PRELIMINARY DESIGN REPORT ON THE EMERGENCY NONDABULA WATER PROJECT

Ilembe District Municipality
October 2014
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1. INTRODUCTION

1.1 Terms of reference

The Ilembe District Municipality (IDM) selected Royal HaskoningDHV (RHDHV) from their database of accredited service providers to provide professional services for the design, documentation, and construction administration for an emergency borehole, 4.7 km rising main, 500 kilolitre steel reservoir and reticulation network to connect into the existing network at the Nondabula rural community located in Ward 9 within the Ndwedwe Local Municipality and Nodwengu Traditional Council. On 09 September 2014 representatives from IDM and RHDHV undertook a site visit where Ilembe DM requested RHDHV to undertake this emergency project comprising the following:

- Investigating supply source options, and drilling and casing for a new borehole
- Installation of a new borehole pumpset and power supply
- Construction of rising main
- Construction of a storage reservoir
- Construction of elevated tank and pumpset
- Reticulation network connected into existing supply and extended to local communities

In a letter of response to Ilembe District Municipality, dated 12 September 2014, Royal HaskoningDHV proposed that the terms of appointment for the project should be an extension to the existing appointment for providing professional services for the Ozwathini Water Supply Scheme under the MIG Project No. 2005MIGFDC290010.

1.2 Background

This project was initiated to improve the security of water supply to residents in the Nondabula area. The main source of supply would be a borehole as an interim measure and ultimately the scheme would be connected to the proposed Wartburg pipeline. This system would, in addition, be sized to be able to be incorporated in the future into the Wartburg pipeline supply both in terms of the capacity and hydraulic requirements.

The Nondabula Emergency water supply project in its simplified form is to comprise the following:

- A borehole with a minimum yield of approximately 32 m³/hr located at the source of the Nsuze River (yield to be determined through geohydrological investigations still to be undertaken)
- A rising main, DN150 x 4.7 km long steel/uPVC, from the borehole to the storage reservoir
- 500 kilolitre steel tank storage reservoir
- Secondary pump and elevated tank
- DN110 uPVC gravity mains to connect into the existing reticulation network
- Extending the reticulation network with DN 110, DN75, DN50 and DN32 uPVC/HDPE pipelines to areas not currently supplied
- Standpipes.
2. SERVITUDE, OTHER PROPERTY ISSUES AND SURVEY

2.1 Servitudes and Property Issues

Nokuthula Dube and Associates (NDA) was appointed by Ilembe District Municipality to undertake ISD (Institutional and Social Development) services for the project, as amongst the concerns was the issue of the site where the new steel reservoir was to be sited. During the site visit on the 09th September 2014, a suitable site for locating the reservoir was identified and NDA was requested to start negotiations with the Nodwengu Traditional Council to acquire permission to occupy the land. After several site visits and meetings with the Nodwengu Traditional Council, NDA, on behalf of IDM, successfully negotiated agreement for the use of the proposed site for the reservoir (see attached report from NDA on appendix B).

In addition to negotiations regarding the reservoir site, NDA will also be responsible for the following through the lifecycle of the project:

- all social and labour issues.
- negotiating proposed pipeline routes and, if required, servitudes with the Nodwengu Traditional Council on behalf of IDM

2.2 Survey

Quotations were requested and received from two topographical surveying companies and an appointment will be made once all environmental issues have been completed as the finalisation of the extent of the survey to be done will depend on the acceptance of the proposed project elements by the provincial environmental department. IDM will need to advise as to the company to be appointed based on the quotations received. See attached quotation in Appendix C.

The survey will comprise of the following:

- Topographical survey of the proposed borehole site.
- 10 m wide strip survey of the proposed rising main route.
- Topographical survey of the proposed reservoir site.

3. GEOHYDROLOGICAL ASPECTS

Geomeasure Group was requested by RHDV to provide a quotation for undertaking the following:

- Geophysical investigation and borehole siting.
- Data evaluation and reporting
- Drilling and part-time pump test supervision
- Data evaluation and reporting

On 28 September 2014, Geomeasure submitted a budget quotation for undertaking the abovementioned tasks and the quotation is attached in Appendix D. IDM needs to approve the quotation for RHDHV to issue an instruction to Geomeasure to commence with investigation, drilling and testing of the borehole.
4. ENVIRONMENTAL ASPECTS

RHDHV recommended to IDM that it would be advisable to get an opinion and the advice of an environmental practitioner as to the requirements of environmental aspects for the proposed infrastructure. RHDV requested their internal environmental department to undertake a pre-screening of the project elements and to advise as to the environmental requirements. A report was prepared by RHDHV’s internal team (see Appendix E for a detailed report) and the following were outcomes of the pre-screening process:

- The Environmental Authorisation is required and the process to be followed is Basic Assessment (BA), see section 4.1.3 of the attached pre-screening report in Appendix E.
- Application will need to be made to the Department of Water and Sanitation (DWS) for the abstraction of water from the borehole and as such a Water Use License Application (WULA) in terms of Section 21 (a) will be necessary, see Section 4.2 of the attached pre-screening report in Appendix E.

5. DEMOGRAPHICS

Population:

The estimated population of the area to be supplied, based on an estimated 6 people per household, is 8,520 people residing in approximately 1,420 homesteads. The unit water demand for the provision of water by means of house/yard connections for rural areas has been estimated based on 60 ℓ/p/d. It should be noted that the supply for this project will be through strategically located standpipes and this will be later upgraded to yard connections, subject to budget being made available and when the proposed Wartburg pipeline is operational. The total estimated Average Annual Daily Demand (AADD) required for the project area is 511.2 kl/d. The population figures within the supply area are as follows:

<table>
<thead>
<tr>
<th>Supply Area</th>
<th>Population</th>
<th>Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodwengu Traditional Council</td>
<td>8 520</td>
<td>1 420</td>
</tr>
<tr>
<td>Nondabula Rural</td>
<td>8 520</td>
<td>1 420</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8 520</strong></td>
<td><strong>1 420</strong></td>
</tr>
</tbody>
</table>

Table 1 Nondabula Population

6. DEMAND

The table below shows the water demand for the supply area derived from the allowed 60ℓ/capita/d and allowing for 6 people per household. Other factors that have been considered in deriving the demand for sizing of pipelines are losses which have been estimated to be 15% and the peak factors for the rising main and reticulation which are 1.5 and 4 respectively.

<table>
<thead>
<tr>
<th>Supply Area</th>
<th>Households</th>
<th>Population</th>
<th>Unit Demand (ℓ/d)</th>
<th>Average Annual Daily Demand (kl/d)</th>
</tr>
</thead>
</table>
### Table 2: Demand

<table>
<thead>
<tr>
<th>Supply Area</th>
<th>Households</th>
<th>Population</th>
<th>Unit Demand (l/d)</th>
<th>Average Annual Daily Demand (kl/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodwengu TC</td>
<td>1420</td>
<td>8520</td>
<td>60</td>
<td>511.2</td>
</tr>
<tr>
<td>Nondabula</td>
<td>8520</td>
<td>1420</td>
<td>60</td>
<td>511.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8520</strong></td>
<td><strong>1420</strong></td>
<td><strong>60</strong></td>
<td><strong>511.2</strong></td>
</tr>
</tbody>
</table>

7. **SCHEMATIC LAYOUT**

Appendix A to this report is a schematic layout of the proposed infrastructure for the emergency project.

8. **BOREHOLE PUMPSTATION**

The source of supply for the project area is to be from a borehole. As stated in Section 3, a quotation has been received from Geomeasure Group to undertake a geophysical investigation of the borehole and the outcome of the investigation will advise on the location of the borehole and the amount of water that can safely be yielded by the borehole. The outcomes of the study will allow RHDHV to determine the following aspects in the design of the project elements:

- Recommended borehole yield will be compared to the required water demand for the area as calculated in Section 6. This will inform any demand shortfalls and the operating philosophy of the borehole so as not to compromise the borehole sustainability by ensuring that pumping is carried out within the recommendations of the geohydrologist report.
- The calculation of the total dynamic head to assist in selecting the required pump.
- The permissible abstraction rate to assist in the pump selection and sizing of rising main.

9. **STORAGE RESERVOIR**

Ilembe District Municipality requested that in the interim as provisional storage for the project, a 500 kilolitre steel reservoir should preferably be provided. Ideally reservoirs should be sized to provide 48 hours storage as this will allow downtime during power outages and for routine maintenance of pumps and supply pipelines to the reservoir.

The capacity of the storage for the project area under normal design conditions is compared in the table below to the 500 kilolitre capacity as requested by IDM. Based on an estimated 6 persons/household, this demand equates to 360 l/household per day for rural areas. Based on these figures, the required total storage capacity has been tabulated below.
Table 3: Required Storage Capacity

<table>
<thead>
<tr>
<th>Supply Area</th>
<th>Average Annual Daily Demand (kℓ/da)</th>
<th>Storage Duration (hrs)</th>
<th>Storage Required @48hrs (kℓ)</th>
<th>Storage Duration (hrs)</th>
<th>Storage Required @24hrs (kℓ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodwengu TC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondabula Rural</td>
<td>511.2</td>
<td>48</td>
<td>1022.4</td>
<td>24</td>
<td>511.2</td>
</tr>
</tbody>
</table>

Two locations were investigated for the positioning of the new storage reservoirs.

The first site is located on top of the hill adjacent to the existing 2 Mℓ concrete reservoir with an approximate top water level of 1052 amsl. This reservoir is owned and operated by UMgungundlovu District Municipality. This is the preferred site for the location of the reservoir as this is the highest point around the project area. However, the owner of the site refused to give IDM permission to construct the proposed reservoir on his land.

The second site is situated approximately 150 m to the south of the existing 2 Ml reservoir and it is the area that IDM have been given permission by Nodwengu Traditional Council to locate the reservoir. If the reservoir is located on this site it would have an approximate top water level of 1044 amsl. The one obstacle with this site is there are approximately 130 households within the supply area located higher than this site and the challenge would then be providing further supply.

In order to supply the 130 households located above the proposed 500 kℓ reservoir site it is proposed that an elevated 50 kℓ steel tank be constructed at the site of the existing 2 Mℓ concrete reservoir. The proposed 50 kℓ elevated tank will provide 24 hour storage capacity (see layout plan in Appendix A). It will be necessary to provide a small pumpset at the site of the new 500 kℓ steel tank and associated rising main to deliver water to the elevated tank. This is deemed preferable to having an automated actuated valve system to enable water to bypass the 500 kℓ to supply the elevated tank from the main borehole pump. Failure of the valve system will compromise the entire supply area, rather than only those consumers supplied from the elevated tank. In the event of failure of the small pumpset, those consumers would still be able to access standpipes, albeit that the distance to the standpipes will be a little further away.

10. RISING MAIN

10.1 Pipeline Route

The preliminary rising main route was selected taking into account existing servitudes and accessibility, to enable the water authority to easily operate, maintain and repair the pipeline;

10.2 Pipeline Diameter

The required diameter of the rising main pipe will be calculated using the flow that would be recommended for abstraction at the borehole. As a provision, the preliminary cost
estimates has been done using the calculated demand of 511.2 kt/d for the supply area and allow for 15% losses and a peak factor of 1.5

A sample pipe size calculation is shown below:
The pipe size was selected based on the following parameters:

- Velocity 1.25 m/s
- Design flow 0.015 m³/s (based on 32 m³/hr)

\[ Q \text{ (flow)} = V \text{ (velocity)} \times A \text{ (area)} = 0.015 \text{ m}^3/\text{s} = 1.25 \text{ m/s} \times (\pi \times d^2/4) \]

\[ D = 0.124 \text{ m}, \text{ the preferred pipe diameter is: } D = 150 \text{ mm} \]

It is to be noted that based on the calculation above, the required pipe diameter to satisfy the demand is DN150. This, however, can only be confirmed and finalised based on the safe yield to be abstracted from the borehole. Assuming that the borehole could yield the required flow, the velocity in the proposed DN150 pipe would be in the region of 1.05 m/s which is acceptable.

10.3 Pipeline Material

The materials that would be considered for this rising main are:

- Klambon steel pipe to be rated 40 bar (for the first 1 500 m of the rising main)
- uPVC pipe to be rated 16 bar (for the following section 3 200 m up to the reservoir)

11. POWER SUPPLY

Power supply would be from Eskom through their existing bulk network. A provisional sum has been allowed for in the cost estimated for power supply requirements.

12. RETICULATION

RHDHV’s scope for the project as requested by IDM was to investigate the borehole, rising main and storage reservoir. In terms of completeness, however, RHDHV has also investigated the requirements of connecting the system into existing reticulation and also providing reticulation in areas where there is currently no reticulation as shown on the schematic layout. IDM is to advise on the way forward regarding the reticulation network.
13. COST ESTIMATES

The following estimates of cost are based on estimates of current construction costs by contractors for similar types of work and are based on recent price levels.

Notwithstanding that a preliminary reticulation layout has been done it is to be noted that the cost estimates below do not include a provision for reticulation construction.

Based on the population to be supplied by the scheme the cost per capita is R 1 118.45

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary and General</td>
<td>850 000</td>
</tr>
<tr>
<td>Borehole Pump M&amp;E, Pipework and Chamber</td>
<td>470 000</td>
</tr>
<tr>
<td>DN150 Rising Main Pipeline (1.5 km steel Klambon &amp; 3.2 km uPVC)</td>
<td>3 750 000</td>
</tr>
<tr>
<td>500 kℓ Steel Reservoir</td>
<td>775 000</td>
</tr>
<tr>
<td>Secondary Pump M&amp;E, Pipework and Chamber</td>
<td>200 000</td>
</tr>
<tr>
<td>50 kℓ Elevated Steel Tank</td>
<td>250 000</td>
</tr>
<tr>
<td>Provision for Power Supply</td>
<td>150 000</td>
</tr>
<tr>
<td>Sub-Total for Construction Works</td>
<td>6 445 000</td>
</tr>
<tr>
<td>Contingencies allowance: 10%</td>
<td>644 500</td>
</tr>
<tr>
<td>Geohydrological Investigation</td>
<td>110 700</td>
</tr>
<tr>
<td>Environmental Impact Assessment</td>
<td>100 000</td>
</tr>
<tr>
<td>Survey</td>
<td>27 500</td>
</tr>
<tr>
<td>Professional fees and Facilitation (13.5%)</td>
<td>870 075</td>
</tr>
<tr>
<td>ISD (2.5%)</td>
<td>161 125</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>8 358 900</td>
</tr>
<tr>
<td>Add VAT @ 14%</td>
<td>1 170 246</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9 529 146</td>
</tr>
</tbody>
</table>

14. RECOMMENDATIONS

It is recommended that:

- The proposal described in this report be adopted as a basis of constructing the infrastructure required for the Emergency Nondabula Water Project.
- Ilembe District Municipality fund the project.
- The detailed design be finalised and tender documentation be prepared in order to allow for implementation.
15. CONCLUSION

We trust that the information presented in this report is sufficient to enable Ilembe District Municipality to approve the proposals for the detailed design and construction of the infrastructure required to supply the Nondabula Area, and we hold ourselves available to discuss any aspects of the designs and financial implications with you and to present our proposals should it be required.

Report compiled by
Thokozani Gigaba                                      October 2014

Royal HaskoningDHV
APPENDIX A: SCHEMATIC LAYOUT
APPENDIX B: ISD REPORT
APPENDIX C: SURVEY QUOTATIONS
APPENDIX D: GEOHYDROLOGICAL INVESTIGATION QUOTATION
APPENDIX E: ENVIRONMENTAL PRE-SCREENING REPORT