KAMIESBERG MUNICIPALITY

KAMIESKROON

PROJECT NUMBER: S709/2012/01

GROUND WATER DESALINATION, BULK WATER, BOREHOLE DEVELOPMENT AND RESERVOIR APPLICATION FOR MIG FUNDING

TECHNICAL REPORT
(REVISED)

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1. TECHNICAL REPORT

1.1 Introduction

This office was appointed by Kamiesberg Municipality to carry out investigations to access the current situation of water supply and demand in the Kamiesberg Municipal region. After completion of these investigations, reports must be compiled for the completion of a MIG-application to upgrade the current bulk water supply of the Kamiesberg Municipal District. The upgrading works will include, replacement of borehole equipment, fixing and upgrading of telemetric control equipment and the construction of reservoirs in the Kamiesberg Municipal District. All technical information provided and tabled in this report, will be applicable for the replacement of borehole equipment, the equipment of newly drilled boreholes, the construction of a reservoir and desalination plant and the upgrading of telemetric control systems in Kamieskroon.

1.2 Background

1.2.1 General

Kamieskroon is situated next to the N7 national road in the Northern Cape, about 65 km from Springbok and 45km from Garies. Kamieskroon also falls within the boundaries of the Namaqua District Municipal area. It is a small rural village which falls under the low income category and the people of Kamieskroon mostly depend on work on nearby commercial farms and to a lesser extend the mines in the region.

Kamieskroon is situated about 770m above sea level. The temperature and climate conditions vary drastically between summer and winter (temperatures up to 40°C in summer and below 20°C in winter). This physical environment is typical of Namaqualand with prominent granite mountains.

1.2.2 Problem Statement

The increasing demand for proper housing in Kamieskroon has lead to an increased demand for drinking water. Many families living on farms are also

moving to the town where services and other facilities are available. A program has been launched by the Department of Housing whereby financial assistance is made available for the building of houses. Previous housing projects that have not been completed will now be completed in conjunction with the new projects.

The Namaqua District Municipality has recently completed a project during which a number of houses were built. In accordance with the current demand, the Municipality is planning to develop a further 150 plots for the building of houses in the near future. This expected increase in consumers will place additional pressure on the existing system.

At present there is insufficient water available and shortages are experienced, especially during the summer months. The pumps in the boreholes are more than 10 years old and not functioning optimally. Staff members in charge of managing and controlling the pumps do not have the knowledge to do so effectively. This situation exacerbates the existing problems.

1.3 Existing Services

Kamieskroon existing water supply system consists of the following:

1.3.1 Water sources (Boreholes)

Boreholes used in the past were mainly the "fresh water" holes north east of the town and the "brackish water" holes south of the town. Supply from these sources was by means of a telemetric system control to ensure the correct mixing of the water. The resulting water was of a quality that met the required standards.

1.3.1.1 Fresh Water Boreholes (Kardouw)

Water is pumped from two boreholes on the farm Letterkop to the Municipal reservoir. The maximum amount of water possible is pumped from these boreholes as the water quality is good. The normal supply is about 2000 kℓ per month or 67 kℓ per day. Due to problems

with the brackish water pumps, these boreholes are sometimes overused and abstraction is far more than the permit stipulations.

According to the investigation undertaken by SRK Consulting in October 2008, the safe supply of the two boreholes is as follows:

Name of Borehole	Safe Abstraction		
	24 hours (ℓ/s)	kℓ/day	kℓ/month
Fresh Water No. 1: Koets E	0.8	69	2 074
Fresh Water No. 2: Koets NE	0.15	13	389

1.3.1.2 Brackish Water Boreholes (Letterkop)

In the past water was pumped from 5 brackish water boreholes. The quality of the water from boreholes P1 and P2 was very poor and supply from these two sources was stopped. About 0.8 kℓ/s were abstracted from borehole N1. The water quality of N1 was around 125ms/m.

Pump tests by SRK Consulting were limited to a borehole on the communal ground, with reference to borehole N2. According to the tests that were carried out, safe abstraction from this borehole is 1.0 ℓ/s. Water is currently abstracted only from borehole N2 because the other boreholes have been over abstracted.

1.3.1.3 New borehole

A new borehole has been drilled by the Department of water affairs during the year 2011. The borehole is located on the western boundary of the town about 400 metres from the Reservoirs in town. The borehole was tested during June 2011 by SRK Consulting. The borehole has a safe abstraction rate of 1.2 ℓ/s over a 24 hour period

1.3.1.4 Available Supply from Boreholes

According to the reports prepared by SRK Consulting in June 2011 and October 2008, the available supply and quality to Kamieskroon is as follows:

Borehole: Description				Available Supply (24 hrs/day)		
Name	**Brackish/ Fresh**	**Conductivity Ms/m**	**pH**	**Abstrac-tion ℓ/s**	**Daily kℓ**	**Monthly kℓ**
Kardouw N2	Brackish	200	7.5	1.0	86.4	2 592
Koets E	Fresh	82	7.8	0.8	69.1	2 073
Koets NE	Fresh	88	7.3	0.15	13.0	390
New Borehole (Town)	Brakish	267	7.4	1.2	104	3 120
Total				3.15	272.5	8 175

The above supply is based on the fact that the pumps are chosen in such a way that abstraction is spread over a 24 hour period. This holds the following advantages:

a) Abstraction is limited to the safe supply determined and prescribed by the Geohydrologists.

b) By lowering and distributing the abstraction tempo over the 24 hour period, boreholes are "protected" and overuse is prevented.

c) At this abstraction rate, a pump with a lower output is required. The decreased flow in the existing pipeline means that there is a decreased friction loss, the pressure in the system therefore also lower.

1.3.1.5 Quality of Water from Boreholes

According to tests completed, the water standard is only compliant with SANS 241 class 3 water. Water of this quality is not suitable in the long term for human consumption.

The water from the brackish boreholes has low classification due to high fluoride, chloride, sodium contents as well as the conductivity. This problem with the high fluoride content is also found in the fresh

water boreholes. There are also high levels of sodium and chloride in the water from these boreholes.

Due to the quality of the two sets of boreholes, fresh water and brackish water respectively, the water was mixed in the past by means of a telemetric control system. The resulting water supply was of a better "average" quality. The fluoride content was still too high, but the conduction was more acceptable. Unfortunately the system is no longer in use.
The test results is summarised in Annexure C.

1.3.2 Borehole Pumps and Equipment

The pumps currently in use in the boreholes are not compliant with the required specifications. The work staff of the Kamiesberg Municipality used any available pump in the boreholes. This arbitrary installation of pumps led to the over abstraction of water from the boreholes, as well as increased pressure in the pipes.

The problem of incorrect pumps in the incorrect boreholes was also highlighted in the SRK report. If a pump with a high abstraction tempo is used in a borehole with a low supply, the borehole may be damaged. This could also lead to damage to the pump itself, or the pump switching off for short periods due to low water levels.

The use of a telemetric control system for the switching on and off of pumps according to the reservoir levels is indispensable. The system that controlled the works effectively in the past is now out of order. Control is now manual and this often leads to the irregular switching on of pumps and water shortages in the town's reservoir.

1.3.3 Supply Pipelines from Boreholes

Water is currently supplied from fresh water and brackish water boreholes respectively, by means of the following supply pipelines:

1.3.3.1 Fresh Water Boreholes (Koets E and NE)

An existing 63mm uPVC pipeline with glued joints carries the water to the two town reservoirs. These pipes are still in use despite being more than 20 years old. With low flow and therefore low pressure, this system can still be used in the short term.

1.3.3.2 Brackish Water Boreholes

The existing pipeline is also a 63 mm uPVC pipeline, already in use for over 15 years. Previous information has indicated that this pipeline consists of a class 6 pipe, which could cause problems. The pressure in the pipeline is exceeded because of friction caused by the static height difference. This leads to pressure bursts.

The use of a temporary booster pump has been considered to solve the problem. This is, however, not viable for the purpose for which it is required.

1.3.4 Storage Reservoirs and Capacities

Water is currently stored in two concrete reservoirs with capacities of 150kℓ and 200kℓ respectively. The second reservoir is 12 years old and both are in a relatively good condition. The water levels of both reservoirs are at the same height and the two are used concurrently.

The pipe networks have been joined in such a way as to allow the inflow of water from both the brackish and fresh water boreholes. Water meters on both inflow pipes were connected electronically to the telemetric control system to regulate the mixing of the water. This system is no longer in use.

The condition of the reservoir is still satisfactory and suitable for future use should the capacity be sufficient.

1.3.5 Distribution Networks

Currently there is a distribution network to both the Kamieskroon town area and Kroonsig. Although it is an old network it is used effectively at present. With the expected increase in plot development for housing projects, the primary supply network could come under pressure. It will have to be increased in the future.

1.4 POPULATION

According to information obtained from surveys by the local CDW, the resident figures are as follows:

Description of Items	Current 2012		Future 2022	
	Plots	Residents	Plots	Residents
Total plots	372	907	522	1 657
Calculated number	390	1950	522	2 379

The above figures are based on information provided by the local service points in Kamieskroon and Garies. Municipal staff have also confirmed that a further 150 plots are necessary to satisfy the future housing demand. This increase is a result of people leaving the rural areas and settling in the main towns like Kamieskroon. Although the current resident figure has been determined at 2.5 people per plot, for design purposes a figure of 5 people per plot will be used.

1.5 CURRENT CONSUMPTION

According to information provided, abstraction and supply figures are as follows:

- Total monthly abstraction from boreholes 5 122kℓ
- Daily supply to each plot 459 litres
- Daily available for 907 residents 183.6ℓ/day

1.6 DESIGN GUIDELINES OF SYSTEMS

The following guidelines have been adapted in order to determine the demand:

- Current Population 1 950 residents
- Expected Population Growth 1%
- Number of residents per plot: 5
- Consumption per person per day (Household): 60ℓ
- Peak factor in summer peak consumption: 1,5
- Maximum time of interruption of supply: 48 hours
- Recovery of Desalination Plant 75%
- Conveyance Losses 10%
- Municipal Usage 10%
- Commercial & Industrial usage 10%

1.7 DETERMINING REQUIRED SUPPLY AND STORAGE CAPACITY

According to the current resident numbers and the expected demand for future plots and needs, the required supply and infrastructure are as follows:

1.7.1 Total Demand

Description of Supply	2012(Calculated)	2022	2032
1. Resident figures	1 950	2 154	2 379
2. Total Demand (ℓ/person/day)	120	120	120
3. Daily consumption (kℓ/d)	234	259	286
4. Monthly demand (kℓ)	7 020	7 754	8 566
5. Monthly Demand before Treatment (kℓ)	9 360	10 339	11 421
6. Demand before Treatment/day(ℓ/s)	4.2	4.6	5.1
7. Available from borehole / month (kℓ)	8 165	8 165	8 165
8. Available from borehole /day(ℓ/s)	3.15	3.15	3.15
9. Shortage in Supply before Treatment	1 195	2 174	3 256
10. Storage capacity required 48 hours (kℓ)	468	517	571
11. Available reservoir capacity (kℓ)	350	600	600
12. Capacity of Desalination Plant Operated 8 hours (ℓ/s)	8.1	9.0	9.9
13. Capacity of Desalination Plant Operated 12 hours (ℓ/s)	5.4	6.0	6.6
14. Capacity of Desalination Plant Operated 24 hours (ℓ/s)	2.7	3.0	3.3

1.7.2 Available Supply and System Shortcomings

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

- The available supply of water is sufficient for the supply of 120litres per person per day. However, if the water is treated with a recovery of 75% at the water treatment plant, the available supply will not be sufficient.
- The reservoir capacities are not sufficient to store 48hours of water in the case of emergencies.
- These calculations were done on the assumptions and guidelines in paragraph 1.6 above.

1.8 PROPOSED WORKS

The current situation with the insufficient supply of water to the town must be addressed as soon as possible. It is proposed to implement the project in phases and the more critical aspects will be addressed at first. As funds are available, the other less critical works will be done. The proposed works is as follows:

1.8.1 PHASE1

- Equipment of new borehole drilled by the Department of Water Affairs. This will included the installation of borehole pumps, installation of pipelines and construction of electricity supply lines.
- Equipment of existing boreholes with pumps.

1.8.2 PHASE2

- Construction of Water Treatment works
- Construction of 600 kl Clean water storage reservoir
- Locate, Bore and equip additional borehole including pipelines and electricity supply.
- Installation of Telemetric control system to switch the pumps on and off and to regulate the mixing of the brackish and fresh water.

2. ESTIMATED PROJECT COSTS

Estimated costs are as follows:

2.1 DIRECT PROJECT COSTS-PHASE1

a. Equip existing boreholes (3):	R 230 000-00
b. Equip new borehole (1):	R 100 000-00
c. Electricity Supply to new borehole:	R 150 000-00
d. Water Supply Pipelines from new borehole:	R 200 000-00
e. Preliminary and General Costs	R 68 000-00
Sub Total	R 748 000-00
f. Contract Price Adjustments and Increases (10%)	R 74 800-00
g. Contingencies (10%)	R 82 280-00
Sub Total	**R 905 080-00**

2.2 DIRECT PROJECT COSTS-PHASE2

a. Locate, Bore and Equip new borehole (1):	R 200 000-00
b. Electricity Supply to new borehole:	R 400 000-00
c. Water Supply Pipelines from new borehole:	R 500 000-00
d. Construction of Water Treatment Plant and Evaporation ponds	R2 500 000-00
e. Construction of Reservoir including fences	R1 000 000-00
f. Telemetric Control System	R 530 000-00
g. Preliminary and General Costs	R 513 000-00
Sub Total	R5 643 000-00
h. Contract Price Adjustments and Increases (10%)	R 564 300-00
i. Contingencies (10%)	R 620 730-00
Sub Total	**R6 828 030-00**

2.3 TOTAL DIRECT PROJECT COSTS	**R 7 733 110-00**
Plus VAT(14%)	R 1 082 635-40
TOTAL	**R 8 815 745-40**

2.4 INDIRECT PROJECT COSTS

a.	PROFESIONAL ENGINEERING FEES	R 786 604-90
b.	REIMBURSEMENTS	
	(SITE SUPERVISION, TRAVELLING COST, ETC.)	R 90 000-00
c.	Sub Total	R 876 604-90
	Plus14% VAT	R 122 724-69
	TOTAL INDIRECT PROJECT COSTS	**R 999 329-59**

2.5 TOTAL PROJECT COST

TOTAL DIRECT PROJECT COSTS	R 8 815 745-40
TOTAL INDIRECT PROJECT COSTS	R 999 329-59
TOTAL PROJECT COSTS	**R 9 815 074-99**

2 DATE OF COMPLETION AND CASHFLOW

According to the provisional work program, if work commence in July 2012, all should be completed by December 2012. The retention payment will be made in December 2013. No environmental impact study is necessary as the project entails only the replacement of existing equipment. Expected costs are as follows:

Month	Amount (R)	Balance
		R 9 815 074-99
Month of Approval +1	R 300 000-00	R 9 515 074-99
Month of Approval +2	R 500 000-00	R 9 015 074-99
Month of Approval +3	R 500 000-00	R 8 515 074-99
Month of Approval +4	R 1 000 000-00	R 7 515 074-99
Month of Approval +5	R 1 500 000-00	R 6 015 074-99
Month of Approval +6	R 1 500 000-00	R 4 515 074-99
Month of Approval +8	R 2 000 000-00	R 2 415 074-99
Month of Approval +	R 1 924 321-24	R 490 753-75
Month of Approval +20	R 490 753-75	R 0-00

3 PROJECT MANAGEMENT

A project team will be appointed at the beginning of the project, consisting of representatives from Kamiesberg Municipality, the local community and Consulting Engineers. The duties of this committee will include the following:

3.1 Final approval of description of the planned works.
3.2 Approval of tender document.
3.3 Appointment of contractors.
3.4 Attendance of monthly site and project meetings.
3.5 Monitoring progress of project.
3.6 Involvement in completion, takeover and testing of system.
3.7 Evaluation of post installation care period, quarterly meetings and monitoring of system management by Municipal staff.

After the application has been approved, representatives of the District Municipality and the Department of Housing will join this project team

4 DRAFTING AND EVALUATION OF TENDER DOCUMENTS

The tender documents will be drafted according to the tender policy of the Kamiesberg Municipality. The accepted Targeted Procurement Conditions of the Municipality will also be used to evaluate the tenders and submit a recommendation to the Council regarding the appointment of the successful contractor.

5 PROJECT COMMENCEMENT DATE

All attempts will be made to have the project allocated to contractors within 2 months after approval of the Application for funds. With an expected construction time of 6 months, retention period of 12 months, the project should be completed 20 months after the approval of funds.

6 MAINTENANCE AND TRAINING

Due to the current problems being experienced, it is advised that the consulting engineers and contractors remain actively involved for 12 months after the completion of the project. During this time the following will take place:

6.1 Evaluation of the use of the system by Municipal staff.

6.2 Examination of pump hours, volume of water supplied and community consumption figures.

6.3 Drafting of water balance on a monthly basis.

6.4 Convening monitoring meetings on a quarterly basis and reporting to the Department of Housing, DWAF and Municipal Manager.

The aim of this involvement for the 12 months after completion is to extend the lifetime of the system by ensuring good training and effective control.
Training will be given to the supplier of the telemetric control system and will be done in accordance to their program and regulations.

7 GENERAL

This technical report was drawn up by BVi Consulting Engineers at the request of the Kamiesberg Municipality. We trust that you find the above in order and that you will contact our offices should you have any queries.

BVi Consulting Engineers **Date**

8 ANNEXURES

8.1 Annexure A: Indigent Register
8.2 Annexure B: General Layout
8.3 Annexure C: Borehole Test Results

Annexure A:
Indigent Register

Annexure B:
General Layout

Annexure C:
Borehole Test Results