195	215	238	263	290
FAMENI - C	Rural Scattered	O R Tambo	241	266	294	324	358
Greater Honono	Rural Scattered	O R Tambo	180	198	219	242	267
Mmangweni - D	Rural Scattered	O R Tambo	225	249	275	304	336
Endwe A	Rural - Small Village <= 5000	O R Tambo	902	996	1 100	1 215	1 343
Bomvini - F	Rural Scattered	O R Tambo	805	889	982	1 085	1 198
Mgaqweni - A	Rural Scattered	O R Tambo	236	260	288	318	351
Kwangloya	Rural - Small Village <= 5000	O R Tambo	1 010	1 116	1 232	1 361	1 504
Qeza	Rural Scattered	O R Tambo	385	425	469	518	573
Nozityana	Rural Scattered	O R Tambo	456	504	556	615	679
Kwa - Ngcola - A	Rural Scattered	O R Tambo	113	125	138	153	169
Etyeni - B	Rural Scattered	O R Tambo	466	515	569	628	694
Gugwini - D	Rural Scattered	O R Tambo	518	572	632	698	772
Mbokazi	Rural - Small Village <= 5000	O R Tambo	749	827	914	1 009	1 115
Etyeni - C	Rural Scattered	O R Tambo	134	148	163	180	199
Nkamasana	Rural Scattered	O R Tambo	102	113	124	137	152
Nkamasana	Rural Scattered	O R Tambo	77	85	93	103	114
Upper Gunqwana	Rural Scattered	O R Tambo	77	85	93	103	114
Upper Gunqwana	Rural Scattered	O R Tambo	195	215	238	263	290
Noziyongwana	Rural Scattered	O R Tambo	190	210	232	256	282
Noziyongwana	Rural Scattered	O R Tambo	220	243	269	297	328

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Noziyongwana	Rural Scattered	O R Tambo	66	73	81	89	99
Noziyongwana	Rural Scattered	O R Tambo	26	28	31	34	38
Noziyongwana	Rural Scattered	O R Tambo	97	107	118	131	144
Noziyongwana	Rural Scattered	O R Tambo	41	45	50	55	61
Noziyongwana	Rural Scattered	O R Tambo	82	90	100	110	122
Upper Gunqwana	Rural Scattered	O R Tambo	31	34	37	41	46
Upper Gunqwana	Rural Scattered	O R Tambo	51	56	62	69	76
Upper Gunqwana	Rural Scattered	O R Tambo	36	39	44	48	53
MOUNT AYLIFF	Urban - Former Township	Alfred Nzo	814	899	993	1 097	1 212
MOUNT AYLIFF	Urban Fringe - Ex-homeland Towns (Formal Towns)	Alfred Nzo	557	615	680	751	829
MOUNT AYLIFF	Squatter Camp - Urban	Alfred Nzo	2	2	2	3	3
MOUNT AYLIFF	Squatter Camp - Urban	Alfred Nzo	187	206	228	252	278
MOUNT AYLIFF	Squatter Camp - Urban	Alfred Nzo	21	24	26	29	32
MOUNT AYLIFF	Urban - Former Township	Alfred Nzo	326	361	398	440	486
NQANTOSI - B	Urban Fringe - Ex-homeland Towns (Formal Towns)	Alfred Nzo	8 453	9 337	10 314	11 393	12 585
MOUNT FRERE	Urban - Former Township	Alfred Nzo	86	95	105	115	128
PAPANANA	Squatter Camp - Urban	Alfred Nzo	93	103	113	125	138
MATATIELE	Urban Fringe - Ex-homeland Towns (Formal Towns)	Alfred Nzo	5 479	6 052	6 685	7 385	8 157
CEDARVILLE	Urban - Formal Town	Alfred Nzo	1 964	2 169	2 396	2 647	2 924
MOUNT CURRIE (FARMS)	Farming	Alfred Nzo	19 555	21 601	23 861	26 358	29 115
MOUNT CURRIE (FARMS)	Farming	Alfred Nzo	19 555	21 601	23 861	26 358	29 115
MAKAULA	Urban - Former Township	Alfred Nzo	750	828	915	1 011	1 116
Bobana	Urban - Former Township	Alfred Nzo	632	699	772	852	942
Lubacweni	Urban - Former Township	Alfred Nzo	2 800	3 093	3 417	3 774	4 169
Sipilini	Urban - Former Township	Alfred Nzo	2 020	2 231	2 465	2 722	3 007
Nyanzele	Urban - Former Township	Alfred Nzo	811	896	990	1 093	1 207
NKULULEKWENI	Urban - Former Township	Joe Gqabi	3 106	3 431	3 790	4 187	4 625
MOUNT FLETCHER	Urban Fringe - Ex-homeland Towns (Formal Towns)	Joe Gqabi	3 421	3 779	4 175	4 612	5 094
ISOLOMZI	Urban - Former Township	Joe Gqabi	3 137	3 465	3 828	4 228	4 670
UGIE	Urban Fringe - Ex-homeland Towns (Formal Towns)	Joe Gqabi	5 566	6 148	6 791	7 502	8 287
MACLEAR	Urban Fringe - Ex-homeland Towns (Formal Towns)	Joe Gqabi	8 689	9 598	10 602	11 712	12 937
CLEARVIEW	Urban - Former Township	Joe Gqabi	1 312	1 449	1 601	1 768	1 953
SONWABILE	Urban - Former Township	Joe Gqabi	4 127	4 559	5 036	5 563	6 145
TSEKONG	Urban - Former Township	Joe Gqabi	870	961	1 062	1 173	1 296
Retreat	Service Centres - Mines, Prisons etc.	O R Tambo	51	56	62	69	76
Ndakeni	Squatter Camp - Urban	O R Tambo	1 420	1 569	1 733	1 914	2 114
Mbagweni	Squatter Camp - Urban	O R Tambo	256	283	312	345	381
Tsolo	Urban Fringe - Ex-homeland Towns (Formal Towns)	O R Tambo	1 097	1 211	1 338	1 478	1 633
Matyeni	Squatter Camp - Urban	O R Tambo	456	504	556	615	679
Matyeni	Squatter Camp - Urban	O R Tambo	2 091	2 310	2 552	2 819	3 114
Ngqubani	Squatter Camp - Urban	O R Tambo	374	414	457	505	557
FAIRVIEW	Service Centres - Mines, Prisons etc.	O R Tambo	26	28	31	34	38
Nomnqoyi	Squatter Camp - Urban	O R Tambo	164	181	200	221	245
Mbagweni	Squatter Camp - Urban	O R Tambo	933	1 031	1 139	1 258	1 390
FLAGSTAFF	Urban - Former Township	O R Tambo	5 818	6 426	7 099	7 841	8 662
Shangillar	Squatter Camp - Urban	O R Tambo	129	142	157	173	191
Malongwana - A	Squatter Camp - Urban	O R Tambo	56	62	68	76	84
ISINUKA	Squatter Camp - Urban	O R Tambo	56	62	68	76	84
Bokleni	Squatter Camp - Urban	O R Tambo	256	283	312	345	381
Port STJohns	Squatter Camp - Urban	O R Tambo	1 543	1 705	1 883	2 080	2 298
QUMBU	Urban - Former Township	O R Tambo	349	385	426	470	519
Tsolo	Service Centres - Mines, Prisons etc.	O R Tambo	2 804	3 098	3 422	3 780	4 175
Qumbu - B	Urban Fringe - Ex-homeland Towns (Formal Towns)	O R Tambo	3 706	4 094	4 522	4 995	5 518
Tsolo	Urban Fringe - Ex-homeland Towns (Formal Towns)	O R Tambo	784	867	957	1 057	1 168
Tsolo	Service Centres - Mines, Prisons etc.	O R Tambo	1 953	2 158	2 384	2 633	2 908
Mkumeni - B	Urban - Former Township	O R Tambo	190	210	232	256	282
Mbangweni - D	Squatter Camp - Urban	O R Tambo	2 291	2 531	2 796	3 088	3 411
Port STJohns	Urban - Former Township	O R Tambo	2 040	2 254	2 489	2 750	3 038
Agate Terrace	Squatter Camp - Urban	O R Tambo	313	346	382	422	466
Port STJohns	Urban Fringe - Ex-homeland Towns (Formal Towns)	O R Tambo	2 460	2 718	3 002	3 316	3 663
Tabankulu	Urban - Former Township	O R Tambo	749	827	914	1 009	1 115
Tabankulu	Urban Fringe - Ex-homeland Towns (Formal Towns)	O R Tambo	82	90	100	110	122
Tabankulu	Urban - Former Township	O R Tambo	954	1 054	1 164	1 286	1 420
Tabankulu	Urban Fringe - Ex-homeland Towns (Formal Towns)	O R Tambo	1 979	2 186	2 415	2 667	2 946
Tabankulu	Urban Fringe - Ex-homeland Towns (Formal Towns)	O R Tambo	129	142	157	173	191
Gxididi	Rural - Small Village <= 5000		954	1 054	1 164	1 286	1 420
Gxididi	Rural - Small Village <= 5000		964	1 065	1 176	1 299	1 435
MAGONKONE	Rural - Small Village <= 5000		805	889	982	1 085	1 198
CEKA	Rural Scattered		666	736	813	898	992
LOWER MJIKA - C	Rural - Small Village <= 5000		928	1 025	1 133	1 251	1 382
MQOBISO - A	Rural Scattered		954	1 054	1 164	1 286	1 420
NOMBODLEDLANA	Rural Scattered		334	368	407	450	497
MPUKUMBINI	Rural Scattered		215	238	263	290	320
NOMBODLELANGA	Rural Scattered		241	266	294	324	358

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
NCETSHANI	Rural Scattered		200	221	244	269	298
Cheka	Rural Scattered		487	537	594	656	724
Mfabantu	Rural - Small Village <= 5000		1 681	1 857	2 051	2 266	2 503
Zibungu	Rural Scattered		364	402	444	491	542
Noziyongwana	Rural Scattered		292	322	356	393	434
Lowel mluka	Rural Scattered		415	459	507	560	618
Lurasini	Rural Scattered		866	957	1 057	1 167	1 289
Mngceleni	Rural Scattered		697	770	850	939	1 037
Egotyibeni	Rural - Small Village <= 5000		984	1 087	1 201	1 327	1 466
Mnqandanto	Rural Scattered		917	1 013	1 119	1 236	1 365
Zandukweni	Rural - Small Village <= 5000		3 516	3 884	4 291	4 739	5 235
Mhlakulo	Rural - Small Village <= 5000		1 481	1 636	1 807	1 996	2 205
Lower Mjika	Rural Scattered		1 276	1 410	1 557	1 720	1 900
Nkamasana	Rural Scattered		149	165	182	201	222
Nkamasana	Rural Scattered		41	45	50	55	61
ZWELITSHA - FF	Rural Scattered		1 051	1 161	1 282	1 416	1 564
ZWELITSHA - FF	Rural Scattered		769	850	939	1 037	1 145
LOWER GUNGULULU	Rural - Small Village <= 5000		1 559	1 722	1 902	2 101	2 321
MATYEBA	Rural - Small Village <= 5000		2 281	2 520	2 783	3 074	3 396
MRHOTSHOZWENI	Rural - Small Village <= 5000		1 230	1 359	1 501	1 658	1 832
TSONGENI	Rural Scattered		390	430	475	525	580
Nqadu - C	Rural Scattered		236	260	288	318	351
Nqadu - B	Rural Scattered		113	125	138	153	169
Mhlahlane - D	Rural Scattered		733	810	895	989	1 092
Langeni - A	Rural - Small Village <= 5000		3 681	4 066	4 491	4 961	5 480
Phakathi	Rural Scattered		728	805	889	982	1 084
Nuaphantsi	Rural Scattered		590	651	719	795	878
Mhlakulu	Rural Scattered		534	589	651	719	794
Ngqwala - B	Rural Scattered		492	543	600	663	732
Ngqwala - A	Rural Scattered		759	838	926	1 023	1 130
Zenzele	Rural Scattered		97	107	118	131	144
Lurasini Industrial	Rural Scattered		251	277	306	338	374
Nyembezi	Rural Scattered		174	193	213	235	260
Mangondo	Rural Scattered		251	277	306	338	374
Noziyongwana	Rural Scattered		36	39	44	48	53
Noziyongwana	Rural Scattered		66	73	81	89	99
Noziyongwana	Rural Scattered		123	136	151	166	184
Noziyongwana	Rural Scattered		97	107	118	131	144
Reservoir C (Mt Frere)				24 921	27 528	30 408	33 589
Reservoir D				41 213	45 525	50 288	55 549
Reservoir E (Joe Gqabi)				30 007	33 147	36 615	40 445
Culunca Command Reservoir				70 151	77 491	85 598	94 553
MPOZA - K	Rural - Small Village <= 5000		923	1 020	1 126	1 244	1 375
CABAZI - A	Rural - Small Village <= 5000		876	968	1 069	1 181	1 305
EKUTSHENI	Rural Scattered		590	651	719	795	878
MAFUSINI - N	Rural Scattered		462	510	564	623	688
MAFUSINI - H	Rural Scattered		274	303	335	370	409
MHLOTSHENI	Rural Scattered		794	877	968	1 070	1 182
BHADALALA	Rural - Small Village <= 5000		1 939	2 142	2 366	2 614	2 887
MKHANGISA	Rural Scattered		289	319	352	389	430
SIQHINGENI - B	Rural Scattered		791	873	965	1 066	1 177
CHANI	Rural Scattered		347	383	423	467	516
MUVNUVNBLOVO	Rural - Small Village <= 5000		1 917	2 117	2 339	2 584	2 854
LUTATENI	Rural - Small Village <= 5000		1 631	1 802	1 990	2 199	2 429
MBODLENI	Squatter Camp - Rural		2 490	2 751	3 038	3 356	3 707
QANQU - A	Rural Scattered		764	844	932	1 030	1 138
SIHLAHLENI - A	Rural Scattered		321	355	392	433	478
SINYAQA	Rural Scattered		383	423	467	516	570
SIHLAHLENI - B	Rural - Small Village <= 5000		742	819	905	1 000	1 104
MACHELENI	Rural Scattered		266	294	325	359	396
MACHELENI	Rural - Small Village <= 5000		1 358	1 500	1 657	1 830	2 022
MPENDLA	Rural Scattered		365	403	446	492	544
NCUNTENI	Rural Scattered		773	854	943	1 042	1 151
GIQEKA	Rural Scattered		119	132	146	161	178
CWALINKUNGU	Rural Scattered		235	259	286	316	349
HLANE	Rural Scattered		458	506	559	617	682
MAGQAGQENI - F	Rural Scattered		369	408	451	498	550
QUMRHA	Rural Scattered		640	707	780	862	952
MAGXENI - A	Rural Scattered		789	871	962	1 063	1 174
MTONYENI - D	Rural Scattered		231	255	281	311	343
MAGQAGQENI - A	Rural Scattered		207	229	253	279	308

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
EKUGQIBELENI	Rural - Small Village <= 5000		723	799	883	975	1 077
MACHOLWENI	Rural Scattered		216	239	264	291	322
MTOMBOKAZI	Rural Scattered		289	319	352	389	430
MGUGA	Rural Scattered		155	171	189	209	231
MAGQAGQENI - D	Rural Scattered		239	264	291	322	355
MTONYENI - E	Rural Scattered		392	433	478	528	583
KUSASA	Rural Scattered		293	323	357	395	436
MNAMBITHI	Rural Scattered		446	492	544	601	664
NGONYAMENI - D	Rural Scattered		658	727	803	887	980
NUSHWINI	Rural Scattered		235	259	286	316	349
BISLANE	Rural - Small Village <= 5000		1 477	1 632	1 802	1 991	2 199
DUNGU - B	Rural - Small Village <= 5000		3 843	4 245	4 689	5 179	5 721
XOLO	Rural Scattered		213	236	260	287	317
MHLANGANISWENI - A	Rural Scattered		605	668	738	815	901
TOLENI - B	Rural - Small Village <= 5000		1 749	1 933	2 135	2 358	2 605
LVANDLANA	Rural Scattered		815	900	995	1 099	1 214
BHUWA - B	Rural Scattered		679	750	829	916	1 012
DANGWANA - A	Rural - Small Village <= 5000		768	848	937	1 035	1 144
DANGWANA - B	Rural Scattered		108	119	132	146	161
ESSECK FARM	Rural Scattered		135	149	164	181	200
ESSEC	Rural Scattered		147	162	179	198	219
ZIBOKWANA	Rural Scattered		690	762	841	929	1 027
BHUWA - C	Rural Scattered		622	687	759	839	926
BUMBENI	Rural Scattered		93	103	113	125	138
MAGCAKINI - D	Rural Scattered		755	834	921	1 017	1 124
CABANE	Rural Scattered		458	506	559	617	682
MPEMBA	Rural Scattered		435	480	530	586	647
GINGWENI	Rural - Small Village <= 5000		671	741	819	905	999
LWANDLANA - B	Rural Scattered		498	550	607	671	741
MAWUSHENI - A	Rural Scattered		347	383	423	467	516
MAJUBA - AA	Rural - Small Village <= 5000		649	717	792	874	966
EMVA KWESIKOLO	Rural - Small Village <= 5000		1 149	1 269	1 402	1 548	1 710
MAJUBA - B	Rural Scattered		221	245	270	298	330
QOKOLWENI - B	Rural Scattered		169	187	207	228	252
BLACK HILL - A	Rural Scattered		88	97	107	118	131
TINA HILL	Rural Scattered		11	12	14	15	17
DANGWANA - C	Rural - Small Village <= 5000		1 801	1 990	2 198	2 428	2 682
Bobana	Urban - Former Township		632	699	772	852	942
Sipilini	Urban - Former Township		2 020	2 231	2 465	2 722	3 007
Nyanzele	Urban - Former Township		811	896	990	1 093	1 207
Ngqumane - C	Rural Scattered		585	646	713	788	870
Gubeni - A	Rural - Small Village <= 5000		949	1 048	1 158	1 279	1 412
Bomvini - C	Rural Scattered		656	725	800	884	977
Mpoza - I	Rural Scattered		205	226	250	276	305
Bomvini - D	Rural Scattered		456	504	556	615	679
Mpoza - H	Rural Scattered		195	215	238	263	290
Mhlahlweni	Rural Scattered		292	322	356	393	434
Silevini	Rural Scattered		51	56	62	69	76
Magqagqeni - G	Rural Scattered		892	985	1 088	1 202	1 327
Mangwaneni - CC	Rural Scattered		51	56	62	69	76
Nkamasana	Rural Scattered		113	125	138	153	169
Mvenyane	Rural - Small Village <= 5000		964	1 065	1 176	1 299	1 435
Msukeni	Rural - Small Village <= 5000		1 322	1 460	1 613	1 782	1 968
Mgodweni	Rural Scattered		302	334	368	407	450
Mwalala - A	Rural Scattered		97	107	118	131	144
Rwantsana - B	Rural Scattered		507	560	619	683	755
Dwaku	Rural Scattered		1 071	1 183	1 307	1 444	1 595
Mwalala - B	Rural Scattered		523	578	639	705	779
Cotshe	Rural Scattered		10	11	12	14	15
Dundulu	Rural Scattered		534	589	651	719	794
New b.v. - A	Rural - Small Village <= 5000		1 676	1 851	2 045	2 259	2 495
Kwagqina	Rural - Small Village <= 5000		2 040	2 254	2 489	2 750	3 038
Ntsheleni	Rural - Small Village <= 5000		487	537	594	656	724
Mvane	Rural - Small Village <= 5000		1 112	1 228	1 357	1 499	1 655
Mpoza - J	Rural Scattered		481	532	588	649	717
Mambalwini	Rural - Small Village <= 5000		1 549	1 711	1 889	2 087	2 306
Sityeni	Rural Scattered		379	419	463	511	565
Magqoozini	Rural Scattered		359	397	438	484	535
Khetani	Rural - Small Village <= 5000		656	725	800	884	977
Sidaville	Rural Scattered		969	1 070	1 182	1 306	1 443
Mngazana	Rural Scattered		200	221	244	269	298

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Lower Mceba	Rural - Small Village <= 5000		974	1 076	1 189	1 313	1 450
Magqagqeni	Rural Scattered		308	340	376	415	459
Cacadu	Rural - Small Village <= 5000		1 046	1 155	1 276	1 409	1 557
Pubguleweni	Rural - Small Village <= 5000		964	1 065	1 176	1 299	1 435
Lubala	Rural Scattered		471	521	575	635	702
Bhubesi	Rural - Small Village <= 5000		974	1 076	1 189	1 313	1 450
Mchilankuku	Rural - Small Village <= 5000		497	549	606	670	740
Caba	Rural - Small Village <= 5000		636	702	775	857	946
Ntsibyane	Rural - Small Village <= 5000		610	674	744	822	908
Bofbanaza	Rural - Small Village <= 5000		1 405	1 552	1 714	1 893	2 091
Masomntwana	Rural - Small Village <= 5000		984	1 087	1 201	1 327	1 466
Bheja	Rural Scattered		1 640	1 812	2 002	2 211	2 442
Sindeni	Rural - Small Village <= 5000		2 276	2 514	2 777	3 067	3 388
Zinyosimi	Rural - Small Village <= 5000		749	827	914	1 009	1 115
Ncumbe	Rural Scattered		1 215	1 342	1 482	1 638	1 809
Ntsheleni	Rural - Small Village <= 5000		2 235	2 469	2 727	3 012	3 328
Lufafa	Rural - Small Village <= 5000		769	850	939	1 037	1 145
Mhlabeniomhlophe	Rural Scattered		425	470	519	573	633
Gqaqhana	Rural Scattered		625	691	763	843	931
Emthojeni	Rural Scattered		139	153	169	187	207
Gxeni - A	Rural Scattered		149	165	182	201	222
Mangqamseni	Rural Scattered		415	459	507	560	618
Nqalo	Rural Scattered		271	300	331	366	404
Kunyingweni	Rural Scattered		82	90	100	110	122
Ngqalo	Rural Scattered		210	232	256	283	313
Mzwakazi	Rural Scattered		318	352	388	429	474
Chibini	Rural Scattered		287	317	350	386	427
Tsolo	Rural Scattered		933	1 031	1 139	1 258	1 390
Mmangweni - A	Rural Scattered		436	481	531	587	649
Nkumba - A	Rural Scattered		420	464	513	566	626
Msukeni - A	Rural Scattered		451	498	550	608	671
Ngozi - B	Rural Scattered		569	629	695	767	847
Nkamasana	Rural Scattered		129	142	157	173	191
Nkamasana	Rural Scattered		61	68	75	82	91
Nkamasana	Rural Scattered		46	51	56	62	68
XHIBENI	Rural Scattered		687	758	838	925	1 022
Mpendlamoya	Rural Scattered		220	243	269	297	328
Luysheko	Rural - Small Village <= 5000		2 973	3 284	3 627	4 007	4 426
Chibini	Rural - Small Village <= 5000		1 696	1 874	2 070	2 287	2 526
Tholeni	Rural - Small Village <= 5000		2 579	2 849	3 147	3 476	3 840
Mjrla	Rural - Small Village <= 5000		744	821	907	1 002	1 107
Upper Gunqwana	Rural Scattered		77	85	93	103	114
Kwaveni	Rural Scattered		185	204	225	249	275
Madamini - A	Rural Scattered		476	526	581	642	709
Skhulu - A	Rural Scattered		534	589	651	719	794
Ngwemnyama - E	Rural Scattered		549	606	670	740	817
Maxhegweni -B	Rural Scattered		147	162	179	198	219
Lugalakaxa	Rural Scattered		220	243	269	297	328
Madamini - B	Rural Scattered		71	79	87	96	106
Ngwemnyama - I	Rural Scattered		282	311	344	379	419
Mpoza - L	Rural Scattered		154	170	188	208	229
New b.v. - C	Rural Scattered		1 076	1 189	1 313	1 451	1 602
Ntaboduli - A	Rural - Small Village <= 5000		2 845	3 143	3 472	3 835	4 236
Nydkweni - B	Rural Scattered		87	96	106	117	129
Ngozi - C	Rural Scattered		139	153	169	187	207
Lugangatho	Rural Scattered		585	646	713	788	870
Tsweleni - A	Rural Scattered		51	56	62	69	76
New b.v. - B	Rural Scattered		236	260	288	318	351
Ngavu - Ngavu - B	Rural Scattered		302	334	368	407	450
Kwanyasa	Rural Scattered		523	578	639	705	779
Ngojini - C	Rural Scattered		185	204	225	249	275
Ngavu - Ngavu - C	Rural - Small Village <= 5000		2 615	2 888	3 190	3 524	3 893
Xukula	Rural Scattered		261	288	319	352	389
Ngavu - Ngavu - A	Rural - Small Village <= 5000		907	1 002	1 107	1 222	1 350
Dumsi - B	Rural Scattered		220	243	269	297	328
Ntaboduli - B	Rural Scattered		754	833	920	1 016	1 122
Kukulozi	Rural - Small Village <= 5000		964	1 065	1 176	1 299	1 435
Dungu - A	Rural Scattered		549	606	670	740	817
Ntlangano	Rural Scattered		446	492	544	601	664
Esithaleni	Rural Scattered		308	340	376	415	459
Sitishini	Rural Scattered		344	380	419	463	512

SetlNme	SetlType	DMName	Pop 2010	Pop 2020	Pop 2030	Pop 2040	Pop 2050
Settlement Name	Classification	DM					
Maplotini	Rural Scattered		174	193	213	235	260
Mhlonyaneni - A	Rural Scattered		313	346	382	422	466
Mhlonyaneni - B	Rural Scattered		733	810	895	989	1 092
Mafusini - A	Rural Scattered		174	193	213	235	260
Kwagqwarhu	Rural Scattered		236	260	288	318	351
Mafusini - F	Rural - Small Village <= 5000		1 702	1 880	2 076	2 293	2 533
Mangqamzeni - A	Rural Scattered		271	300	331	366	404
Nyandeni - B	Rural Scattered		241	266	294	324	358
Chibini - G	Rural Scattered		236	260	288	318	351
Mngeni - C	Rural Scattered		313	346	382	422	466
Ngcabhela	Rural Scattered		200	221	244	269	298
Mngefeni	Rural Scattered		739	816	901	995	1 100
Siqithini	Rural Scattered		241	266	294	324	358
Ngcabeia	Rural Scattered		385	425	469	518	573
Matshona - C	Rural Scattered		518	572	632	698	772
Ngojini - B	Rural Scattered		692	764	844	932	1 030
Ngozi - A	Rural Scattered		492	543	600	663	732
Edrayini - A	Rural Scattered		487	537	594	656	724
Emanaleni - B	Rural Scattered		512	566	625	690	762
Kwanyabeni - A	Rural Scattered		718	793	876	968	1 069
Upper Gunqwana	Rural Scattered		51	56	62	69	76

APPENDIX B

POTABLE BULK WATER DISTRIBUTION SYSTEM: QUANTITIES AND COSTS

PRIMARY ZONE 1

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1.19	900 steel	m	5 920	7 020	41 558 400
1.3	Excavation in all materials				
1.3.2	0 - 2 m	m	5 920	71	419 136
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	651	20	13 024
1.3.4.2	Intermediate	m3	6 512	80	520 960
1.3.4.3	Hard rock	m3	4 558	350	1 595 440
1.3.4.4	Boulder	m3	1 302	172	223 492
1.4	Bedding				
1.4.1	From trench	m3	577	30	17 316
1.4.2	From borrow pit	m3	3 463	60	207 792
1.4.3	Borrow pit haul	m3km	34 632	10	346 320
1.4.4	Commercial sources	m3	7 504	350	2 626 260
1.5	Backfill				
1.5.1	From trench	m3	740	25	18 500
1.5.2	Import from borrow	m3	740	40	29 600
1.5.3	Borrow haul	m3km	7 400	10	74 000
1.6	Allowance for fittings	%	41 558 400	15	6 233 760
1.7	Allowance for sundries	%	41 558 400	15	6 233 760
3.16	950 l/s @ 260 m	sum	1	20 000 000	20 000 000
4	Reservoirs				
4.5	3 Ml	sum	1	6 500 000	6 500 000
5	Electrical supply	sum	4	2 500 000	10 000 000
	Total 1				***96 617 760***
	Contingencies	%	96 617 760	15	14 492 664
	Total 2				***111 110 424***
	Engineering fees	%	111 110 424	12	13 333 251
	Total 3				***124 443 675***
	VAT	%	124 443 675	14	17 422 114
	Total				***141 865 789***

PRIMARY ZONE 2

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.19	900 steel	m	9 771	7 020	68 592 420
1.3	Excavation in all materials				
1.3.2	0 - 2 m	m	9 771	71	691 787
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	1 075	20	21 496
1.3.4.2	Intermediate	m3	10 748	80	859 848
1.3.4.3	Hard rock	m3	7 524	350	2 633 285
1.3.4.4	Boulder	m3	2 150	172	368 875
1.4	Bedding				
1.4.1	From trench	m3	953	30	28 580
1.4.2	From borrow pit	m3	5 716	60	342 962
1.4.3	Borrow pit haul	m3km	57 160	10	571 604
1.4.4	Commercial sources	m3	12 385	350	4 334 660
1.5	Backfill				
1.5.1	From trench	m3	1 221	25	30 534
1.5.2	Import from borrow	m3	1 221	40	48 855
1.5.3	Borrow haul	m3km	12 214	10	122 138
1.6	Allowance for fittings	%	68 592 420	15	10 288 863
1.7	Allowance for sundries	%	68 592 420	15	10 288 863
3	Pumpstations				
3.16	950 l/s @ 260 m	sum	1	20 000 000	20 000 000
4	Reservoirs				
4.5	3 Ml	sum	1	6 500 000	6 500 000
4.11	40 Ml	sum	1	65 000 000	65 000 000
5	Electrical supply	sum	4	2 500 000	10 000 000
	Total 1				***200 724 769***
	Contingencies	%	200 724 769	15	30 108 715
	Total 2				***230 833 484***
	Engineering fees	%	230 833 484	12	27 700 018
	Total 3				***258 533 502***
	VAT	%	258 533 502	14	36 194 690
	Total				***294 728 193***

PRIMARY ZONE 3

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.17	700 steel	m	11 692	4 601	53 794 892
1.3	Excavation in all materials				
1.3.2	0 - 2 m	m	11 692	71	827 794
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	1 286	20	25 722
1.3.4.2	Intermediate	m3	12 861	80	1 028 896
1.3.4.3	Hard rock	m3	9 003	350	3 150 994
1.3.4.4	Boulder	m3	2 572	172	441 396
1.4	Bedding				
1.4.1	From trench	m3	836	30	25 079
1.4.2	From borrow pit	m3	5 016	60	300 952
1.4.3	Borrow pit haul	m3km	50 159	10	501 587
1.4.4	Commercial sources	m3	10 868	350	3 803 700
1.5	Backfill				
1.5.1	From trench	m3	4 501	25	112 536
1.5.2	Import from borrow	m3	4 501	40	180 057
1.5.3	Borrow haul	m3km	45 014	10	450 142
1.6	Allowance for fittings	%	53 794 892	15	8 069 234
1.7	Allowance for sundries	%	53 794 892	15	8 069 234
3	Pumpstations				
3.13	500 l/s @ 200m	sum	1	20 644 000	20 644 000
4	Reservoirs				
4.8	10 Ml	sum	1.2	25 000 000	30 000 000
5	Electrical supply	sum	3	2 500 000	7 500 000
	Total 1				***138 926 214***
	Contingencies	%	138 926 214	15	20 838 932
	Total 2				***159 765 147***
	Engineering fees	%	159 765 147	12	19 171 818
	Total 3				***178 936 964***
	VAT	%	178 936 964	14	25 051 175
	Total				***203 988 139***

PRIMARY ZONE 4

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.12	350 STEEL	m	14 413	1 950	28 105 350
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	14 413	43	618 318
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	919	20	18 377
1.3.4.2	Intermediate	m3	9 188	80	735 063
1.3.4.3	Hard rock	m3	6 432	350	2 251 130
1.3.4.4	Boulder	m3	1 838	172	315 342
1.4	Bedding				
1.4.1	From trench	m3	577	30	17 296
1.4.2	From borrow pit	m3	3 459	60	207 547
1.4.3	Borrow pit haul	m3km	34 591	10	345 912
1.4.4	Commercial sources	m3	7 495	350	2 623 166
1.5	Backfill				
1.5.1	From trench	m3	3 423	25	85 577
1.5.2	Import from borrow	m3	3 423	40	136 924
1.5.3	Borrow haul	m3km	34 231	10	342 309
1.6	Allowance for fittings	%	28 105 350	15	4 215 803
1.7	Allowance for sundries	%	28 105 350	15	4 215 803
3	Pumpstations				
3.10	92 l/s @ 330m	sum	1	16 500 000	16 500 000
4	Reservoirs				
4.7	5 Ml	sum	1	11 000 000	11 000 000
5	Electrical supply	sum	2	2 500 000	5 000 000
	Total 1				***76 733 915***
	Contingencies	%	76 733 915	15	11 510 087
	Total 2				***88 244 002***
	Engineering fees	%	88 244 002	12	10 589 280
	Total 3				***98 833 282***
	VAT	%	98 833 282	14	13 836 660
	Total				***112 669 942***

SECONDARY ZONE 1

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.2	50 HDPE Class 12	m	110	32	3 571
1.1.4	75 uPVC Class 12	m	28	68	1 893
1.1.11	355 uPVC Class 12	m	5 863	1 228	7 199 823
1.1.12	400 uPVC Class 12	m	6 894	1 648	11 360 760
1.1.14	500 steel	m	15 641	2 736	42 793 776
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	12 895	43	553 196
1.3.2	0 - 2 m	m	15 641	71	1 107 383
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	2 543	20	50 851
1.3.4.2	Intermediate	m3	25 426	80	2 034 053
1.3.4.3	Hard rock	m3	17 798	350	6 229 287
1.3.4.4	Boulder	m3	5 085	172	872 609
1.4	Bedding				
1.4.1	From trench	m3	6 317	30	189 512
1.4.2	From borrow pit	m3	7 580	60	454 830
1.4.3	Borrow pit haul	m3km	75 805	10	758 049
1.4.4	Commercial sources	m3	11 371	350	3 979 759
1.5	Backfill				
1.5.1	From trench	m3	17 908	25	447 703
1.5.2	Import from borrow	m3	7 675	40	306 996
1.5.3	Borrow haul	m3km	76 749	10	767 490
1.6	Allowance for fittings	%	61 359 823	15	9 203 973
1.7	Allowance for sundries	%	61 359 823	15	9 203 973
	Total 1				***97 519 488***
	Contingencies	%	97 519 488	15	14 627 923
	Total 2				***112 147 411***
	Engineering fees	%	112 147 411	12	13 457 689
	Total 3				***125 605 100***
	VAT	%	125 605 100	14	17 584 714
	Total				***143 189 814***

SECONDARY ZONE 2

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.2	50 HDPE Class 12	m	16 325	32	529 910
1.1.3	63 uPVC Class 12	m	63	49	3 071
1.1.4	75 uPVC Class 12	m	976	68	65 978
1.1.5	90 uPVC Class 12	m	86	97	8 309
1.1.6	110 uPVC Class 12	m	7 759	119	926 890
1.1.7	160 uPVC Class 12	m	5 564	249	1 383 322
1.1.8	200 uPVC Class 12	m	8 742	388	3 390 322
1.1.9	250 uPVC Class 12	m	6 091	611	3 721 662
1.1.10	315 uPVC Class 12	m	9 297	1 019	9 471 784
1.1.14	500 steel	m	22 599	2 736	61 830 864
1.1.16	600 steel	m	9 054	3 564	32 268 456
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	54 903	43	2 355 339
1.3.2	0 - 2 m	m	31 653	71	2 241 032
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	6 982	20	139 638
1.3.4.2	Intermediate	m3	69 819	80	5 585 517
1.3.4.3	Hard rock	m3	48 873	350	17 105 646
1.3.4.4	Boulder	m3	13 964	172	2 396 187
1.4	Bedding				
1.4.1	From trench	m3	2 860	30	85 793
1.4.2	From borrow pit	m3	17 159	60	1 029 520
1.4.3	Borrow pit haul	m3km	171 587	10	1 715 867
1.4.4	Commercial sources	m3	37 177	350	13 011 989
1.5	Backfill				
1.5.1	From trench	m3	41 221	25	1 030 530
1.5.2	Import from borrow	m3	41 221	40	1 648 847
1.5.3	Borrow haul	m3km	412 212	10	4 122 118
1.6	Allowance for fittings	%	113 600 567	15	17 040 085
1.7	Allowance for sundries	%	113 600 567	15	17 040 085
3.17	2 Ml	sum	1	4 500 000	4 500 000
3.2	4 Ml	sum	1	8 000 000	8 000 000
3.21	5 Ml	sum	1	11 000 000	11 000 000
	Total 1				***223 648 761***
	Contingencies	%	223 648 761	15	33 547 314
	Total 2				***257 196 075***
	Engineering fees	%	257 196 075	12	30 863 529
	Total 3				***288 059 604***
	VAT	%	288 059 604	14	40 328 345
	Total				***328 387 949***

SECONDARY ZONE 3

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.2	50 HDPE Class 12	m	17 668	32	573 503
1.1.3	63 uPVC Class 12	m	2 570	49	125 288
1.1.4	75 uPVC Class 12	m	5 721	68	386 740
1.1.6	110 uPVC Class 12	m	1 166	119	139 290
1.1.7	160 uPVC Class 12	m	4 762	249	1 183 928
1.1.9	250 uPVC Class 12	m	6 009	611	3 671 559
1.1.10	315 uPVC Class 12	m	8 268	1 019	8 423 438
1.1.11	355 uPVC Class 12	m	6 222	1 228	7 640 678
1.1.12	400 uPVC Class 12	m	6 737	1 648	11 102 037
1.1.13	400 steel	m	4 917	2 000	9 834 000
1.1.14	500 steel	m	7 197	2 736	19 690 992
1.1.16	600 steel	m	20 207	3 564	72 017 748
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	71 237	43	3 056 067
1.3.2	0 - 2 m	m	20 207	71	1 430 656
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	6 764	20	135 283
1.3.4.2	Intermediate	m3	67 641	80	5 411 303
1.3.4.3	Hard rock	m3	47 349	350	16 572 115
1.3.4.4	Boulder	m3	13 528	172	2 321 449
1.4	Bedding				
1.4.1	From trench	m3	3 208	30	96 228
1.4.2	From borrow pit	m3	19 246	60	1 154 735
1.4.3	Borrow pit haul	m3km	192 456	10	1 924 559
1.4.4	Commercial sources	m3	41 699	350	14 594 572
1.5	Backfill				
1.5.1	From trench	m3	35 565	25	889 133
1.5.2	Import from borrow	m3	35 565	40	1 422 612
1.5.3	Borrow haul	m3km	355 653	10	3 556 531
1.6	Allowance for fittings	%	134 789 202	15	20 218 380
1.7	Allowance for sundries	%	134 789 202	15	20 218 380
2	Pumpstations				
2.9	170 l/s @ 100m	sum	1	8 814 000	8 814 000
5	Electrical supply	sum	1.0	2 500 000	2 500 000
	Total 1				***239 105 205***
	Contingencies	%	239 105 205	15	35 865 781
	Total 2				***274 970 986***
	Engineering fees	%	274 970 986	12	32 996 518
	Total 3				***307 967 504***
	VAT	%	307 967 504	14	43 115 451
	Total				***351 082 954***

TERTIARY ZONE 1

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.2	50 HDPE Class 12	m	19 400	32	629 724
1.1.3	63 uPVC Class 12	m	329	49	16 039
1.1.4	75 uPVC Class 12	m	699	68	47 252
1.1.5	90 uPVC Class 12	m	3 304	97	319 232
1.1.6	110 uPVC Class 12	m	6 876	119	821 407
1.1.7	160 uPVC Class 12	m	414	249	102 929
1.1.8	200 uPVC Class 12	m	1 878	388	728 326
1.1.11	355 uPVC Class 12	m	5 878	1 228	7 218 243
1.1.19	250 steel	m	6 610	1 025	6 775 250
1.1.20	200 steel	m	8 839	750	6 629 250
1.1.21	150 steel	m	4 429	550	2 435 950
1.1.22	100 steel	m	13 420	400	5 368 000
1.1.23	80 steel	m	1 273	300	381 900
1.1.24	50 steel	m	29 330	200	5 866 000
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	38 778	43	1 663 576
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	15 224	20	304 484
1.3.4.2	Intermediate	m3	152 242	80	12 179 358
1.3.4.3	Hard rock	m3	106 569	350	37 299 284
1.3.4.4	Boulder	m3	30 448	172	5 224 945
1.4	Bedding				
1.4.1	From trench	m3	6 143	30	184 288
1.4.2	From borrow pit	m3	36 858	60	2 211 461
1.4.3	Borrow pit haul	m3km	368 577	10	3 685 768
1.4.4	Commercial sources	m3	79 858	350	27 950 404
1.5	Backfill				
1.5.1	From trench	m3	90 813	25	2 270 313
1.5.2	Import from borrow	m3	90 813	40	3 632 501
1.5.3	Borrow haul	m3km	908 125	10	9 081 251
1.6	Allowance for fittings	%	37 339 502	15	5 600 925
1.7	Allowance for sundries	%	37 339 502	15	5 600 925
3	Reservoirs				
3.2	300 Kl	sum	4	600 000	2 400 000
3.3	450 Kl	sum	2	750 000	1 500 000
3.8	10 kl	sum	7	50 000	350 000
3.9	20 kl	sum	5	75 000	375 000
3.10	30 kl	sum	3	100 000	300 000
3.11	40 kl	sum	4	120 000	480 000
3.12	50 kl	sum	3	200 000	600 000
3.13	75 kl	sum	7	300 000	2 100 000
3.14	100 kl	sum	2	350 000	700 000
3.15	150 kl	sum	1	400 000	400 000
3.16	200 kl	sum	5	450 000	2 250 000
3.17	250 kl	sum	4	500 000	2 000 000
	Total 1				***177 516 029***
	Contingencies	%	177 516 029	15	26 627 404
	Total 2				***204 143 433***
	Engineering & EMP fees	%	204 143 433	12	24 497 212
	Total 3				***228 640 645***
	VAT	%	228 640 645	14	32 009 690
	Total				***260 650 336***

TERTIARY ZONE 2

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.2	50 HDPE Class 12	m	154 546	32	5 016 563
1.1.3	63 uPVC Class 12	m	49 826	49	2 429 018
1.1.4	75 uPVC Class 12	m	50 442	68	3 409 879
1.1.5	90 uPVC Class 12	m	12 533	97	1 210 938
1.1.6	110 uPVC Class 12	m	42 481	119	5 074 780
1.1.7	160 uPVC Class 12	m	39 931	249	9 927 645
1.1.8	200 uPVC Class 12	m	19 005	388	7 370 519
1.1.9	250 uPVC Class 12	m	33 145	611	20 251 926
1.1.10	315 uPVC Class 12	m	22 013	1 019	22 426 844
1.1.11	355 uPVC Class 12	m	5 926	1 228	7 277 187
1.1.20	1000 steel	m	2 112	8 383	17 704 896
1.1.21	150 steel	m	1 504	550	827 200
1.1.22	100 steel	m	6 856	400	2 742 400
1.1.23	80 steel	m	13 847	300	4 154 100
1.1.24	50 steel	m	29 190	200	5 838 000
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	429 848	43	18 440 479
1.3.2	0 - 2 m	m	3 616	71	256 013
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	39 775	20	795 498
1.3.4.2	Intermediate	m3	397 749	80	31 819 912
1.3.4.3	Hard rock	m3	278 424	350	97 448 481
1.3.4.4	Boulder	m3	79 550	172	13 650 742
1.4	Bedding				
1.4.1	From trench	m3	13 130	30	393 908
1.4.2	From borrow pit	m3	78 782	60	4 726 895
1.4.3	Borrow pit haul	m3km	787 816	10	7 878 158
1.4.4	Commercial sources	m3	170 693	350	59 742 696
1.5	Backfill				
1.5.1	From trench	m3	266 446	25	6 661 157
1.5.2	Import from borrow	m3	266 446	40	10 657 851
1.5.3	Borrow haul	m3km	2 664 463	10	26 644 627
1.6	Allowance for fittings	%	115 661 897	15	17 349 285
1.7	Allowance for sundries	%	115 661 897	15	17 349 285
3	Reservoirs				
3.2	300 Kl	sum	2	600 000	1 200 000
3.3	450 Kl	sum	4	750 000	3 000 000
3.4	500 Kl	sum	3	1 000 000	3 000 000
3.6	750 Kl	sum	2	2 000 000	4 000 000
3.8	10 kl	sum	21	50 000	1 050 000
3.9	20 kl	sum	21	75 000	1 575 000
3.10	30 kl	sum	27	100 000	2 700 000
3.11	40 kl	sum	18	120 000	2 160 000
3.12	50 kl	sum	19	200 000	3 800 000
3.13	75 kl	sum	29	300 000	8 700 000
3.14	100 kl	sum	6	350 000	2 100 000
3.15	150 kl	sum	10	400 000	4 000 000
3.16	200 kl	sum	13	450 000	5 850 000
3.17	250 kl	sum	6	500 000	3 000 000
	Total 1				***485 159 905***
	Contingencies	%	485 159 905	15	72 773 986
	Total 2				***557 933 891***
	Engineering fees	%	557 933 891	12	66 952 067
	Total 3				***624 885 958***
	VAT	%	624 885 958	14	87 484 034
	Total				***712 369 992***

TERTIARY ZONE 3

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.2	50 HDPE Class 12	m	62 501	32	2 028 782
1.1.3	63 uPVC Class 12	m	7 257	49	353 779
1.1.4	75 uPVC Class 12	m	31 416	68	2 123 722
1.1.5	90 uPVC Class 12	m	10 989	97	1 061 757
1.1.6	110 uPVC Class 12	m	18 887	119	2 256 241
1.1.7	160 uPVC Class 12	m	38 333	249	9 530 350
1.1.8	200 uPVC Class 12	m	9 430	388	3 657 143
1.1.9	250 uPVC Class 12	m	6 916	611	4 225 745
1.1.10	315 uPVC Class 12	m	16 925	1 019	17 243 190
1.1.11	355 uPVC Class 12	m	2 053	1 228	2 521 105
1.1.18	300 steel	m	8 555	1 050	8 982 750
1.1.19	250 steel	m	8 832	1 025	9 052 800
1.1.20	200 steel	m	3 139	750	2 354 250
1.1.21	150 steel	m	15 740	550	8 657 000
1.1.22	100 steel	m	18 228	400	7 291 200
1.1.23	80 steel	m	31 733	300	9 519 900
1.1.24	50 steel	m	28 074	200	5 614 800
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	204 707	43	8 781 930
1.3.2	0 - 2 m	m	36 266	71	2 567 633
1.3.3	0- 3 m	m	78 035	191	14 933 558
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	35 768	20	715 355
1.3.4.2	Intermediate	m3	357 677	80	28 614 185
1.3.4.3	Hard rock	m3	250 374	350	87 630 942
1.3.4.4	Boulder	m3	71 535	172	12 275 485
1.4	Bedding				
1.4.1	From trench	m3	18 788	30	563 650
1.4.2	From borrow pit	m3	112 730	60	6 763 795
1.4.3	Borrow pit haul	m3km	1 127 299	10	11 272 991
1.4.4	Commercial sources	m3	244 248	350	85 486 851
1.5	Backfill				
1.5.1	From trench	m3	169 794	25	4 244 853
1.5.2	Import from borrow	m3	169 794	40	6 791 765
1.5.3	Borrow haul	m3km	1 697 941	10	16 979 412
1.6	Allowance for fittings	%	96 474 514	15	14 471 177
1.7	Allowance for sundries	%	96 474 514	15	14 471 177
2	Pumpstations				
2.2	30 l/s @ 11m	sum	1	1 404 000	1 404 000
2.4	100 l/s @100m	sum	1	2 834 000	2 834 000
3	Reservoirs				
3.2	300 Kl	sum	1	600 000	600 000
3.3	450 Kl	sum	10	750 000	7 500 000
3.6	750 Kl	sum	1	2 000 000	2 000 000
3.8	10 kl	sum	14	50 000	700 000
3.9	20 kl	sum	17	75 000	1 275 000
3.10	30 kl	sum	11	100 000	1 100 000
3.11	40 kl	sum	9	120 000	1 080 000
3.12	50 kl	sum	8	200 000	1 600 000
3.13	75 kl	sum	18	300 000	5 400 000
3.14	100 kl	sum	2	350 000	700 000
3.15	150 kl	sum	5	400 000	2 000 000
3.16	200 kl	sum	10	450 000	4 500 000
3.17	250 kl	sum	5	500 000	2 500 000
	Total 1				***451 982 272***
	Contingencies	%	451 982 272	15	67 797 341
	Total 2				***519 779 613***
	Engineering fees	%	519 779 613	12	62 373 554
	Total 3				***582 153 167***
	VAT	%	582 153 167	14	81 501 443
	Total				***663 654 610***

TERTIARY ZONE 4

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.2	50 HDPE Class 12	m	42 878	32	1 391 820
1.1.3	63 uPVC Class 12	m	8 967	49	437 141
1.1.4	75 uPVC Class 12	m	14 547	68	983 377
1.1.5	90 uPVC Class 12	m	11 627	97	1 123 401
1.1.6	110 uPVC Class 12	m	4 332	119	517 501
1.1.7	160 uPVC Class 12	m	46 470	249	11 553 371
1.1.8	200 uPVC Class 12	m	3 083	388	1 195 649
1.1.10	315 uPVC Class 12	m	470	1 019	478 836
1.1.24	150 steel	m	950	20 000	19 000 000
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	132 374	43	5 678 845
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	8 667	20	173 337
1.3.4.2	Intermediate	m3	86 668	80	6 933 474
1.3.4.3	Hard rock	m3	60 668	350	21 233 764
1.3.4.4	Boulder	m3	17 334	172	2 974 460
1.4	Bedding				
1.4.1	From trench	m3	2 371	30	71 141
1.4.2	From borrow pit	m3	14 228	60	853 695
1.4.3	Borrow pit haul	m3km	142 283	10	1 422 826
1.4.4	Commercial sources	m3	30 828	350	10 789 761
1.5	Backfill				
1.5.1	From trench	m3	62 955	25	1 573 867
1.5.2	Import from borrow	m3	62 955	40	2 518 187
1.5.3	Borrow haul	m3km	629 547	10	6 295 466
1.6	Allowance for fittings	%	36 681 096	15	5 502 164
1.7	Allowance for sundries	%	36 681 096	15	5 502 164
2	Pumpstations				
2.1	20 l/s @ 70m	sum	1	780 000	780 000
2.2	4 l/s @ 186m	sum	1	1 404 000	1 404 000
3	Reservoirs				
3.3	450 Kl	sum	1	750 000	750 000
3.8	10 kl	sum	3	50 000	150 000
3.9	20 kl	sum	9	75 000	675 000
3.10	30 kl	sum	6	100 000	600 000
3.11	40 kl	sum	5	120 000	600 000
3.12	50 kl	sum	4	200 000	800 000
3.13	75 kl	sum	1	300 000	300 000
3.15	150 kl	sum	8	400 000	3 200 000
3.16	200 kl	sum	2	450 000	900 000
3.17	250 kl	sum	10	500 000	5 000 000
4	Electrical supply	sum	0.5	2 500 000	1 250 000
	Total 1				***124 795 050***
	Contingencies	%	124 795 050	15	18 719 257
	Total 2				***143 514 307***
	Engineering fees	%	143 514 307	12	17 221 717
	Total 3				***160 736 024***
	VAT	%	160 736 024	14	22 503 043
	Total				***183 239 067***

APPENDIX C

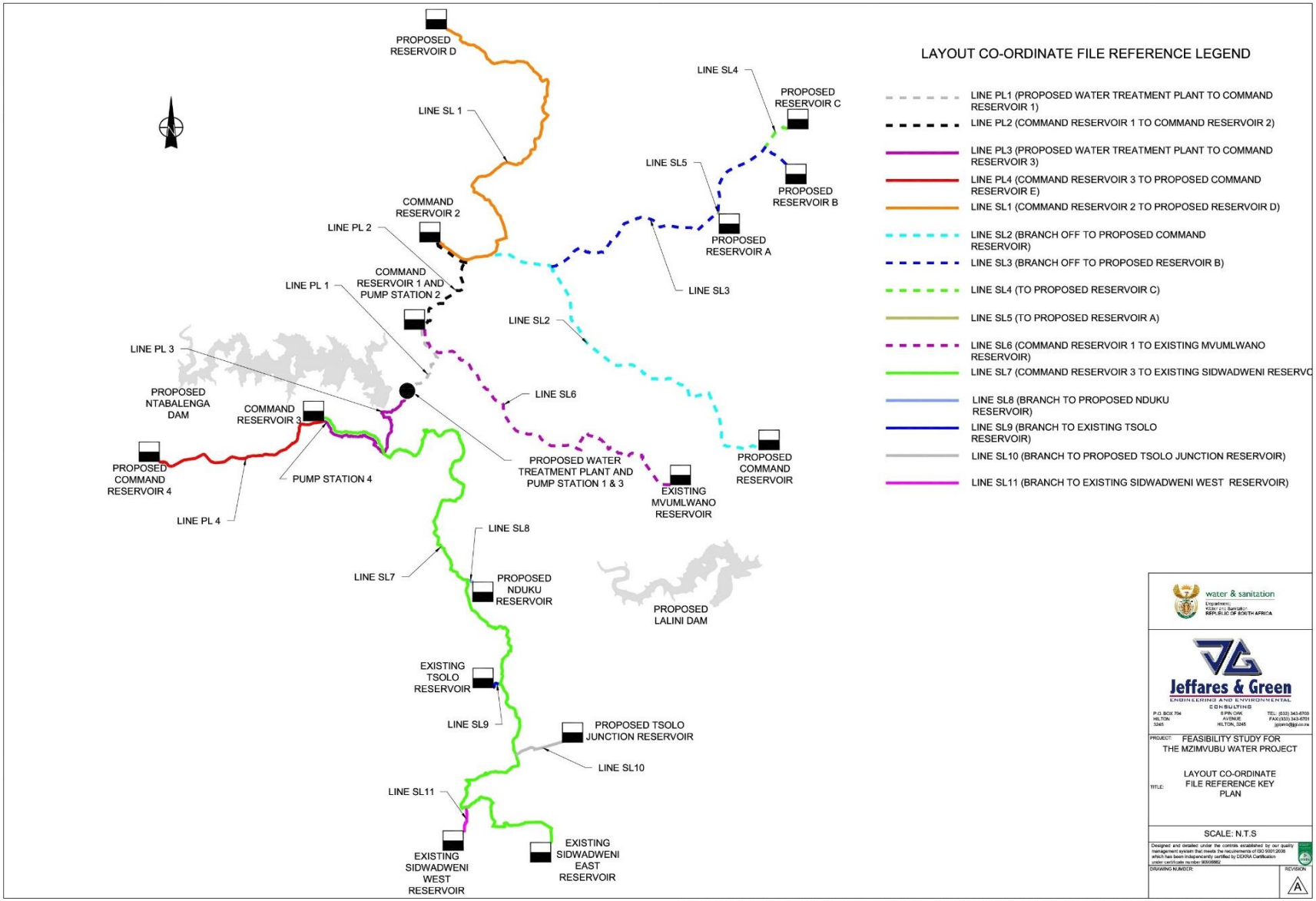
IRRIGATION BULK WATER DISTRIBUTION SYSTEM: QUANTITIES AND COSTS

IRRIGATION OPTION 3

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1	Pipelines - supply, lay, joint, test, disinfect				
1.1	Bulk Pipelines				
1.1.8	200 uPVC Class 12	m	2 143	388	831 098
1.1.10	315 uPVC Class 12	m	9 970	1 019	10 157 436
1.1.11	355 uPVC Class 12	m	1 770	1 228	2 173 578
1.1.14	500 steel	m	3 100	2 736	8 481 600
1.1.18	800 steel	m	9 660	5 732	55 371 120
1.1.19	900 steel	m	2 000	7 020	14 040 000
1.1.20	1000 steel	m	16 400	8 383	137 481 200
1.1.21	1200 steel	m	9 780	8 674	84 831 720
				0	
1.2	Other connectors			0	
1.2.11	400 uPVC Class 12	m	5 900	683	4 029 700
1.3	Excavation in all materials				
1.3.1	0 - 1.5m	m	13 883	43	595 581
1.3.2	0 - 2 m	m	46 840	71	3 316 272
1.3.4	Extra over for :				
1.3.4.1	Soft Class 3	m3	6 037	20	120 749
1.3.4.2	Intermediate	m3	60 374	80	4 829 953
1.3.4.3	Hard rock	m3	42 262	350	14 791 731
1.3.4.4	Boulder	m3	12 075	172	2 072 050
1.4	Bedding				
1.4.1	From trench	m3	5 350	30	160 500
1.4.2	From borrow pit	m3	32 100	60	1 925 994
1.4.3	Borrow pit haul	m3km	320 999	10	3 209 990
1.4.4	Commercial sources	m3	69 550	350	24 342 427
1.5	Backfill				
1.5.1	From trench	m3	6 875	25	171 864
1.5.2	Import from borrow	m3	6 875	40	274 983
1.5.3	Borrow haul	m3km	68 746	10	687 457
1.6	Allowance for fittings	%	317 397 452	5	15 869 873
1.7	Allowance for sundries	%	317 397 452	5	15 869 873
2	Pumphouse				
2.4	Up to 80 Ml/d	sum			8 000 000
3	Pumpstations				
3.5	100 l/s @200m	sum	1	4 901 000	4 901 000
3.9	200 l/s @ 200m	sum	1	8 814 000	8 814 000
3.17	1000 l/s @ 200m	MW	3.2	3 000 000	9 565 152
4	Reservoirs				
4.2	1 Ml	sum	5	3 000 000	15 000 000
4.3	2 Ml	sum	2	4 500 000	9 000 000
4.7	5 Ml	sum	1	11 000 000	11 000 000
4.11	40 Ml - Earth Bund	sum	1	15 000 000	15 000 000
5	Electrical supply	KM	5	2 000 000	10 000 000
	Total 1				***496 916 900***
	Contingencies	%	496 916 900	10	49 691 690
	Total 2				***546 608 590***
	Engineering fees	%	546 608 590	6	32 796 515
	Total 3				***579 405 105***
	VAT	%	579 405 105	14	81 116 715
	Total				***660 521 820***

APPENDIX D

SCHEDULE OF PIPELINES AND RESERVOIRS SIZES, CAPACITY AND CO-ORDINATES


PROPOSED RESERVOIR D
LINE SL 1
LINE SL4
PROPOSED RESERVOIR C
LINE SL5
PROPOSED RESERVOIR B
COMMAND RESERVOIR 2
LINE PL 2
PROPOSED RESERVOIR A
LINE SL3
COMMAND RESERVOIR 1 AND PUMP STATION 2
LINE PL 1
LINE SL2
LINE PL 3
LINE SL6
PROPOSED NTABALENGA DAM
COMMAND RESERVOIR 3
PROPOSED COMMAND RESERVOIR 4
PUMP STATION 4
PROPOSED WATER TREATMENT PLANT AND PUMP STATION 1 & 3
EXISTING MVUMLWANO RESERVOIR
PROPOSED COMMAND RESERVOIR
LINE PL 4
LINE SL8
LINE SL7
PROPOSED NDUKU RESERVOIR
PROPOSED LALINI DAM
EXISTING TSOLO RESERVOIR
LINE SL9
PROPOSED TSOLO JUNCTION RESERVOIR
LINE SL10
LINE SL11
EXISTING SIDWADWENI WEST RESERVOIR
EXISTING SIDWADWENI EAST RESERVOIR
LAYOUT CO-ORDINATE FILE REFERENCE LEGEND
LINE PL1 (PROPOSED WATER TREATMENT PLANT TO COMMAND RESERVOIR 1)
LINE PL2 (COMMAND RESERVOIR 1 TO COMMAND RESERVOIR 2)
LINE PL3 (PROPOSED WATER TREATMENT PLANT TO COMMAND RESERVOIR 3)
LINE PL4 (COMMAND RESERVOIR 3 TO PROPOSED COMMAND RESERVOIR E)
LINE SL1 (COMMAND RESERVOIR 2 TO PROPOSED RESERVOIR D)
LINE SL2 (BRANCH OFF TO PROPOSED COMMAND RESERVOIR)
LINE SL3 (BRANCH OFF TO PROPOSED RESERVOIR B)
LINE SL4 (TO PROPOSED RESERVOIR C)
LINE SL5 (TO PROPOSED RESERVOIR A)
LINE SL6 (COMMAND RESERVOIR 1 TO EXISTING MVUMLWANO RESERVOIR)
LINE SL7 (COMMAND RESERVOIR 3 TO EXISTING SIDWADWENI RESERVO
LINE SL8 (BRANCH TO PROPOSED NDUKU RESERVOIR)
LINE SL9 (BRANCH TO EXISTING TSOLO RESERVOIR)
LINE SL10 (BRANCH TO PROPOSED TSOLO JUNCTION RESERVOIR)
LINE SL11 (BRANCH TO EXISTING SIDWADWENI WEST RESERVOIR)
water & sanitation
Jeffares & Green
ENGINEERING AND ENVIRONMENTAL CONSULTING
PROJECT: FEASIBILITY STUDY FOR THE MZIMVUBU WATER PROJECT
TITLE: LAYOUT CO-ORDINATE FILE REFERENCE KEY PLAN
SCALE: N.T.S
DRAWING NUMBER:
REVISION
A
T:\ACTIVE PROJECTS\2819 - MZIMVUBU FEASIBILITY STUDY (SJ)\03 DRAWINGS\WORKING DRAWINGS\WATER\BULK LAYOUTS\PRIMARY AND SECONDARY LAYOUTS 1 - CO ORDINATES.DWG

Pipeline schedule and geometry coordinate data files reference key plan

Primary and secondary pipeline schedule						
Line name	Section	Line description	Material	Diameter	Pressure class	Length
PL1	1	Primary line rising main from proposed Ntabalenga WTW to Command Reservoir 1	Steel	DN900	As designed	5920
PL2	1	Primary line rising main from proposed Command Reservoir 1 to Command Reservoir 2	Steel	DN900	As designed	9770
PL3	1	Primary line rising main from proposed Ntabalenga WTW to Command Reservoir 3	Steel	DN700	As designed	11690
PL4	1	Primary line gravity main from proposed Command Reservoir 3 to Command Reservoir 4	Steel	DN350	As designed	14400
SL1	1	Secondary line gravity main from Command Reservoir 2 to Proposed Reservoir D	Steel	DN550	As designed	3932
SL1	2	Secondary line gravity main from Command Reservoir 2 to Proposed Reservoir D	uPVC	DN160	As designed	5550
SL1	3	Secondary line gravity main from Command Reservoir 2 to Proposed Reservoir D	uPVC	DN110	As designed	7550
SL1	4	Secondary line gravity main from Command Reservoir 2 to Proposed Reservoir D	uPVC	DN75	As designed	800
SL1	5	Secondary line gravity main from Command Reservoir 2 to Proposed Reservoir D	HDPE	DN50	As designed	14470
SL2	1	Branch off to Proposed Command Reservoir	Steel	DN550	As designed	4880
SL2	2	Branch off to Proposed Command Reservoir	Steel	DN200	As designed	1680
SL2	3	Branch off to Proposed Command Reservoir	Steel	DN315	As designed	9290
SL2	4	Branch off to Proposed Command Reservoir	Steel	DN250	As designed	6090
SL2	5	Branch off to Proposed Command Reservoir	Steel	DN200	As designed	6800
SL3	1	Branch off to Proposed Reservoir B	Steel	DN500	As designed	19560
SL3	2	Branch off to Proposed Reservoir B	Steel	DN450	As designed	2970
SL4	1	Branch off to Proprosed Reservoir C	uPVC	DN250	As designed	2270
SL4	2	Branch off to Proprosed Reservoir C	HDPE	DN50	As designed	1180
SL5	1	Branch off to Proprosed Reservoir A	HDPE	DN50	As designed	170
SL6	1	Command Reservoir 1 to Existing Mvumlwano Reservoir	Steel	DN500	As designed	15610
SL6	2	Command Reservoir 1 to Existing Mvumlwano Reservoir	uPVC	DN355	As designed	1420
SL6	3	Command Reservoir 1 to Existing Mvumlwano Reservoir	uPVC	DN350	As designed	5850
SL6	4	Command Reservoir 1 to Existing Mvumlwano Reservoir	uPVC	DN355	As designed	5470
SL7	1	Command Reservoir 3 to Existing Sidwadweni Reservoir	Steel	DN550	As designed	20070
SL7	2	Command Reservoir 3 to Existing Sidwadweni Reservoir	Steel	DN500	As designed	7170
SL7	3	Command Reservoir 3 to Existing Sidwadweni Reservoir	uPVC	DN355	As designed	2680

SL7	4	Command Reservoir 3 to Existing Sidwadweni Reservoir	Steel	DN300	As designed	8260
Primary and secondary pipeline schedule						
Line name	Section	Line description	Material	Diameter	Pressure class	Length
SL7	5	Command Reservoir 3 to Existing Sidwadweni Reservoir	uPVC	DN250	As designed	6000
SL7	6	Command Reservoir 3 to Existing Sidwadweni Reservoir	uPVC	DN160	As designed	4670
SL7	7	Command Reservoir 3 to Existing Sidwadweni Reservoir	uPVC	DN75	As designed	2780
SL7	8	Command Reservoir 3 to Existing Sidwadweni Reservoir	HDPE	DN63	As designed	2470
SL7	9	Command Reservoir 3 to Existing Sidwadweni Reservoir	HDPE	DN50	As designed	7530
SL8	1	Branch off to Proposed Nduku Reservoir	Steel	DN400	As designed	570
SL9	1	Branch off to Existing Tsolo Reservoir	Steel	DN50	As designed	350
SL10	1	Branch off to Proposed Tsolo Reservoir	HDPE	DN50	As designed	1700
SL11	1	Branch off to Existing Sidwadweni Reservoir	HDPE	DN50	As designed	1770

Note: Pipeline geometry coordinate data amounts to thousands of data points and has therefore been excluded from the pipeline schedule. However, these data have been submitted to DWS in electronic format as part of the deliverables.

Reservoir data				
Name	Capacity	Full supply level	Y	X
WTW		912.25 m³	31081.141	3443971.932
Cr 1	4300.0 m³	1133.89 m³	28252.359	3440537.342
Cr 2	33100.0 m³	1400.72 m³	27565.497	3433646.249
Cr 3	15300.0 m³	1159.89 m³	35854.639	3446698.218
Cr 4	3700.0 m³	1443.91 m³	48018.73	3449501.399
Secondary command	8750.0 m³	1284.00 m³	2327.806	3427992.525
Secondary command	1963.0 m³	1014.33 m³	-2443.743	3415375.714
Kwekweni	68.4 m³	1129.14 m³	28516.52	3442092.403
Culunca	68.0 m³	1132.99 m³	26431.01	3442048.518
Debeza - B	323.3 m³	1113.47 m³	24797.265	3442859.939
Lower tyira – A	35.8 m³	983.55 m³	21065.785	3447752.398
Lower tyira – B	65.0 m³	994.32 m³	22033.733	3448581.676
Lower tyira – C	47.8 m³	1028.17 m³	20912.762	3446025.186
Mbenza	418.7 m³	1022.74 m³	20910.436	3446189.214
Middle tyira	85.6 m³	1077.57 m³	21193.71	3444864.145
Balasi – A	246.7 m³	1028.73 m³	17196.727	3449001.769
Ndakeni – G	17.6 m³	963.69 m³	16906.087	3451958.01
Ncemeni	181.4 m³	1015.11 m³	17837.332	3450928.813
Mjikweni – B	350.4 m³	982.74 m³	19616.106	3453516.392
Erayini	11.7 m³	941.00 m³	21432.045	3454690.087
Lower tyirha	363.1 m³	1046.42 m³	17028.021	3447380.503
Marhambeni - B	246.7 m³	1041.26 m³	16028.144	3445671.588
Machibini – D	283.4 m³	1048.99 m³	16772.363	3444751.277
Balasi – B	10.0 m³	979.54 m³	15804.655	3447882.987
Luqolweni – B	147.1 m³	1068.20 m³	13687.642	3447413.395
Upper kroza	75.1 m³	1023.36 m³	8236.526	3454447.652
Fameni – C	23.7 m³	947.40 m³	11097.072	3456955.162
Neustad – B	159.6 m³	881.08 m³	6001.922	3455006.736
Ndamanga	180.4 m³	877.58 m³	5315.172	3454181.454
Greater honono	17.6 m³	806.96 m³	4906.079	3456072.748
Mkhotshozweni - A	30.8 m³	792.08 m³	3190.529	3456989.607
Mtshazi	422.9 m³	920.41 m³	2546.088	3455487.705
Mncetvana	71.5 m³	927.17 m³	1124.805	3456882.698
Tina falls	319.1 m³	829.16 m³	-2021.942	3455510.778
Dumba – A	45.3 m³	724.57 m³	-5154.221	3454580.901
Ngwemnyama - A	41.3 m³	811.82 m³	-4977.595	3455834.833
Ngwemnyama - B	78.6 m³	823.26 m³	-2338.526	3459567.166
Ngwemnyama - C	29.2 m³	821.27 m³	-733.083	3460278.961
Gandana	57.5 m³	1055.94 m³	-4346.807	3460246.001
Mdeni – U	279.2 m³	950.08 m³	-3676.607	3462183.304
Mampingeni - D	259.2 m³	984.93 m³	-5867.241	3459039.216
Manzana – A	173.1 m³	989.98 m³	-6973.721	3459349.532
Kwam	272.8 m³	1005.37 m³	-6479.409	3459950.966

Gongo – B	74.0 m³	933.06 m³	-5912.847	3465036.926
Reservoir data				
Name	Capacity	Full supply level	Y	X
Bhayi	240.4 m³	946.53 m³	-10608.066	3459987.629
Egolideni	38.8 m³	867.25 m³	-9678.986	3462367.055
Upper gunqwana	7.5 m³	663.54 m³	-10193.737	3463619.88
Endwe B	217.2 m³	765.09 m³	-12875.772	3459638.129
Endwe A	184.6 m³	834.56 m³	-13183.605	3461067.209
Nongenkqe	34.3 m³	943.97 m³	-12421.095	3462364.746
Nkamasana 76	10.0 m³	709.84 m³	-11061.318	3462813.824
Nkamasana 77	10.0 m³	914.00 m³	-13205.737	3463687.302
Nkamasana 78	11.1 m³	840.57 m³	-14008.855	3463534.299
Nkamasana	7.0 m³	364.60 m³	-18796.769	3463795.269
Nkamasana 80	6.5 m³	305.75 m³	-18798.308	3461555.47
Nkamasana 81	12.6 m³	269.85 m³	-19588.277	3463165.251
Mpindweni – I	9.0 m³	386.19 m³	-17816.207	3461954.815
Bomvini	21.7 m³	793.99 m³	-19007.743	3465115.671
Lwandlana – N	188.8 m³	1267.85 m³	24070.895	3430517.602
Njanisweni	167.9 m³	1183.52 m³	20473.792	3428292.888
Nonyikilai	204.7 m³	1281.44 m³	20748.609	3426104.896
Sivivana	10.0 m³	1174.36 m³	19649.047	3424699.341
Maqhubini	11.7 m³	1139.28 m³	19941.41	3424113.805
Gqili – A	6.5 m³	1096.51 m³	19439.548	3432296.759
Mampola – B	204.7 m³	1091.90 m³	17918.866	3433856.985
Gora	114.5 m³	1134.96 m³	17327.07	3434051.369
Gqiu	52.4 m³	1084.24 m³	16157.19	3434121.729
Ngxotho – A	80.1 m³	1074.47 m³	15882.827	3434800.438
Mafusini – D	286.5 m³	992.09 m³	14086.647	3432070.937
Dangwana – B	10.6 m³	957.88 m³	11187.44	3432500.716
Tina hill	1.1 m³	1030.84 m³	8544.926	3432445.71
Lvandlana	80.1 m³	1049.84 m³	7255.301	3431665.659
Dangwana – A	157.2 m³	1097.18 m³	8058.37	3429082.68
Essec	36.3 m³	1073.89 m³	8126.643	3429960.984
Esseck farm	132.2 m³	1025.46 m³	8983.573	3430811.22
Bumbeni	9.2 m³	1084.89 m³	9088.295	3427889.639
Toleni – B	156.3 m³	1147.62 m³	9172.558	3427571.086
Dangwana – C	368.8 m³	1172.52 m³	6345.592	3428138.363
Magxeni – A	70.4 m³	1149.45 m³	1390.751	3425314.634
Galali – B	10.0 m³	1262.25 m³	3003.602	3422237.381
Emoyeni – B	10.0 m³	1318.01 m³	1707.512	3422721.835
Lubacweni	573.3 m³	1119.49 m³	-2238.893	3419498.406
Giqeka	10.6 m³	1014.98 m³	-4741.03	3418533.587
Chani	31.0 m³	1004.27 m³	-4538.999	3415578.833
Mpendla	32.7 m³	940.04 m³	-6687.253	3416211.059
Kwaveni	18.1 m³	907.00 m³	-7325.065	3414083.689

Madamini - A	46.8 m³	1080.00 m³	-8870.668	3414236.707
Mjrla	152.2 m³	1157.00 m³	-11377.307	3414304.011
Reservoir data				
Name	Capacity	Full supply level	Y	X
Bhadalala	173.2 m³	1051.00 m³	-10362.653	3411186.169
Mafusini – H	24.5 m³	1034.00 m³	-8882.683	3405124.607
Ndokendibone	29.3 m³	1087.00 m³	-9028.824	3404358.26
Mhlotsheni	70.9 m³	990.00 m³	-8624.334	3406771.944
Macheleni	26.2 m³	1097.00 m³	-6081.806	3407816.027
Qanqu – A	75.1 m³	1085.00 m³	-6087.004	3406656.111
Ekutsheni	52.7 m³	994.00 m³	-4043.019	3412998.477
Mafusini – N	41.3 m³	936.00 m³	-4520.598	3410880.995
Cabazi – A	78.3 m³	1042.00 m³	-1209.733	3412334.386
Cabazi – B	121.3 m³	1035.00 m³	-788.692	3412354.883
Mbinda	187.7 m³	1097.81 m³	8015.439	3444606.835
Upper gunqwana	7.5 m³	1104.66 m³	8035.301	3443005.081
Ngxakoko	53.4 m³	964.61 m³	7222.402	3445113.216
Upper gunqwana 1	7.5 m³	1073.85 m³	7295.444	3448134.211
Upper gunqwana 2	7.5 m³	1177.34 m³	5370.316	3448551.972
Manxiweni - B	33.8 m³	1242.37 m³	4418.448	3448588.27
Neustad - A	191.1 m³	1193.89 m³	4760.079	3449406.484
Buhlungwana	378.9 m³	923.23 m³	1388.657	3453738.69
Dumba – B	67.0 m³	888.21 m³	-422.825	3450112.441
Sikhobeni - D	184.6 m³	1081.39 m³	3840.252	3447112.246
Gabazi	459.6 m³	1058.59 m³	2804.183	3447431.668
Natal	28.2 m³	998.09 m³	12090.85	3441545.354
Mbokodwebomvu	26.7 m³	956.40 m³	11372.877	3441955.891
Lower ngcolokili	9.5 m³	914.70 m³	11113.353	3441004.03
Ngxotho - B	56.4 m³	963.97 m³	12578.545	3438700.512
Upper gunqwana 3	15.6 m³	808.11 m³	10361.915	3439118.646
Upper gunqwana 4	8.6 m³	908.82 m³	9615.357	3440385.707
Mangwaneni - CC	5.0 m³	899.74 m³	7435.241	3440142.907
Gqunu	60.5 m³	984.38 m³	6931.422	3440617.201
Kumadukuda	15.6 m³	792.80 m³	3204.049	3440442.321
Emva kwesikolo	235.2 m³	1143.44 m³	4896.775	3431777.021
Magcakini – D	74.2 m³	1205.40 m³	4570.86	3431633.962
Majuba – B	21.8 m³	1009.73 m³	3867.496	3434500.005
Qokolweni – B	16.7 m³	950.45 m³	3295.771	3433781.097
Mpemba	42.7 m³	940.60 m³	3463.165	3434667.393
Ekugqibeleni	64.6 m³	1279.97 m³	2086.397	3428137.802
Majuba – AA	132.8 m³	1158.68 m³	1208.273	3430556.263
Mguga	15.2 m³	1189.95 m³	-2675.226	3431012.469
Bofbanaza	287.5 m³	1083.28 m³	-4393.703	3433246.883
Bheja	335.8 m³	1061.40 m³	-5708.803	3435396.397
Ngojini – B	68.0 m³	906.36 m³	-10446.146	3434444.185

Ngojini – C	18.1 m³	789.02 m³	-9871.283	3432753.907
Chibini – G	23.2 m³	751.66 m³	-11722.444	3431532.135
Mdyobe	40.8 m³	889.39 m³	-5533.134	3444721.868
Reservoir data				
Name	Capacity	Full supply level	Y	X
Mpindweni - E	32.3 m³	757.81 m³	-2773.285	3444912.909
Mpindweni - A	38.3 m³	710.34 m³	-3559.038	3448748.851
Kwagqina	200.4 m³	993.10 m³	-14875.064	3444590.617
Sindeni	465.9 m³	785.70 m³	-17733.384	3441402.746
Dwaku	105.2 m³	828.02 m³	-16498.675	3438267.85
New b.v. – A	164.7 m³	1044.29 m³	-21883.287	3441010.609
Tsweleni – A	5.0 m³	863.90 m³	-21955.529	3439985.489
Rwantsana - B	49.9 m³	799.00 m³	-22739.701	3438591.809
Lugangatho	57.5 m³	833.92 m³	-24221.029	3439113.017
Dundulu	52.4 m³	872.54 m³	-24401.296	3439892.87
Mpoza – L	15.1 m³	728.10 m³	-25542.189	3441482.844
Mwalala – B	51.4 m³	847.50 m³	-25657.614	3438361.535
Mgodweni	29.6 m³	862.01 m³	-26174.43	3437671.705
Mwalala – A	9.5 m³	743.18 m³	-29029.056	3437619.52
Ngonyameni - C	15.6 m³	846.16 m³	-7964.866	3450009.509
Mbombo	222.4 m³	956.80 m³	-6548.784	3449476.32
Kwamadiba	10.0 m³	619.53 m³	-3848.24	3451941.876
Ntsheleni	457.6 m³	1104.33 m³	-12746.35	3447719.061
Mangxamfu - B	36.3 m³	1025.69 m³	-10419.77	3449129.244
Gubeni – B	241.3 m³	1043.35 m³	-9815.919	3449995.478
Bomvini – D	44.8 m³	1118.37 m³	-13628.036	3448137.348
New b.v. – C	105.8 m³	965.15 m³	-16296.136	3446556.245
Bomvini – C	64.5 m³	1164.00 m³	-15380.602	3449266.602
Ngcolo	61.4 m³	855.74 m³	-15222.793	3451682.288
Mpoza – I	20.1 m³	825.48 m³	-15897.56	3451628.703
Kwanyasa	51.4 m³	1127.35 m³	-17129.657	3449823.869
Ngavu - ngavu - B	29.6 m³	1120.39 m³	-17422.883	3450036.592
Ngavu - ngavu – C	535.2 m³	1094.28 m³	-19884.661	3448354.639
New b.v. – B	23.2 m³	908.07 m³	-23725.145	3448562.794
Dumsi – B	21.7 m³	828.34 m³	-26059.411	3451325.573
Mvane	227.7 m³	1061.82 m³	-19723.66	3451312.794
Mpoza – H	19.2 m³	517.47 m³	-15461.2	3453086.392
Mpoza – J	98.6 m³	874.45 m³	-17727.643	3454936.973
Ngavu - A	185.7 m³	1024.77 m³	-20004.319	3451135.052
Ntaboduli – B	74.0 m³	973.80 m³	-20085.086	3452663.145
Kukulozi	197.3 m³	998.57 m³	-19924.991	3454476.078
Ngqumane – C	57.5 m³	883.96 m³	-19175.49	3457684.157
Nkamasana	10.0 m³	883.13 m³	-22232.07	3456385.764
Nkamasana	10.0 m³	847.01 m³	-21587.559	3458457.141
Ntlangano	43.8 m³	627.39 m³	-19235.301	3460185.932

Upper gunqwana	15.6 m³	375.48 m³	-16558.814	3458945.86
Cabane	45.0 m³	1142.45 m³	-991.571	3432358.851
Esithaleni	30.2 m³	1083.11 m³	-1470.886	3432280.66
Magqagqeni - G	87.6 m³	1101.40 m³	-1438.867	3432965.973
Reservoir data				
Name	Capacity	Full supply level	Y	X
Sitishini	33.8 m³	1006.01 m³	213.223	3434412.1
Nkamasana	10.0 m³	995.83 m³	-2169.544	3436625.671
Xabana	41.8 m³	957.98 m³	-2146.034	3438392.81
Mjikwa	34.3 m³	929.79 m³	-1462.977	3439615.554
Nyokana - A	61.4 m³	951.41 m³	-702.028	3440223.212
Mpindweni - F	12.6 m³	942.19 m³	743.175	3438607.459
Mhlangala	17.1 m³	807.29 m³	452.835	3440262.073
Mfundisweni - C	42.3 m³	985.06 m³	-2057.017	3437664.66
Noziyongwana	30.2 m³	1245.20 m³	22786.8	3433084.976
Komkhulu - F	24.2 m³	1181.44 m³	26981.724	3440149.082
Diphini - B	25.1 m³	1259.50 m³	28771.321	3439573.445
Mabholomba	63.4 m³	1198.50 m³	28561.941	3440391.161
Qurana - A	125.3 m³	1090.00 m³	35409.512	3446954.413
Qurana - B	125.3 m³	1137.90 m³	33832.308	3448045.281
Didi - BB	33.7 m³	978.51 m³	32689.342	3448342.04
Siqungweni - A	29.0 m³	991.74 m³	31697.979	3447924.71
Ntshongweni - A	63.4 m³	1118.49 m³	29364.085	3448505.693
Esikolweni - D	43.8 m³	1122.12 m³	27829.947	3447261.12
Manzamnyama - D	190.1 m³	1074.63 m³	26512.258	3447353.82
Ndzebe - B	25.1 m³	1042.05 m³	26262.895	3448466.004
Nxotwe	193.2 m³	1052.68 m³	24721.886	3450992.958
Mzuzanto	67.0 m³	1037.54 m³	26352.979	3450489.589
Ngqwangi	190.1 m³	903.77 m³	28113.478	3453131.638
Malepe	138.5 m³	966.83 m³	27751.969	3454563.325
Xibeni	167.9 m³	1035.15 m³	26920.549	3456037.596
Ncetyana	27.6 m³	1023.52 m³	24690.56	3455438.799
Edrayini - B	23.2 m³	991.60 m³	23080.36	3454235.113
Nkamasana	10.0 m³	982.76 m³	27583.955	3456880.292
Goqwana - G	24.2 m³	1127.26 m³	26158.435	3457732.41
Manka - B	81.6 m³	1165.45 m³	25561.881	3458284.321
Nkamasana	10.0 m³	1072.48 m³	23363.209	3457648.104
Nkamasana	10.0 m³	1092.50 m³	22489.196	3459096.058
Mdeni - H	57.5 m³	996.59 m³	21807.215	3458886.057
Nkamasana	10.0 m³	978.00 m³	21075.879	3460508.365
Ntshintshi - A	14.6 m³	922.94 m³	18945.047	3461231.266
Gpmrbi	204.7 m³	927.51 m³	19343.399	3459780.587
Mboktwana	243.5 m³	897.84 m³	17357.535	3457497.32
Nkamasana	10.0 m³	793.07 m³	14674.632	3457691.917
Nkamasana	15.1 m³	844.00 m³	15366.671	3459052.053

Xokonxa	5.5 m³	943.22 m³	19801.382	3461625.828
Libry	41.3 m³	948.95 m³	20231.12	3463055.386
Qanda - BB	23.2 m³	996.67 m³	19373.439	3464159.927
Qanda - A	74.0 m³	978.87 m³	19068.611	3463735.393
Kukumehlo	22.1 m³	961.71 m³	17705.097	3462413.696
Reservoir data				
Name	Capacity	Full supply level	Y	X
Nkamasana	10.0 m³	1031.95 m³	16639.591	3462523.351
Mhlabeni - E	18.1 m³	1025.65 m³	16092.929	3462481.176
Mhlabati - B	17.1 m³	904.40 m³	15292.276	3460977.641
Cingco - B	6.0 m³	855.78 m³	13707.653	3460539.623
Mmangweni - D	22.1 m³	1050.78 m³	15893.539	3463677.874
Mangweni	60.9 m³	1020.38 m³	13567.938	3463867.617
Mangweni	60.9 m³	1005.65 m³	12229.37	3463098.773
Mdeni	45.5 m³	925.98 m³	11086.782	3461328.852
Nkamasana	10.0 m³	864.96 m³	9585.66	3459807.181
Lalini	190.1 m³	870.01 m³	8054.194	3459340.269
Upper lotana	153.2 m³	916.29 m³	8522.909	3461210.798
Lower lotina	184.6 m³	814.97 m³	7126.384	3462638.71
Mahoyana	258.1 m³	887.01 m³	2926.477	3460300.295
Cingco - C	74.0 m³	1079.24 m³	17594.838	3464933.854
Madadeni	141.0 m³	1026.68 m³	17445.585	3465352.766
Cingco	204.7 m³	1121.24 m³	15232.068	3466227.969
Noziyongwana	30.2 m³	1108.87 m³	12892.41	3465042.698
Gwali	65.0 m³	1124.00 m³	11769.938	3465816.761
Upper lotana	153.2 m³	1134.95 m³	10830.187	3466461.883
Kwayalela	17.1 m³	951.00 m³	5785.903	3465496.324
Chibini - F	31.3 m³	949.98 m³	5086.047	3465004.228
Ngcolorha	69.5 m³	1125.97 m³	10390.174	3466824.365
Chibini - B	54.4 m³	1079.79 m³	9054.224	3467411.347
Manzimabi	19.2 m³	1019.13 m³	9883.735	3467641.816
Noziyongwana	30.2 m³	1010.20 m³	11374.605	3468860.932
Nkamasana	10.0 m³	910.57 m³	7859.619	3470634.711
Ndungunyeni - A	9.5 m³	1068.29 m³	5783.031	3470192.007
Ndungunyeni - A	19.2 m³	1029.77 m³	5072.559	3469316.424
Nkamasana	10.0 m³	1005.71 m³	2992.69	3469228.274
Esiqikini - C	166.8 m³	1031.25 m³	1790.432	3467421.078
Esiqikini - D	20.7 m³	1023.53 m³	418.437	3466464.626
Mjobeni	103.8 m³	1238.19 m³	4303.729	3470752.941
Phezukwamawa	191.1 m³	1088.12 m³	-325.951	3471670.201
Mhlanganisweni - B	447.1 m³	1093.26 m³	-435.921	3471686.757
Ngavungavu	236.2 m³	1077.66 m³	-1995.199	3470279.025
Lutubeni - A	16.7 m³	985.54 m³	-2210.895	3472210.446
Dokodela	55.0 m³	861.78 m³	-5305.312	3472130.629
Gongo - A	14.2 m³	768.57 m³	-7261.749	3472656.577

Mthombe	155.3 m³	1024.00 m³	-10964.142	3473392.473
Mthombo - B	129.1 m³	974.00 m³	-10073.362	3471831.89
Mthombo - C	157.4 m³	963.96 m³	-9404.314	3469357.067
Ngolo 1	57.5 m³	949.80 m³	-11705.365	3471387.502
Ngolo 2	47.8 m³	905.01 m³	-13460.462	3470524.43
Mangcwanguleni	160.7 m³	834.00 m³	-15620.713	3468173.463
Reservoir data				
Name	Capacity	Full supply level	Y	X
Gebane	317.0 m³	998.95 m³	-7401.823	3477869.554
Marhubeni - C	33.3 m³	1005.65 m³	-6657.342	3479612.748
Marhubeni	414.5 m³	1013.39 m³	-5115.808	3479775.701
Ezinkumbeni	385.1 m³	1012.08 m³	-4049.162	3478314.018
Mhlanga	224.5 m³	1017.99 m³	-1720.983	3479283.735
Mlomo	390.3 m³	1169.12 m³	4977.316	3473826.42
Ethumbeni	337.9 m³	1265.19 m³	6543.659	3474040.286
Luthumbeni	348.4 m³	1139.96 m³	5890.319	3475493.04
Mbutho	197.3 m³	1038.42 m³	16535.251	3468911.857
Manka - B2	81.6 m³	1197.84 m³	25101.723	3458572.031
Emdibanisweni - B	162.7 m³	1091.87 m³	26313.227	3459090.606
Noziyongwana	30.2 m³	1025.68 m³	27195.92	3458890.374
Bulembu farm - B	21.2 m³	1087.01 m³	25158.749	3459227.899
Emdibanisweni - B	2.5 m³	987.87 m³	25210.077	3460134.845
Bulembu farm - A	26.7 m³	1029.14 m³	23911.697	3461251.116
Bhungeni - B	113.4 m³	943.09 m³	22573.995	3463757.915
Tsolo	91.8 m³	899.19 m³	22895.378	3464309.461
Tsolo	91.8 m³	976.69 m³	24191.936	3464234.79
Tsolo	91.8 m³	1118.04 m³	24108.453	3465918.944
Mnqandanto - C	34.8 m³	1047.17 m³	24938.432	3467079.752
Magonkone	164.8 m³	1078.36 m³	27347.416	3468705.825
Ceka	65.5 m³	1061.97 m³	28299.497	3469069.249
Mangondo	24.6 m³	1129.47 m³	28037.934	3470176.306
Tsolo	91.8 m³	959.47 m³	23061.673	3466483.353
Labry	28.7 m³	977.32 m³	21608.912	3469612.673
Goqwane	55.0 m³	1058.82 m³	22053.177	3470917.059
Ezintutyaneni	18.7 m³	1084.90 m³	21020.782	3472012.626
Esibhalweni	42.8 m³	1123.97 m³	20372.721	3472540.085
Mngwnvbeni	33.8 m³	1131.36 m³	20470.635	3473586.442
Nkamasana	10.0 m³	1150.87 m³	17118.503	3471747.461
Tshisani - A	49.3 m³	1147.26 m³	16362.607	3471409.926
Tshisani - B	207.8 m³	1139.00 m³	16016.64	3471636.25
Mhlakulo	303.3 m³	1094.15 m³	15108.318	3475257.467
Nkanini	235.2 m³	1093.15 m³	14977.463	3475198.758
Nkanini	235.2 m³	1090.44 m³	14891.447	3475155.936
Mhlakulo	303.3 m³	1099.77 m³	14738.119	3475538.694
Sidani	102.7 m³	1103.98 m³	14613.299	3475470.227

Sidani	102.7 m³	1095.09 m³	14365.061	3475202.411
Zandukweni	719.9 m³	1167.12 m³	10908.161	3475960.881
Kilili	48.3 m³	1073.66 m³	22437.123	3472434.166
Magoqoza	19.6 m³	1034.90 m³	24016.442	3472501.959
Emanxiweni - B	12.1 m³	1148.94 m³	26287.75	3472296.088
Duka	410.4 m³	1154.00 m³	26181.945	3472011.505
Phocani	26.2 m³	1149.40 m³	26528.365	3472061.59
Reservoir data				
Name	Capacity	Full supply level	Y	X
Phakathi	71.5 m³	1156.75 m³	28071.026	3472465.559
Madwaleni - D	63.9 m³	1167.35 m³	25631.335	3475802.648
Waterfall	10.0 m³	1092.71 m³	23865.542	3474172.533
Hlangani - C	18.1 m³	1074.91 m³	23988.627	3473569.63
Boycy - A	54.4 m³	1072.87 m³	23341.224	3473845.092
Boycy - B	3.5 m³	1059.18 m³	22501.831	3473911.097
Nkamasana	10.0 m³	1100.30 m³	22943.252	3475978.527
Nkamasana	10.0 m³	1134.32 m³	19447.622	3476000.789
Nqadu - B	11.1 m³	1175.96 m³	23102.889	3477909.073
Nqadu - C	23.2 m³	1247.62 m³	22062.888	3477770.702
Ntibane	65.9 m³	1043.57 m³	27495.298	3461720.765
Ntshiqo	28.7 m³	1023.62 m³	28193.252	3461660.284
Mandela	321.1 m³	1018.40 m³	30289.855	3461694.926
Ntibane	65.9 m³	979.00 m³	26346.866	3463021.046
Godzi - B	60.5 m³	1016.83 m³	28558.459	3463867.898
Godzi - A	70.0 m³	1038.86 m³	28603.338	3465679.667
Ebelezi	47.3 m³	1093.08 m³	29064.355	3465895.3
Magonkone	164.8 m³	1043.48 m³	30202.532	3467328.891
Mayalutweni	307.4 m³	1041.28 m³	30699.365	3465228.737
Bele - B	3.5 m³	1039.28 m³	32161.97	3462800.235
Qudu	283.4 m³	1059.54 m³	35254.226	3465448.018
Jojweni - K	63.9 m³	1081.26 m³	34733.902	3466130.403
Jojweni - H	36.8 m³	1086.46 m³	34518.077	3466629.508
Dandalazile	65.0 m³	1083.56 m³	37234.117	3463300.307
Mountain - A	240.2 m³	1454.49 m³	47622.093	3449728.572
Hopedale	316.6 m³	1444.54 m³	47998.48	3450408.933
Ngcele - B	156.6 m³	1445.11 m³	45081.553	3449232.485
Ntabelanga	231.6 m³	1476.50 m³	44720.169	3449297.271
Mqokolweni - B	210.9 m³	1094.22 m³	44456.108	3446542.664
Mqokolweni - D	210.9 m³	1099.55 m³	43349.499	3445457.76
Mabheleni - F	33.1 m³	1046.84 m³	40405.055	3444861.585
Ngxoto	133.4 m³	1102.89 m³	47115.544	3442959.032
Mtshezi - A	213.0 m³	1413.98 m³	43802.888	3452022.121
Mtshezi - A	213.0 m³	1460.65 m³	43516.448	3451695.271
Sidekeni	20.7 m³	1363.71 m³	42746.174	3454403.81
Gugwini - C	147.1 m³	1444.71 m³	43174.347	3449608.492

Ntywenka	53.8 m³	1443.83 m³	41050.483	3448912.76
Govane	20.4 m³	1172.83 m³	39749.142	3448406.155
Hlwatika	125.3 m³	1399.71 m³	38700.297	3448965.123
Ntywenka - C	204.7 m³	1419.79 m³	36527.863	3450055.696
Upper sinxago	44.3 m³	1240.44 m³	38863.478	3448569.922
Mambulwini - A	237.9 m³	1166.39 m³	35805.779	3446038.066
Block A - B	16.8 m³	1095.98 m³	33188.414	3445827.543
Siqhungqwini	36.9 m³	1066.44 m³	34095.441	3444556.731
Reservoir data				
Name	Capacity	Full supply level	Y	X
Lower sinxako	292.4 m³	1070.29 m³	34144.845	3444014.661
Kolosane	11.8 m³	1472.51 m³	49705.561	3445521.406
Sithana	284.4 m³	1424.04 m³	50405.021	3451749.52
Ngxaza - C	24.4 m³	1085.02 m³	45430.241	3454937.321
Mpinkone	105.8 m³	1385.23 m³	46994.042	3455670.783
Mboniswebi - B	26.4 m³	1443.53 m³	47439.6	3456134.038
Mewangele - B	10.8 m³	1443.94 m³	48133.04	3455831.498
Dirhini	18.7 m³	1394.79 m³	48950.79	3457200.306
Xolombana	7.8 m³	1206.13 m³	49640.232	3459436.584
Ncele	10.8 m³	1445.04 m³	48814.179	3455470.214
Luxeni - D	28.3 m³	1428.45 m³	49650.578	3456495.568
Mewangele - A	28.3 m³	1423.16 m³	49482.615	3455295.509
Kose	17.5 m³	1435.11 m³	51110.158	3453855.322
Mbidlana	153.7 m³	1442.59 m³	56538.821	3457597.591
Ngxothwana	40.1 m³	1267.22 m³	55358.735	3461166.619
Gqaqhala - A	20.0 m³	1351.96 m³	56559.332	3462088.868
Gqaqhala - C	35.1 m³	1369.55 m³	59428.334	3461960.582
Gqagala	112.1 m³	1356.24 m³	57703.392	3462886.28
Mdeni	45.5 m³	1367.91 m³	58061.049	3464167.156
Gqaqala	117.2 m³	1397.23 m³	56319.777	3457843.118
Cicira	44.2 m³	1286.29 m³	52444.329	3460985.706
Cicirha	6.4 m³	1347.62 m³	52835.122	3462935.121
Maqwanguleni	30.1 m³	1339.29 m³	54120.73	3463731.595
Sihlehleni	12.7 m³	1403.42 m³	53298.916	3466285.995
Nayijele	109.2 m³	1410.82 m³	55161.845	3465735.257
Josefu	31.1 m³	1498.94 m³	54942.848	3468353.606
Elalini	108.2 m³	1445.73 m³	58089.261	3468695.174
Nkalweni - B	34.0 m³	1441.89 m³	57985.09	3468092.229
Liberton farm	3.0 m³	1370.08 m³	59247.697	3467897.065
Klufini	10.0 m³	1010.69 m³	34646.684	3453094.965
Ntywenka	53.8 m³	978.40 m³	36931.586	3454300.584
Ntywenka - B	10.0 m³	1110.66 m³	39197.98	3453356.072
Ntywenka	53.8 m³	1100.18 m³	39359.214	3451446.559
St augustine	71.6 m³	1079.92 m³	39049.304	3455268.059
Mbonisweni - A	35.4 m³	1121.36 m³	41146.205	3455710.382

Eqolweni - C	50.3 m³	1028.34 m³	41908.166	3459119.231
Emagqubeni	48.8 m³	1074.35 m³	44581.708	3459625.15
Mnga - C	48.8 m³	1070.76 m³	46367.189	3459886.969
Mnga - B	12.6 m³	1041.97 m³	47932.784	3460194.676
Balasi - C	26.4 m³	1045.66 m³	49506.616	3462208.671
Bijo	22.6 m³	994.92 m³	31316.906	3454499.077
No 9	14.6 m³	1000.84 m³	32256.277	3454019.4
Kuhleke	38.8 m³	988.12 m³	32221.608	3456772.766
Malongwe	58.4 m³	1020.45 m³	32131.784	3457394.895
Reservoir data				
Name	Capacity	Full supply level	Y	X
Ziwelitsha	17.6 m³	1010.32 m³	33767.642	3457413.29
Inxu-drift store	3.5 m³	965.70 m³	33967.877	3456478.013
Manka	43.3 m³	978.36 m³	32723.25	3459563.966
Gqcaka	63.4 m³	1042.12 m³	34999.156	3458876.948
Malonggwe	27.1 m³	1024.13 m³	35535.678	3458824.453
Gqeyana	33.3 m³	1041.62 m³	37645.423	3459170.559
Gqeyane	15.1 m³	1094.32 m³	38965.865	3459020.972
Mangweni	60.9 m³	1028.99 m³	38699.083	3460490.237
Jonginkundla	98.8 m³	1131.19 m³	38211.257	3462371.216
Xeni - B	27.6 m³	1127.57 m³	38581.657	3462319.045
Mabululu	15.6 m³	1123.01 m³	38961.645	3463511.145
Nogqadasi - B	12.6 m³	1240.68 m³	38692.061	3464964.245
Mcheni	15.6 m³	1147.31 m³	39909.697	3466330.56
Esingweni	30.8 m³	1223.26 m³	40274.308	3464965.431
Maqakambeni	58.9 m³	1046.11 m³	41536.065	3463984.099
Esingeni - F	22.6 m³	1189.12 m³	41797.005	3465020.329
Mbinja	187.7 m³	1201.28 m³	43887.493	3466908.425
Nkamasana	10.0 m³	1291.64 m³	42466.913	3469549.908
Quthubeni - B	19.6 m³	1306.29 m³	43321.569	3470335.031
Mpoza - K	82.5 m³	1141.00 m³	-7251.212	3402892.351
Mntsila - A	42.4 m³	1121.00 m³	-6173.821	3402025.022
Lutateni	145.7 m³	1059.00 m³	-3048.754	3403432.059
Muvnuvnblovo	171.2 m³	1018.00 m³	-636.431	3404176.147
Sihlahleni - B	151.8 m³	1206.00 m³	1837.107	3408155.861
Sihlahleni - A	31.5 m³	1231.00 m³	487.09	3407275.454
Sinyaqa	37.6 m³	1052.00 m³	-2259.504	3407555.111
Magqagqeni - A	18.5 m³	962.91 m³	-789.804	3427710.158
Mtonyeni - E	38.5 m³	1012.84 m³	-1673.631	3427291.858
Magqagqeni - D	23.4 m³	957.94 m³	-1979.805	3426984.04
Magqagqeni - F	33.0 m³	946.85 m³	-2443.001	3426331.634
Mtonyeni - D	20.6 m³	956.76 m³	-2346.68	3425756.038
Mnambithi	43.8 m³	1005.58 m³	-1073.663	3423717.59
Qumrha	57.1 m³	931.81 m³	-4693.109	3423379.575
Ngonyameni - D	64.6 m³	1045.28 m³	-2193.001	3422973.438

Hlane	41.0 m³	1021.57 m³	-4026.304	3421607.309
Mtombokazi	28.3 m³	995.00 m³	-2488.247	3429505.718
Kusasa	28.8 m³	980.33 m³	-3712.67	3429508.065
Macholweni	21.3 m³	931.81 m³	-4952.32	3428886.863
Mangqamzeni - A	26.7 m³	1033.08 m³	-5630.602	3430217.529
Mafusini - F	348.4 m³	1063.87 m³	-7195.047	3430792.205
Mafusini - A	17.1 m³	862.43 m³	-7471.723	3428186.826
Gqaqhana	61.4 m³	911.70 m³	-9676.658	3426892.57
Maplotini	17.1 m³	868.24 m³	-11914.806	3426382.946
Kunyingweni	8.0 m³	812.95 m³	-14983.182	3428440.787
Reservoir data				
Name	Capacity	Full supply level	Y	X
Mangqamseni	40.8 m³	899.01 m³	-13105.844	3427165.441
Nyandeni - B	23.7 m³	840.23 m³	-15969.608	3430103.874
Kwagqwarhu	23.2 m³	782.38 m³	-13798.36	3429215.415
Xukula	25.7 m³	998.09 m³	-14947.458	3431344.015
Ngcabhela	19.6 m³	762.24 m³	-13530.926	3432240.21
Ngqalo	20.7 m³	1022.29 m³	-17281.01	3429417.065
Nqalo	26.7 m³	873.69 m³	-18111.39	3428162.737
Mhlonyaneni - B	72.1 m³	1050.67 m³	-19852.205	3429816.969
Mhlonyaneni - A	30.8 m³	1089.17 m³	-21293.306	3430889.134
Mngefeni	72.6 m³	1154.00 m³	-21204.375	3432197.959
Ngcabeia	37.8 m³	868.11 m³	-17214.044	3432738.513
Ngozi - B	55.9 m³	662.49 m³	-18337.018	3435762.469
Ngozi - C	13.7 m³	725.22 m³	-19471.841	3433488.36
Ngozi - A	48.3 m³	870.00 m³	-19395.333	3432923.382
Silevini	5.0 m³	881.76 m³	-22961.089	3432661.778
Matshona - C	50.9 m³	1053.89 m³	-24709.604	3431975.323
Siqithini	23.7 m³	952.51 m³	-26583.323	3432415.69
Mzwakazi	31.3 m³	993.83 m³	-27773.214	3434622.188
Msukeni - A	44.3 m³	808.06 m³	-27202.145	3435685.95
Mmangweni - A	42.8 m³	1097.23 m³	-29271.777	3434035.891
Edrayini - A	47.8 m³	1154.24 m³	-30646.337	3432853.537
Mngeni - C	30.8 m³	1201.00 m³	-30395.12	3431697.237
Belezingcuka	580.3 m³	1137.31 m³	32888.416	3465014.579
Gingweni	137.4 m³	980.34 m³	8747.187	3434893.532
Lwandlana - B	48.9 m³	972.36 m³	10721.805	3436829.158
Black hill - A	8.6 m³	925.29 m³	10570.363	3435472.788
Mawusheni - A	34.0 m³	933.67 m³	9369.673	3437367.215
Nkamasana	10.0 m³	1051.04 m³	20542.121	3470393.084
Tank PS2 Z4	50.0 m³	1321.46 m³	54202.653	3464319.178