RAND WATER

TECHNICAL FEASIBILITY STUDY FOR THE PROVISION OF BULK WATER SUPPLY FROM RUST DE WINTER DAM TO THE MATHANJANA MAGISTERIAL DISTRICT

FEASIBILITY STUDY REPORT

August 2013

REVISION – **DRAFT 01**

PREPARED FOR:	**PREPARED BY:**
RAND WATER 522 IMPALA ROAD GLENVISTA Contact Person: Tel: Fax: Email:	GKB DESIGN ASSOCIATES (PTY) LTD OFFICE M66, INNOVATION CENTRE BUILDING AT THE INNOVATION HUB BRUMMERIA PRETORIA 0040 Contact Person: Mr G.T. Mupona Tel: 012 844 0120 Fax: 086 512 4829 Cell: 084 676 9132 Email: gmupona@gkbgroup.co.za

Project Number	Document Title
	FEASIBILITY STUDY REPORT

HISTORY					
Version	**Date**	**Comment**	**Prepared by**	**Checked By**	**Approved By**
01		For Approval	Moses Tembo		

EXECUTIVE SUMMARY

Contents

ACRONYMNS

AADD	-	Annual Average Daily Demand
Dr JSMLM	-	Dr. JS Moroka Local Municipality
DWA	-	Department of Water Affairs
GAADD	-	Gross Annual Average Daily Demand
IA	-	Implementation Agent
IAP	-	Invasive Alien Plants
IDP	-	Integrated Development Plan
LOS	-	Level of Service
MAR	-	Mean Annual Runoff
MSA	-	Municipal Supplies Act
NT	-	National Treasury
NWA	-	National Water Act
OHSA	-	Occupation Health and Safety Act
OWAAS	-	Olifants Water Assessment and Availability Study
OWRDP	-	Olifants Water Resources Development Planning
PEP	-	Project Execution Plan
RBIG	-	Regional Bulk Infrastructure Grant
RBWSIG	-	Regional Bulk Water Services Infrastructure Programme
RBWSIP	-	Regional Bulk Water Services Infrastructure Programme
SANS	-	South African National Standards
SDD	-	Summer Daily Demand
WC/WDM	-	Water Conservation /Demand Management
WHRS	-	Western Highveld Regional Scheme
WSA	-	Water Service Authority
WSA	-	National Services Act
WSDP	-	Water Service Development Plan
WSP	-	Water Service Provider
WTW	-	Water Treatment Works
WwTW	-	Wastewater Treatment Works

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 BACKGROUND TO THE PROJECT

Dr JS Moroka Municipality is one of six (6) local municipalities of the Nkangala district Municipality serviced by the Western Highveld Water Supply System. The Western Highveld Water Supply System spans the Kungwini LM of the Metsweding District, Greater Marble Hall and Groblersdal LM of the Sekhukhune District, and to the north Dr JS Moroka LM and Thembisile Hani LM of the Nkangala District Municipality. The existing bulk water network only provides supply to approximately 82% of the Dr JSM District Municipality population with 16% of households being dependent on the boreholes. These areas are primarily found in the western region and form part of the Mathanjana Magisterial District. The supply from the boreholes is intermittent and problematic due to reducing ground water, vandalism and theft of equipment and poor or non-existent maintenance. As a result most of the villages in the Mathanjana Magisterial District do not have infrastructure to RDP level.

The only existing water treatment works at the Weltevreden is overcommitted and is operating at maximum capacity and it geographical location is in the order of 70km to the furthest settlement of the study area. Furthermore, the difference in elevation between the Weltevreden WTW and the Mathanjana Magisterial District is some 200m. In consideration of these factors, extending water supply to the Mathanjana Magisterial District from this source has not been considered as a viable alternative. The Rust de Winter Dam is has surplus water resources and is located less than 10km from the nearest village in Mathanjana Magisterial District.

Dr JS Moroka Local Municipality was designated a water service authority (WSA) with effect from 1 July 2003 with the constitutional responsibility of ensuring efficient and effective water and sanitation service provision to the consumers in its area of jurisdiction. The water infrastructure within its area of jurisdiction, of the KwaNdebele Homeland, has been transferred to JSM LM from the Department of Water Affairs as per agreement signed on 28 December 2004. The WHRS covers an area of approximately 3,900km^2 and includes portions of three provinces and five municipalities incorporating 145 villages and towns with an estimated population of about 700 000 people

In accordance with this obligation, the Municipality has been involved in several planning initiatives to assess the bulk and internal infrastructure requirements for vital implementation. The Nkangala water board was established on 27 February 1998 to fulfil the regional water supply function in the Western Hihgveld. This institution has, however, not been successful in fulfilling its mandate.

The Department of Water Affairs (DWA) is the custodian and sector leader in the water sector which plays a key role ensuring effective development and management of regional bulk infrastructure. In 2007 the National Treasury (NT) approved funding for a three year programme called Regional Bulk Infrastructure Grant (RBIG). This programme has been subsequently extended and is an on-going programme where the wider scope of all the regional bulk water supply management requirements was consolidated. It has been decided that all the regional bulk infrastructure roles and functions will merge under one programme, named Regional Bulk Water Services Infrastructure Programme (RBWSIP). The aim of the fund is to support Government's development targets where in this project is to supply a regional bulk infrastructure eradication of basic water supply backlogs.

The Rand Water was appointed by DWA as an Implementation Agent (IA) for the RBIG programme and will be responsible for implementing the project.

1.2 SCOPE AND ORGANIZATION OF PROJECT

GKB Consulting Engineering has been appointed by the Rand Water to undertake an investigation into the provision of bulk water supply to the Mathanjana Magisterial District (MMD). The investigation addresses the bulk infrastructure requirements necessary for sourcing water from the Rust de Winter Dam, its treatment and distribution to the respective villages of the MMD.

The project will be executed in four phases and the scope of works as determined and finalised with Rand Water and the DWA will include the following:

- Task 1: Conducting the Project Scoping and Inception
- Task 2: Assessment of Technical Feasibility (This Report)
- Task 3: Undertaking the Preliminary Design and Research
- Task 4: Compilation of an Implementation Readiness Study (IRS).

1.2.1 Task 1: Study Inception

The objective of this task is to:

- Review all existing available technical reports, studies and documentation;
- Review the strategic aspects in line with the Water Service Authority (WSA), Intergraded Development Plan (IDP), Water services Development Plan
- Compiling an overview of the existing infrastructure and population Demographics
- Assessing the overall environment and WSA intuitional arrangements
- Identify the existing and future water demand projections
- Establish methodology for undertaking Task 2 – 4
- Ensure involvement, buy-in and approval of the WSA and relevant stakeholders throughout the above-mentioned activities

1.2.2 Task 2: Feasibility Study

The objective of this task is to:

- Undertake a detailed water demand analysis based on the existing and future demand projections
- Undertake a water resource planning protocol to assess the possible water resource augmentation options available
- Undertake a water quality investigation covering assessment of water samples, points of pollution, possible pollution risks, and the WSA's water quality monitoring and management plans
- Analyse the status of the existing water infrastructure including aspects of capacity, performance, condition, rehabilitation, optimization and / or upgrading of existing infrastructure
- Identify the various technical options required to meet with the project objectives, and then analyse and investigate the feasibility of these options in terms of capital and operations and maintenance costs, operations and maintenance requirements reliability and risk of supply
- Assess the various design criteria for each option and carry out an option analysis to determine the final suitable option and

- Ensure the involvement. Buy-in and approval of the WSA and relevant stakeholders throughout the above-mentioned activities.

1.2.3 Task 3: Preliminary Study and Research

The objective of this task is to:

- Develop preliminary designs to enable the Environmental Impact Assessment (EIA) process and detailed budgeting process
- Assist the WSAs to complete and submit all necessary water use license applications required for approval.
- Develop a detailed project implementation plan including critical path analysis and detailed project cost estimates (capital as well as Operation & Maintenance costs)
- Compile an operations and maintenance and asset management plan based on activities, budget, human resources and institutional requirements for the project, and
- Ensure the involvement, buy-in and approval of the WSA and relevant stakeholders throughout the above-mentioned activities.

1.2.4 Task 4: Implementation Readiness Study (IRS)

The objective of this task is to:

- Ensure that the strategic planning IRS issues in terms of IDP and WSDP linkages, Provincial Growth and Development Strategy linkages, water supply chain infrastructure, delivery targets, levels of service, stakeholder consensus, economic growth, water scarcity, functionality, cost and available co-funding are all included and addressed;
- Ensure that the social criteria IRS issues in terms of number of households to be provided with a basic services and / higher level of services, poor households to be served, the social cost, jobs to be created, affordability of proposed water tariffs, contribution towards poverty eradication, social up-lift and health improvement, associated benefitting services, and socio-political support are all included and addressed;
- Ensure that the economic criteria IRS issues in terms of number of current businesses and industries to be served, expected new economic value to the generated, SMMEs and B-BBEE enterprises to benefit, and regional economic benefit for the proposed water user and their value chain integrated are all included

into the development objectives for the proposed options are all included and addressed;

- Ensure that the technical criteria IRS issues in terms of the project being part of a water services master plan, the appropriateness and acceptability of the proposed solution, the appropriate water resource choice and adequate water allocation, compliance to the water demand and water conservation objectives, optimal choice of bulk distribution networks and proof of best suited technology are all included and addressed;
- Ensure that the institutional criteria IRS issues in terms of infrastructure ownership, institutional capacity to implement, infrastructure ownership and implementation and operations and maintenance responsibility agreements, co-operation agreements between stakeholders, WSA cost recovery systems and policies, water conservation and demand performance and responsibility and accountability are all included and addressed;
- Ensure that the financial criteria IRS issues in terms of the required funding, funding sources, financial analysis of cost projections, financial modelling and viability in terms of expected returns on investments, proposed tariff adjustments to reconcile cost and projected income, and financial status, performance and creditworthiness of the WSA and implementing agents are all included and addressed;
- Ensure that the legal criteria IRS issues in terms of water licenses and adequate allocation for all water users, environmental authorizations for the construction of the project and all land and property rights issues are all included and addressed;
- Ensure that the sustainability criteria IRS issues in terms of financial viability, operating and management capacity, performance and commitment, and environmental and social acceptability and impact are all included and addressed;
- Ensure the involvement, buy-in and approval of the WSA and relevant stakeholders throughout the above mentioned activities.

1.3 DESCRIPTION OF PROJECT AREA

The Mathanjana Managerial District is one of the three former transitional local councils namely Mdutjana, Mbibane and Mathanjana in the KwaNdebele homeland, formed as a result of the developmental and institutional changes of the Local Government in the

Western Highveld. The three TLC were later amalgamated to form the Dr. JS Moroka Local Municipality in the year 2000.

The Mathanjana Magisterial District is situated in Dr.JSM LM sharing the border with Bela Bela LM in Limpopo, and approximately 7km North West of the Rust De Winter Dam. The District covers an area that stretches over 40km from west to east and is accessible via the N1 national route from the west and the R573/R568 from the south. An arterial road links the respective villages/settlements.

The Mathanjana Magisterial District is characteristic of a peri-urban area comprising small holdings utilised for subsistence farming and limited commercial farming. Land ownership is a major problem as most of the land is under state ownership or under the various Tribal Authorities. This issue is considered to be of major importance as only two communities within the Dr JS Moroka LM are proclaimed as formal townships, i.e. Siyabuswa and Libangeni. The collection of revenue in the non-proclaimed areas is hampered severely as ownership of property is not established and property rates and taxes cannot be implemented. No policy in this regard exists.

The Mathanjana Magisterial District comprises of 8 wards with a population of about 71 203 people and 19 332 households (Census 2011). Dr J S Moroka Local Municipality is located in the north-western corner on Mpumalanga Province and borders on Gauteng Province to the south-west and Limpopo province to the North. It spans more than 40km north-south from Lefiso to Kameelport and more than 80km east-west from Maganagobuswa near Marble Hall to Masobe near Hammanskraal covering a total area of 1 416km^2. The Dr JSM LM has a total population of about 249 705 people and 62 162 households (Census 2011) living in about 60 different Towns and villages throughout the 31 wards in the municipality. Table 1 provides an overview of the study area in relation to the Dr JS Moroka Municipality.

The villages within the Mathanjana Magistrate District do not have bulk/potable water supply and hence rely on underground water. The supply from the boreholes is however intermittent and problematic due to reducing ground water, vandalism and theft of equipment and poor or non-existent maintenance. As a result most of the villages in the Mathanjana Magisterial District do not have infrastructure to RDP level.

Table 1: Overview of Study Area

Item	Mathanjana Magisterial District (Study Area)	Dr JS Moroka Municipality
Area (km2)	370km^2	1,416km^2
Wards (No.)	8	31
Villages (No.)	16	60
Households (No.)	19,332	62,162

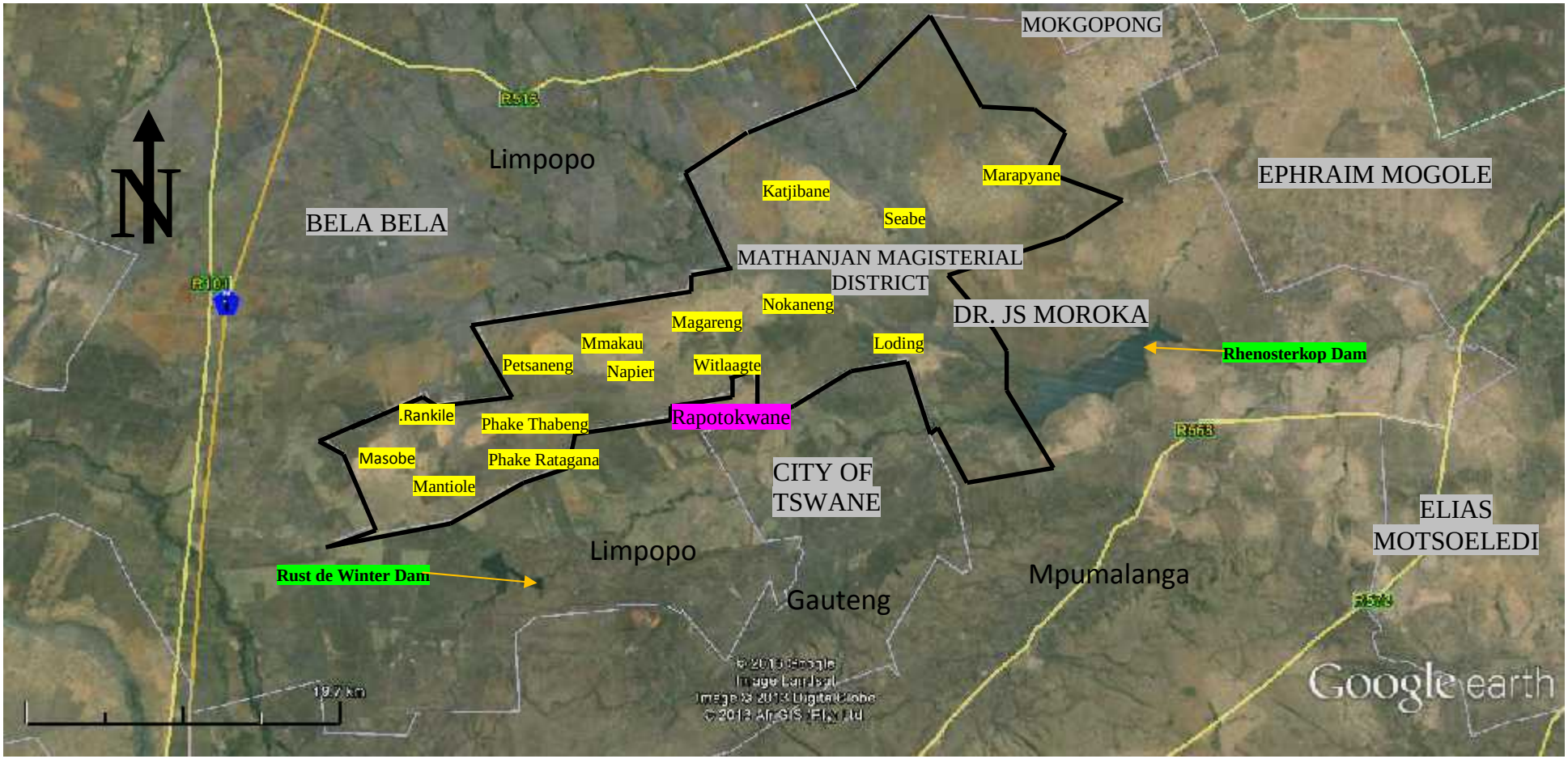


Fig.1: Mathanjana Magisterial District Location Plan

1.4 SCOPE OF REPORT

This report describes Task 3. Technical Feasibility. The outcome of the task will help Rand Water and DWA in making decision of which infrastructure component should be implemented to provide bulk water supply to Mathanjana Magisterial District.

1.5 PROJECT OBJECTIVE

The purpose of the project is to undertake an investigation into the provision of bulk water supply to the Mathanjana Magisterial District (MMD). The investigation addresses the bulk infrastructure requirements necessary for sourcing water from the Rust de Winter Dam, its treatment and distribution to the respective villages of the MMD.

The project is intended to improve the level of service of the water supply to the Mathanjana Magistrate District community. The proposed project will be implemented with the overall objectives of the Department of Water Affairs in expanding the accessibility of water.

2 SITUATION ASSESSMENT

2.1 EXISTING INFORMATION AND STUDIES

Existing feasibility study results and information were relied upon to a large extent for this study. For parallel studies ongoing liaison will be maintained with other study teams to ensure transfer of information, data and reports occurs.

The main sources of information reviewed during the compilation of this feasibility report were limited to the following. At this stage this list is not considered to be exhaustive as the review is on-going.

- Nkangala District Municipality, (2012): *Final 2012/13 Integrated Development Plan (IDP)*
- Dr JS Moroka Local Municipality, (2008): *Final 2008/09 Integrated Development Plan (IDP)*
- Dr JS Moroka Local Municipality, (2010): *Final 2010/11 Integrated Development Plan (IDP)*

- Dr JS Moroka Local Municipality, (2011): *Final 2011/16 Integrated Development Plan (IDP)*
- Dr JS Moroka Local Municipality, (2012): *Final 2012/13 Integrated Development Plan (IDP)*
- Dr JS Moroka Local Municipality, (2013): *Draft 2013/14 Integrated Development Plan (IDP)*
- Dr JS Moroka Local Municipality, (2011): *Water Services Development Plan (WSDP); Module 1 Overview and assessment of the status of information and strategies of WSA level*
- Dr JS Moroka Local Municipality, (2010) *Water Services Development Plan (WSDP); Module 3 Further plans and strategy Supportive information*
- Hlanganani Engineers and Project Manager (Pty) Ltd, (May 2012): *Rust de Winter to Mathanjana Magisterial District Bulk Water Supply Scheme, Feasibility Report , Rand Water*
- DWA, (December 2011): *Development of a Recompilation Strategy for the Olifants River Water Supply System, Water Requirements and Water Resources Report*.
- DWA, (December 2011): *Development of a Recompilation Strategy for the Olifants River Water Supply System, Report on Possible Water Conservation and Water Demand Management.*
- DWA, (March 2012): *Development of a Recompilation Strategy for the Olifants River Water Supply System.*
- DWA, (March 2010): *Development of a Recompilation Strategy for the Olifants River Water Supply System.*
- GLS Consulting, (September *2012): Computer Analysis and Master Planning of the Portion of the Western Highveld Bulk Water Scheme Within the Dr. Moroka Local Municipality*
- DWA, (December 2011): *Development of a Recompilation Strategy for the Olifants River Water Supply System, Environmental Screening Report*
- Water for Africa Environmental Engineering and Management Consultant, (July 2009): *The Engineering Study & Solution Provision in the Bulk Water Supply from Rust De Winter to Mathanjana Magisterial District of Dr JS Moroka LM*,
- Mackenzie R., Adams N., and Manganyi A., November 2003. *Water Supply Situation in the Western High Area*.
- DWA, (November 2011): *Development of A Reconciliation Strategy for the Olifants River Water Supply System, Final Reconciliation Report*

- Nkangala District Municipality, (November 2008): *Municipal Demarcation Board, Assessment of Capacity for 2008/09 Period, District Municipality Report.*
- Thompson, H.; C. M. Stimie; E. Richters; S. and Perret. (2001): *Policies, legislation and organizations related to water in South Africa, with special reference to the Olifants river basin.* Working Paper 18 (South Africa Working Paper No. 7). Colombo, Sri Lanka: International Water Management Institute.
- McCartney, M.P.; Yawson, D.K.; Magagula, T.F.; Seshoka, J. (2004): *Hydrology and water resources development in the Olifants River Catchment.* Working Paper 76. Colombo, Sri Lanka: International Water Management Institute (IWMI).
- Aurecon, (January 2013): *BBLM Water Service Master Plan 2012*. BelaBela Local Municipality.
- SRK Consulting, (October 2010): *Development of a Reconciliation Strategy for all Towns in the Northern Region; First Order Reconciliation Strategy for the Siyabuswa Cluster, Nkangala District Municipality*: Dr. JS Moroka Local Municipality.
- DWA, (November 2010): *Development of A Reconciliation Strategy for the Olifants River Water Supply System, Yield Analysis of the De Hoop and Flag Boshelo Dams*

These reports, as well as others that are identified have been assessed during the feasibility phase of the study.

2.2 EXISTING WATER SUPPLY INFRASTRUCTURE

2.2.1 Existing Borehole Sources

Mathanjana Magisterial District is depends on the borehole water for its water supply. Relatively high yielding boreholes in excess of 5 l/s are located toward the east in Katjibane and Seabe. All boreholes, however, are equipped with basic chlorination equipment as a treatment measure. A summary of existing boreholes is provided in Table 2.

As discussed above, treatment of borehole water is limited to chlorination usually installed at the site of the borehole. Previous water quality testing has revealed that the most significant water quality problems associated with the ground water is the high prevalence of nitrates and salinity. Most of the communities currently served by boreholes have existing reticulation systems at RDP standards, but it was indicated that Mmamethlake does not have sufficient water or infrastructure.

Other existing sources of water include the purchasing of water from the Municipality and/or neighbouring communities.

It should be noted that the water supply systems are not in any way linked to neighbouring villages /settlements to optimise use of the resources.

Table 2: Summary of Borehole

Community	No of boreholes	Sewage Conta-mination	Chlorination installed	*Nitrates high*
	No	No	No	*No*
Phake	13	2	6	-
Masobe	9	1	5	-
Nokaneng	22	-	3	-
Katjibane	16	-	4	*5*
Mmamethlake	1	-	1	-
Semohlase	*1*	-	-	-

Source: Dr JS Moroka 2010 WSDP

The majority of the boreholes are electrified, while several are hand operated and some are diesel powered. It is also reported that vandalism is a general problem at installations and that effective O&M is lacking throughout the area. Only reactive maintenance is done. Current refurbishment costs have not been determined.

2.2.2 Existing Bulk Supply Mains

A 315mm diameter bulk supply main has recently been installed to supply water from Greenside toward Kajibane (terminating in a concrete reservoir). It is not clear if the reservoir was intended to be supplied by the Greenside borehole as the reservoir remains dry. Further, a 160mm diameter supply main to Nokaneng has been installed on the same line as part of a separate project. This line is functional. It therefore can be concluded that the two supply lines installed serve the purpose of supplying Seabe and Nokaneng from a borehole in Greenside.

2.2.3 Existing Service Storage

It is estimated that the existing concrete storage reservoir located at Seabe has a capacity of approximately 6 Megalitres. The reservoir, however, is not in use.

Localised steel storage facilities are installed in villages where boreholes have been equipped with pumps. Their capacities are limited to provide a days' storage at basic level of service and facilities are currently in very poor state of repair and therefore not in use. As result water from the boreholes is pumped directly into the distribution network. This has led to poor security of supply in the event of borehole pump failure.

2.2.4 Existing Internal Reticulation Systems

The internal reticulation is generally poor. Therefore investigation will be extended to incorporate assessment of reticulation systems to facilitate prioritisation of backlog eradication in proposed planning.

2.2.5 Existing Water Treatment Works

The Weltevreden WTW is the only treatment plant in the Dr JS Moroka LM from where potable water is distributed to the various communities in the Dr JS MLM. Water for the treatment plant is abstracted from the Weltevreden Weir. The major source of water for the weir is the Rhenosterkop (Mkhombo) Dam, which is about 8 km upstream of the weir. Some runoff from the Kameel River catchment contributes to the flow available for abstraction at the weir. Water is also transferred from Loskop Dam through the Mtombo Transfer Pipeline and is discharged into the Weltevreden Weir.

The total subsystem yield has been calculated (DWAF, 2005 (a), 4-22) at 9.65 million m^3 /a (including 2, 55 million m^3/a from the Loskop Dam canal). This translates to only 26, 4 Ml/d which is significantly lower than the capacity of the Weltevreden WTW of 68 Ml/d.

The only external surface source of water is the supply from the Loskop Dam Canal. This source has not been utilized in the recent past and the abstraction and booster pumping stations at the Mkhombo Balancing Dam and at Valschfontein have been vandalized and cannot be operated without extensive refurbishment. The contracted supply volume is some 2.55Million m^3/year.

The existing water treatment works at the Weltevreden is overcommitted and is operating at maximum capacity and its geographical location is in the order of 70km to the furthest settlement of the study area. Furthermore, the difference in elevation between the Weltevreden WTW and the Mathanjana Magisterial District is some 200m. In consideration of these factors, extending water supply to the Mathanjana Magisterial District from this source has not considered a viable alternative.

2.2.6 Wastewater Treatment

Currently there is no wastewater works in the study area and no plans have been tabled due to the low wastewater generation. Approximately 65% of the settlements are currently equipped with VIPs and only 2.67% are serviced with flush toilet connected to the sewerage

system and 1.34% serviced with flush toilets and septic tank. Details of access to sanitation are as shown in Table 3. With the upgrade as proposed, it is anticipated that a regional works may have to be in operation within 3-5 years to accommodate the effluent/sewage loads.

Table 3: Access to sanitation

Ward	None	Flush Toilet (Connected to Sewerage)	Flush toilet (with septic tank)	Chemical toilet	Pit toilet with ventilation (VIP)	Toilet without ventilation	Bucket Toilet	Other
Ward 23	16	66	50	2	17	1398	3	1
Ward 24	80	137	32	33	943	1761	3	3
Ward 25	19	29	15	6	630	1201	1	5
Ward 26	21	11	5	-	827	1480	15	3
Ward 27	55	36	12	12	423	1366	7	-
Ward 28	13	32	28	11	264	1420	6	5
Ward 29	22	144	56	4	361	1735	2	14
Ward 30	90	32	12	5	671	1395	1	7
Ward 31	27	30	50	3	1222	820	125	4
Total	343	517	260	76	5358	12576	163	42

Source: Dr JS Moroka 13/14 IDP

2.3 WATER CONSERVATION AND WATER MANAGEMENT DEMAND

The National Water Audit requires the Water Services Authority (WSA) to prepare Water Conservation and Water Demand Management (WC/ WDM) strategies in order to achieve more efficient use of water. This requirement is of special importance to Dr. JSM LM where the actual bulk water supply to the focus area exceeds the theoretical required water demand by an estimated factor of approximately 1.7. Dr. JS Moroka Local Municipality currently receives a circa 42Ml/day from the Weltevreden WTW instead of the approximate theoretical figure of 25Ml/day. Acceptable losses in a reasonably well managed system are between 20 and 25%. Given the status quo a considerable percentage of the population still regularly complains about interrupted water supply. The problem occurs more severely during the hot summer months. The recent investigations for additional water sources could alleviate the immediate problems, but the underlying problems of the inequitable distribution of water, operational issues and wastage of water by consumers needs to be adequately addressed. WC & WDM is probably the most effective way to ensure effective supply of water to DR. JSM LM where approximately 67% of the households are expected to earn income below R800 per month and can be classified as indigents.

2.4 OPERATION AND MAINTENANCE

The Dr JS Moroka Local Municipality is the designated Water Services Authority (WSA) in terms of the Municipal Structures Act. It is responsible for the policy setting, planning, management and oversight of water service provision in its area of jurisdiction. The municipality is the designated Water Services Provider and is therefore responsible for operation and maintenance the infrastructure within its area of operation (with or without the assistance of contractors). However there is lack of operation maintenance plans and adequate budgetary allocation to keep the infrastructure in good state of repair. This is compounded by the lack of appropriately trained and skilled staff to support this function. Unless there is support from the DWA and District municipality, this situation will be made worse with expansion of the infrastructure.

At the moment the actual and potential levels of institutional capacity and support for operation and maintenance are weak.

3 INFRASTRUCTURE NEEDS

3.1 POPULATION PROJECTION

The population of Dr J S Moroka local Municipality from the census count of 2001 was 243 313 persons (Census 2001), and increased to 247 705 persons (Census 2011). This implies an annual growth rate of 0.26% between 10 year periods. If one applies this growth rate over-time, the projected population of the local municipality is expected to be 251 014 by 2013. The population growth has been stable over the 20 years and this could be attributed to the migration of people to neighboring towns in Gauteng province.

The IDP (Dr. JSM LM, 2007) reports that the Development Bank of Southern Africa (DBSA) calculated a growth rate of between 2.3% and 2.8% for the area. It is clear that there are inconsistencies in the annual population growth for the municipality. The information obtained from the Census data though appears very low provide a more realistic and reliable data. In order to determine the current and reliable projected population of the study area until year 2033, 1.06 % average annual growth rate should be applied to the census 2011 statistics. The estimated predicted population figures based on this growth rate are as shown in table 4 below.

Table 4. Current and Projected Mathanjana population

Village	2011	2013	2023	2033
Ward 23-Marapyane (Schilpadfontein)	5283	5311	5450	5594
Ward 24-Mmaduma (Greenside, klippan, Opgeruimd, Mbagwane)	10203	10256	10526	10803
Ward 25- Seabe (Ga-ramantshane, Leseleseleng, Terateng)	7496	7535	7733	7937
Ward 26-Loding (Sehokgo), Dihekeng, Ramantsho, Semahlase	8913	8959	9195	9437
Ward 27- Katjibane (kalkfontein)	7994	8036	8247	8464
Ward 28- Nokaneng (Nagareng,Magareng, Lefifi, Rooifontein)	6564	6598	6772	6950
Ward 29-Mmanentlhake (Dierefeng), Phake Ratlagana, Phake Phaphamang	7956	7997	8208	8424
Ward 30-Phake Rebone, Rankile, Thabeng, Mantlole	8299	8342	8562	8787
Ward 31-Pankop Masobye) (31)	8495	8539	8764	8994
Total	**71203**	**71574**	**73457**	**75389**

3.2 HOUSEHOLD COUNT

The household number within Dr J.S. Moroka Local Municipality has grown from **54 339** (Census 2001) to 62 162(Census 2011) with the annual growth of 1, 35% and the average size of household has dropped at 4, 01 in comparison to 4.45% (census 2001). It is noted however the population of Mathanjana Magisterial District is some 71203 with a corresponding number of households of 19332. This implies that the household size of the MMD is 3.68 which is lower the Dr JS Moroka LM average.

3.3 SOCIAL ECONOMIC STATUS

The household income status in the study area as recorded by the DWAF NIS database indicates a 65-80% range of households that can be considered as poor households or in poverty. The national benchmark for indigent categorisation is income per household not exceeding R1100 per month. The survey ranges of the DWAF NIS figures does not allow for a more accurate estimate.

The Census 2011 figures do not provide a report at village level, only total household income in the Municipality; therefore the study areas income statistics cannot be determined.

The current indigent subsidy policy implemented by the Municipality prescribes that the household income should not exceed that of two state pensioners which is equivalent to approximately R1, 800. The policy further prescribes that for water services, registered indigents will automatically receive 6 kilolitres of water per month fully subsidised. In addition, registered indigents may receive a further 4 kilolitres per month subject to funding being available from the equitable share. A subsidy, determined at the beginning of every financial year and not more than the applicable tariff for that year, will be applied for the duration of that particular financial year. The amount of the subsidy will be determined and approved as part of the tariff policy applicable for the financial year.

3.4 WATER REQUIREMENTS

3.4.1 Level of Service

Table 5 shows the existing level of service (LOS) Mathanjana Magisterial District. Investigations proved that the majority of the population wants at least yard connections (Dr. JSMLM WSDP, 2010). Although about 48% have no access to piped water it is noted that

6% of the households are serviced with a house connection and it is expected that this trend will continue to increase and was therefore taken into account during planning stage.

Table 5: Manthanjana Level of Service

Ward	Number of Households	House Connection	Yard Connection	Community stand < 200m from Dwelling	Community stand 200m to 500m from Dwelling	Community stand-500m to1000m from Dwelling	Community stand > 1000m from Dwelling	No access top piped water
Ward 23	1 553	65	536	103	26	22	4	797
Ward 24	2 993	355	1401	162	49	8	0	1 018
Ward 25	1 906	47	410	131	2	9	28	1 278
Ward 26	2 361	278	585	787	197	88	32	394
Ward 27	1 911	89	788	613	29	63	3	327
Ward 28	1 779	95	633	218	47	27	17	742
Ward 29	2 337	72	565	98	12	5	1	1 584
Ward 30	2 213	93	427	160	15	91	0	1 427
Ward 31	2 279	64	207	245	66	19	3	1 675
Total	19 332	1 158	5 552	2 517	443	332	88	9 242
Percentage		6%	29%	13%	2%	2%	0.5%	48%

Source: Dr JS Moroka 13/14 IDP

3.4.2 Mathanjana Magisterial District Water Requirements

The assessment of the water requirements of the area was carried out taking into account inter alia service levels, socio economic development, water losses and the type of development. The estimated water requirements were derived from the population data within each settlement and a water requirement in litres/capita/day related to the level of service delivered.The per capita demands have been based on the national norms (DWAF Guidelines: Water Supply Service Levels) and historical consumptive patterns of the DJSMM areas supplied from the potable water supply system. These per capita estimates are also in-line with the "Guidelines for Human Settlement and Planning" (Red Book) as based on income and housing density (see table 6).

Table 6: Per capita water consumption estimates

Development Areas-House Connection Water Supply	Typical Water Usage (l/c/d)	Range (l/c/d)
Moderate	80	48-98
Moderate to high	130	80-148
High	250	130-280
Very High	450	260-480

Three service levels were considered, namely basic (25 l/c/d), Moderate (80 l/c/d) and moderate to high (135 l/c/d). A summary of the anticipated water requirements for the Study area is given in Table 7 and Table 8 shows the overall water demand in million cubic metres per year. The moderate to high level of service has been adopted as the acceptable level of the service for the study area. This translates to a total water demand of 13 038kl/day (4.76Mm3/year)..

Table 7: Water Requirements for Different Service Levels

		Survival				Moderate				Moderate to High		
Parameter	Unit	Yr. 2013	Yr. 2023	Yr. 2033		Yr. 2013	Yr. 2023	Yr. 2033		Yr. 2013	Yr. 2023	Yr. 2033
AADD (kl/d)	kl/d	1789	1836	1885		5726	5877	6031		9662	9917	10178
GAADD(kl/d)	kl/d	1968	2020	2073		6298	6464	6634		10629	10908	11195
SDD (kl/d)	kl/d	3248	3333	3421		10393	10666	10946		17537	17999	18472

Table 8: Water Requirements- Mm^3/a

Water requirements for different level of service Mm^3/a									
Survival			Moderate			Moderate to High			
Yr. 2013	Yr. 2023	Yr. 2033	Yr. 2013	Yr. 2023	Yr. 2033	Yr. 2013	Yr. 2023	Yr. 2033
1.18	1.22	1.25	3.79	4.00	4.00	6.40	6.57	6.74

3.4.3 Rapotokwane Village –Bela Bela

Rapotokwane Village was incorporated into the municipality from Dr J.C. Moroka Municipality (Mpumalanga Province) in 2000.Rapotokwane is a village which does not have an economic base and is dormitory settlement with settlement with most people working as migrant labourers.

Rapotokwane is currently supplied from boreholes; however the amount of water is not sufficient to meet the daily basic needs. It is therefore proposed that the village be provided with basic municipal infrastructure including water supply.

According the report completed by Aurecon 'Bela BelaWater Service Master Plan 2012 Revision 0' a Rapotokwane water current demand in including water losses is estimated at 271kl/day (99Ml/year) and is expected to increase to 355kl/day (130Ml/year). The current and forecast water demands are estimated at 406.5kl/day and 532.5kl/day if the summer peaking factor of 1.5 is taken into consideration.

From published reports and BBLM's previous experience in the area, the success rate to drill a borehole with usable yield would be in the region of 50%. Drilling a borehole with a sustainable yield in excess of 2l/s in occurring geology cannot be guaranteed.

In order to provide a lasting solution to the water supply problem in Rapotokwane it is proposed to construct a new pipe line, estimated at 15km, 160mm diameter, from neighbouring village in the mathanjana District Municipality.

3.4.4 Total Water Requirements

Table 9 below provide the total water requirements for the mathanjana water supply scheme to meet both the water requirements for the Mathanjana magisterial District and the Rapotokwane village in Belabela LM. This translates to 6.94Mm3/a

Table 9: Total Water Requirements

Supply Area	Demand (kl/day)
Mathanjana Magisterial District	18472
Rapotokwane Village	533
Total	**19005**

3.5 PROPOSED WATER SOURCE –RUST DE WINTER DAM

The following sections assess the suitability of the Rust de Winter Dam to provide the required bulk water supply to the Mathanjana Magisterial District.

3.5.1 Rust de Winter Dam-Yield

The Rust De Winter Dam on the Elands River is located approximately 10km south from the nearest village of the Mathanjana Magisterial District. The dam is in the jurisdiction of the Bela-Bela Local Municipality and has a storage capacity of 27, 2 million m^3/a. The firm yield of the dam is 9.8 million m^3/a. The registered water use according to WARMS is 1.63 million m^3/a, which is less than the firm yield capacity of the dam. Table 10 provides a summary of the Rust de Winter Dam.

Table 10. Yield of Dams

Sub catchment	Natural MAR (Million m^3/a)	Historic Firm yield (Million m^3/a).	1:50 Year Yield million m^3/a.	Full Supply Capacity (Mm^3)
Rust de Winter	25.5	9.8	11.7	27.3

Source: Water Requirements and Water Resource Report (DWA, Dec 2011)

3.5.2 Rust de Winter Dam-Water

Water from the Rust de Winter Dam is primarily used for irrigation (see Table 11). There is no information regarding other uses.

Table 11: Total irrigation Water from the Rust de Winter Dam

	Demand (Million m^3/a).		Supply (Million m^3/a).	
Location of Irrigator	ORWRDP	OWAAS	ORWRDP	OWAAS
Rust de Winter Dam	15.2	1.8	8.3	1.8

Source: Yield Analysis of the De Hoop and Flag Boshielo (DWA, Nov 2010)

The registered and categories of water users are provide in Tables 12 and 13 below based on the information obtained from DWA Mpumalanga Regional office.

Table 12: Registered Water User

Details	Farm Portion	Abstraction Point	Draw off (m^3/a)
Faan Bason	Portion 13	Rust De Winter Dam	450
A van Der Poel	Portion 17	Rust De Winter Dam	71 150
PBD Properties	Portion 15	Rust De Winter Dam	2 500
Tedo Belleggings	Portion 8	Rust De Winter Dam	60 000

Table 13. Categories of water users

Water Use Sector	Customer name	Total vol (m^3/a)
Agriculture: Irrigation	African Ranchers	35 000
	LJ De Villiers	168 000
	Rust De Winter Property Holding	7 000
Agriculture: Watering Livestock	AJ De Klerk	1 005
	P.B.D Properties	2 500
Mining	Vergenoeg Mining	450 000
Schedule 1	Department of public works	18 000
	MG Ngobeni	100
	MH Kekana	100
	MM Mudau	216
	SC Sebothuma	5
	SP Mnguni	15

3.5.3 Rust de Winter Dam-Alien and Invasive Vegetation

No spatial data is available to determine the extent of coverage of invasive and alien plants (IAPs) within the catchment. IAPs contribute to losses in the system. The removal of AIPs is important both to biodiversity and to reduce losses from the system.

Invasive Alien Plants use more water than the original indigenous plants and by removing IAP and allowing the re-growth of indigenous plants, significant quantities of additional water can be made available. Table 14 shows summary of impact of AIPs on the yield of the dams.

Table 14. Impact of IAPs on Dam Yield

	Yield million m^3/a		
Sub catchment	Without IAPs	With IAPs	Impact
Rust de Winter	14.5	13.8	0.7

Source: Final Reconciliation strategy (DWA, Dec 2011)

3.5.4 Ecological Water Reserve

The Reserve is that portion of the natural flow that has to be available in a river or stream in order to sustain the aquatic ecology, and also to provide for basic human needs (BHN), in order to comply with Sections 16, 17 and 18 of the National Water Act (NWA), Act 36 of 1998. The Reserve is not a steady flow, but is a variable flow that mimics natural variations in flows in the river.

There is no information regarding the dam reserve at present. For purpose of the feasibility study the dam reserve or dead water storage is assumed to be 1.47 Mm^3/year or 15% percent of the dam's firm yield of 9.8Mm3/year.

3.5.5 Water Quality

According to the report completed by the Hlanganani Engineers and Project Manager (Pty) LTD,Rust de Winter to Mathanjana Magisterial District Bulk Water supply Scheme, in May 2012, the surface water quality of the Rust De Winter dam is suitable for processing at a raw water treatment plant for purposes of potable water distribution. Data as obtained from DWA were analysed and the only three indicators of concern were related to:

- Total Alkalinity (water hardness)
- Fluoride
- Sodium Absorption Ratio

The rest of the constituents/indicators in the data were within the 'Target Water Quality Range' as stipulated in the South African Water Quality guidelines, Volume 1, Domestic Use. The Constituents are: Dissolved Major Salts (DMS), Electrical Conductivity (EC), pH, Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Chloride, Sulphate, Phosphorus, Nitrate and Ammonia.

The reports suggest that the water quality for the Rust De Winter dam is within the Target range for Domestic use. The fluoride content was above target range for both dams in 2007 but it improved to within the target range past 2007. The Sodium Absorption ratio has also improved to within target range past 2007. Table 15 provides a summary of the raw water analysis.

Table 15: Water quality analysis summary

Constituents/Indicators	Analysis	Effects
TAL_Diss_Water Total Alkalinity (Water Hardness)	90% of values from 2008-2010 were below the recommended range for water hardness (soft), 50-150	Excessively soft water can result in poor buffering, corrosion of copper plumbing and the consequent release copper in water
F_Diss_Water (mg/l) Fluoride	Only two values logged in 2007 were above the Target Water Quality range (TWOR) Negligible negative effect	Slight mottling of dental enamel may occur in sensitive individuals
SAR_Diss_Water Sodium Adsorption Ratio Calculated from Na, Mg, Ca	Only a single value logged in 2007 was above the recommended range. Negligible negative effect	A significant indicator of irrigation productivity

Source: Hlanganani Engineers and Project Manager (Pty) LTD

3.6 AVAILABLE WATER

Table 16 provides a summary of available water with respect to the total water demand

Table 16: Available water vs total water demand

Parameter	Mm^3/a
Rust de Winter Firm Yield	9.8
Ecological Reserve Water	1.23
Irrigation Water	1.60
Available water	6.97
Total Scheme Demand	6.94
Water Surplus	0.03

It is clear that Rust de Winter Dam has enough capacity or deployable output to meet the water supply requirement for the Mathanjana Magisterial District and Rapotokwane Village in Belebela Local Municipality.

4 BULK PIPELINE OPTION EVALUATION

4.1 OPTIONS CONSIDERED

Three options were considered for abstracting raw water from the Rust de Winter dam and delivery to the proposed water treatment works at the nearest village within the Mathanjana Magisterial District. The options are outlined below:

- Option 1: Abstraction point downstream of dam wall with WTW near Phake
- Option 2: Abstraction point downstream of dam wall with WTW near Mantiole
- Option 3: Abstraction point upstream of dam wall with WTW near Mantiole.

4.2 DESCRIPTION OF OPTIONS

4.2.1 Option 1: Abstraction point Downstream of dam wall with WTW Near Phake

The abstraction structure and the raw water pumping station will be installed downstream of the existing Rust De Winter Dam wall. The abstraction pipe will be connected to one of the two existing 500mm diameter abstraction pipes used to deliver raw water to the to the farmers via the concrete lined channel. The pipes are connected to an abstraction located upstream of the dam wall and only one pipe is in used at a time and second pipe provides redundancy to facilitate repair works on the duty pipe in the event of failure. A 450mm diameter HDPE, 8200m long bulk pipeline would be constructed to deliver raw water to the proposed the proposed balancing dam at the proposed water treatment works to be located near Phake. The pipe would be constructed such it would run through the Rust de Winter Special habitat reserve and the private farmland (see Fig. 2). The hydraulic for this option is shown in fig. 3

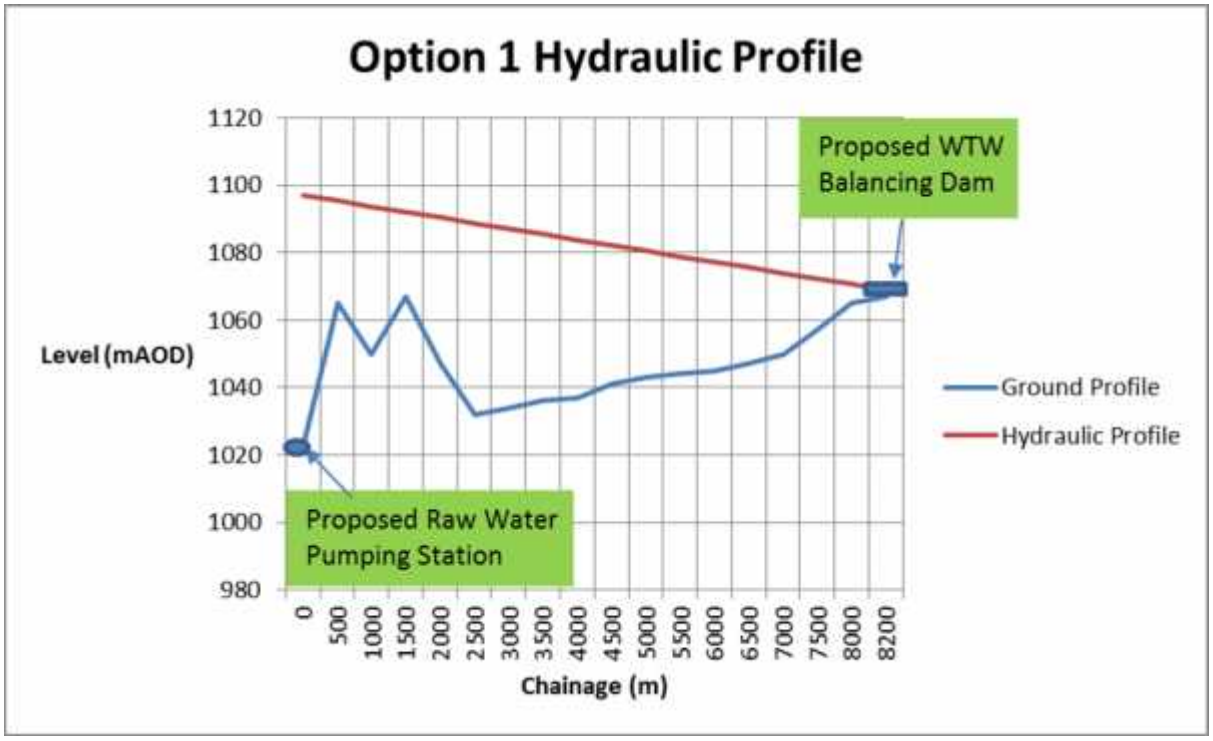


Fig.3: Option 1 Hydraulic profile

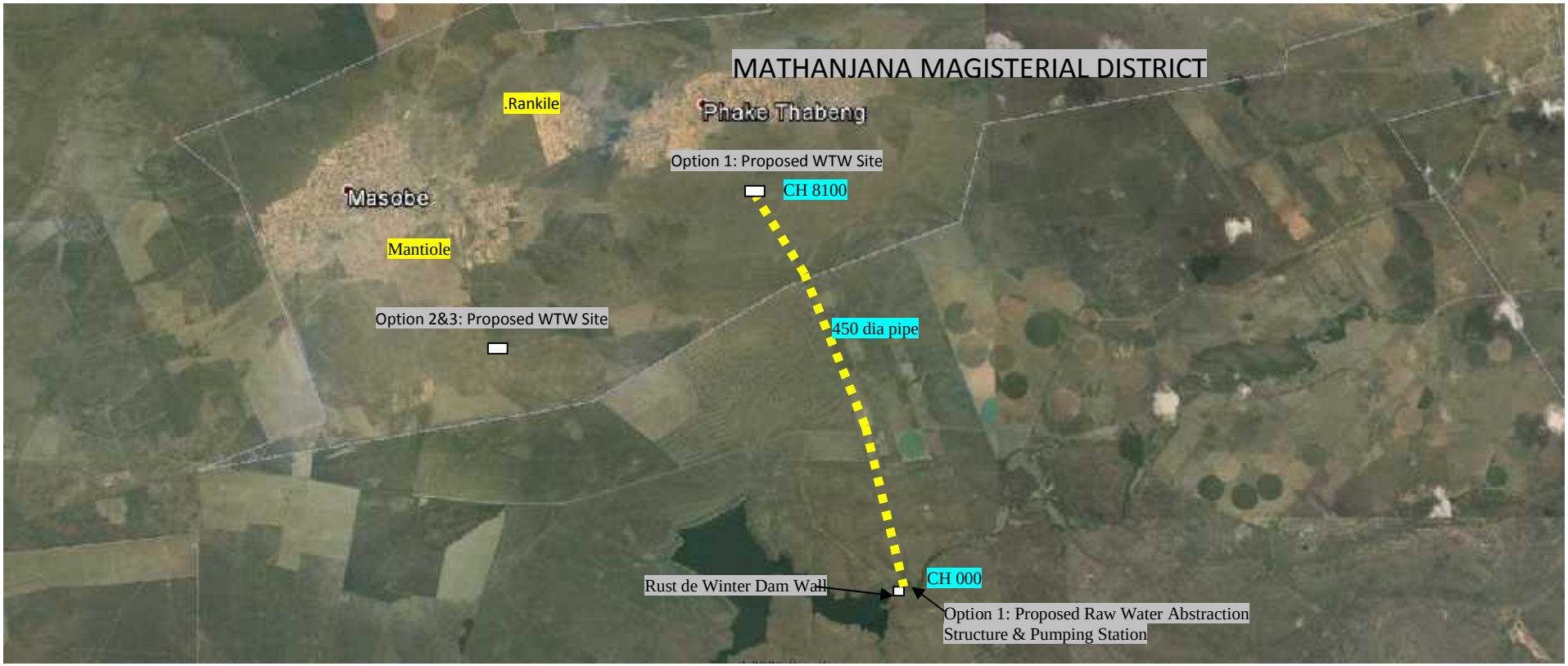


Fig.2: Option 1Pipe Route

4.2.2 Option 2: Abstraction point Downstream of dam wall with WTW Near Mantiole

The abstraction structure and the raw water pumping station will be installed downstream of the existing Rust De Winter Dam wall. The abstraction pipe will be connected to one of the two existing 500mm diameter abstraction pipes used to deliver raw water to the to the farmers via the concrete lined channel. The pipes are connected to an abstraction located upstream of the dam wall and only one pipe is in used at a time and second pipe provides redundancy to facilitate repair works on the duty pipe in the event of failure. A 450mm diameter HDPE, 9200m long bulk pipeline would be constructed to deliver raw water to the proposed the proposed balancing dam at the proposed water treatment works to be located near Phake. The pipe would be constructed such it would follow the road reserve for about 3Km and then run through the Rust de Winter Special habitat reserve and the foreste reserve private farmland for the rest of the pipe section (see Fig. 4). Option 2 hydraalic profile is shown in fig.4.

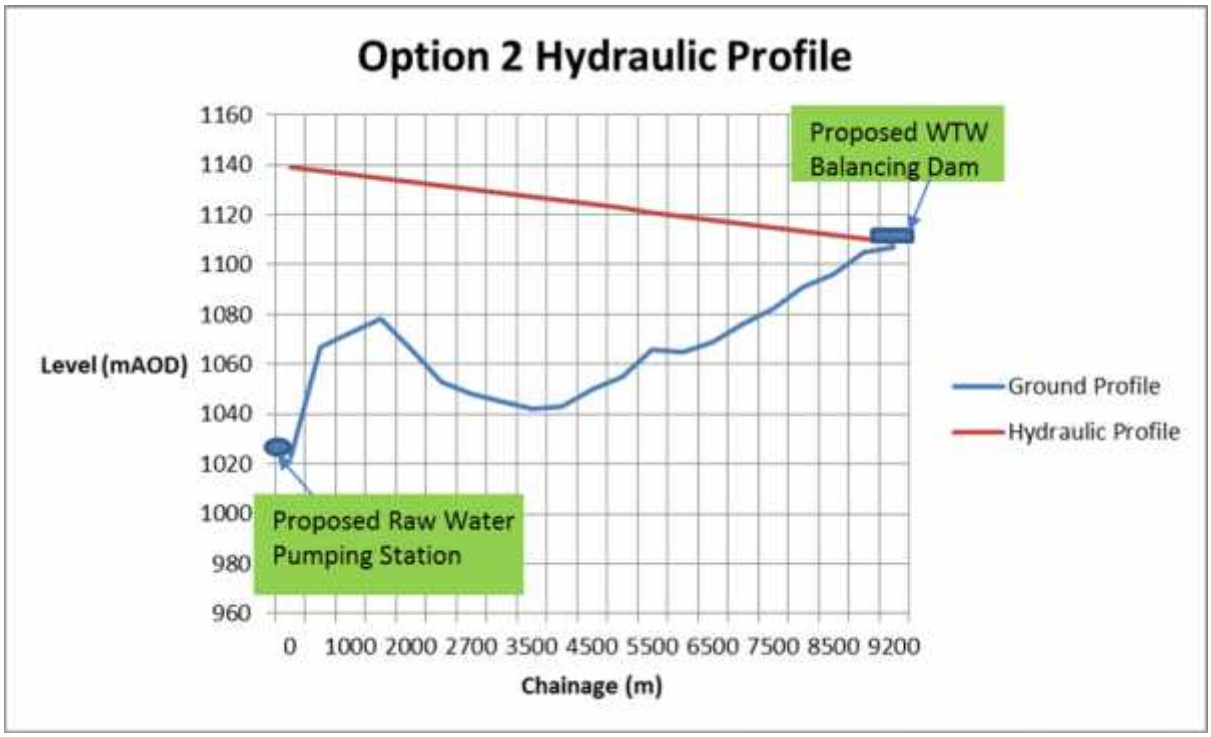


Fig 4. Option 2 hydraulic profile

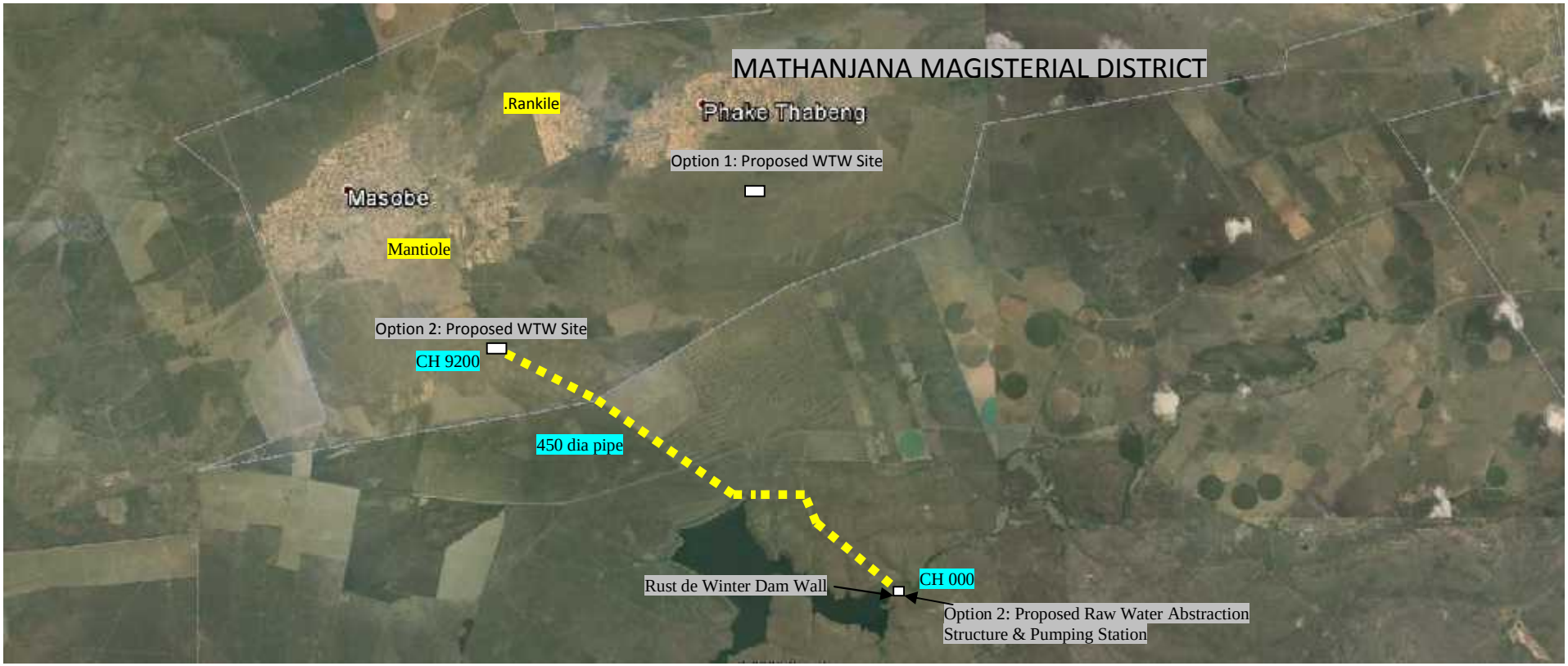


Fig.3: Option 2 Pipe route

4.2.3 Option 3: Abstraction point 3km upstream of dam wall with WTW Near Mantiole

The report completed by the Hlanganani Engineers and Project Manager (Pty) LTD,Rust de Winter to Mathanjana Magisterial District Bulk Water supply Scheme, in May 2012 proposes to install the abstraction structure and the raw water pumping station about 3km upstream of the Rust de winter dam wall. A 450mm diameter HDPE, 7500m long bulk pipeline would be constructed to deliver raw water to the proposed the proposed balancing dam at the proposed water treatment works to be located near Phake. The pipe would be constructed such that run through the Rust de Winter Special habitat reserve and forest reserve (see Fig. 5). Option 3 hydraulic profile is shown in fig. 6

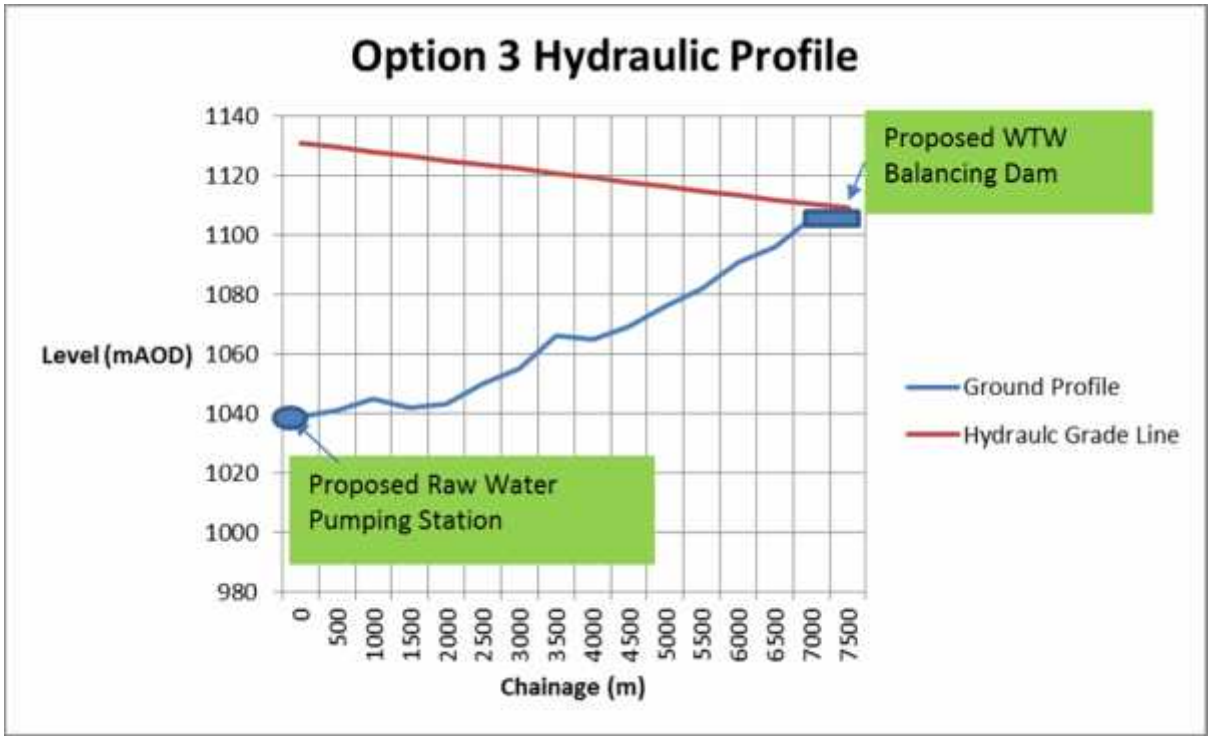


Fig 3: Option3 hydraulic profile

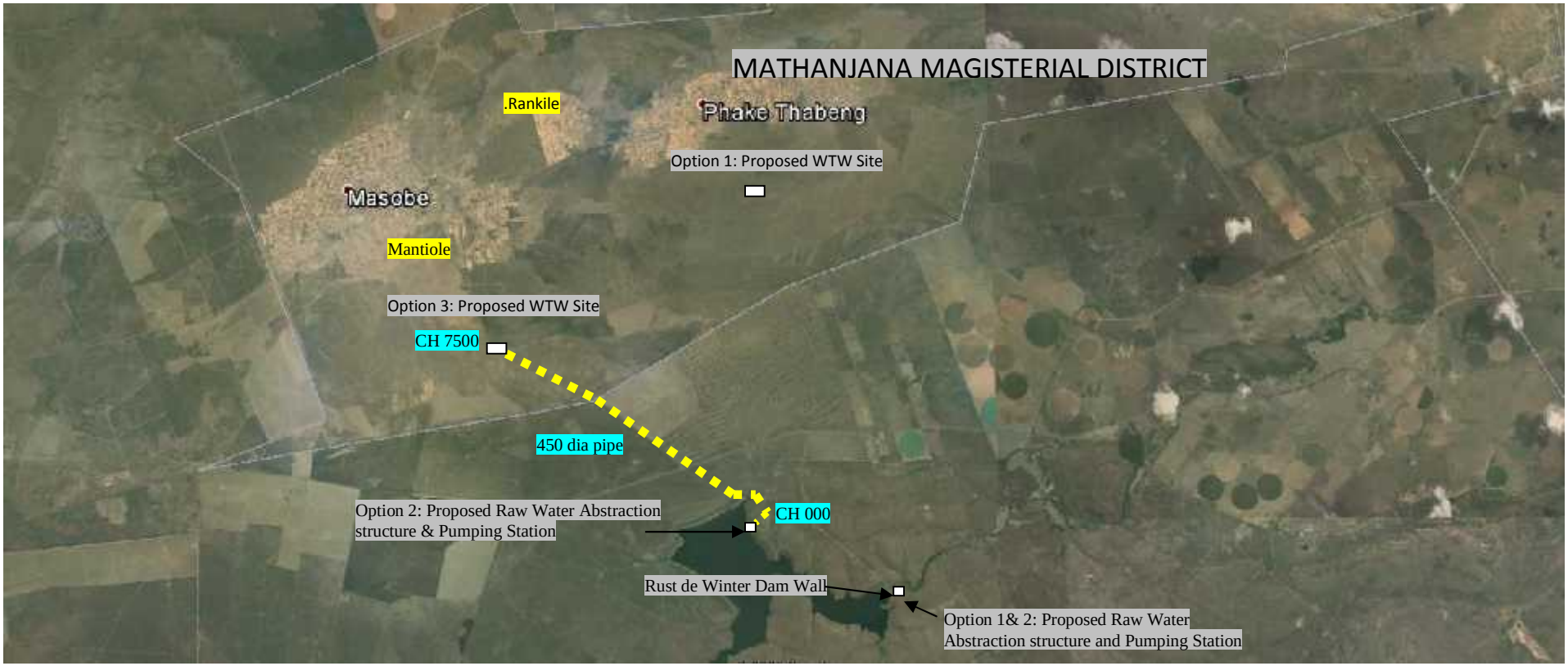
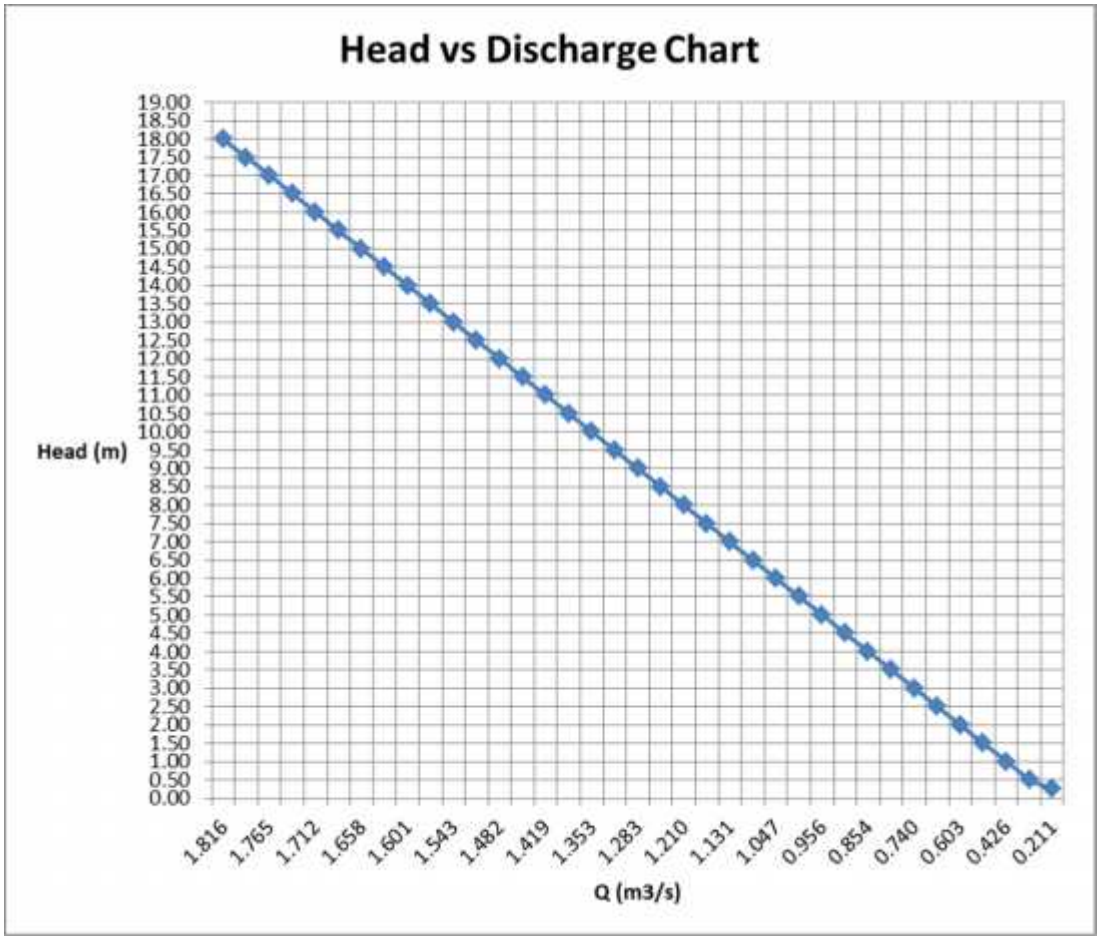


Fig.4. Option 3 Pipe Route

4.3 ANALYSIS OF OPTIONS

4.3.1 Option 1: Abstraction point Downstream of dam wall with WTW Near Phake

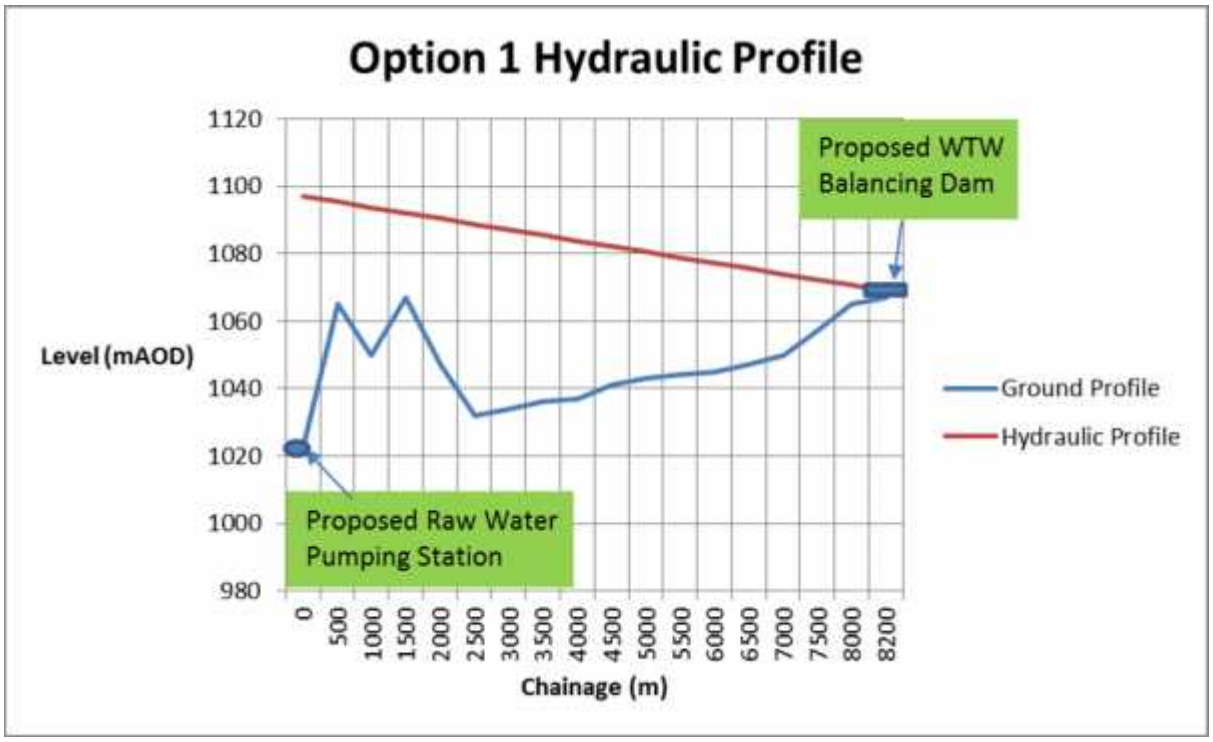
Information obtained from the DWA office reveals that there is a minimum sustained head between the top surface water level and the invert level of the abstraction pipe of some 16m. The pipe length of the abstraction pipe between the abstraction tower to the delivery point is estimated and preliminary calculations show that if, a 1 m head between the top water level and abstraction pipe invert level at discharge point would result in a discharge of about 36.6kl/day assuming the pipe friction factor is some 0.6mmand neglecting minor friction losses. It is noted also that as a result of high water pressure head the abstraction pipe supplying the water to the farmers is partially open in order to maintain the required abstraction level.



This option has been the following advantages:

- Guaranteed all-year round security of raw water supply
- Simpler abstraction structure

- More direct and less complex bulk supply pipe route
- Ease constructability of the abstraction structure and pumping station
- Pumping station easily accessible from existing access road.
- Three phase low voltage power supply terminating about 200m away from site
- Low high operational energy costs due to low pumping head



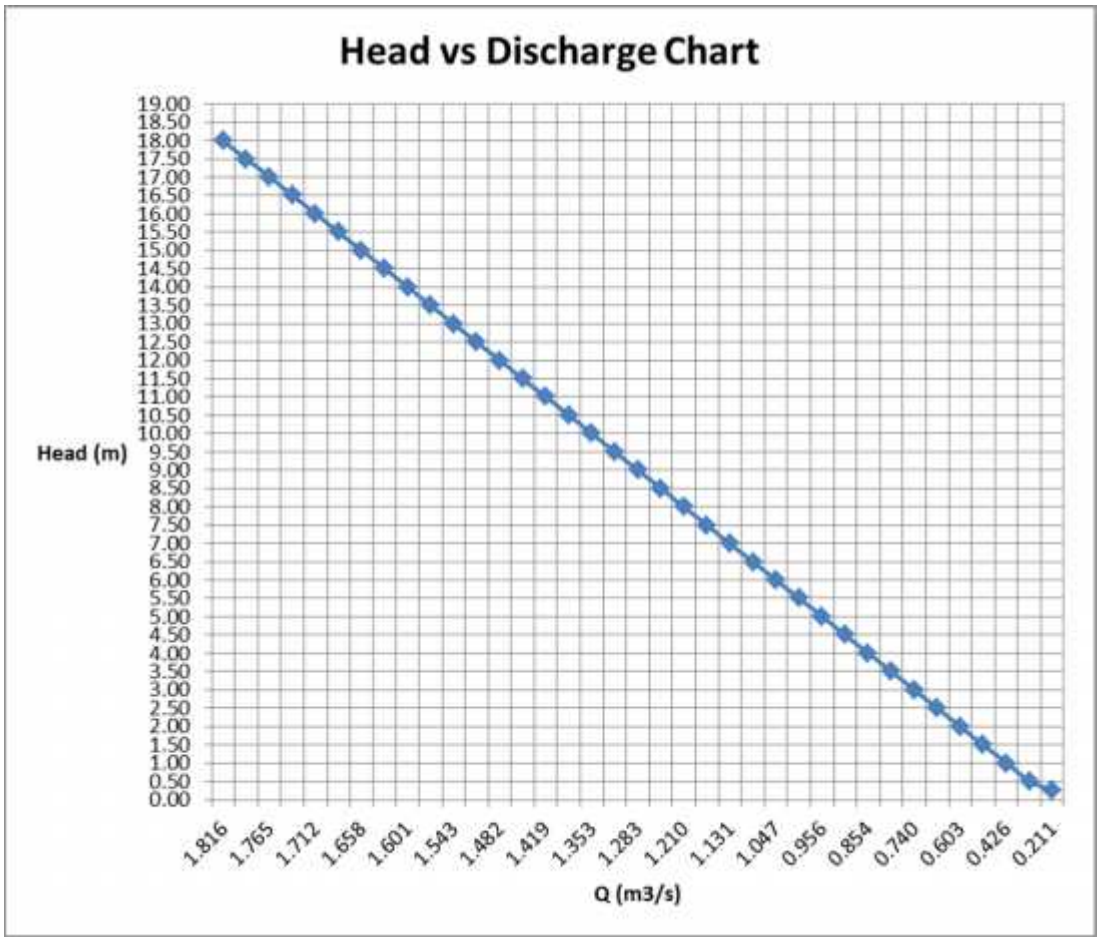
This option has the following disadvantages:

- High whole life cost due to long pipe route
- Long lead times in resolving land issues
- Pipe line crossing the ESKOM high voltage power line and SANRAL busy road to Rust de Winter Township
- The high static head between the proposed water treatment works location (1066MSl and highest ground level (1116MSL) in Masobe means high pumping head to the command reservoir and subsequent high operational energy costs
- A bulk pipeline of approximately 9000m would be required to deliver treated water to the command reservoir.

This option has been discounted on account of long lead time in resolving the land issues and high whole life costs.

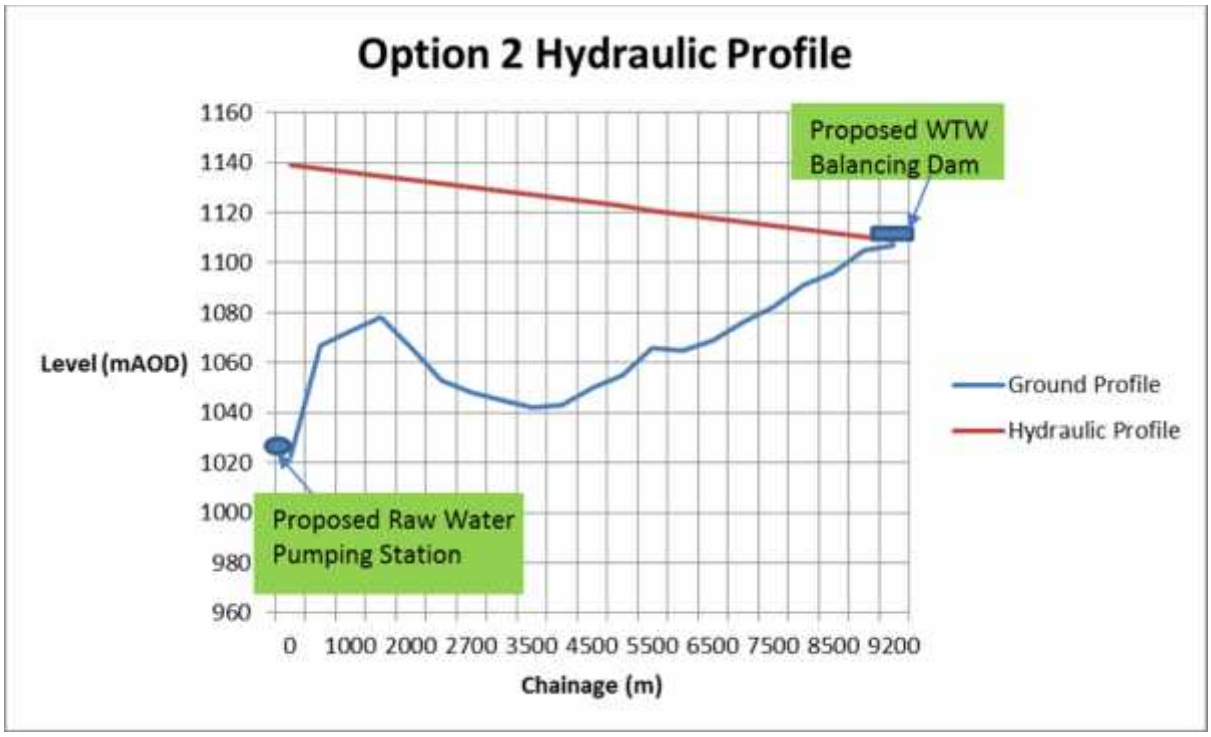
4.3.2 Option 2: Abstraction point Downstream of dam wall with WTW Near Mantiole

Information obtained from the DWA office reveals that there is a minimum sustained head between the top surface water level and the invert level of the abstraction pipe of some 16m. The pipe length of the abstraction pipe between the abstraction tower to the delivery point is estimated and preliminary calculations show that if, a 1 m head between the top water level and abstraction pipe invert level at discharge point would result in a discharge of about 36.6kl/day assuming the pipe friction factor is some 0.6mm and neglecting minor friction losses. It is noted also that as a result of high water pressure head the abstraction pipe supplying the water to the farmers is partially open in order to maintain the required abstraction level.



This option has been the following advantages:

- Guaranteed all-year round security of raw water supply
- Simpler abstraction structure
- Ease constructability of the abstraction structure and pumping station
- Pumping station easily accessible from existing access road.
- The lower static head between the proposed water treatment works location (1105MSl and highest ground level (1116MSL) in Masobe means less pumping head to the command reservoir and subsequent low energy costs
- Three phase low voltage power supply terminating about 200m away from site



This option has the following disadvantages:

- High whole life cost due to long pipe route
- Longest pipe and complex route
- Long lead times in resolving land issues
- Pipe line crossing the ESKOM high voltage power line and SANRAL busy road to Rust de Winter Township
- High operational energy costs due to high pumping head.

Although this option provides the highest whole life cost it provides the best option in terms of engineering functionality and therefore adopted as the preferred option

4.3.3 Option 3: Abstraction point 3km upstream of dam wall with WTW Near Mantiole

This option has been the following advantages:

- More direct and less complex bulk supply pipe route
- The lower static head between the proposed water treatment works location (1105MSl and highest ground level (1116MSL) in Masobe means less pumping head to the command reservoir and subsequent low energy costs
- Lowest whole life cost.

This option has the following disadvantages:

- Deep and costly abstraction well
- Costly temporary water diversion works required during construction of the abstraction structure.
- High risk of loss of supply during adverse and prolonged drought conditions
- Long lead times in resolving land issues
- Pipe line crossing the ESKOM high voltage power line and SANRAL busy road to Rust de Winter Township
- High additional costs for construction of access road.

Although provides the lowest whole life cost there is a high risk of loss of supply during adverse drought conditions and is therefore discounted on this basis.

5 DESISGN CRITERIA

5.1 RAW WATER PIPELINE AND PUMPING STATION

5.1.1 Design Criteria and Methodology

This section describes the design criteria and constraints, the key design parameters and design concepts for all activities and work items of this design element. The guidelines prescribed in the 'Technical Guidelines for Planning and Design in the Development of Water and Sanitation services, second edition: 2004 are used to provide the primary basis for the design work. In addition, appropriate South African National design standards and other approved international engineering best practice reference materials are used to ensure that the design meets the functionality requirements. Details of the general design criteria are outlined in table 17.

Table 17: General Design Criteria

1	Minimum summer peak factor (SPF)	1.2
2	Maximum summer peak factor (SPF)	1.5
3	Minimum pipeline velocity- raw water	0.6m/s
4	Maximum pipeline velocity-bulk supply	3 m/s
5	Target pipeline velocity range	0.7 -1.2m/s
6	Maximum pump suction velocity	2m/s
7	Design loss factor- water treatment works (LF_w)	LF_w = 10% of AADD
8	Design loss factor- pumping main (LF_r)	LF_r = 10% of AADD
9	Gross Annual Average Day Demand (GAADD)	GAADD =(AADD x(1 +LF_r)
9	Design Flow-Summer Daily Demand (SDD)	SDD = GAADD x SPF (1+LF_w)
10	Design pumping period per day	20hours

5.1.2 Identification of Potential Pipeline Route and location of Proposed Balancing Dam

Various pipeline routes to each of the command reservoirs were identified and evaluated to determine the most economical options, taking factors such as capital costs (mainly a function of pipeline length), operating costs (influenced by pumping head and pipe friction), maintenance costs, and operational aspects (e.g. access to pipeline route) into account.
A description of the identified alternative pipeline routes to the proposed water treatment works is described in Section 4.2 of this Report.

The location of the proposed balancing dam is dictated by (a) siting it within the existing boundary of the WTW,) (b) the shortest possible pipeline lengths to tie in with the other infrastructure, and (c) by designing an overflow from the balancing dam back to the river.

5.1.3 Water Demand

The average annual daily demands (AADD) for the 2033 scenario is 10172kl/day. The peak week factor of 1. 5 used for the rising mains include provision for pumping 20 hours per day. The annual average day demand (AADD) for the scheme was calculated based on a service level of 135 l/c.d (litres per capita per day.

The Gross Annual Average Daily Demand (GAADD) estimation is based on the assumed treatment works process water losses of some 10% of AADD. It is also anticipated that a further 10% of AADD would be lost in the pumping main and water distribution network.
The Summer Daily Demand (SDD) or design flow is the product of GAADD and summer peak factor (SPF) of 1.5.

5.1.4 optimization of Pumping Stations

Pumping systems were optimised on the basis of the present value of capital, operating and maintenance costs for each pipeline for different pipeline. This was used as a basis for evaluating the possibility of
phasing the construction of infrastructure.

The net present value calculations were based on the following parameters:

- Discount period = 25 years
- Discount rate = 6%
- Electricity cost = 25 c/kWh (including voltage and transmission costs)
- Mechanical and electrical maintenance costs = 4% per annum of mechanical and electrical costs

- Civil maintenance costs = 0,5% per annum of civil costs

The construction cost estimates were based on recent tendered rates for projects similar in size and nature.

5.1.5 Pipe Friction Head Loss

Darcy Weisbatch and Colebrook White formulas were used to calculate pipeline friction head loss. Based on the pipe effective roughness of 0.6

The head loss on pipeline fittings were estimated based on the manufacturer and water industry recommended loss coefficients.

5.1.6 Pipe Selection

The pipe was selected and specified in accordance with SABS 791-1977, DWA specifications DWS 1130 (design, manufacture and supply of steel pipes and DWS1131 (Lining and coating of steel pipes and specials). The pipeline joints will be welded and all adaptors and fittings flanges will be specified in accordance with Table D, BS4504. The pipeline and associated fittings are designed to be capable of withstanding the test pressure of at least 1.25 times maximum operating pressure.

5.1.7 Raw Water Storage Dam

It is proposed that the raw water storage dam be sized for 24 hours balancing capacity to Provide buffer storage capacity of the WTW in the event of failure of the raw water pumps and to allow redundancy for during repair works

6 SURVEYS AND INVESTIGATIONS

It is proposed that a complete survey be conducted of all the pipe line routes as soon as possible. This is required to verify existing information as well as to obtain accurate ground levels and levels of existing infrastructure.

In addition, it is recommended that a detailed soil resistivity survey be conducted to ascertain the corrosion potential of the soil for the full length of all pipelines. This will enable the engineer to take an informed decision with regards to the external corrosion protection required for the proposed pipelines. It is also recommended that a full geotechnical investigation be conducted over all pipe line routes to determine the soil formation to be expected.

7 LEGAL REQUIREMENTS

7.1 ENVIRONMENTAL ISSUES

This project is due for a full environmental impact assessment. The project is located in Rust de Winter Special habitat reserve which is an ecologically sensitive biome and will require extreme care and strict control over activities during construction. In addition, the area to be disturbed, the diameter of the proposed pipes and the volume of water to be conveyed dictate that an assessment be done in any case.

A suitably experienced environmental consultant has been appointed to undertake the EIA, as the obtaining of the Record of Decision to commence with construction will take anything between 9 months to a year to be obtained.

7.2 WATER USE LICENCING

The required water allocation for the Mathanjana Magisterial District Water supply scheme including an extension to Rapotokwane Village within the Bela Bela Local municipality is estimated at 7 million cubic meters per annum. For this to happen, a new Water Use License application will need to be submitted to the Department of Water Affairs as soon as possible. Approval of such applications can take anything from 2 to 3 years after submission.

7.3 WAY LEAVEAS AND CONSENT APPLICATIONS

The proposed construction works will impact on the road. Any activities taking place within 60m on either side of the road centerline are subject to an approved way leave from SANRAL. It is suggested that this process begin immediately by scheduling a meeting with the SANRAL

In addition to the above, both ESKOM and TELKOM will need to be approached for way leaves as the pipe route crosses their services occasionally.

8 INSTITUTIONAL ARRANGEMENT

8.1 Water Service Authority (WSA)

Dr JS Moroka Local Municipality was designated a water service authority (WSA) with effect from 1 July 2003 with the constitutional responsibility of ensuring efficient and effective water and sanitation service provision to consumers in its area of jurisdiction. In accordance with this obligation, the Municipality has been involved in several planning initiatives to assess the bulk and internal infrastructure requirements for vital implementation.

Nkangala water board was established on 27 February 1998 to fulfil the regional water supply function in the Western Highveld. This institution has, however, not been successful in fulfilling its mandate.

8.2 Water Service Provider

The Water Services Provider (WSP) for the area is the Dr. J S Moroka Municipality. It is therefore responsible for operation and maintenance of the infrastructure within its area of operation (with or without the assistance of contractors).

8.3 Water Services Financial and Budgeting

Dr JS Moroka LM allocates their funds to various WSP activities which includes (i) new capital infrastructure (ii) Operations and Maintenance (O&M) (iii) Refurbishment of existing infrastructure. Funds are received from various funding institution as follows:

- Municipal Infrastructure Grant (MIG)
- Funding from lending institutions e.g. DBSA, World bank
- Funding by DWA e.g. RBIG grants
- GSDM grant funding
- Private sector co-funding.

This specific project will be funded by the DWA using the RBIG programme.

8.4 Key Stakeholder

The key stakeholders include the following:

- Department of Water Affairs – The Custodian and Client
- Nkangala District Municipality – Water board
- Rand Water – Implementing Agent (IA)
- Dr. J S Moroka Local Municipality - Water Services Authority (WSA)
- Dr J S Moroka Local Municipality - Water Service Provider (WSP)
- Department of Environmental Affairs and Tourism (DEAT)
- ESKOM
- PSP - GKB Consulting Engineers
- Mathanjana Magisterial District Community.

9 CONCLUSSION AND RECOMMENDATIONS

10 REFERENCES

1. Nkangala District Municipality, 2012. *Final 2012/13Integrated Development Plan (IDP)*
2. Dr JS Moroka Local Municipality, 2008. *Final 2008/09 Integrated Development Plan (IDP)*
3. Dr JS Moroka Local Municipality, 2010. *Final 2010/11 Integrated Development Plan (IDP)*
4. Dr JS Moroka Local Municipality, 2011. *Final 2011/16 Integrated Development Plan (IDP)*
5. Dr JS Moroka Local Municipality, 2012. *Final 2012/13 Integrated Development Plan (IDP)*
6. Dr JS Moroka Local Municipality, 2011. *Water Services Development Plan (WSDP); Module 1 Overview and assessment of the status of information and strategies of WSA level*
7. Dr JS Moroka Local Municipality, 2010. *Water Services Development Plan (WSDP); Module 3 Further plans and strategy Supportive information*
8. Hlanganani Engineers and Project Manager (Pty) Ltd, May 2012*. Rust de Winter to Mathanjana Magisterial District Bulk Water Supply Scheme, , Rand Water*
9. DWA, December 2011. *Development of a Recompilation Strategy for the Olifants River Water Supply System, Water Requirements and Water Resources Report*.
10. DWA, December 2011. *Development of a Recompilation Strategy for the Olifants River Water Supply System, Report on Possible Water Conservation and Water Demand Management.*
11. DWA, March 2012. *Development of a Recompilation Strategy for the Olifants River Water Supply System.*
12. DWA, March 2010. *Development of a Recompilation Strategy for the Olifants River Water Supply System.*
13. GLS Consulting, September *2012. Computer Analysis and Master Planning of the Portion of the Western Highveld Bulk Water Scheme Within the Dr. Moroka Local Municipality*
14. DWA, December 2011. *Development of a Recompilation Strategy for the Olifants River Water Supply System, Environmental Screening Report*
15. Water for Africa Environmental Engineering and Management Consultant, July 2009. *The Engineering Study & Solution Provision in the Bulk Water Supply from Rust De Winter to Mathanjana Magisterial District of Dr JS Moroka LM*,

16. Mackenzie R., Adams N., and Manganyi A., November 2003. *Water Supply Situation in the Western High Area*.
17. DWA, November 2011. *Development of A Reconciliation Strategy for the Olifants River Water Supply System, Final Reconciliation Report*
18. Nkangala District Municipality, November 2008. *Municipal Demarcation Board, Assessment of Capacity for 2008/09 Period, District Municipality Report.*
19. Thompson, H.; C. M. Stimie; E. Richters; S. and Perret. 2001. *Policies, legislation and organizations related to water in South Africa, with special reference to the Olifants river basin.* Working Paper 18 (South Africa Working Paper No. 7). Colombo, Sri Lanka: International Water Management Institute.
20. McCartney, M.P.; Yawson, D.K.; Magagula, T.F.; Seshoka, J. 2004. *Hydrology and water resources development in the Olifants River Catchment.* Working Paper 76. Colombo, Sri Lanka: International Water Management Institute (IWMI).
21. Aurecon, January 2013. *BBLM Water Service Master Plan 2012*. BelaBela Local Municipality.
22. SRK Consulting, October 2010. *Development of a Reconciliation Strategy for all Towns in the Northern Region; First Order Reconciliation Strategy for the Siyabuswa Cluster, Nkangala District Municipality*: Dr. JS Moroka Local Municipality.