Rustenburg Local Municipality

Rustenburg Local Municipality Water Project

Bospoort Bulk Water Pipeline

Preliminary Design Report (Revision 0)

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1. INTRODUCTION

1.1. Background

Rustenburg Local Municipality (RLM) is growing rapidly due to major mining operations in the area. The economy of Rustenburg is driven mainly by mining activities and more specifically, platinum mining.

In the past, RLM has generated significant interest in the national press due to its well published water shortages. High lying areas of the town were without water for extended periods and the crisis generated sufficient interest to the point that the Minister of Water and Sanitation (DWS) instructed the Department to intervene. A series of workshops were held during which the Rustenburg water crisis was extensively discussed and short, medium and long term water plans were put on the table and submitted to the Department for approval.

Following the above, GLS Consulting was appointed to undertake a formal Water Services Master Plan for the area. The Master Plan looked holistically at the water supply to RLM and proposed amendments to the system(s) based on 40 year growth projections.

The GLS Master Plan identified that the growth nodes (resulting in increased water demands) will be between Bospoort Water Treatment Works (WTW) and Rustenburg town. In order to supply water to these areas, GLS proposed the following:

- Upgrading of the Bospoort WTW from 12 Mℓ/d to 24 Mℓ/d;
- Upgrading the existing Bospoort high lift pump station;
- Constructing a new 35 Mℓ Bospoort North reservoir;
- Constructing of a new (± 2.0km long) access road to the reservoir;
- Constructing a new 1.5km x 500mm diameter bulk water rising main from the Bospoort Water Treatment Works (WTW) to the Bospoort reservoir;
- Constructing a new 8.3km x 800mm diameter bulk water gravity main from the Bospoort reservoir to Boitekong.

Water will be abstracted from the Bospoort dam and treated at the upgraded 24 Mℓ/d Bospoort WTW. From the WTW, it will be pumped to the proposed 35 Mℓ Bospoort North reservoir through a section of the existing 400mm diameter Bospoort pipeline and new 500mm diameter rising main. It will then gravitate from the reservoir, through the proposed 800mm diameter pipeline to the Kanana connection, before being distributed in the existing network.

An MIG funding Application for the above scope was submitted in November 2018.

1.2. Appointment

In terms of the Appointment Agreement between the Rustenburg Water Services Trust (RWST) – the utility company of RLM – and Rustenburg Consulting Consortium (RCC), an Instruction to Proceed with Work (IPW) for Phase II of the upgrading of the conveyance system from the Bospoort WTW, was issued to RCC as described above.

1.3. Purpose of this Report

This Preliminary Design Report (PDR) deals with technical, cost and programming aspects associated with the new Bospoort pipeline infrastructure. The main objective is to define the preliminary details of the supply and distribution pipeline and to identify additional information that will be required to complete the detail design and tender documentation for the infrastructure.

Technical details of the upgrading of the Bospoort WTW, upgrading of the existing Bospoort high lift pump station, the construction of a new 35 Mℓ Bospoort North reservoir and the construction of a new (± 2.0km long) access road to the reservoir are not covered in this Report. Separate PDR's are drafted for each of these elements.

2. SITE DESCRIPTION

2.1. Location of works

The Bospoort WTW is located north-west of the Bospoort Dam overflow, north-east of Rustenburg. The proposed reservoir site for the new 35 Mℓ Bospoort North reservoir is situated further north-west of the WTW on the Remainder of Portion 5 of Farm Tweedepoort 283-JQ.

2.2. Proposed pipeline routes

Use of the existing 450mm diameter steel Bospoort pipeline will be made from the Bospoort WTW to the new 35 Mℓ Bospoort North reservoir off take (length = ± 1 250m). From the connection point on the existing pipeline, a new 500mm diameter pumping line will run in a northerly direction for ± 400m, before turning west and crossing the tar road. The pipeline will continue westwards for ± 200m before turning south-west towards the proposed reservoir position (length = ± 650m). The total length of the 500mm diameter pumping line is ± 1.25km.

The 800mm diameter gravity line from the Bospoort Reservoir will run parallel to the supply line up to the tar road (length = ± 800m). The pipeline will turn south towards Rustenburg and be constructed parallel to the tar road, on the northern side for ± 3 200m. The pipeline will cross the R510, before

turning south-west. It will be laid parallel to the R510, on the western side for ± 4 300m. The total length of the 800mm diameter gravity line is ± 8.3km.

Refer to **ANNEXURE A** for a locality plan and the proposed pipeline route plan.

3. PRELIMINARY PIPELINE DESIGN

3.1. Supply area

As has been eluded to before, the new Water Services Master Plan compiled by GLS Consulting, has conclusively revealed that the real growth centres for future residential expansion in Rustenburg will be predominantly in two nodes, namely:

- The Boitekong area between Rustenburg town and Bospoort Dam;
- The Delta Area between Rustenburg town and Olifantsnek Dam.

According to the Master Plan, the following townships and associated households will be serviced by the Bospoort supply system. These areas are mostly low-to medium income households and are currently served by connections to the Magalies Water (MW)'s Vaalkop system.

TOWNSHIP	HOUSEHOLDS (2011 CENSUS)	2018 HOUSEHOLDS*	ULTIMATE HOUSEHOLDS**
Greater Boitekong area (all extensions)	29 855	39 238	83 274
Meriting	4 855	6 381	13 542
Seraleng	3 594	4 724	10 025
Freedom Park	13 390	17 598	37 348

Table 1: Townships and population of the Boitekong area

* *Calculated in accordance with 4.66% statistical annual growth from 2004 to 2014 in the area*

** *Allows for a reduction in growth rate to from 4.66% to 2.0% from 2018 to 2060*

Refer to **ANNEXURE B** for a layout drawing indicating the demands of each supply area.

The main advantages of a properly segregated bulk and reticulation systems, including the ability to isolate zones within the areas, are the following:

- It is easier to control pressures in the zones by having a dedicated system feeding into a specific zone with a reservoir either at the correct level or with the necessary pressure reducing valves;
- RLM suffers from unacceptably high unaccounted for water losses (UAW) of up to 40%. This is partly due to aging reticulation infrastructure with leaks which is exacerbated by the high pressures and also various other institutional problems. Water Demand Management and Water Loss Control (WDMLC) and the reduction of UAW is one of the primary performance objectives of the Municipality. A properly segregated bulk system and reticulation properly subdivided into pressure

zones, will make it possible to implement effective WDMLC. Currently the Municipality cannot pinpoint problematic areas.

3.2. Proposed supply systems to and from the Bospoort North reservoir

3.2.1. Supply pipeline to the new Bospoort North reservoir

For the supply pipeline to the new Bospoort North reservoir, use of a section of the existing 450mm diameter Bospoort pipeline will be made in accordance with the Water Services Master Plan. Although its physical condition would be fully investigated, the capacity should be sufficient to convey the full 24 Mℓ/d, as this section of pipe has not been as problematic as other sections of the pipeline closer to town.

A new 1.25km x 500mm diameter pipeline will connect to the existing 450mm diameter Bospoort pipeline cross connection and be constructed to the new Bospoort North reservoir, also in accordance with the Master Plan.

3.2.2. Supply pipeline from the new Bospoort North reservoir to Kanana

According to the latest Water Services Master Plan, an 8.3km x 800mm diameter pipeline from the Bospoort North reservoir to Kanana is required. The pipeline will be constructed parallel to the existing pipeline and will convey water from the Bospoort WTW, via the Bospoort North reservoir, to the Boitekong area.

Use of the existing distribution pipelines will be made, downstream of the Kanana connection point. Preliminary investigations revealed that the existing 700mm, 600mm, 550mm and 500mm diameter pipes from Kanana to Boitekong may still have some useful life. Rather than blindly replacing these pipelines, a decision was taken to rather assess the condition of these pipes to try and quantify the remaining life of these lines.

3.3. Pipeline material

3.3.1. Supply pipeline to the new Bospoort North reservoir

The Bospoort High Lift Pump Station PDR recommends installing two pump sets (1 x duty and 1 x standby), with each set consisting of 2 pumps in series. The specified duty of the pump sets is 278 ℓ/s at 164m head.

From the above, the following pipe all thickness or pipe classes are considered for preliminary design purposes:

- 500mm diameter PCV-O: PN 20 (wall thickness = 14mm)*
- 500mm diameter HDPE: PE 100, SDR 9, PN 20 (wall thickness = 62mm)*
- 500mm diameter steel: Steel Grade X42, wall thickness (t) = 4.5mm*

* *These are first order pressure class estimates in order to compare different pipe material options. Final pipe classes will be dependent on the results of a detail surge analysis as well as external pressure calculations. Once the pressure classes are finalised, the pipe diameters will be aligned.*

Table 2 illustrates a preliminary cost estimate of the three different pipe materials that were considered for each pipeline.

PIPE MATERIAL	TOTAL COST (Excl. VAT)
PVC-O, 500mm diameter, PN20	R 7 550 000
HDPE, 500mm diameter, PN20	R 10 000 000
Steel Grade X42, 500mm diameter, t =4.5mm	R 5 600 000

Table 2: Estimated construction costs – 500mm diameter pipeline

Based on the preliminary cost comparison, it is recommended that a 500mm diameter steel pipe (Grade X42, t = 4.5mm) be installed.

3.3.2. Supply pipeline from the new Bospoort North reservoir

The top water level of the new Bospoort North reservoir is ± 1208 m.a.m.s.l., with the Kanana connection height ± 1096 m.a.m.s.l. This results in a static head of ± 112m at the lowest point of the pipeline.

From the above, the following pipe all thickness or pipe classes are considered for preliminary design purposes:

- 800mm diameter PCV-O: PN 16 (wall thickness = 14mm)*
- 900mm diameter HDPE: PE 100, SDR 9, PN 16 (wall thickness = 62mm)*
- 800mm diameter steel: Steel Grade X42, wall thickness (t) = 6.0mm*

* *These are first order pressure class estimates in order to compare different pipe material options. Final pipe classes will be dependent on the results of a detail surge analysis as well as external pressure calculations. Once the pressure classes are finalised, the pipe diameters will be aligned.*

Table 3 illustrates a preliminary cost estimate of the three different pipe materials that were considered for each pipeline.

PIPE MATERIAL	TOTAL COST (Excl. VAT)
PVC-O, 800mm diameter, PN16	R 91 009 000
HDPE, 900mm diameter, PN16	R 115 428 000
Steel Grade X42, 500mm diameter, t =4.5mm	R 65 625 000

Table 3: Estimated construction cost – 800mm diameter pipeline

Based on the preliminary cost comparison, it is recommended that an 800mm diameter steel pipe (Grade X42, t = 6.0mm) be installed.

3.4. Hydraulic assessment

3.4.1. Supply pipeline to the new Bospoort North reservoir

The following details are used in the hydraulic assessment of the pipeline:

- Design flow: 278 ℓ/s (or 24 Mℓ/d) – Peak flow
- Pump head: 164m
- Pipe details: 500mm diameter steel grade X42, t = 4.5mm
- Velocities: 1.93 m/s (450mm diameter) and 1.54 m/s (500mm diameter) under peak flow conditions
- Internal lining: Cement mortar lining (CML)
- External coating: To be confirmed
- Pipeline length: 2.5km (1.25km x 450mm diameter and 1.25km x 500mm diameter)
- Roughness (k) value: 0,4 mm (Colebrook-White formula);
- Secondary losses in accordance with AWWA manual M11.

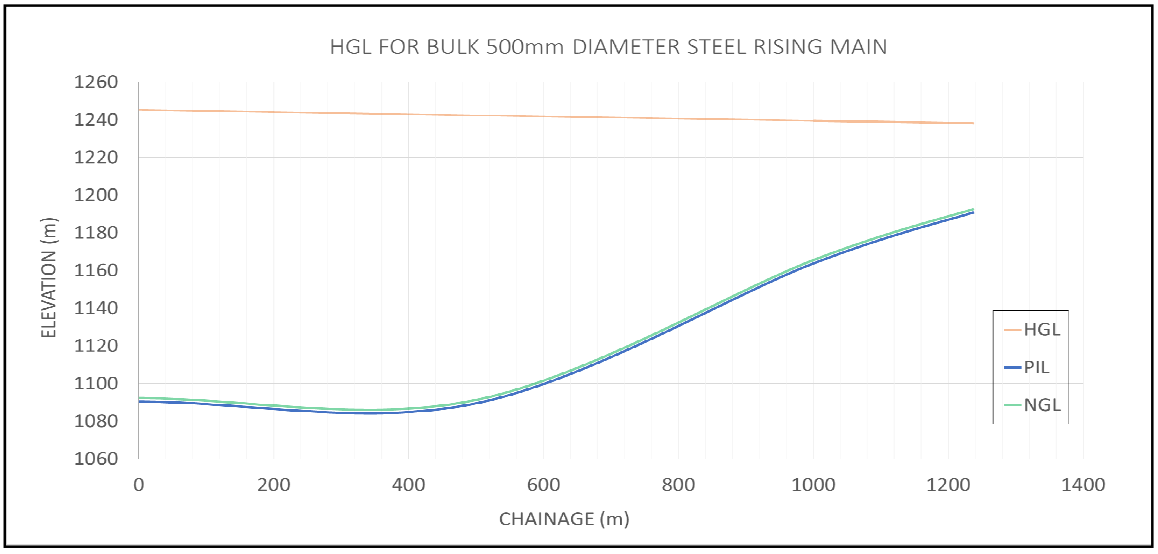

Figure 1: Hydraulic grade line of the 500mm rising main

3.4.2. Supply pipeline from the new Bospoort North reservoir

The following details are used in the hydraulic assessment of the pipeline:

- Design flow: 750 ℓ/s – Instantaneous peak flow
- Static head: 112m
- Pipe details: 800mm diameter steel grade X42, t = 6mm
- Velocities: 1.57 m/s under instantaneous peak flow conditions
- Internal lining: Cement mortar lining (CML)

- External coating: To be confirmed
- Pipeline length: 8.3km
- Roughness (k) value: 0,4 mm (Colebrook-White formula);
- Secondary losses in accordance with AWWA manual M11.

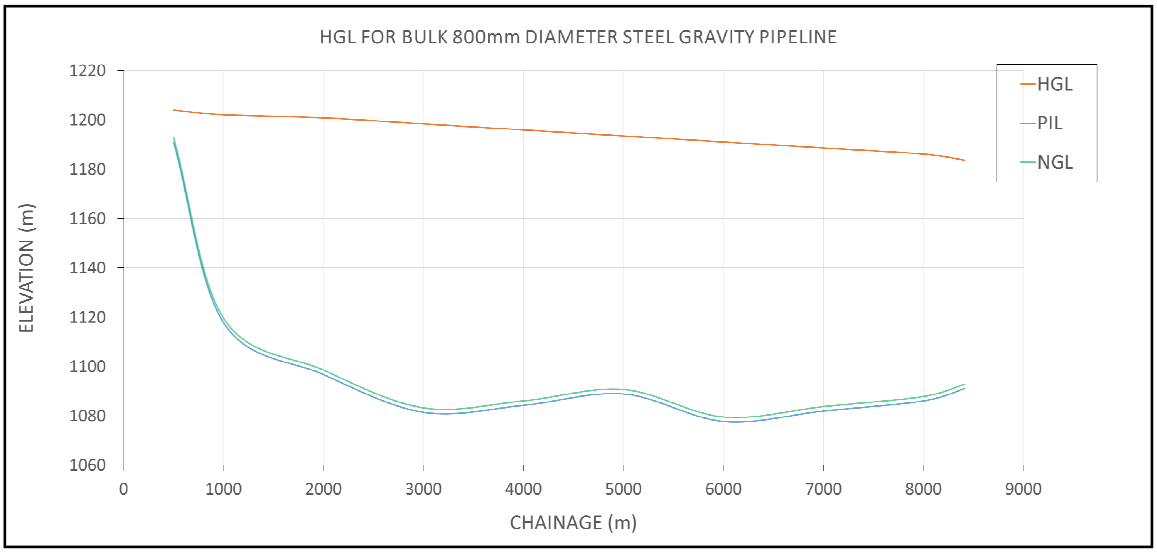

Figure 2: Hydraulic grade line of the 800mm diameter pipeline

According to the latest IMQS model, the current instantaneous peak flow demands, downstream of the Kanana connection point, already exceeds the available supply from the Bospoort North reservoir. However, the supply shortfalls, which will increase due to future developments in the area, will be supplied from MW's Vaalkop system.

3.5. Pipework, valves and flow meters

3.5.1. Supply pipeline to the new Bospoort North reservoir

For operational purposes, isolating and control valves will be provided at the 450mm / 500mm cross connection, as well as at the Bospoort reservoir site.

The cross connection will allow water to be supplied to both the RLM Bospoort North reservoir as well as to the MW Bospoort reservoirs. Accordingly, flow meters, with associated dirt traps will be installed at this connection to measure supply to any one of these reservoirs.

Allowance for air and scour valves have been made in the preliminary designs.

Refer to **ANNEXURE C** for preliminary layout drawings of the air- and scour valve installations, as well as the proposed cross connection layout.

It is currently foreseen that the pressure rating of valves and flanges will be PN 25 for the rising main.

3.5.2. Supply pipeline from the new Bospoort North reservoir

An isolating valve as well as a flow meter will be installed at the Bospoort reservoir.

Allowance for air and scour valves have been made in the preliminary designs.

For operational purposes, isolating and control valves are provided at the Kanana connection. At the connection, water can be provided from both the MW and RLM systems. Flow meters, with associated dirt traps, are therefore also provided.

Refer to **ANNEXURE C** for preliminary layout drawings of the air- and scour valve installations, as well as the proposed Kanana connection layout.

It is currently foreseen that the pressure rating of valves and flanges will be PN 16.

4. SPECIALIST SERVICES

The following surveys will be conducted during the detail design stage:

- Location of existing services
- CP & AC mitigation investigations
- Geotechnical investigations

5. ENVIRONMENTAL MATTERS

Ecoleges Environmental Consultants was appointed as the environmental sub-consultant for the project.

According to the EIA Regulations (2010) the following:

Listing Notice 1 – Activity No. 9:
The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water –

- With an internal diameter of 0.36 metres or more; or
- With a peak throughout of 120 litres per second or more,

Excluding where:

- Such facilities or infrastructure are for bulk transportation of water, sewage or storm water drainage inside a road reserve; or
- Where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.

Application for both the Environmental Authorisation as well as the Water Use Licence is currently in process

6. LAND MATTERS, MINING RIGHTS AND WAYLEAVES

The proposed pipeline routes cross Royal Bafokeng Administration (RBA) tribal land and engagements with RBA have taken place to obtain In-principle Agreement to the project.

Although the Agreement has been signed, final approval from RBA is still required before the implementation of the project.

An application was submitted to the Department of Mineral Resources (DMR) to obtain approval for the project on 13 December 2018. Although no formal approval has been received from the Department, engagements with existing mining right holders have taken place. A draft agreements with Red Graniti and Impala Platinum, existing mining licence holders, are currently being reviewed.

Wayleave approvals of the relevant service providers have been obtained for the pipeline. Service providers include Eskom, Telkom, SANRAL, Neotel, Sasol, Vodacom, MTN, Rand Water and RLM.

7. PROCUREMENT OF CONTRACTORS

The new pipeline should be constructed by selected experienced specialist contractors for the following reasons:

- Large diameter steel pipelines require specialist skills and expertise with regard to the welding of the pipes, repairs to lining and coating for corrosion protection and cathodic protection and AC mitigation;
- Special construction methods and procedures are required to prevent damage to existing services;
- Special measures are required to ensure the safety of the public.

8. PROGRAMME

Currently the securing of Municipal Infrastructure Grant (MIG) funding for the project is on the critical path. Once funding has been secured, detail design can commence including performing the outstanding investigations.

The following timeframes are envisaged:

- Completion of the detail designs once funding is approved: 2 months
- Procurement of a suitable construction contractor: 2-3 months
- Construction of the pipeline(s): 12 months

The planned start of construction is currently November 2019.

9. CONCLUSIONS

The following aspects are still under consideration and need to be finalized / addressed before the detail designs can commence:

1. Finalising MIG funding for the project;
2. Obtaining Environmental Authorisation and Water Use Licence for the relevant Departments;
3. Confirmation of existing services along the pipeline route, by means of wayleaves and existing services detection;
4. Obtaining land access rights and mining rights from relevant authorities and licence holders;
5. Geotechnical conditions along the pipeline route should be investigated to identify excavation and bedding material requirements and to mitigate the risk of claims during construction.

ANNEXURE A

LOCALITY PLAN
SCHEMATIC LAYOUT OF THE PROPOSED PIPELINES

ANNEXURE B

LAYOUT DRAWING OF DEMANDS OF EACH SUPPLY AREA

ANNEXURE C

AIR VALVE INSTALLATION
SOUR VALVE INSTALLATION
CROSS CONNECTION LAYOUT
KANANA CONNECTION LAYOUT