NAMA-KHOI MUNICIPALITY

KOMAGGAS BULKWATER SUPPLY

DESIGN REPORT – PHASE 4

REFURBISHMENT OF WATER INFRASTRUCTURE

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Revision 02

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1. INTRODUCTION

BVi Consulting Engineers was appointed by Nama Khoi Municipality as professional service providers for the refurbishment and upgrading of the Water Infrastructure in various communities in the Nama Khoi Municipal District. The appointment includes infrastructures upgrades in the following communities:

- Komaggas/Buffelsrivier
- Matjieskloof
- Bergsig
- Okiep
- Bulletrap
- Fonteintjie
- Steinkopf
- Rooiwal
- Skietbank

This report will focus on the water infrastructure upgrades to be done in Komaggas.

2. BACKGROUND

2.1 GENERAL

BVi Consulting Engineers (Northern Cape) (Pty) Ltd was commissioned in 2016 to investigate the condition and working of the existing water supply infrastructure in Komaggas. After initial investigations was concluded, a Technical Report with a Municipal Infrastructure Grant (MIG) Business Plan was submitted to the Department of Water and Sanitation (DWS) for approval to obtain funding for the project. Funding for the Project was approved for a total amount of R 24, 785,205.74 (VAT Inclusive).

2.2 DESCRIPTION OF THE PROJECT

The works includes the following:

- Testing and equipment of existing boreholes
- Upgrading of existing water supply pipelines from boreholes
- Testing and equipment of new boreholes including water supply pipelines and electricity supply to boreholes
- Construction of a new water storage reservoir.
- Installation of a telemetric control system

2.3 LOCATION OF THE PROJECT

The community of Komaggas is located about 60km west of Springbok in the Northern Cape. The figure below indicates the locality of the proposed works.

Figure 1 : Project Location Map

2.4 PROBLEM STATEMENT

The increasing demand for proper housing in Komaggas has led to an increased demand for drinking water. At present water is pump from various boreholes through supply pipelines to two (2) storage reservoirs. The available water is insufficient for the community of Komaggas and shortages are experienced, especially during the dry summer seasons. The water levels in the municipal boreholes has declined considerably over the years due to the ongoing drought conditions experienced in the region and the over abstraction of the boreholes. The supply from the existing boreholes are therefore not feasible to ensure adequate water supply to the community of Komaggas.

The general condition of the infrastructure is poor and has reached the end of its useful design life. The primary problem on the existing infrastructure is the age thereof and lack of extensive maintenance over a long period of time.

2.5 PURPOSE OF THE PROJECT

The purpose of this project is to upgrade the water infrastructure in Komaggas to ensure adequate water supply to the community for at least the next 20 years.

3. WORK COMPLETED TO DATE

3.1 PHASE 1&2: REFURBISHMENT OF EXISTING BOREHOLE PIPELINE

The following work was done during Phase 1&2 implementation of the project:

- Phase 1 - Replacement of above ground 500m X 150mm diameter steel pipeline section
- Phase 2 - Replacement of underground ground 1,100m X 160mm diameter uPVC pipeline section

3.2 PHASE 3: BOREHOLE INVESTIGATIONS

3.2.1 DRILLING OF BOREHOLES

The borehole siting and investigations was carried out by SRK Consulting and six (6) new drilling sites was identified near the community of Komaggas. Three new Boreholes were drilled at drilling targets KG19-DT1, KG19-DT2, DT5 and a fourth near the old borehole KG110. The results of the drilling process are described in the SRK Hydrogeological Report attached in Annexure A

3.2.2 BOREHOLE PUMP TESTING – AVAILABLE WATER SUPPLY FROM BOREHOLES

Three of the new boreholes as well as nine of the existing boreholes were video camera surveyed and pump tested by AB Pumps. The following discussions can be made from the video surveillance:

- Boreholes KG 2, KG 4, KG 100, KG 102, KG 106, and KG 107 is still in good condition.
- Borehole KG 108 is blocked with a pipe below 90m depth.
- Borehole KG 109 is blocked with a pipe below 95m depth. The borehole casing is also badly corroded.

The outcomes of the yield tests are discussed in the attached SRK Hydrogeological Report.

The following table provides a summary of the borehole yield test results:

Table 1 : Borehole Yield Test Results

Borehole ID	Coordinates(WGS84)		Borehole Depth	Rest Water Level	Recommended Pump Intake Depth	Pumping Rate	Maximum Daily Abstraction	Recommended Low Level Switch Depth
	Latitude	Longitude	mbc	mbc	mbc	KL/h	KL/d	mbc
EXISTING BOREHOLES								
KG 2	29.79876˚S	17.49282˚E	70.1	14.67	65	2.2	52	60
KG 4	29.80321˚S	17.49298˚E	139.6	39.62	120	3.6	85	115
KG 100	29.79123˚S	17.49951˚E	122.9	79.08	118	1.1	26	115
KG 102	29.80344˚S	17.49886˚E	152.7	23.06	120	1.1	26	115
KG 106	29.80288˚S	17.49714˚E	148.6	19.76	120	1.1	26	115
KG 107	29.78831˚S	17.50178˚E	149.3	66.54	109	0.7	17	100
KG 108	29.78864˚S	17.50358˚E	124.4	90.14	120	1.1	26	115
KG 109a	29.78266˚S	17.50699˚E	96.7	55.38	90	1.1	26	86
TOTAL EXISTING BOREHOLES						12	284	821
NEW BOREHOLES								
KG 19-DT1	29.747617˚S	17.530103˚E	165	9.56	118	0.7	17	110
KG 19-DT5	29.750469˚S	17.530662˚E	91	15.23	85	1.0	23	80
TOTAL NEW BOREHOLES						1.7	40	
TOTAL						13.7	324	

4. EXISTING WATER SUPPLY INFRASTRUCTURE

4.1 WATER SOURCE:

4.1.1 EXISTING BOREHOLES IN KOMAGGAS

There are currently ten (10) boreholes located in Komaggas of which six (6) is operational. Water is pumped from the operational boreholes with a combined water pipeline network of approximately 9km to the existing municipal reservoirs. The total safe yields from the existing boreholes as described in paragraph 3.2.2 above and the SRK Hydrogeological report is 284 kl/day.

4.1.2 SUPPLY FROM BUFFELSRIVIER

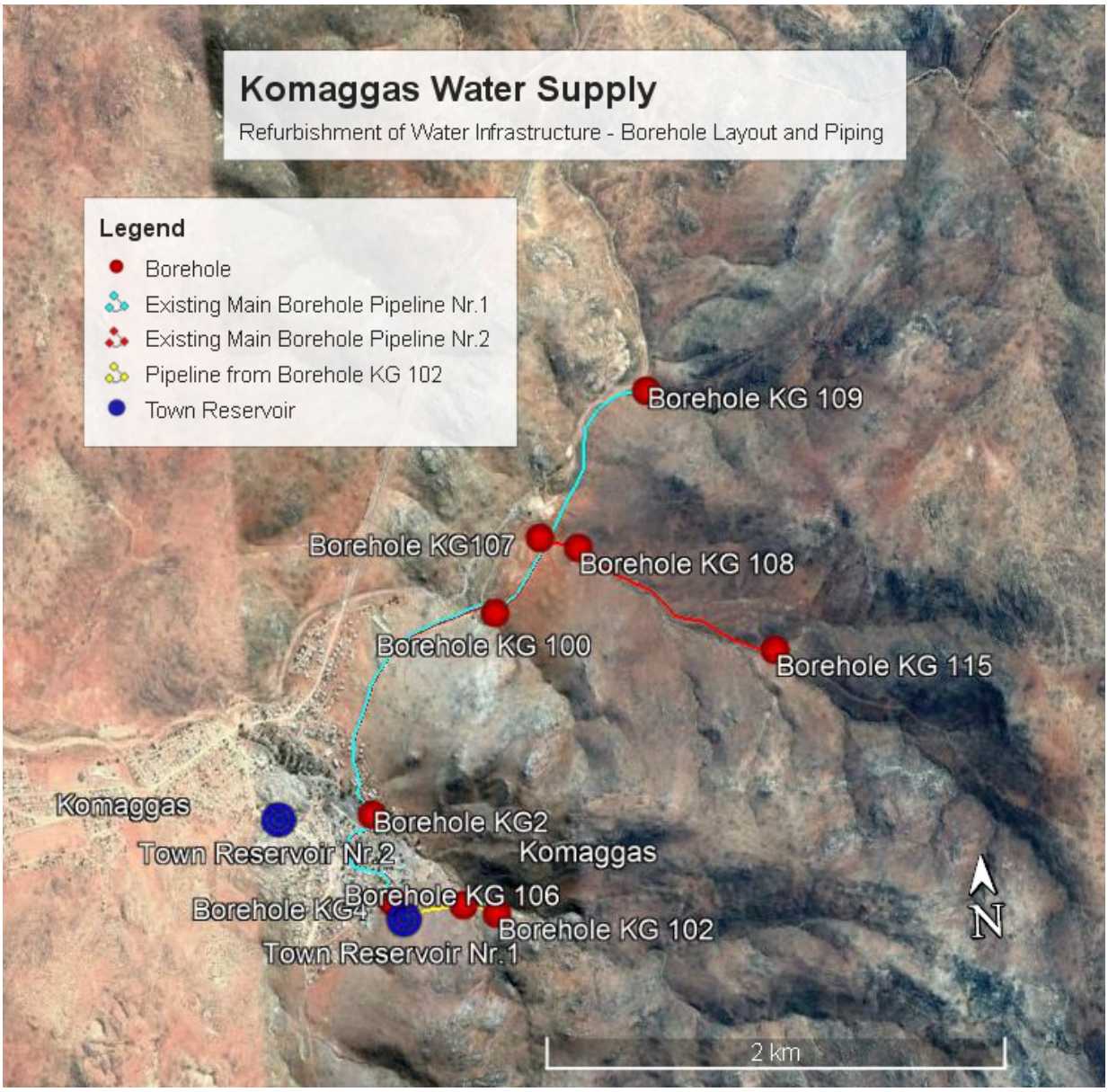
Water is also pumped from Buffelsrivier to Komaggas as a supplementary supply source. The pipeline between Buffelsrivier and Komaggas was installed to provide water at a flow rate of 5.0 ℓ/s or 432 kℓ/day or a total amount of 12 960 kℓ/month. The Buffelsrivier borehole system has recently been refurbished and water is now available from to be pumped to Komaggas.

4.1.3 NEW BOREHOLES

The total safe yields from the new boreholes as described in paragraph 3.2.2 above and the SRK Hydrogeological report is 40 kl/day. The yields from these boreholes is to low and it is therefore not feasible to equip these boreholes for water supply to the community due to high capital costs to construct water pipelines and electricity supply lines to connect to the existing infrastructure.

The following figure is a layout of all the existing Boreholes and water pipelines that supply water to the community of Komaggas.

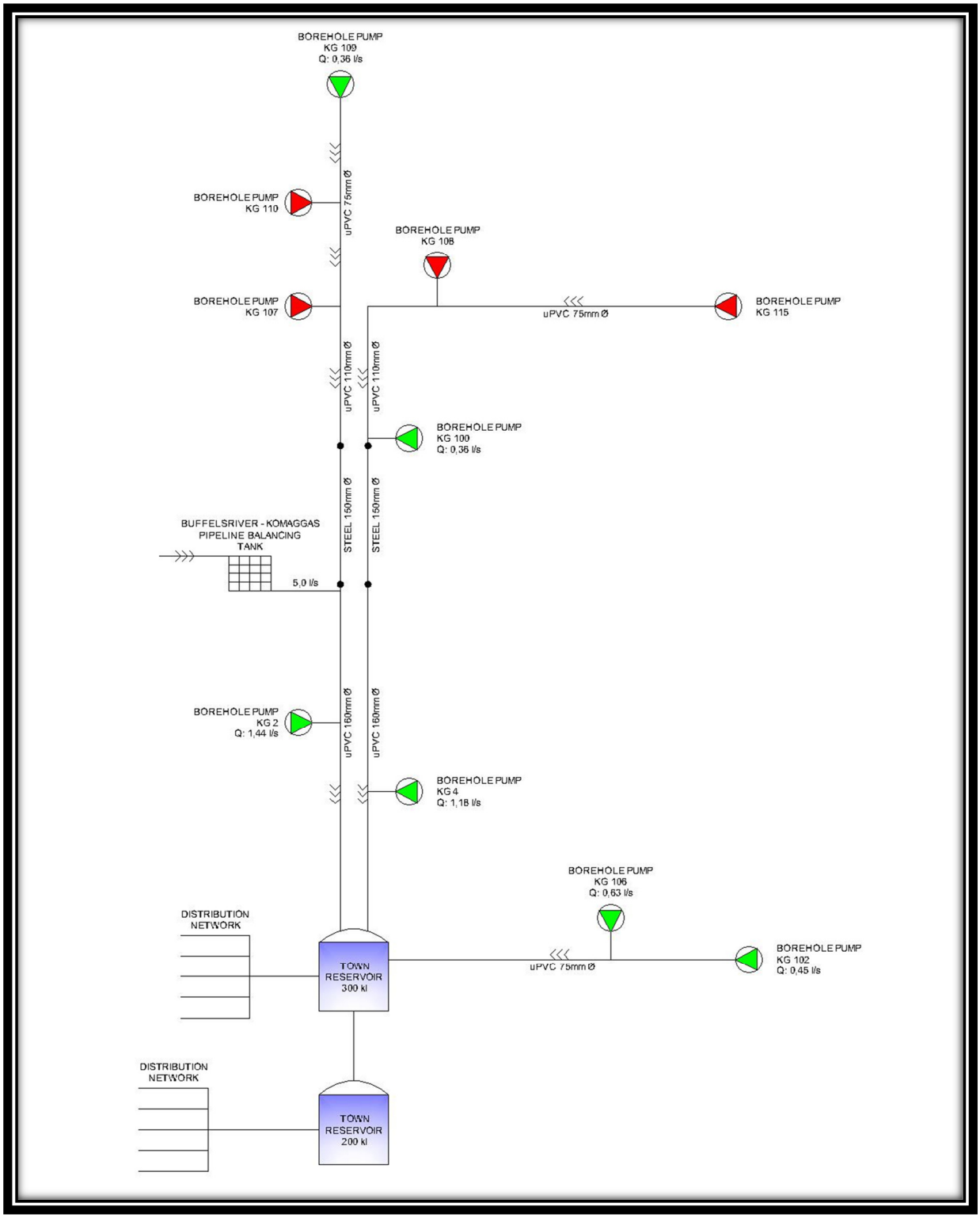
Figure 2 : Existing Borehole Layout and Piping



4.2 SUPPLY PIPELINES

The figure below illustrates the existing water supply system flow diagram:

Figure 3 : Existing Water Supply System Flow Diagram



4.2.1 SUPPLY PIPELINES FROM BOREHOLES

The water is pumped through a network of pipelines consisting of uPVC and steel pipes for approximately 9km to the existing 350kℓ and 200kℓ concrete reservoirs. This pipeline is general in poor condition and is constantly leaking. A total of 6 km of this pipeline is approved to be upgraded.

4.2.2 SUPPLY PIPELINE FROM BUFFELSRIVIER

Water is abstracted from the Buffelsrivier bulk water system and pumped to Komaggas through a pipeline with a total length of 25km. The pipeline consists of a combination of 110mm diameter uPVC pipes and 100mm diameter and 75mm diameter steel pipes. The high pressure steel pipeline section needs to be refurbished as leakages are evident at some pipe connections in order to ensure that the available supply of water from Buffelsrivier is utilised the Buffelsrivier Water Supply System.

4.2.3 STORAGE RESERVOIRS AND CAPACITIES

Water is currently stored in two concrete reservoirs with capacities of 200kℓ and 350kℓ in Komaggas. The existing storage capacities are insufficient to supply the town with water during peak demand periods.

5. POPULATION DATA

According to information obtained from Nama Khoi Municipality, the resident figures of Komaggas are as follows:

Table 2 : Population Data of Komaggas

Description of Items	Current 2020		Future 2040	
	Plots	Residence	Plots	Residence
1. Total plots	1,490	5,036	1,818	6,145
2. Calculated Number	1,490	7,450	1,818	9,090

There are currently 1,490 households with a population of 5,036 persons in Komaggas. The average persons per plot is calculated as 3.38. Although the current resident figure has been determined at 3.38 persons per plot, for design purposes a figure of 5 persons per plot will be used. The population growth for the next 20 years is assumed to be 1% per year. With all the above taken into account, the population are estimated to be about 9 090 in 203.

6. WATER DEMAND

6.1 AVAILABLE WATER DEMAND DATA

According to the borehole yield test results, the current available abstraction rates of the operational boreholes in Komaggas and the supply from Buffelsrivier are as follows:

- Average monthly safe abstraction from boreholes 8,520kℓ
- Average daily abstraction from boreholes 284kℓ
- Average monthly available supply from Buffelsrivier 12,960kℓ
- Average daily available supply from Buffelsrivier 432kℓ

6.2 CURRENT AND FUTURE WATER DEMAND GROWTH

6.2.1 DESIGN GUIDELINES AND ASSUMPTIONS

The following criteria were used in the design of the water supply system

Table 3 : Design Criteria

1.	Design Period	20 years
2.	Population (2018)	Existing Delivery Area = 7 450 people
3.	Growth Rate	1.00%
4.	Design Water Usage	Normal = 60 ℓ/c/d
		Municipal = 10%
5.	Design Loss Factors (LF)	i) Water treatment works, $LF_W = 7\%$
		ii)Total conveyance losses, $LF_r = 10\%$
6.	Gross Average Annual Daily Demand (GAADD)	$GAADD = (1 + LF_r)\ X\ AADD$
7.	Summer Peak Factor (SF)	$SF = 1.5$
8.	Summer Daily Demand WTW $(SDD)_{ww}$	$SDD_{ww} = SPF\ X\ GAADD\ X\ (1 + LF_W)$
9.	Summer Daily Demand Pipelines (SDD_{pl})	$SDD_{pl} = SPF\ X\ GAADD$
10.	Bulkwater Reservoir Storage Capacity	48 hours
11	Borehole Pumping Hours	24 hours/day

6.2.2 CURRENT AND FUTURE WATER DEMAND

The water demand was calculated using the guidelines and assumptions in table 3 above.

The following table is a summary of the calculations:

Table 4 : Water Demand Calculations

WATER DEMAND CALCULATIONS		
Population 2020	7,450	person
Demand per person	60	ℓ/c/day
Municipal Usage	10%	%
Water Losses in System	10%	%
Water Losses at Treatment Plant	7%	%
Pumping Hours	12	hour
Summer Peak Factor	1.50	
Population Growth	1%	%
Design Period	20	year
Population @ 2020	9,090	people
PRESENT DEMAND		
Demand per Person	73	ℓ/p/day
Total Demand for Population	541	kℓ/day
Total Summer Peak Demand	811	kℓ/day
FUTURE DEMAND		
Total Demand	811	kℓ/day
Total Future Demand	990	kℓ/day

a) Shortage with Current Water Supply

The shortage in the current water supply is calculated in the table below taking into account that no water is supplied from the Buffelsrivier boreholes:

Table 5 : Water Supply from Komaggas Boreholes plus limited supply from Buffelsrivier

Description of Supply	**2020 (Calculated)**	**2030**	**2040**
1. Resident Figures	7,450	8,229	9,090
2. Total Demand (ℓ/person/day)	109	109	109
3. Daily Consumption (kℓ/day)	811	896	990
4. Monthly Demand (kℓ)	24,339	26,886	29,698
5. Current Water Supply to Komaggas :			
5.1 Average water supply from boreholes in Komaggas/ day (kℓ)	285	285	285
5.2 Average supply from Buffelsrivier/ day (kℓ)	0	0	0
5.3 Total current supply (5.1+5.2)	285	285	285
6. Shortage in Supply (kℓ) (4-5.3)	526	611	705

From the calculations made in the above table, the following can be concluded:

- A total of 526 kℓ/day or 6.1 ℓ/s over a 24 hour period is needed to address the current water demand.
- A total of 705 kℓ/day or 8.2 /s over a 24 hour period is needed to address the future water demand.

b) Shortage with available supply from Buffelsrivier

The following table summarise the calculations made if a constant water supply of 5.0 ℓ/s or 432 kℓ/day is added to the water supply system:

Table 6 : Water Supply from Boreholes plus increased supply from Buffelsrivier

Description of Supply	**2020 (Calculated)**	**2030**	**2040**
1. Resident Figures	7,450	8,229	9,090
2. Total Demand (ℓ/person/day)	109	109	109
3. Daily Consumption (kℓ/day)	811	896	990
4. Monthly Demand (kℓ)	24,339	26,884	29,697
5. Current Available Water Supply to Komaggas :			
5.1 Average water supply from boreholes in Komaggas/ day (kℓ)	285	285	285
5.2 Average supply from Buffelsrivier/ day (kℓ)	432	432	432
5.3 Total current supply (5.1+5.2)	717	717	717
6. Shortage in Supply (kℓ) (4-5.3)	94	179	273

c) Storage Capacity

Table 7 : Available Storage Capacity

Description of Supply	**2019 (Calculated)**	**2029**	**2039**
1. Resident Figures	7,450	8,229	9,090
2. Total Demand (ℓ/person/day)	109	109	109
3. Daily Consumption (kℓ/day)	811	896	990
4. Storage Capacity required 48 hours (kℓ)	1623	1792	1980
5. Current reservoir Capcacity (kℓ)	550	550	550
6. Shortage in Storage Capacity (kℓ)	1073	1242	1430

d) Available supply and system shortcomings

According to the above calculations, the following can be concluded:

- The available water supply to Komaggas is insufficient for the current and future demand, according the calculations of 6.2.2 (a).

- If a constant supply of 5 ℓ/s or 432 kℓ/day or 12 960 kℓ/month is ensured from Buffelsrivier together with the current boreholes abstraction of Komaggas the available water supply will still be insufficient for the present demand of Komaggas, with reference to the calculations of 6.2.2 (b).

- A constant supply of 705 kℓ/day or 8.2 kℓ/s is required from the Buffelsrivier boreholes to meet the future water demand.
- The reservoir capacities are insufficient to store 48 hours of water in the case of peak demand periods.

7. PROPOSED INFRASTRUCTURE – PHASE 4

The scope of work as per the approved Business Plan consist of the following components:

- Equipment of all existing boreholes with new pumps as per the recommended pumping rates.
- Refurbishment and partial upgrade of the Buffelsrivier water supply pipeline to ensure constant water supply from Buffelsrivier at 705 kℓ/day.
- Further development of the Buffelsrivier Aquiver as recommended in the Hydrogeological investigation report to augment the current supply from Buffelsrivier.
- Construction of a 1.5Mℓ concrete reservoir with pipeline and accessories to connect to the existing infrastructure.
- Supply and Installation of telemetric control system controlling the borehole supply and the supply from Buffelsrivier.

8. TECHNICAL ANALYSIS

8.1 PROPOSED DESIGN CONCEPT

8.1.1 BOREHOLE DEVELOPMENT – DESIGN PHILOSOPHY

a) General System Description

All boreholes in the water supply system was pump tested and the current safe yield was calculated. Several boreholes were developed in Komaggas and were operational over long periods of time to supply the town with water. It was recently reported that only six (6) of these boreholes is in operation.

All water supply pipelines from the boreholes joins the main supply pipeline at different locations and is pumped to the Town Reservoir Nr.1. The water supply pipeline from Buffelsrivier also joins this pipeline near the town. A new 1.5 Ml reservoir is constructed at the same site to compliment the storage capacity.

The borehole pumps are level controlled by reservoir Nr.1 through level sensing instruments. The raw water is treated at the new Water Treatment Facility and the clear water is stored in the new 1.5 Ml reservoir. The water treatment process is controlled by level sensing instruments in the new clean water reservoir. The clean water is distributed to the water reticulation network and the Town Reservoir Nr.2.

The inflow of water from the new clean water reservoir to the Town Reservoir Nr.2 will be controlled by mechanical flow control valves. The water is distributed to the rest of the water reticulation network.

b) Main Control Philosophy

The main aim of the control of the system is to keep the Town Reservoir Nr.1 full through a scheduled pumping program from the various boreholes as energy efficient as possible while taking into account the level of the new clean water reservoir. The pumping tempo and hours will be controlled to ensure that boreholes are not over abstracted.

8.1.2 TELEMETRY AND SCADA SYSTEM

Main SCADA base station will be at the Nama Khoi offices in Komaggas with a secondary monitoring and control station at Nama Khoi Offices in Springbok.

Due to the mountainous terrain the telemetry signal will be send over the GSM/GPRS network to the main SCADA base station where it will be displayed on the SCADA. The SCADA will consist of a main overview screen, a station detail screen and a trend screen which will trend the level on the station.

The telemetry must consist of an RTU unit, power supply, enclosure and battery with sufficient I/O and surge protection modules to control the borehole and reservoirs.

At the borehole the telemetry will monitor the level and the statuses of the pump.

At Town Reservoir 2 and New Reservoir the telemetry will monitor the levels of the reservoir and at the Water Treatment works the telemetry will monitor the pump statuses and the level Reservoir.

The Reservoirs' levels will be used to control the pumps at the Water Treatment works. If the New Reservoir and Town Reservoir 2 water is low, the pumps at the Water Treatment works will start pumping water to the New Reservoir, only if Town Reservoir No 1 has sufficient water to supply the Water Treatment works with Water.

Equipment of Boreholes

All existing borehole pump structures will be refurbished and upgraded to an acceptable standard to protect equipment against theft and vandalism. New boreholes and existing non-operational boreholes will be equipped with new pumps and motors with flowmeters, pressure transducers and other instrumentation on each pump.

All pumps will be fitted with Variable Speed Drives (VSD's) with PLC control. New instrumentation will also be installed at the existing boreholes so that the operating conditions of each pump can be closely monitored and controlled.

8.1.3 CONCRETE RETAINING STRUCTURES

All concrete water retaining structures will be waterproofed where deemed necessary. Security fencing will be rectified and upgraded where deemed necessary. Reservoirs will all have ultrasonic level sensing as well as High and Low-level switches.

8.2 PIPELINES HYDRAULIC FLOW DESIGN

The hydraulic flow design of the existing borehole pipelines was done in the previous version of this report. Sections of the pipelines was replaced and no further works is required on the existing borehole pipelines from the Komaggas boreholes.

This report will thus only focus on the hydraulic flow design of the Buffelsrivier Water Supply pipeline.

The hydraulic flow design of the existing pipeline system was first calculated to confirm if the available flow in the pipeline is 5 l/s.

In order to increase the flow in the pipeline system from 5 l/s to 8.2 l/s, the following options were considered:

- Option 1 - Replace partial sections of the pipeline with bigger diameter pipes to allow for flow increase in the pipeline to 8.2l/s.

- Option 2 - Construct a new pipeline parallel to the existing pipeline with a flow capacity of 3.2 l/s.

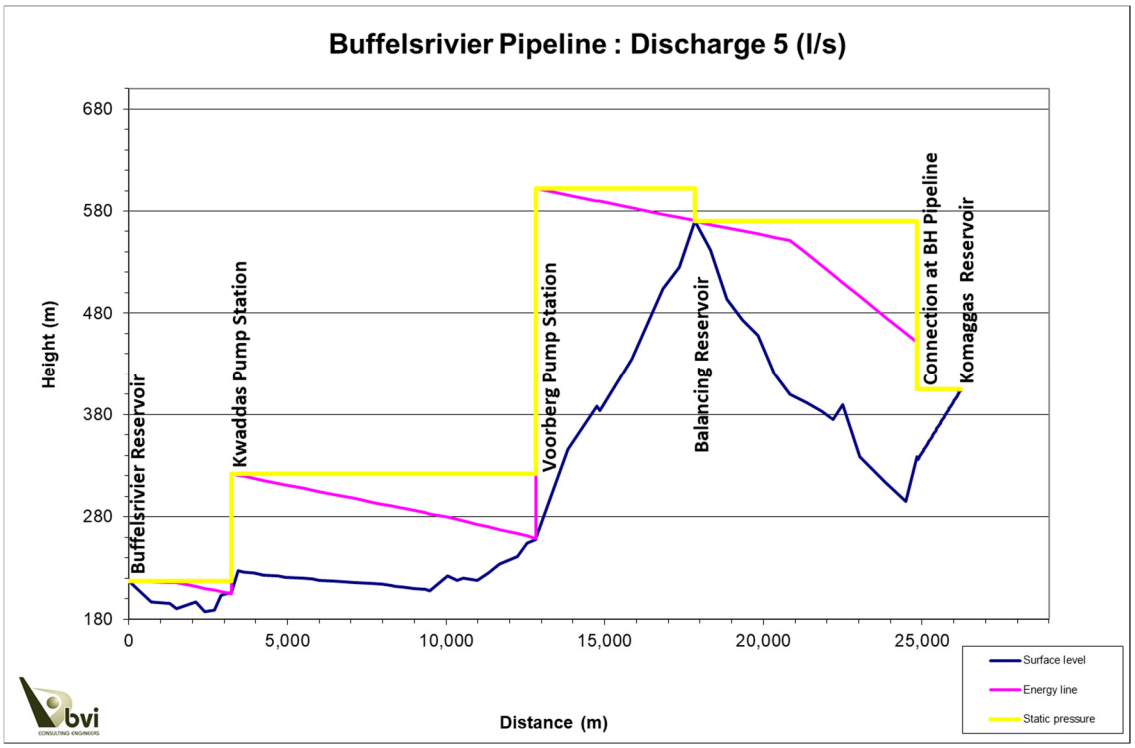
Various pipe sizes were investigated for the two main options mentioned. The following design parameters were used in analysing these options:

- Allowable range for pipe flow velocities: 0.2 m/s to 2.0 m/s
- No negative pressured in the pipeline system

8.2.1 EXISTING PIPELINE HYDRAULIC FLOW DIAGRAM

The as-build data of the existing pipeline was used to plot the hydraulic gradient of the pipeline system. The graphical results are illustrated in the figure below:

Figure 4 : Hydraulic Flow diagram: Existing System



The available hydraulic flow in the pipeline system is summarised in the table below:

Table 8 : Pipe Hydraulic Flow

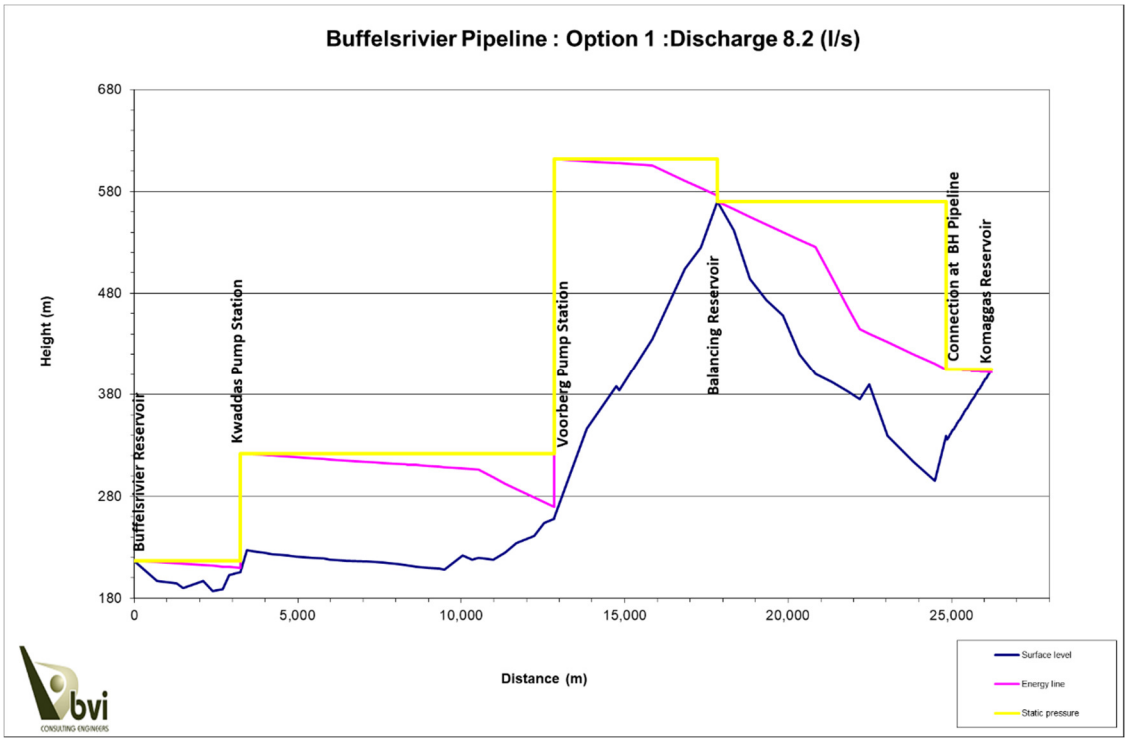
Pipe Section Description	Length (km)	Flow (**ℓ/s**)
Buffelsrivier Res. – Kwaddas PS	3.2	5
Kwaddas PS – Voorberg PS	9.6	5
Voorberg PS – Balancing Res.	5.0	5
Balancing Res – Komaggas Connection	7.0	6

From the table above and the hydraulic flow diagram, it can be concluded that available flow capacity in the rising main section is 5.0 ℓ/s and the gravity main section is 6.0 ℓ/s.

8.2.2 PIPELINE HYDRAULIC FLOW DIAGRAM – OPTION 1

The design was revised for the future demand of 8.2 ℓ/s. The following figure illustrates the result of the hydraulic model for option 1:

Figure 5 : Hydraulic Flow Diagram : Upgraded System



The table below summarise the upgrades required in the pipeline system in order to ensure that a hydraulic flow of 8.2 ℓ/s:

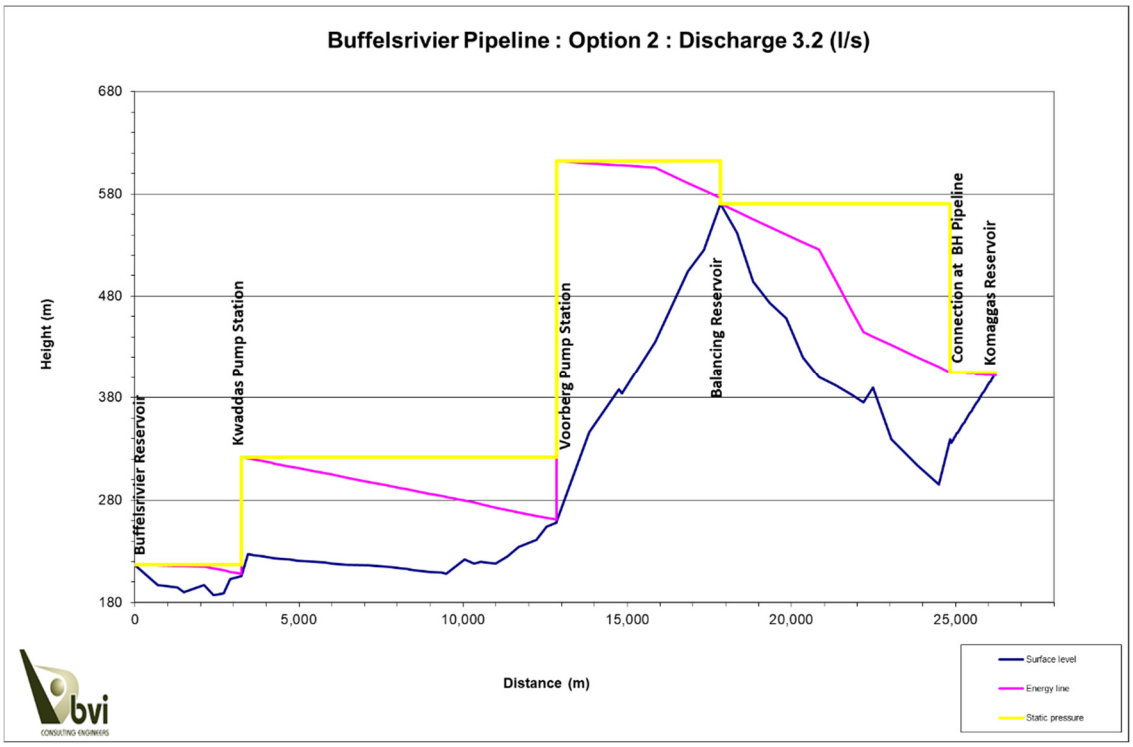
Table 9 : Required Pipe replacements – Option 1

Pipe Section Description	Total Length (m)	Pipe Description	Length to be replaced for pipe class	Length to be replaced for pipe section	Pipe Diameter (mm)	
					Existing	New
Buffelrivier Res. – Kwaddas PS	3,200	uPVC Class 12	2,100	0	160	----
		uPVC Class 9	1,100	1,100	110	160
Kwaddas PS – Voorberg PS	9,600	uPVC Class 12	3,800	7,400	110	160
		uPVC Class 16	3,600		110	160
Voorberg PS – Balancing Res.	5,000	Steel Class 40	2,000	4,000	100	150
		Steel Class 25	2,000		100	150
		Steel Class 16	0		100	----
Balancing Res – Komaggas Connection	7,000	Steel Class 10	0	2,350	100	100
		Steel Class 16	0		100	100
		Steel Class 25	0		100	100
		Steel Class 25	0		75	----
		Steel Class 40	2,350		75	100
Total			14,850			

8.2.3 PIPELINE HYDRAULIC FLOW DIAGRAM – OPTION 2

The design done for the parallel pipeline with a flow of 3.2 ℓ/s. The following figure illustrates the result of the hydraulic model for option 2:

Figure 6 : Hydraulic Flow Diagram - New Parallel System



The table below summarise the upgrades required in the pipeline system in order to ensure that a hydraulic flow is increased with 3.2 ℓ/s:

Table 10 : Required Pipe Installation - Option 2

Pipe Section Description	Total Length (m)	Pipe Description	Length to be replaced for pipe class	Length to be replaced for pipe section	Pipe Diameter (mm)	
					Existing	New
Buffelrivier Res. – Kwaddas PS	3,200	uPVC Class 9	2,100	3,200	----	160
		uPVC Class 9	1,100		----	110
Kwaddas PS – Voorberg PS	9,600	uPVC Class 12	1,480	9,600	----	110
		uPVC Class 16	6,620		----	110
		uPVC Class 12	1,200		----	110
		uPVC Class 9	300		----	110
Voorberg PS – Balancing Res.	5,000	Steel Class 40	2,000	4,000	100	150
		Steel Class 25	2,000		100	150
		Steel Class 16	0		100	----
Balancing Res – Komaggas Connection	7,000	Steel Class 10	0	2,350	100	100
		Steel Class 16	0		100	100
		Steel Class 25	0		100	100
		Steel Class 25	0		75	----
		Steel Class 40	2,350		75	100
Total			19,150			

8.2.4 SURGE ANALYSIS

The KY Pipe Surge Software will be used to analyse the effect of water hammer on each of the pipelines in the Borehole supply network. The surge analyses will be done in the next stage of design after confirmation of final pipeline routes and pipe diameters.

8.3 SPECIFICATIONS

8.3.1 GEOTECHNICAL INVESTIGATIONS AND PIPE MATERIAL SELECTION

Geotechnical investigations must be done at the new reservoir site to classify the soil and to confirm the reservoir foundation design. It is also proposed to do soil profiling on the pipeline route in order to do more accurate estimates on the quantities of rock material to be expected during trench excavations.

8.3.2 STANDARD SPECIFICATIONS

The following is a list of standard specifications that will be applicable to the construction of the pipeline:

South African National of Standard Standardised for Civil Engineering Construction SANS 1200.

SANS	1200 A	- 1986	:	GENERAL
SANS	1200 AB	- 1986	:	ENGINEERS OFFICE
SANS	1200 AH	- 1986	:	GENERAL (STRUCTURAL)
SANS	1200 C	- 1980	:	SITE CLEARANCE
SANS	1200 DB	- 1989	:	EARTHWORKS (PIPE TRENCHES)
SANS	1200 DM	- 1981	:	EARTHWORKS (ROADS, SUB-GRADE)
SANS	1200 L	- 1983	:	MEDIUM PRESSURE PIPELINES
SANS	1200 LB	- 1983	:	BEDDING (PIPE)
SANS	1200 LC	- 1981	:	CABLE DUCTS
SANS	1200 LG	- 1983	:	PIPE JACKING
SANS	1200 G	- 1982	:	CONCRETE (STRUCTURAL)

8.3.3 PIPELINE SPECIFICATIONS

a) Pipe Trenches

Pipe trench excavations, bedding cradle preparations and trench backfilling must be done according to the specifications of SANS 1200 LB: BEDDING (PIPES). Refer to the drawings attached in Annexure F. Allowance of at least 300 mm on both sides of the pipes must be made to ensure that backfilling is effectively rammed. To avoid air pockets in the pipeline, a slope of steeper than 0, 3% must be maintained. The minimum pipe cover of 800 mm from the top of the pipeline must be adhered to.

b) Pipe markers

Pipe markers must be installed at a minimum spacing of 500 m unless the pipeline follows a road. Markers must also be installed at all pipe bends as well as locations on the pipeline where the pipe material properties change.

c) Air release and air intake valves

Air release and intake management forms an integral part of the hydraulic design of a pipeline system. A Hydraulic air valve design program to size, position and classify valves on the pipeline system was used to design the air management system. The air valves must be provided on summits of the pipelines, upstream and downstream of isolation valves on ascending and descending pipeline slopes respectively. The valves must also be spaced at a minimum distance of 500 m. Refer to the air valve drawing in Annexure F for more details.

d) Scour valves

Scour valves must be provided at all low points where possible.

e) Flow Meters

Metering must be provided at the start and end point of all pipelines, and at the inlet and outlet of all reservoirs. The supply to any water user must also be metered at the distribution point.

f) Valve chambers

Valve chambers must be constructed to allow sufficient working space around the pipes and valves to remove bolts. The chambers must provide sufficient ventilation and a drainage sump for dewatering

g) Thrust blocks and anchors

Thrust blocks and anchor blocks must be provided whenever the horizontal or vertical alignment of the pipeline change more than 10°.

8.4 BULKWATER STORAGE FACILITIES

8.4.1 KOMAGGAS TOWN RESERVOIR 1

The Town Reservoir Nr.1 is a circular flat roofed concrete reservoir located outside the border of the town at 390 masl with a total storage capacity of 350kl. Water from the Komaggas boreholes and Buffelsrivier supply pipeline is fed into this reservoir. Water is distributed to a certain part of the water distribution network and also to the Town Reservoir Nr.2.

8.4.2 KOMAGGAS TOWN RESERVOIR 2

The Town Reservoir Nr.2 is also a circular flat roofed concrete reservoir located in the middle of the town at 334 masl with a total storage capacity of 200kl. Water is distributed to the remaining part of the water distribution network.

8.4.3 KOMAGGAS TOWN NEW RESERVOIR

A new reservoir is proposed to be constructed near the site of the Town Reservoir Nr1 to increase the water storage capacity of the town's storage system. The reservoir is designed with a 48 hour storage **capacity of 1.5 Ml**. The inlet level of the reservoir will be designed at the same inlet level of the Town Reservoir Nr.1 to avoid possible problems with overflows in the reservoir system.

9. ANNEXURES

9.1 ANNEXURE A: SRK BOREHOLE MONITORING REPORT - 2019

9.2 ANNEXURE B: COST ESTIMATIONS

9.2.1 BUFFELSRIVIER PIPELINE OPTION 1

Table 11 : Refurbishment of Buffelsrivier Pipeline System: Cost Estimate Option 1

Item Description	Unit	Quantity	Rate	Cost
SECTION 1: PIPE TRENCHES		7400.00		
EXCAVATION AND FILL				
Preperation of pipeline route	m²	37000	R 5.00	R 185,000.0
Excavation: 0.75-1.0 m deep	m	7,400	R 150.00	R 1,110,000.0
Extra over item 1.2 for:				
Intermediate Excavation	m³	1850	R 150.00	R 277,500.0
Hard rock Excavation(Mechanical)	m³	1850	R 400.00	R 740,000.0
Hard rock Excavation(Blasting)	m³	1850	R 800.00	R 1,480,000.0
Removal of hard rock materials	m³	3700	R 50.00	R 185,000.0
Bedding and blanket material	m³	2775	R 50.00	R 138,750.0
Extra over item 1.4 for:				
Sieving/Borrow pits	m³	1387.5	R 200.00	R 277,500.0
Fill material @ R40/m³	m³	2775	R 40.00	R 111,000.0
Extra over item 1.4&1.5 for:				
Import Material	m³	1387.5	R 300.00	R 416,250.0
SUBTOTAL SECTION 1				**R 4,921,000.0**
SECTION 2: INSTALLATION OF PIPELINE				
PIPES AND APPLIANCES				
uPVC 160mm PN9	m	0.00	R 150.00	R 0.00
uPVC 160mm PN12	m	3800.00	R 180.00	R 684,000.00
uPVC 160mm PN16	m	3600.00	R 250.00	R 900,000.00
Steel 150mm PN40	m	2000.00	R 990.00	R 1,980,000.00
Steel 150mm PN25	m	2000.00	R 865.00	R 1,730,000.00
Steel 150mm PN16	m	0.00	R 765.00	R 0.00
Steel 100mm PN40	m	2350.00	R 810.00	R 1,903,500.00
Installation of underground pipes	m	7400.00	R 38.67	R 286,133.33
Installation of above ground pipes	m	6350.00	R 171.50	R 1,089,025.00
Check valve incl. inline gate and concrete chamber	Nr	3.00	R50,000.00	R 150,000.00
ND 25 Air valves including valve chamber	Nr	17.00	R10,000.00	R 170,000.00
ND 150 Air valves including valve chamber	Nr	17.00	R15,000.00	R 255,000.00
ND 50mm Scour valve including chamber	Nr	14.00	R15,000.00	R 210,000.00
Plinths for above ground installation	Nr	700.00	R 4,500.00	R 3,150,000.0
Thrust Blocks underground	Nr	74.00	R 1,000.00	R 74,000.0
Thrust Blocks aboveground	Nr	64.00	R 5,000.00	R 320,000.0
SUBTOTAL SECTION 2				**R 12,901,658.3**
REFURBISH PUMPSTATIONS				
Pump Sets Complete	Nr	4	250000	R 1,000,000.0
SUBTOTAL SECTION 3				**R 1,000,000.0**
SUBTOTAL				**R 18,822,658.3**
PRELIMENARIES AND GENERAL PROVISIONS				R 2,823,398.75
SUBTOTAL				R 21,646,057.1
CONTINGENCIES				R 2,164,605.7
SUBTOTAL				R 23,810,662.8
ENGINEERING FEES				R 2,857,279.5
SUBTOTAL				R 26,667,942.3
VAT 15%				R 4,000,191.35
TOTAL				**R 30,668,133.68**

9.2.2 BUFFELSRIVIER PIPELINE OPTION 2

Table 12 : Refurbishment of Buffelsrivier Pipeline System: Cost Estimate Option 2

Nr	Item Description	Unit	Quantity	Rate	Cost
	SECTION 1: PIPE TRENCHES		12800.00		
1	**EXCAVATION AND FILL**				
1.1	Preperation of pipeline route	m²	64000	R 5.00	R 320,000.0
1.2	Excavation: 0.75-1.0 m deep	m	12,800	R 150.00	R 1,920,000.0
	Extra over item 1.2 for:				
1.2.1	Intermediate Excavation	m³	3200	R 150.00	R 480,000.0
1.2.2	Hard rock Excavation(Mechanical)	m³	3200	R 400.00	R 1,280,000.0
1.2.3	Hard rock Excavation(Blasting)	m³	3200	R 800.00	R 2,560,000.0
1.3	Removal of hard rock materials	m³	6400	R 50.00	R 320,000.0
1.4	Bedding and blanket material	m³	4800	R 50.00	R 240,000.0
	Extra over item 1.4 for:				
1.4.1	Sieving/Borrow pits	m³	2400	R 200.00	R 480,000.0
1.5	Fill material @ R40/m³	m³	4800	R 40.00	R 192,000.0
	Extra over item 1.4&1.5 for:				
1.5.1	Import Material	m³	2400	R 300.00	R 720,000.0
	SUBTOTAL SECTION 1				**R 8,512,000.0**
2	**SECTION 2: INSTALLATION OF PIPELINE**				
2.1	**PIPES AND APPLIANCES**				
2.2	uPVC 160mm PN9	m	2100.00	R 150.00	R 315,000.00
2.3	uPVC 110mm PN9	m	1400.00	R 120.00	R 168,000.00
2.4	uPVC 110mm PN12	m	2680.00	R 150.00	R 402,000.00
	uPVC 110mm PN16	m	6620.00	R 180.00	R 1,191,600.00
2.5	Steel 150mm PN40	m	2000.00	R 990.00	R 1,980,000.00
2.6	Steel 150mm PN25	m	2000.00	R 865.00	R 1,730,000.00
2.7	Steel 150mm PN16	m	0.00	R 765.00	R 0.00
2.8	Steel 100mm PN40	m	2350.00	R 810.00	R 1,903,500.00
2.9	Installation of underground pipes	m	12800.00	R 28.00	R 358,400.00
2.10	Installation of above ground pipes	m	6350.00	R 171.50	R 1,089,025.00
2.11	Check valve incl. inline gate and concrete chamber	Nr	4.00	R50,000.00	R 200,000.00
2.12	ND 25 Air valves including valve chamber	Nr	24.00	R10,000.00	R 240,000.00
2.13	ND 150 Air valves including valve chamber	Nr	24.00	R15,000.00	R 360,000.00
2.14	ND 50mm Scour valve including chamber	Nr	19.00	R15,000.00	R 285,000.00
2.15	Plinths for above ground installation	Nr	700.00	R 4,500.00	R 3,150,000.0
2.16	Thrust Blocks underground	Nr	128.00	R 1,000.00	R 128,000.0
2.17	Thrust Blocks aboveground	Nr	64.00	R 5,000.00	R 320,000.0
	SUBTOTAL SECTION 2				**R 13,820,525.0**
3	**REFURBISH PUMPSTATIONS**				
3	Pump Sets Complete	Nr	4	250000	R 1,000,000.0
	SUBTOTAL SECTION 3				**R 1,000,000.0**
	SUBTOTAL				**R 23,332,525.0**
3	PRELIMENARIES AND GENERAL PROVISIONS				R 3,499,878.75
	SUBTOTAL				R 26,832,403.8
4	CONTINGENCIES				R 2,683,240.4
	SUBTOTAL				R 29,515,644.1
5	ENGINEERING FEES				R 3,541,877.3
	SUBTOTAL				R 33,057,521.4
6	VAT 15%				R 4,958,628.21
7	**TOTAL**				**R 38,016,149.63**

9.3 ANNEXURE C: DETAIL DRAWINGS

Table 13 : Drawing Register – 1.5 Ml Reservoir

	DWG No.	SHORT DESCRIPTION
		PRELIMINARY DRAWINGS:
1	32650.01-100-01	RESERVOIR SITE LAYOUT
2	32650.01-155.156-01	ROOF & FLOOR LAYOUT + TYPICAL SECTION
3	32650.01-157-01	DRAINAGE IN FLOOR DETAIL
4	32650.01-157-02	RESERVOIR CONCRETE DETAILS
5	32650.01-157-03	STRUCTURAL STEELWORK & LOCKING BAR DETAILS
6	32650.01-157-04	RESERVOIR OUTSIDE - LADDER DETAILS
7	32650.01-157-05	RESERVOIR INSIDE - LADDER DETAILS
8	32650.01-158-01	RESERVOIR PIPEWORK DETAIL
9	32650.01-159-01	FLOOR LAYOUT: STEELWORK
10	32650.01-159-02	ROOF LAYOUT: STEELWORK
11	32650.01-159-03	BEAMS & COLUMNS: STEELWORK

Table 14 : Drawing Register – Main Borehole Pipeline

	DWG No.	SHORT DESCRIPTION
		PRELIMINARY DRAWINGS:
1	32650.01-002-01	PROJECT NAME BOARD
2	32650.01-100-01	GENERAL PIPELINE ROUTE LAYOUT: 1 OF 2
3	32650.01-100-02	GENERAL PIPELINE ROUTE LAYOUT: 2 OF 2
4	32650.01-141-01	PIPELINE LONG SECTION: 0.00 – 1000.00
5	32650.01-141-02	PIPELINE LONG SECTION: 1000.00 – 2000.00
6	32650.01-141-03	PIPELINE LONG SECTION: 2000.00 – 3000.00
7	32650.01-141-04	PIPELINE LONG SECTION: 3000.00 – 3200.00
8	32650.01-143-01	TYPICAL WATER DETAILS
9	32650.01-143-02	TYPICAL TRENCH EXCAVATION
10	32650.01-143-03	TYPICAL AIRVALVE DETAIL
11	32650.01-143-04	TYPICAL SCOUR VALVE DETAIL
12	32650.01-143-05	TYPICAL ISOLATING VALVE DETAIL
13	32650.01-143-06	TYPICAL NON-RETURN VALVE DETAIL
14	32650.01-143-07	ANCHOR BLOCK DETAILS
15	32650.01-203-01	CONCRETE PLINTH DETAILS
16	32650.01-203-02	RAISED CONCRETE PLINTH DETAILS
17	32650.01-210-01	BOREHOLE CAGE AND PIPEWORK