Simondium Industrial Park
Borehole Yield Assessment

Dr Ricky Murray (Pr.Sci.Nat.)
Groundwater Africa
PO Box 162
Lynedoch
Stellenbosch, 7603
South Africa

www.groundwaterafrica.co.za
email: ricky@groundwaterafrica.co.za
ph & fax: +27 21 8813082
cell: +27 823238303

March 2008

GROUNDWATERAFRICA

CONTENTS

TABLES

1. INTRODUCTION

On the 28th January, 2008, Johan Meyer (IQ Vision Project Mangers), the project manager for the Simondium Industrial Park project, on behalf of the client Telegenix Trading 856 Pty Ltd represented by Mr Mark Groenewald, appointed Groundwater Africa to assess the yields of the three existing boreholes (Bh's 1 – 3) at Simondium Industrial Park. Bh 2 was in operation, and Bhs 1 & 3 were not being used.

During a site visit by Dr R Murray of Groundwater Africa, Mr Groenewald said that by far the greatest current water user was the bottling plant, and he provided the following information from the bottling plant's flow meter:

14 Dec. 2007:	6172 m^3
8 Feb. 2008:	6569 m^3
Time period:	56 days
Less Plant closure:	14 days
Days supplied:	42 days
Volume used:	397 m^3
Use:	9.5 m^3/day
	Or 0.11 L/s of continuous supply

It is assumed that the current demand is in the order of 10 m^3/day.

2. TEST PUMPING PROGRAMME

Table 1 describes the test pumping tests that were conducted. The test pumping curves are given below (Figures 1 – 11).

Table 1: Summary of Test Pumping Programme

Bh No	*Bh Depth (m)*	*Pump Inlet Depth (m)*	*Step Test Rates in L/s (all 60 min)*	*Constant Rate Test*	*Constant Rate Test Recovery*
1	61.3	57	0/.32; 1.03; 1.51; 2.34 L/s (pump suction during 3rd & 4th steps)	0.33 L/s for 24 hrs	Full recovery after 18 hrs
2	53.0	46.5	1.36; 2.15; 3.08; 4.53 (pump suction during 4th step)	2.05 L/sfor 32 hrs	Residual drawdown of 0.29 m after 32 hrs
3	53.9	51	0.63; 1.02;1.5 L/s (pump suction during 3rd step)	0.41 L/s for 24 hrs	Full recovery after 5 hrs

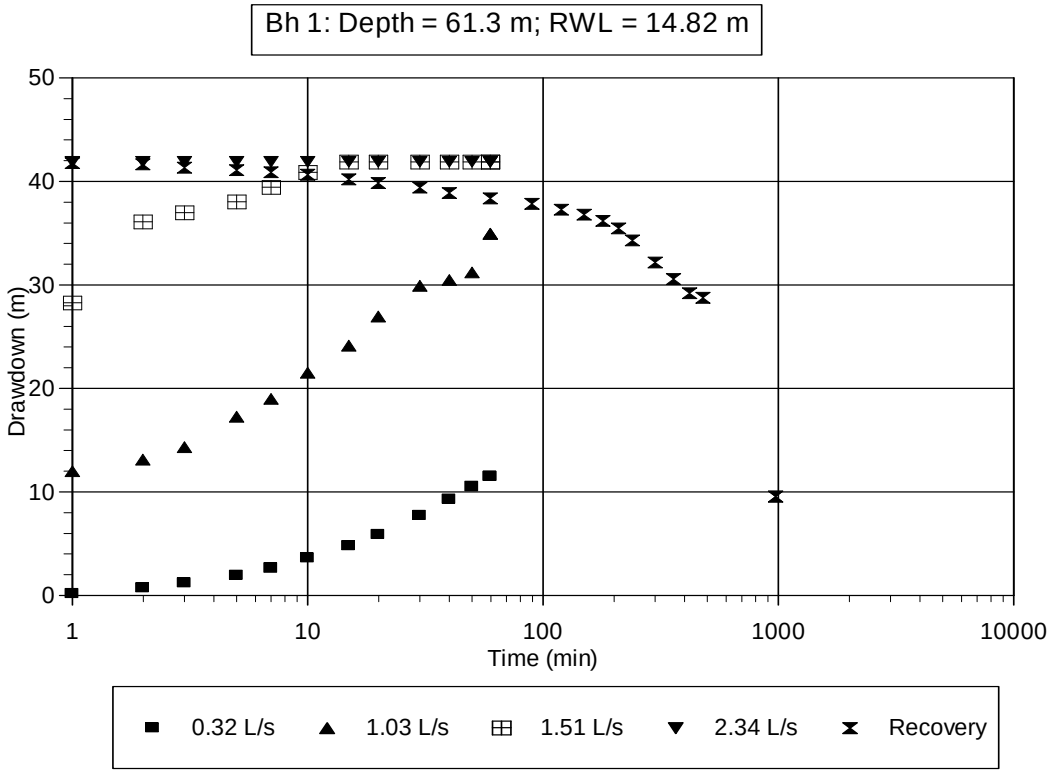

Figure 1. Bh 1 Step Test

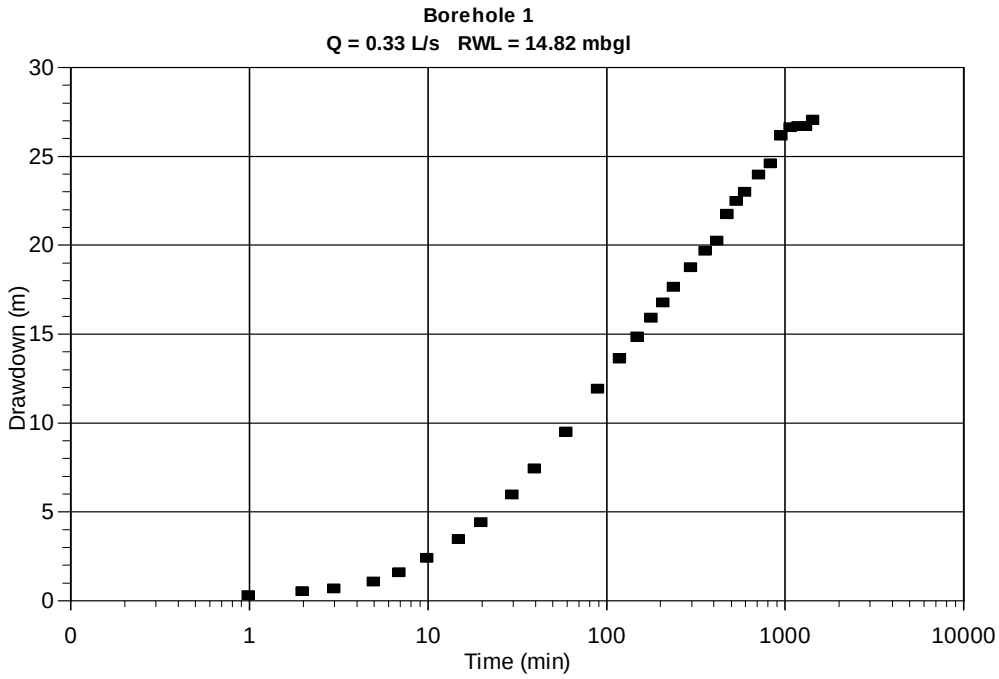

Figure 2. Bh 1 Constant Discharge Test

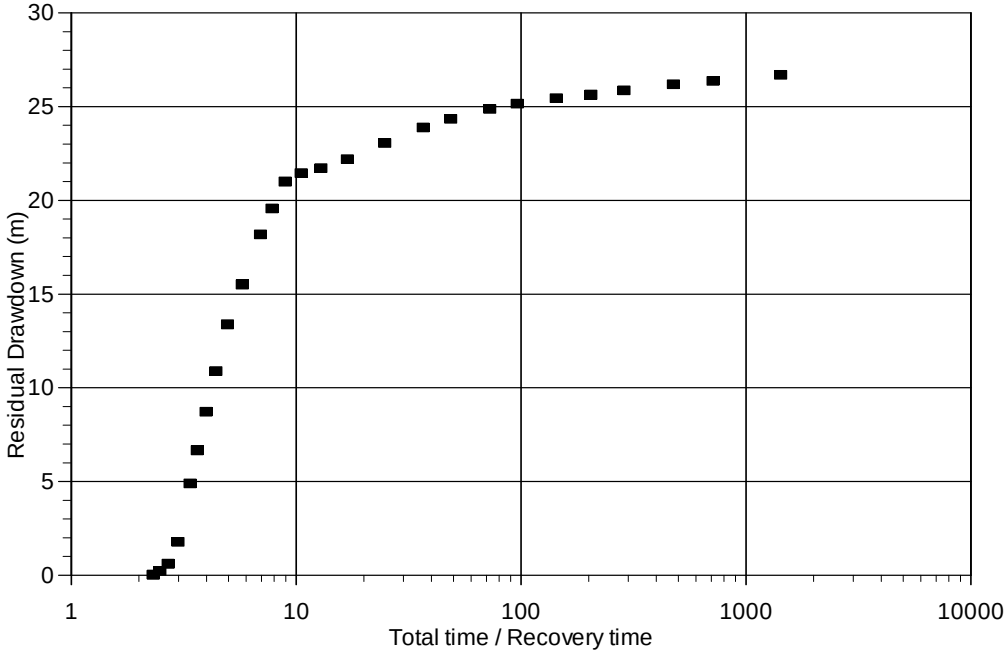

Figure 3. Bh 1 Recovery Test after the Constant Discharge Test

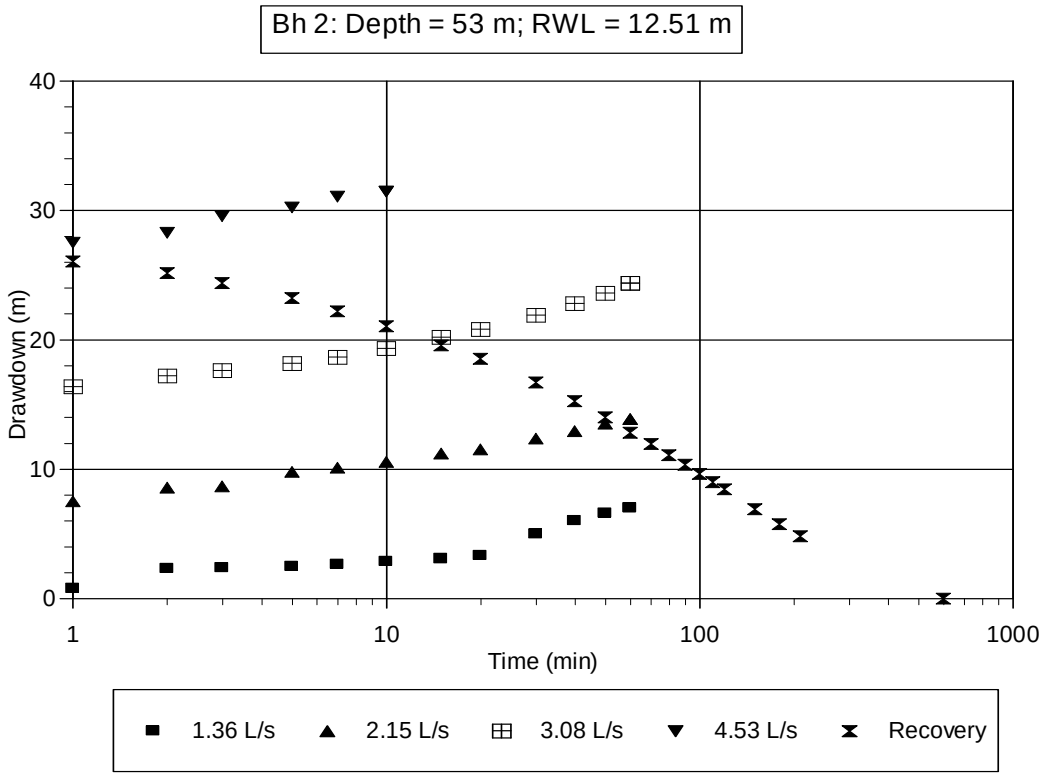

Figure 4. Bh 2 Step Test

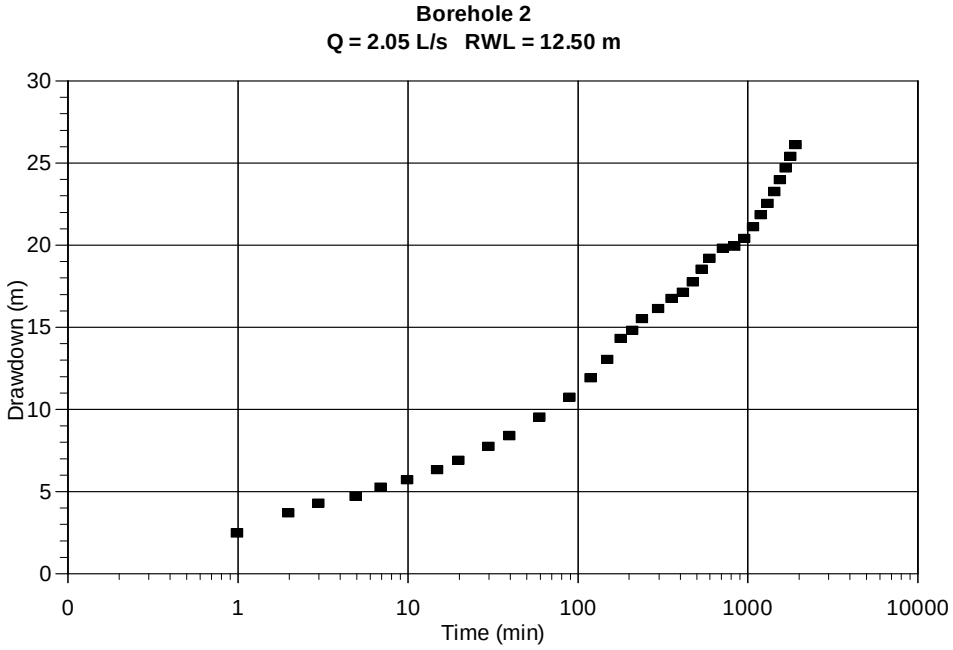

Figure 5. Bh 2 Constant Discharge Test

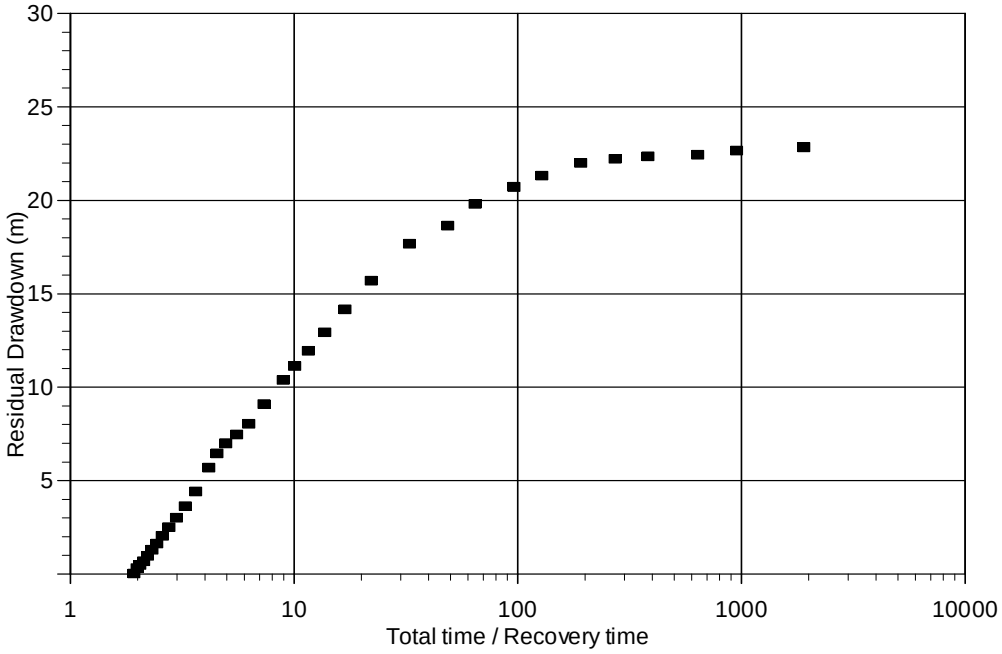

Figure 6. Bh 2 Recovery Test after the Constant Discharge Test

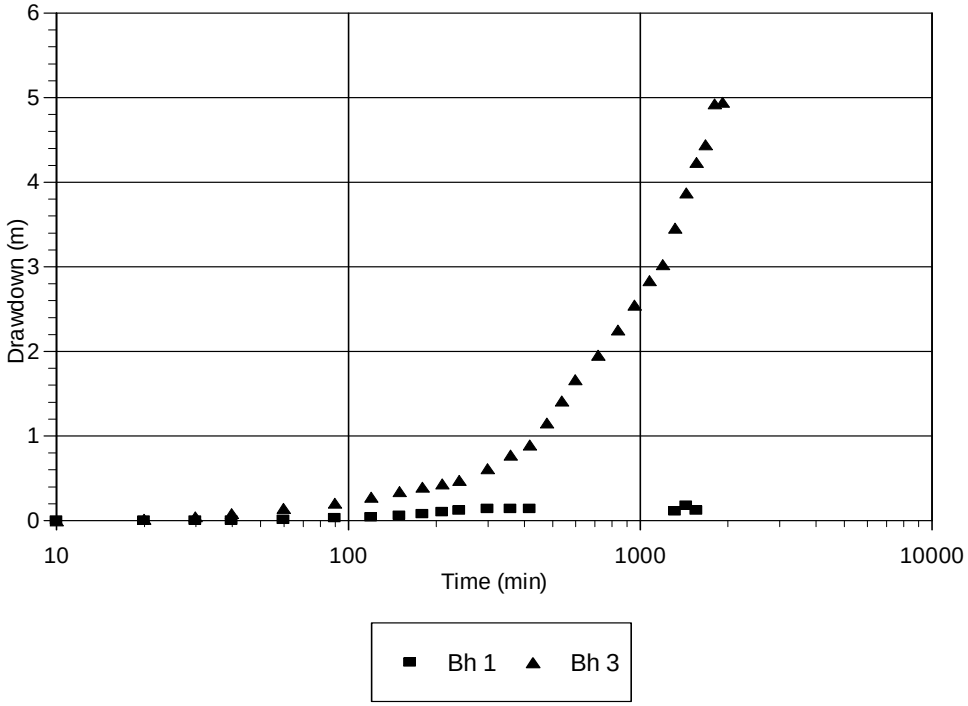

Figure 7. Pumping Bh 2 Observation Bh 1 & 3 CD Drawdown

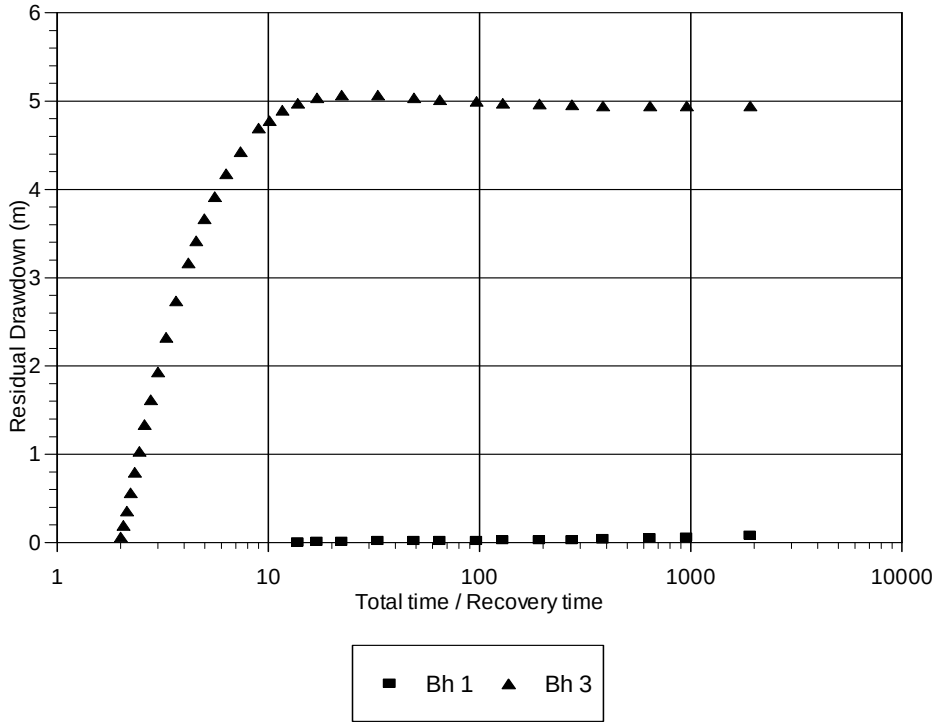

Figure 8. Bh 3 Pumping Bh 2 Observation Bh 1 & 3 CD Recovery

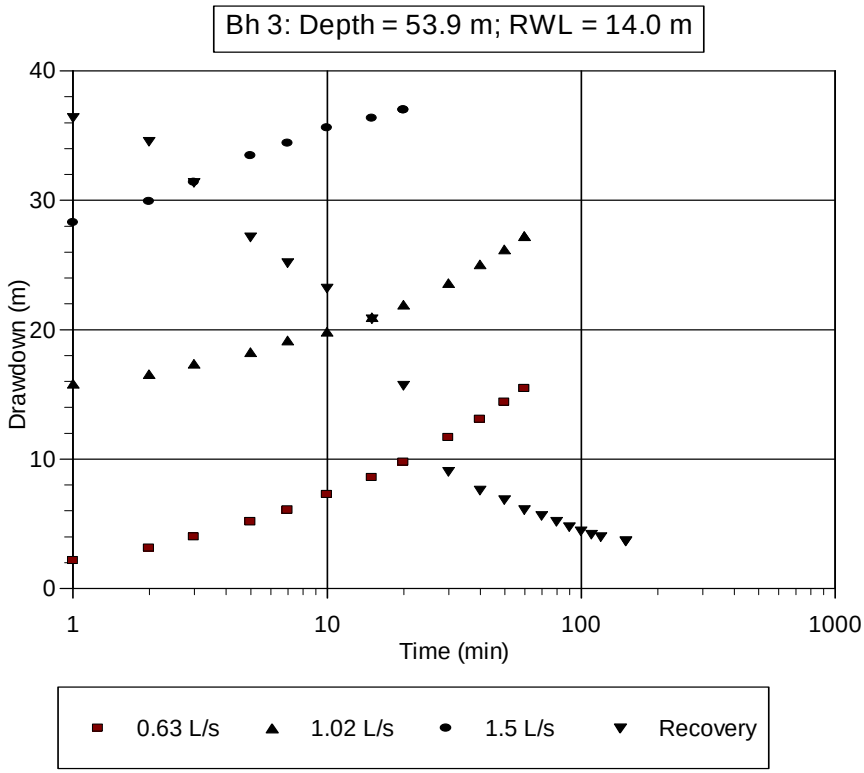

Figure 9. Bh 3 Step Test

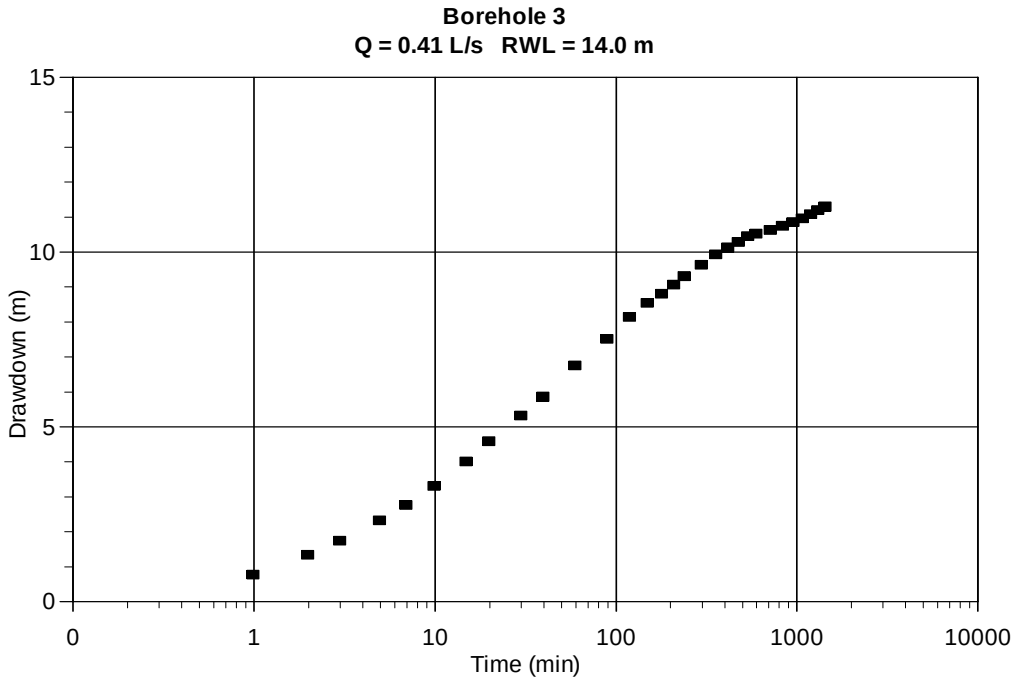

Figure 10. Bh 3 Constant Discharge Test

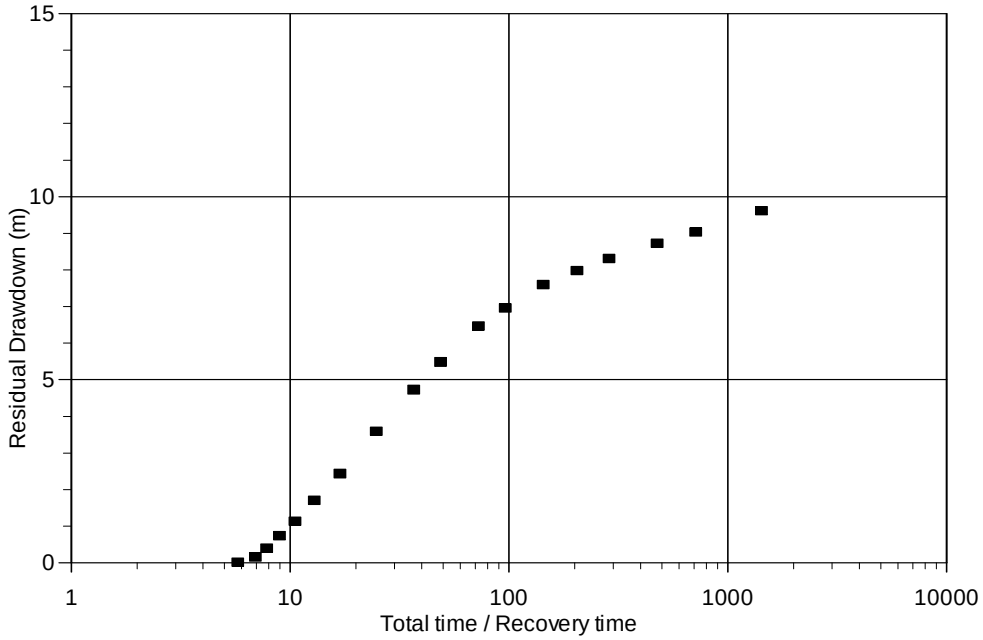

Figure 11. Bh 3 Recovery Test after the Constant Discharge Test

3. ABSTRACTION RECOMMENDATIONS

The following is recommended:

- Pump Boreholes 1 and 2 simultaneously
- Keep Borehole 3 as a back-up / standby borehole

The abstraction recommendations in Table 2 are proposed to meet estimated current demand of about 10 m^3/day.

Table 2: Abstraction Recommendations: Current demand

Bh No.	*Pump intake depth (m)*	*Pumping rate (L/s)*	*Pumping hours (hrs/day)*	*Abstraction per day (m^3)*
Bh 1	50	0	0	0
Bh 2	45	0.8	3.5	10
Bh 3	45	0	0	0
Total				**10**

The abstraction recommendations in Table 3 are proposed based on estimated long-term sustainable borehole yields.

Table 3: Abstraction Recommendations: Borehole yields

Bh No.	*Pump intake depth (m)*	*Pumping rate (L/s)*	*Pumping hours (hrs/day)*	*Abstraction per day (m^3)*
Bh 1	50	0.2	10	7
Bh 2	45	0.8	7	20
Bh 3	45	0	0	0
Total				**27**

The abstraction recommendations in Table 4 are proposed for emergency use. This would be required if boreholes 1 and 2 failed for whatever reason, or the water at these boreholes was contaminated. Borehole 3 and borehole 1 can be pumped simultaneously, but borehole 2 and 3 cannot.

Table 4: Abstraction Recommendations: Borehole 3 (Emergency back-up borehole)

Bh No.	*Pump intake depth (m)*	*Pumping rate (L/s)*	*Pumping hours (hrs/day)*	*Abstraction per day (m^3)*
Bh 3	45	0.4	14	20

An option may be to equip Bh 3 with a generator set to be used when there are electricity power failures.

4. WATER QUALITY

4.1 Bacteriological quality

Table 5 gives the bacteriological analytical results.

Table 5: Bacteriological analyses

Bh No.	**Heterotrophic P/C per 1 mL at 35 ^{0}C**	**Total coliforms per 100 mL**	**Faecal coliforms per 100 mL**	***E. coli* per 100 mL**
Bh 1*	+/- 75 000	520	60	None found
Bh 2	323	66	32	None found
Bh 3	4 300	830	None found	None found

* Bh 1 sample was 3-days old when delivered to the laboratory. Results of samples older tan 24 hours are considered unreliable.

The water from all boreholes falls into DWAF's Class III water quality which is considered "Poor water quality – unsuitable for use without treatment". Where the Faecal coliforms lie between 10 - 100 counts per 100 mL (ie Bhs 1 & 2), and where Total coliforms lie between

100 – 1000 counts per 100 mL (ie Bhs 1 & 3), DWAF states that for both direct consumption and for food preparation, “Clinical infections are common, even with once-off consumption”.

All borehole water needs to be disinfected prior to consumption.

4.2 Chemical quality

Table 6 gives the chemical analytical results. The chemical water quality is good and suitable for domestic consumption. When Bh 3 is used for back-up, the water should initially be pumped to waste until it is reasonably clear. This should take about 15 minutes (but could be longer) – it needs to be observed by the pump operator. If the turbidity of the water gets worst – ie it becomes increasingly murky (or brown), it can indicate microbacterial contamination, and it would be best to stop using the borehole.

Table 5: Chemical analyses

SAMPLE ID:	BH1	BH2	BH3
SAMPLE DATE:	22-Feb-08	25-Feb-08	19-Feb-08
Potassium as K mg/L	4.0	5.5	5.1
Sodium as Na mg/L	46.5	38.3	36.4
Calcium as Ca mg/L	16.80	15.10	2.7
Magnesium as Mg mg/L	9.00	7.63	8.4
Sulphate as SO4 mg/L	5.0	12.0	9.0
Chloride as Cl mg/L	85	60	62
Alkalinity as CaCO3 mg/L	46	39	12
Nitrate plus nitrite as N mg/L	1.4	1.78	3.6
Fluoride as F mg/L	0.19	0.16	<0.1
Iron as Fe mg/L	0.23	0.34	0.12
Manganese as Mn mg/L	0.26	0.01	0.04
Arsenic as As mg/L	0.004	0.003	0.005
Conductivity mS/m (25°C)	41	34	22
pH (Lab) (20°C)	6.8	6.6	5.7
Saturation pH (pHs) (20°C)	8.7	8.8	10.0
Total Dissolved Solids (Calc) mg/L	259	218	143
Hardness as CaCO3 mg/L	79	69	41
Sodium Adsorption Ratio (SAR)	2.3	2.0	2.5
Turbidity NTU	0.99	0.6	**10.8**
% Difference	2.39	5.62	4.11
CATIONS meq/L	3.70	3.19	2.54
ANIONS meq/L	3.53	2.85	2.44

5. RECOMMENDATIONS

The following recommendations are made:

1. Disinfect all borehole water prior to consumption.
2. Equip and pump the boreholes as follows:
    a. Bh 1: Pump intake depth: 50 m; Pump rate: 0.2 L/s; Abstraction: 7 m^3/day
    b. Bh 2: Pump intake depth: 45 m; Pump rate: 0.8 L/s; Abstraction: 20 m^3/day
    c. Bh 3: Pump intake depth: 45 m; Pump rate: 0.4 L/s; Abstraction: 20 m^3/day only if Bh 2 is out of order.
3. Install 35 mm HDPE piezometer tubes in all boreholes for water level monitoring purposes
4. If more water is required that the 27 m^3/day recommended here, the process prior to drilling new boreholes should be:
    a. Insert data loggers into the piezometer tubes and monitor water levels for a month
    b. Review data and establish whether the boreholes can be pumped for longer periods each day
    c. If so, increase abstraction and continue monitoring
    d. If not, drill new boreholes.
5. Install a sampling tap at each borehole
6. Cast new slabs for all the pump houses and ensure that all water in and around the pump houses runs away from the boreholes. No standing water should be allowed around the boreholes. Ensure that no waste/rubbish is left around the pump houses.
7. With good borehole protection bacteriological contamination should not be a problem. For the first year, sample for bacteria in February and October to establish whether there has been contamination. As a precautionary measure, disinfect all borehole water until the source of contamination has been identified and dealt with.

_____

Dr R Murray
13 March 2008