



GEOHYDROLOGICAL REPORT

Groundwater source development at Moletje sentral.

**For
Bigen Africa**

**Polokwane Municipality
Capricorn District
Limpopo Province**

**REPORT-VSALEB/PR05/161
March 2006**

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TABLE OF CONTENTS:

1 INTRODUCTION:	2
1.1 BACKGROUND:.....	2
1.2 LOCATION:.....	2
1.3 OBJECTIVE:.....	2
1.4 METHODOLOGY:.....	3
2 VERIFICATION OF EXISTING GROUNDWATER SOURCES	3
3 GEOLOGY:	5
3.1 MOLETSIGRANITE (RMO):.....	5
3.2 HOUT RIVER GNEISS (RHR):.....	5
4 TESTPUMPING:	6
4.1 THE STEP DRAW DOWN TEST:.....	6
4.2 THE CONSTANT DISCHARGE TEST:.....	6
5 TEST PUMPING RESULTS:	7
6 HYDROCHEMISTRY:	8
6.1 SAMPLE PROCEDURE:.....	8
6.2 WATER QUALITY:.....	8
6.3 WATER QUALITY:.....	9
7 CONCLUSIONS:	9
8 RECOMMENDATIONS:	10
9 REFERENCES:	11

LIST OF TABLES:

<i>Table 1: Summary of existing borehole information:</i>	4
<i>Table 1 : Regional geology:</i>	5
<i>Table 2: Summary of testing results.</i>	7
<i>Table 3: Classification parameters:</i>	8
<i>Table 4: Preliminary hydro chemical results:</i>	9

LIST OF MAPS:

MAP A: Locality map.

MAP B: Investigation area with proposed production borehole positions with the radius of influence.

MAP C: Investigation area with borehole positions and recommended abstraction yields.

1 INTRODUCTION:

1.1 Background:

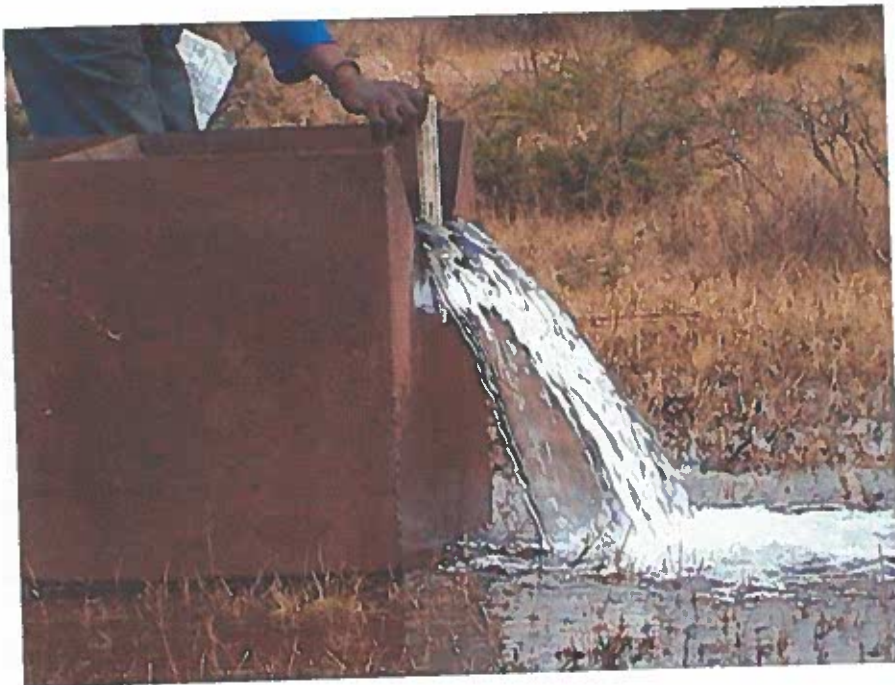
Bigen Africa appointed VSA Leboa Consulting in October 2005 as the Geohydrological consultant for the scientific yield testing of existing groundwater sources within the Moletje Central area. The scientific yield testing of boreholes within the area was needed to determine the availability of groundwater as a source of water supply for the proposed water distribution within the area. An area south east of the Koloti village was proposed as the target area for the abstraction of approximately 15l/s from existing boreholes.

1.2 Location:





Moletje central bulk water supply project is in an area approximately 15km north west of Polokwane, Capricorn District, Limpopo provinces. (MAP A).

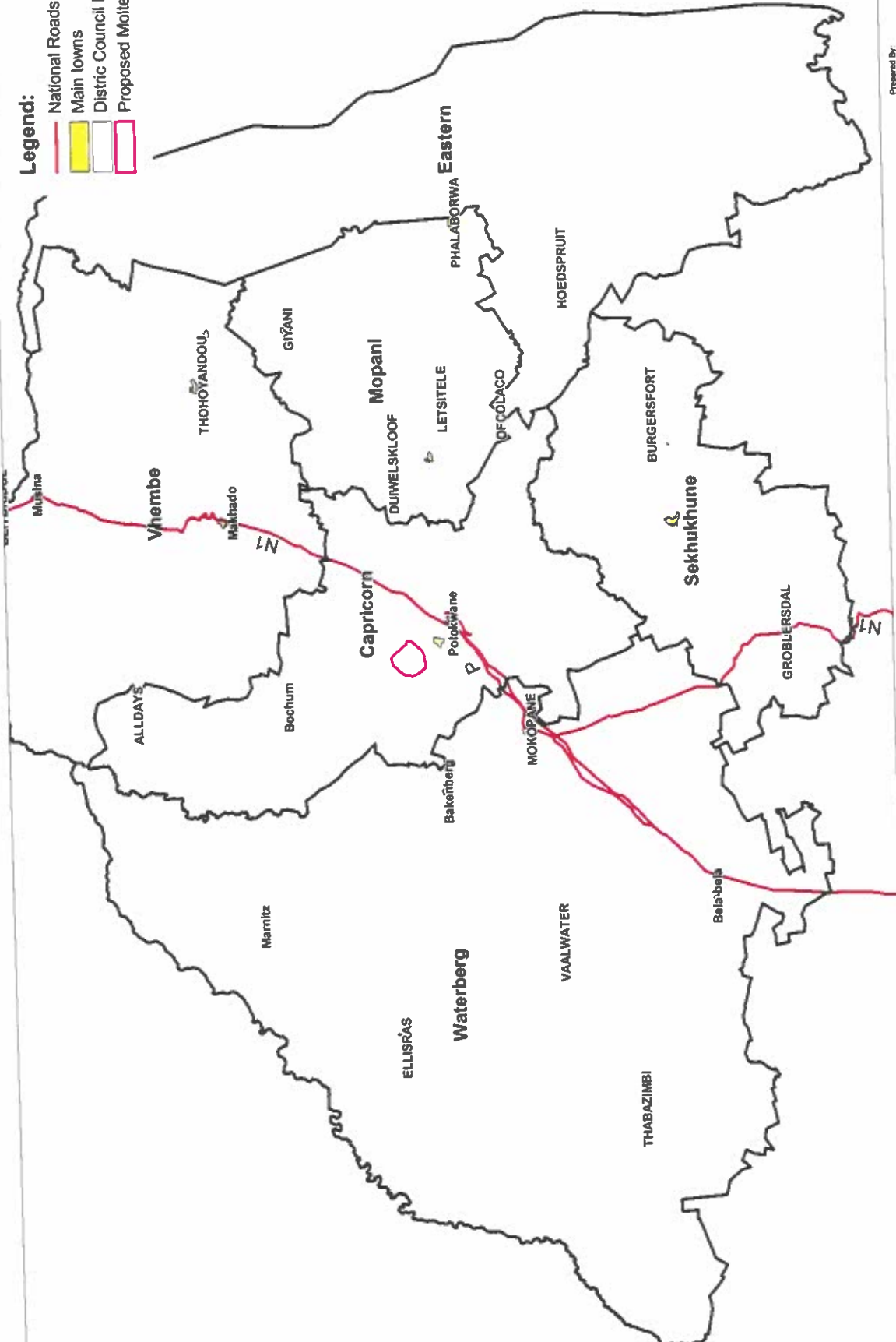
1.3 Objective:

The aim of the investigation was to scientifically test the existing sources, to chemically analyse the water and to submit management recommendations on future abstraction within this area from groundwater sources.



Map A : Locality Map

- Legend:**
-  National Roads
 -  Main towns
 -  District Council Boundary
 -  Proposed Molteje Central Area



Scale 1 : 2,500,500
Scanned Maps

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1.4 Methodology:

- Acquisition and evaluation of existing data on the database and available reports.
- Submission of a cost estimate for the regional yield testing of approximately 22 boreholes within an area of approximately 137 km².
- Approval of a second cost estimate for ten boreholes on the southeastern side of the project area.
- Field visit to verify the program for testing.
- Testing supervision and recommended actions during the testing program – Step draw down tests, Constant yield testing and Recovery's between each phase, the borehole construction was also inspected and the status reported.
- Progress reporting.
- Recommendations to utilize two well fields for abstraction due to the high volume required.
- Final testing of three additional boreholes within the recommended target area.
- Progress reporting and recommendations.
- Analysis of water collected during the testing phase, data analyses and classification of chemical results.
- Management recommendations
- Final reporting.

2 VERIFICATION OF EXISTING GROUNDWATER SOURCES

Available data on existing boreholes were collected within the project area. Information was updated from the grip website. The following table summarizes all existing boreholes within this radius before drilling started.

Table 1: Summary of existing borehole information:

BOREHOLE NUMBER	CURRENT STATUS	EQUIPMENT	COMMENTS
H04-0001	In use	Mono pump	Equipment must be replaced
H04-0002	In use	Mono pump	Equipment must be replaced
H04-0022	In use	Mono pump	Can be tested
H04-0054	Unused	No Equipment	Blocked
H04-0726	Unused	No Equipment	Redrill borehole – Blocked
H04-1090	Unused	No Equipment	Can be tested
H04-1098	Unused	No Equipment	Can not be tested
H04-1708	In use	Mono pump	Concrete pump house Cannot be tested
H04-1717	Unused	No Equipment	Filled with rocks.
H04-1722	In use	Mono pump	Can be tested



H04-1090

3 GEOLOGY:

Table 2 : Regional geology:

Data from the 1:250 000 geological mapsheet 2328 Pietersburg:

Age	Group	Intrusive rocks and sequence	Lithological description
Quaternary			
Radium		Moletsi granite	Medium-grained porphyritic, grey to pink biotite granite.
		Houtrivier gneiss	Leucocratic migmatite and gneiss, grey and pink hornblende-biotite gneiss, grey biotite gneiss, minor muscovite-bearing granite, pegmatite and gneiss.

3.1 Moletsigranite (Rmo):

This biotite granite, which weathers typically into huge oval boulders, consists of two varieties: a pink, medium grained porphyritic rock. The latter is more widespread. Locally the granite, which has a granodioritic composition, contains aligned clusters of biotite, now largely altered to chlorite. It also contains inclusions of banded gneiss and leucocratic granite. Garnets may occasionally be present.

3.2 Hout River Gneiss (Rhr):

A wide variety of granitoid rocks have been grouped under this lithology. They include leucocratic migmatite and gneiss, grey and pink hornblende-biotite gneiss, grey biotite gneiss and pegmatitic rocks. The grey biotite gneiss and pegmatites are the most common varieties in the area (Fig. 3). Underlying flat country and poorly exposed, the gneiss is typified by the absence of anatectic material. The foliation, which shows up very well on weathered surfaces, parallels the fabric in the adjacent schistose rocks of the Pietersburg Group. Pegmatites are prominently developed near the contact with the Pietersburg Group. They are largely massive exfoliated rocks that may have a directional fabric.

4 TESTPUMPING:

The correct operation and utilisation of boreholes result from the assessment of the productive capacity (yield potential) of the hole as well as the productivity of the aquifer supporting the borehole. Three different types of pumping tests performed separately provide such knowledge. The purpose for which the borehole is to be used and the amount of water required to supply in the demand, are the circumstances that will determine whether one, two or all three tests are required. The calibration test is normally incorporated with the Step draw down test.

The borehole yield-testing program for this project consists of a step draw down test and/or a constant discharge test for higher yielding boreholes.

4.1 The step draw down test:

The step draw down test is performed to assess the efficiency of the borehole, and to determine at which rate a longer duration test (constant discharge test) can be performed. It entails pumping the hole at three or more sequentially higher pumping rates each maintained for an equal length of time (generally not less than 60 minutes and seldom longer than 120 minutes). The magnitude by which the water level in the borehole drops (known as the **draw down**) in response to these known pumping rates is measured and recorded in accordance with a prescribed time schedule. The water level is also measured and recorded, again to a prescribed time schedule, for a period of time immediately following the period of pumping. This represents the period of recovery in which the water level rises towards its starting level before pumping.

4.2 The constant discharge test:

The constant discharge test is performed to determine aquifer parameter values (transmissivity and storativity) and to determine the possible existence of groundwater barrier boundaries. The test entails pumping the borehole at a single pumping rate, which is kept constant for the entire duration of the test (12-72 hours). The draw down in water level in the borehole during the course of the test is again measured and recorded according to a prescribed time schedule. In the case of the constant discharge test the recovery period is also measured and recorded.

The data obtained from the constant discharge test (Appendix) permits the calculation of the specific capacity of the borehole at the set-pumping rate after a substantially longer period of pumping. A comparison of this value with those obtained from the step drawdown test offers a means of assessing the more realistic productivity of the borehole under operating conditions. It also permits the

transmissivity of the aquifer to be calculated. This parameter quantifies the ability of the groundwater resource to transmit water, thereby describing the conduit function of the aquifer.

Quantification of the second function of an aquifer, namely its water storage capacity (**storativity**), is achieved if the water level response in an observation borehole is known. It defines that volume of the rock material, which is able to store water.

Although test pumping cannot be considered as the ideal way of evaluating the long-term sustainability of a groundwater resource, it does provide a quick and simple way of evaluating the short to medium term performance characteristics of a borehole. It must be emphasised that calculations done from test pumping data are only representative of the aquifer characteristics in the immediate surrounding of the borehole. Factors such as aquifer transmissivity as well as the length of a test, will determine the area of influence reached during testing (the longer the test, the greater the area of influence).

5 TEST PUMPING RESULTS:

Table 3: Summary of testing results.

Borehole	Testing Program	Recovery	Recommended Daily abstraction	Water quality
H04-0053	3X Multi step test with a constant discharge test (24hrs)	99% within 1440min	0.5l/s for 24hrs pumping cycle	Class 3
H04-0055	4X Multi step test with a constant discharge test (24hrs)	97 % within 480min	0.7 l/s for 24hrs pumping cycle	Class 3
H04-0057	3X Multi step test with a constant discharge test (24hrs)	100% within 1440min	0.4 l/s for 24hrs pumping cycle	Class 2
H04-1114	4X Multi step test with a constant discharge test (48hrs)	98 % within 2880min	2.5 l/s for 24hrs pumping cycle	Class 2
H04-1699	4 x step-draw down test Constant discharge test (24hrs)	99 % within 1440min.	0.8 l/s for 24hrs pumping cycle	Class 3
H04-1702	4 x step-draw down test Constant discharge test (60hrs)	99 % within 3600min.	6.00 l/s for 24hrs pumping cycle	Class 2
H04-1715	4 x step-draw down test Constant discharge test (48hrs)	98 % within 2880min	3.00 l/s for 24hrs pumping cycle	Class 1

6 HYDROCHEMISTRY:

Groundwater samples were collected from boreholes during the testing phase. The samples were sent to UIS Analytical Services (PTY) Ltd for preliminary analysis as well as to the DWAF laboratory in Pretoria for a full analysis of the main hydro chemical concentration (macro-elements) in the groundwater sample. Elements analysed for include: Ca, Mg, Na, K, Cl, NO₃, SO₄, PO₄, NH₄, CO₂, and HCO₃. The full DWAF laboratory analyses are not yet available.

6.1 Sample procedure:

Groundwater samples were taken at the end of the last testing phase. This sample is usually taken towards the end of the constant discharge test, as this water is more representative of the aquifer when flow increases towards the pumped borehole from a wider zone of the aquifer with an increased pumping time.

6.2 Water quality:

Water quality of domestic water, utilized for human consumption and food preparation, must be safe to use if the consumers' health is to be protected. For this reason the "Proposed Guide for the Health Related Assessment of the Quality of Water Supplies" (First Edition, 1998)" was set forward by the Department of Water Affairs and Forestry in 1998. This document facilitates the evaluation of water on the basis of five water quality classes:

Table 4: Classification parameters:

CLASS	pH	TDS	EC	Total Hard	Ca	Mg	Cl	SO ₄	NO ₃	Na	K	F
Class 0	5.00-9.50	<450	<70	0-200	0-80	<30-70	<100	<100-200	<6	<100	<25	<0.7
Class 1	4.50-5.00	450-1000	70-150	200-300	80-150	70-100	100-200	200-400	6-10	100-200	25-50	0.7-1.00
Class 2	4-4.50	1000-2400	150-370	300-600	150-300	100-200	200-600	400-600	10-20	200-400	50-100	1.00-1.50
Class 3	3.00-4.00	2400-3400	370-520	>600	>300	200-400	600-1200	600-1000	20-40	400-1000	100-500	1.50-3.50
Class 4	<3->11	>3400	>520			>400	>1200	>1000	>40	>1000	>500	>3.50

Class 0: Ideal water quality. Suitable for lifetime use.

Class 1: Good water quality. Suitable for use, rare instances of negative effects.

Class 2: Marginal water quality-conditionally acceptable. Negative effects may occur in some sensitive groups.

Class 3: Poor water quality. Unsuitable for use without treatment. Chronic effects may occur.

Class 4: Dangerous water quality, totally unsuitable for use. Acute effects may occur.

6.3 Water quality:

Table 5: Preliminary hydro chemical results:

BOREHOLE	Ph	EC	TDS	Fe	Mn	Cl	N	F	CLASS
H04-0053	7.91	116	762	0.05	0.05	68.1	2.6	2.4	Class 3
H04-0055	7.21	74	516	0.05	0.05	69.7	18.1	1.9	Class 3
H04-0057	7.22	46	324	0.05	0.05	35.2	9	1	Class 2
H04-1114	7.58	116	696	0.05	0.05	170	11.8	0.4	Class 2
H04-1699	6.98	94	678	0.05	0.05	91.6	36.1	1.2	Class 3
H04-1702	7.81	93	610	0.05	0.05	84.5	2.9	1.1	Class 2
H04-1715	7.34	39	310	0.05	0.05	20.2	9.3	0.3	Class 1

Hydro chemical results of sampled boreholes indicate that the groundwater in the area is of good to poor quality (Class 1 to Class 3). The poorer water quality is mainly due to the Fluoride (F) and Nitrite (N) concentration.

7 CONCLUSIONS:

- The recommended abstraction from four boreholes within the proposed well field south of the Koloti village is 604 800 l/day and can supply water to 10 080 people at 60 litres per person per day.
- The recommended abstraction from three other boreholes within the well field east of Mabotsa2 is 1 123 200 l/day and can supply water to 18 720 people at 60 liters per person per day.
- From seven boreholes a total of 1 728 000 liters per day are available as a save abstraction volume when no additional abstraction is made for an area of approximately 65km². (20l/s @ 24 hours duty cycle)

- The transmissivity of the aquifer is very high and therefore the high yielding sources, but the storativity is a concern and therefore the reduced recommended abstraction and the **need for groundwater modelling** especially due to shallow and deep water strikes.
- Groundwater management will be the most important aspect of water supply when designing, planning, and implementing this project.
- The water in the tested boreholes was chemically classed between Class1 and Class3 water. The water is suitable for use but for the best results the water from all the boreholes should be mixed within the same reservoir. It is however evident that the stronger boreholes has better water qualities!

8 RECOMMENDATIONS:

- It **must be considered to conduct a groundwater model** on the collected data. After calculating the reserve and recharge, a more accurate abstraction value available from groundwater can be given.
- Attempts should be made to utilize **both the proposed well fields together with the available surface water and to install a regional supply network** to all the villages involved.
- **Artificial recharge should also be considered** during the rainy season. This is a process whereby filtered and treated surface water is channelled to a normally unused borehole with known fractures and by doing so recharge the aquifer rapidly. Depending on the willingness of the aquifer to accept the water, high yields and huge volumes of water can be stored within the aquifer.
- **Equip all the boreholes according the attached recommendations** and install monitoring facilities. For best efficiency the borehole must be electrified and equipped according the 24 hour abstraction rate and equipment designed accordingly to supply the **1 728 000 litres per day,**
- **Monitoring** of the water levels, rainfall and groundwater abstraction values will be essential and only through proper management of the water source can the under or over utilization of the source be determined. Should artificial recharge be implemented the volumes inserted should also be measured regularly.
- **The water from the seven recommended boreholes should be mixed** to ensure the quality of the water at the supply point is chemically Class2 or better water.

9 REFERENCES:

- Existing information from the grip Internet site, The National Groundwater Data Base and The Limpopo Aquabase Data Base. This information sites is updated and maintained by The Department of Water Affairs and Forestry.
- BRANDL, G. (1986). The geology of the Pietersburg area: Expl. Sheet geol. Surv. S. Afr., 2328 (Pietersburg),
- MIDGLEY, D.C., PITMAN, W.V., MIDDLETON, B.J. (1994). Surface water resources of South Africa 1990. WRC Report no 298/1.1/94, Vol. 1 Appendices (First edition).
- Water Research Commission. Quality of domestic water supplies. Report no TT101/98, Vol. 1 Assessment guide (Second edition).

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H04-1708

Appendix

Test Pumping Results
(Per Borehole)

PUMPING TEST REPORT

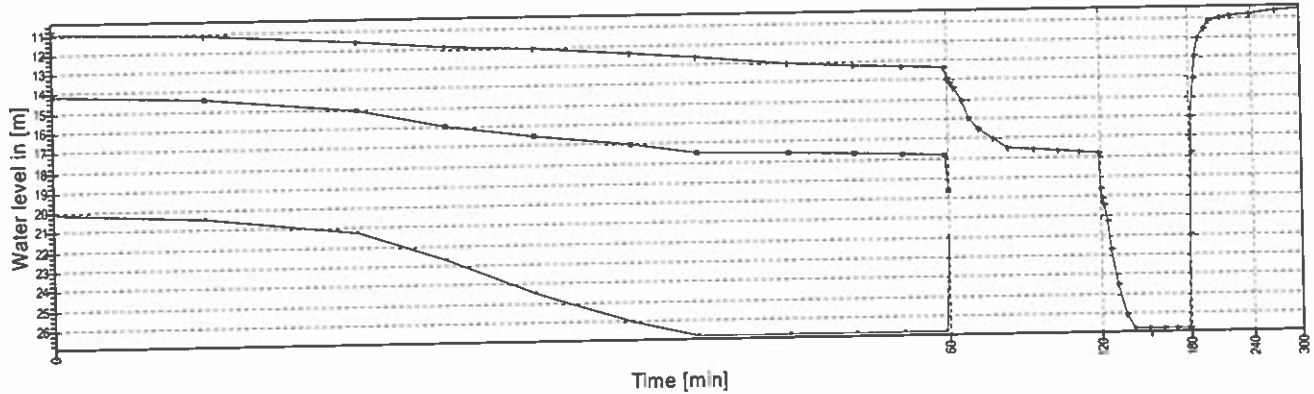
Date compiled: 2006/03/15

BASIC SITE INFORMATION: Site Identifier: 2329GCB0083 Number: H04-0053 Site type: Borehole
 Distr./Farm No.: LPLS606 Site Name/Des.: MALIETZIES/RAMPHELA

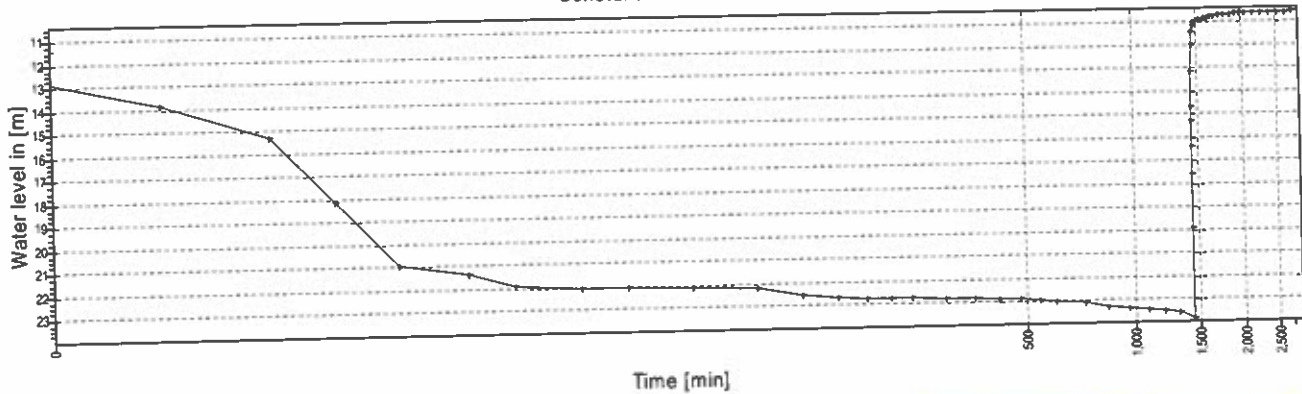
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Altitude [m]:	1220.00	Rep. inst.: VSA	Col. ht. [mm]:	0.35	Date WL meas.:	20060111

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



PUMPING TEST:

Rep. inst.	Meth. tested	Depth to intake [m]	Starting Date	Time	Ending Date	Time	Transmis. [m ² /d]	Storativ.	Rec. abs. [l/s]
VSA	Multirate test	26.85	20060111	1755	20060111	2254			
VSA	Constant rate test	26.85	20060112	0630	20060116	0629			

TESTING DETAILS:

Description	Time start.	Durat. [min]	Depth to intk. [m]	Disch. rate [l/s]	Drawd. [m]	Recov. [m]	Rec. Dur. [min]	Trans. [m ² /d]	Perm. [m/d]	Storat.	Q/st
MULTI STEP 1	1755	60	26.85	0.56	13.33						0.04
MULTI STEP 2	1855	60	26.85	1.34	17.79						0.08
MULTI STEP 3	1955	60	26.85	2.40	26.75	10.54	99	120			0.09
CONSTANT RATE	0630	1440	26.85	2.16	23.83	10.49	99	1440			0.09



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PUMPING TEST REPORT

Date compiled: 2006/03/15

BASIC SITE INFORMATION:

Site Identifier: 2329CDV3016 Number: H04-0057

Site type: Borehole

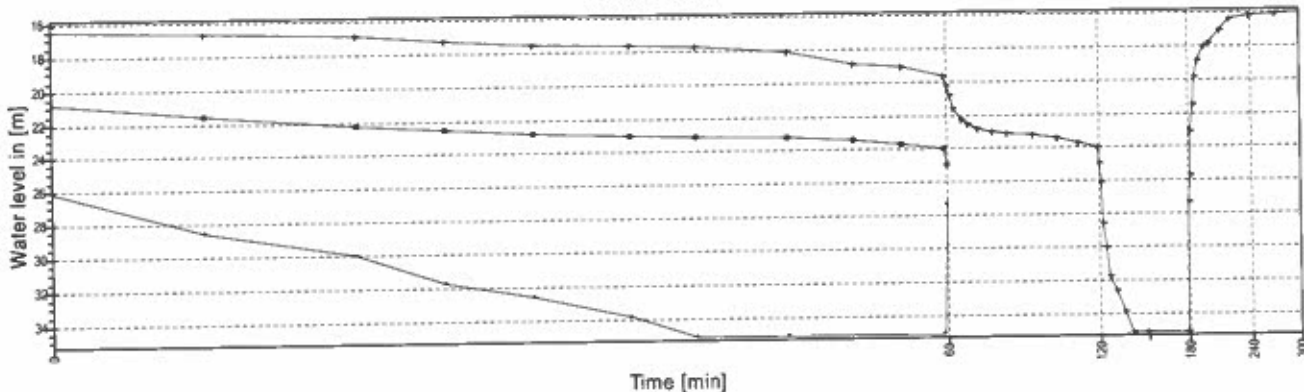
Distr./Farm No.: LPLS606

Site Name/Des.: MALIETZIES/MADIKOTI

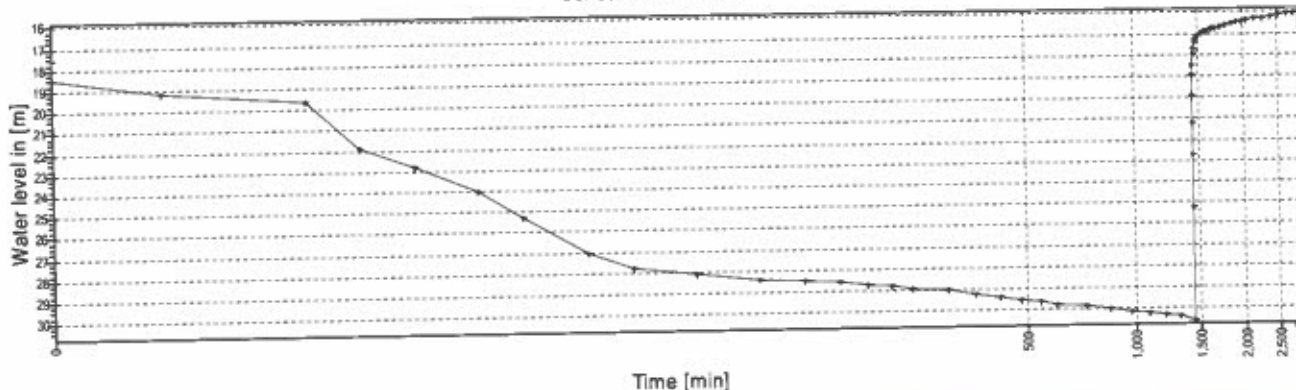
Latitude [°]	23.754169	Alt. No. 1:	Diam. [mm]:	165	Water lev. [m]:	30.58
Longitude [°]	29.316390	Alt. No. 2:	Depth [m]:	41.62	Piezometer:	0
Altitude [m]:	1280.00	Rep. inst.: VSA	Col. ht. [mm]:	0.04	Date WL meas.:	20051212

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



PUMPING TEST:

Rep. inst.	Meth. tested	Depth to intake [m]	Starting Date	Time	Ending Date	Time	Transmis. [m ² /d]	Storativ.	Rec. abs. [l/s]
VSA	Multirate test	36.50	20051211	1145	20051211	1644			
VSA	Constant rate test	36.50	20051211	1720	20051213	1720			

TESTING DETAILS:

Description	Time start.	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recov. [m]	Rec. Dur. [min]	Trans. [m ² /d]	Perm. [m/d]	Storat.	Q/st
MULTI STEP 1	1145	60	36.50	0.41	19.68						0.02
MULTI STEP 2	1245	60	36.50	0.91	23.96						0.04
MULTI STEP 3	1345	30	36.50	1.90	35.07	16.00	99	120			0.05
CONSTANT	1621	1440	36.50	1.41	30.58	15.97	100	1440			0.05



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PUMPING TEST REPORT

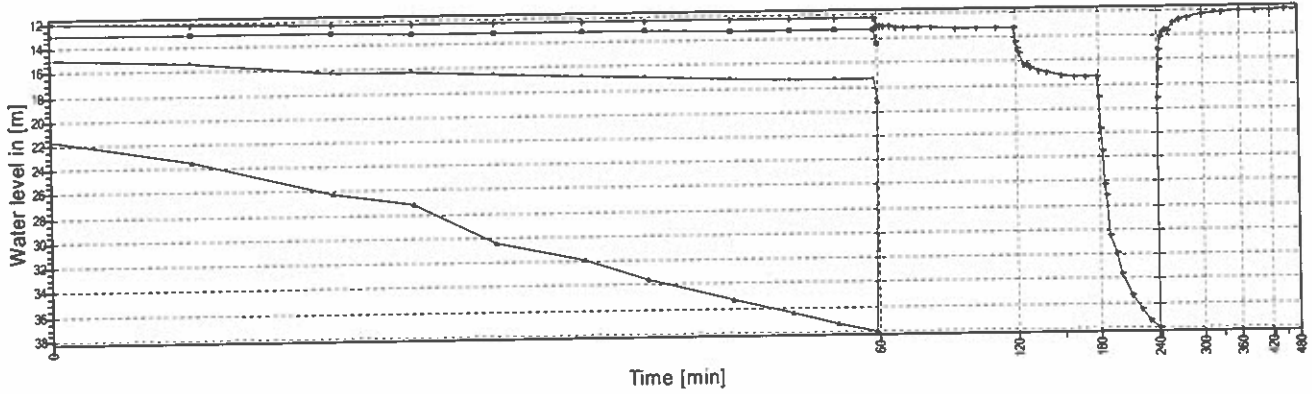
Date compiled: 2006/03/15

BASIC SITE INFORMATION: Site Identifier: 2431CBV0001 Number: H04-1114 Site type: Borehole
 Distr./Farm No.: LPLS606 Site Name/Des.: MALIETZIES/MABUKELELE

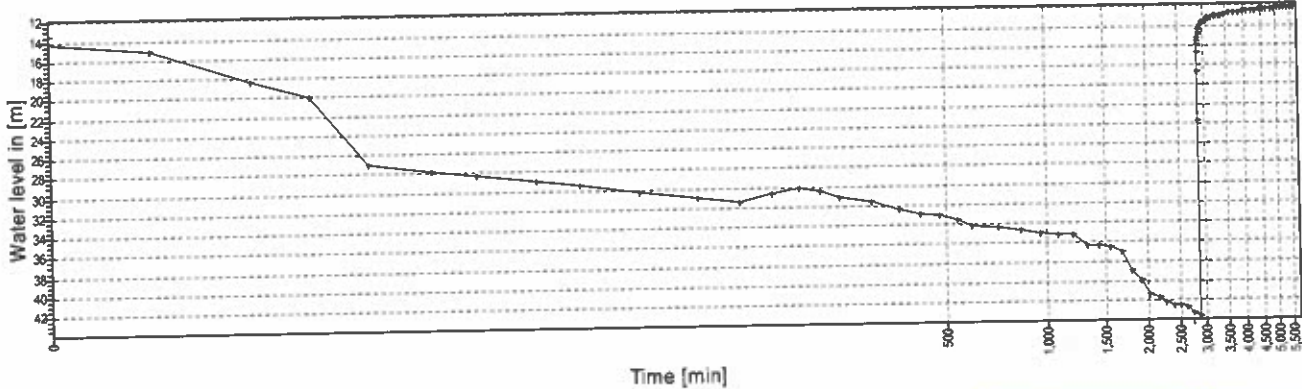
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Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



PUMPING TEST:

Rep. Inst.	Meth. tested	Depth to intake [m]	Starting Date	Time	Ending Date	Time	Transmis. [m ² /d]	Storativ.	Rec. abs. [l/s]
VSA	Multirate test	93.65	20051209	1026	20051209	1825			
VSA	Constant rate test	93.65	20051211	1108	20051215	1107			

TESTING DETAILS:

Description	Time start	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recov. [m]	Rec. Dur. [min]	Trans. [m ² /d]	Perm. [m/d]	Storat.	Q/st
MULTI STEP 1	1026	60	93.65	0.61	12.26						0.05
MULTI STEP 2	1126	60	93.65	1.40	13.24						0.11
MULTI STEP 3	1226	60	93.65	4.14	17.34						0.24
MULTI STEP 4	1326	60	93.65	9.47	38.03	11.89	99	240			0.25
CONSTANT RATE	1107	2880	93.65	8.18	43.62	12.10	98	2880			0.19



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PUMPING TEST REPORT

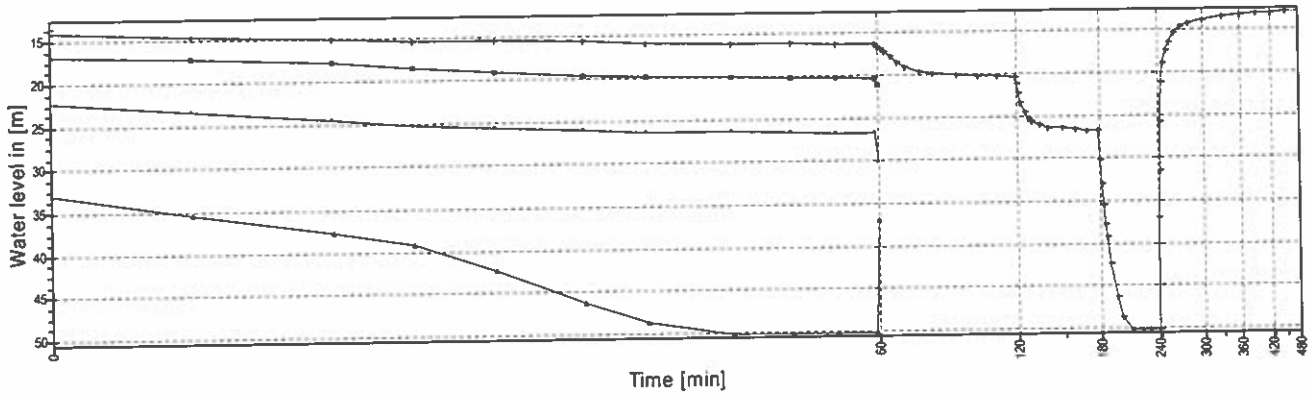
Date compiled: 2006/03/15

BASIC SITE INFORMATION: Site Identifier: 2329CBV3039 Number: H04-1699 Site type: Borehole
 Distr./Farm No.: LPLS606 Site Name/Des.: MALIETZIES/MMADIKOTI

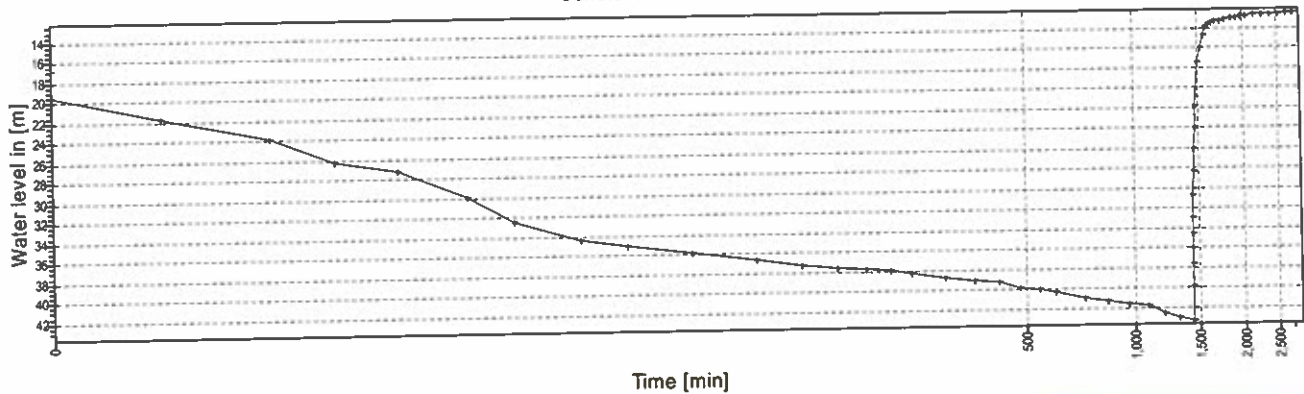
Latitude [°]	23.731194	Alt. No. 1:	Diam. [mm]:	155	Water lev. [m]:	11.70
Longitude [°]	29.317333	Alt. No. 2:	Depth [m]:	66.85	Piezometer:	0
Altitude [m]:	1340.00	Rep. inst.: VSA	Col. ht. [mm]:	0.50	Date WL meas.:	20060120

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



PUMPING TEST:		Depth to intake [m]	Starting Date	Ending Date	Transmis. [m ² /d]	Rec. abs. [l/s]
Rep. inst.	Meth. tested		Time	Time	Storativ.	
VSA	Multirate test	50.50	20060120 0921	20060120 1720		
VSA	Constant rate test	50.50	20060121 1711	20060123 1710		

TESTING DETAILS:		Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recov. [m]	Rec. Dur. [min]	Trans. [m ² /d]	Perm. [m/d]	Storat.	Q/st
Description	Time start.										
MULTI STEP 1	0921	60	50.50	0.52	16.30						0.03
MULTI STEP 2	1021	60	50.50	1.12	20.31						0.06
MULTI STEP 3	1121	60	50.50	2.15	26.85						0.08
MULTI STEP 4	1221	60	50.50	3.80	50.20	12.90	91	240			0.08
CONSTANT RATE	1711	1440	50.50	3.42	43.31	12.47	99	1440			0.08



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PUMPING TEST REPORT

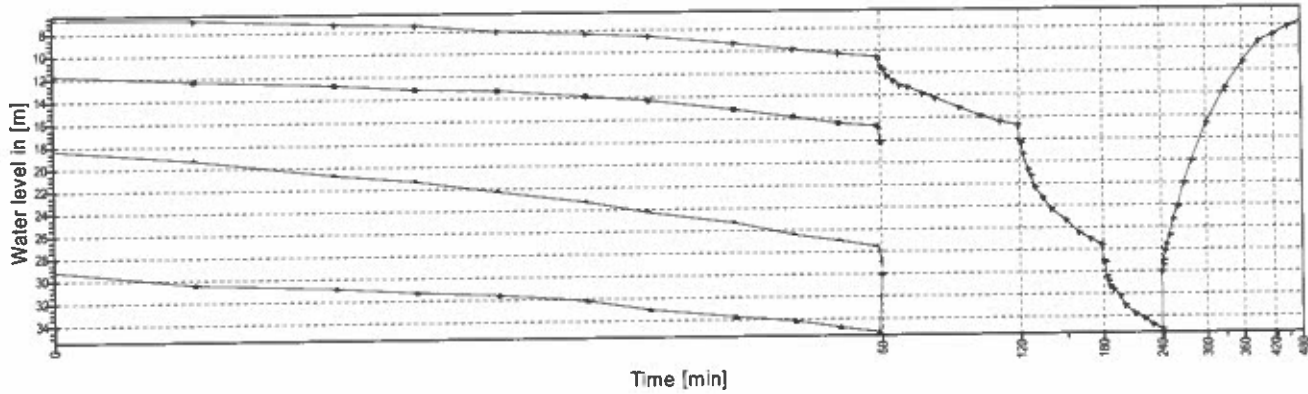
Date compiled: 2006/03/15

BASIC SITE INFORMATION: Site Identifier: 2329CBV1017 Number: H04-1702 Site type: Borehole
 Distr./Farm No.: LPLS606 Site Name/Des.: MALIETZIES/MABOTSA 2

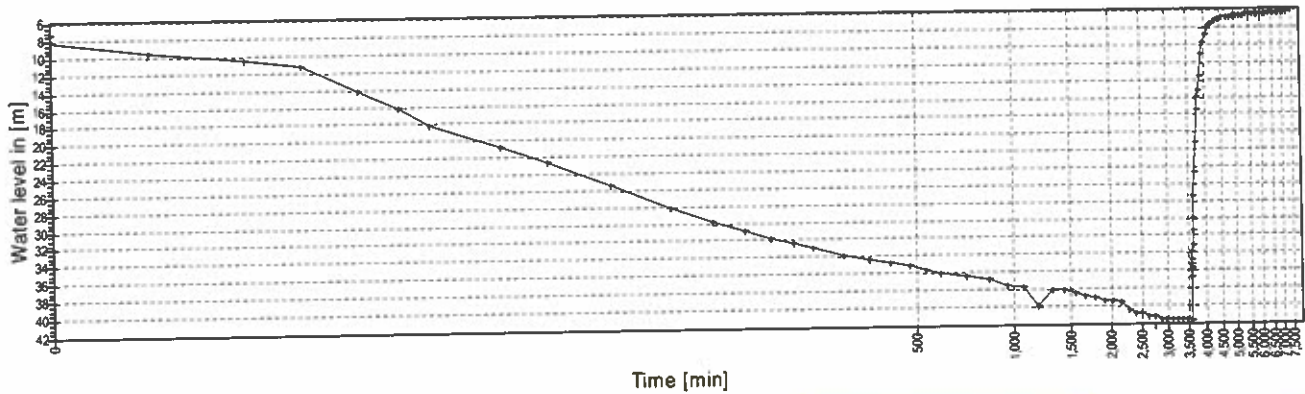
Latitude [°]	23.726861	Alt. No. 1: 5245	Diam. [mm]:	165	Water lev. [m]:	5.90
Longitude [°]	29.370333	Alt. No. 2: G45795	Depth [m]:	76.72	Piezometer:	0
Altitude [m]:	1210.00	Rep. inst.: VSA	Col. ht. [mm]:	0.25	Date WL meas.:	20060111

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



PUMPING TEST:		Depth to intake [m]	Starting Date	Ending Date	Time	Transmis. [m ² /d]	Storativ.	Rec. abs. [l/s]
Rep. Inst.	Meth. tested							
VSA	Multirate test	48.65	20060111	20060111	0608 - 1407			
VSA	Constant rate test	48.65	20060111	20060116	1544 - 1539			

Description	Time start.	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recov. [m]	Rec.		Perm. [m/d]	Storat.	Q/st
							Dur. [min]	Trans. [m ² /d]			
MULTI STEP 1	0608	60	48.65	5.18	10.60						0.49
MULTI STEP 2	0708	60	48.65	10.48	16.69						0.63
MULTI STEP 3	0808	60	48.65	21.69	27.63						0.79
MULTI STEP 4	0908	60	48.65	30.20	35.18	7.62	95	240			0.86
CONSTANT RATE	1544	3600	48.65	25.32	41.59	6.11	99	3600			0.61



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PUMPING TEST REPORT

Date compiled: 2006/03/15

BASIC SITE INFORMATION:

Site Identifier: 2329CBV1015 Number: H04-1715

Site type: Borehole

Distr./Farm No.: LPLS606

Site Name/Des.: MALIETZIES/MAKGODU

Latitude [°] 23.729190

Alt. No. 1:

Diam. [mm]: 165

Water lev. [m]: 31.14

Longitude [°] 29.390700

Alt. No. 2:

Depth [m]: 149.78

Piezometer: 0

Altitude [m]: 1240.00

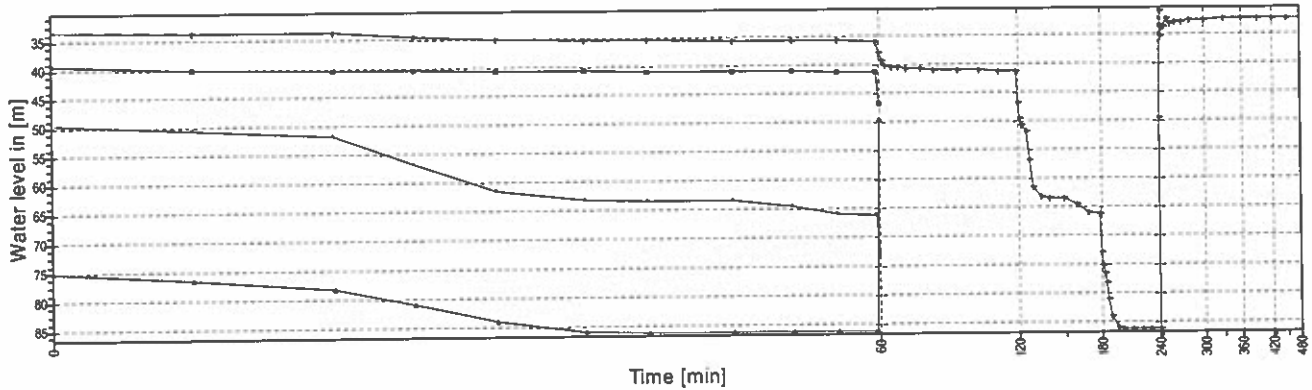
Rep. inst.: VSA

Col. ht. [mm]: 0.38

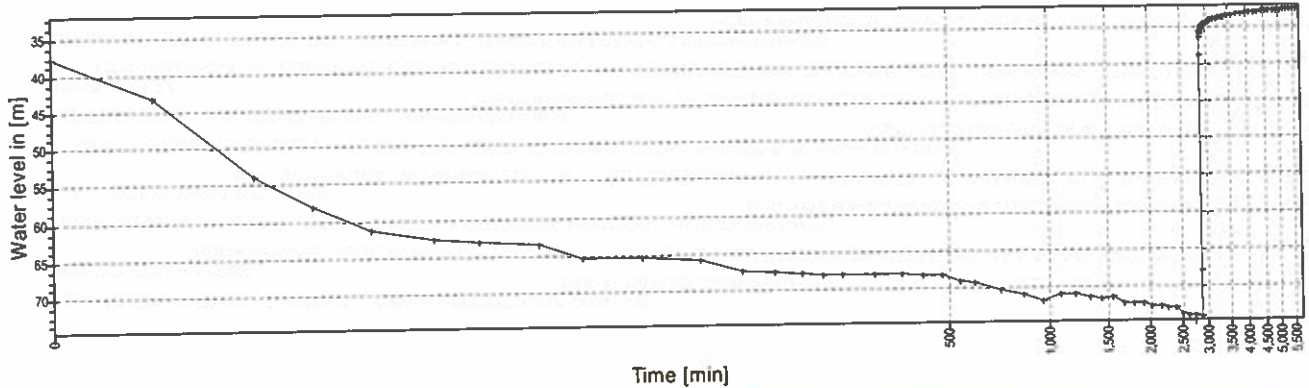
Date WL meas.: 20051215

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Multirate Test



Constant Rate Test



PUMPING TEST:

Rep. Inst.	Meth. tested	Depth to intake [m]	Starting Date	Time	Ending Date	Time	Transmis. [m ² /d]	Storativ.	Rec. abs. [l/s]
VSA	Multirate test	89.60	20051215	1951	20051216	0350			
VSA	Constant rate test	89.60	20051216	0601	20051220	0600			

TESTING DETAILS:

Description	Time start	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recov. [m]	Rec. Dur. [min]	Trans. [m ² /d]	Perm. [m/d]	Storat.	Q/st
MULTI STEP 1	1951	60	89.60	2.05	35.60						0.06
MULTI STEP 2	2051	60	89.60	4.08	40.95						0.10
MULTI STEP 3	2151	60	89.60	9.07	66.13						0.14
MULTI STEP 4	2251	60	89.60	10.60	86.24	32.00	99	240			0.12
CONSTANT RATE	0601	2880	89.60	9.16	74.10	32.55	98	2880			0.12



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Management
Recommendation
(Per Borehole)

MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION: Site Identifier: 2329GCB0083 Number: H04-0053 Site type: Borehole

Distr./Farm No.: LPLS606 Site Name/Descr.: MALIETZIES/RAMPHELA

Latitude [°]:	23.736109	Alt. No. 1:	Diam. [mm]:	155	Water lev. [m]:	10.00
Longitude [°]:	29.362500	Alt. No. 2:	Depth [m]:	33.49	WL status:	Static
Altitude [m]:	1220.00	Rep. inst.: VSA	Col. ht. [m]:	0.35	Date WL meas.:	20060111

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:		Pulley Diam. [mm]:	
Type of Inst.:	Mono-type pump	Pulley Diam. [mm]:	
Manufacturer:	MONOMEESTER	Depth to Intk. [m]:	
Engine:		Power Rating [kW]	
Manufacturer:		Power Rating [kW]	
Type of Power:	Electric motor	Pulley Diam. [mm]: 13	

USE APPLICATION:

Site Status: In use
 Purpose: Production (water supply)
 Consumer:
 Application: Domestic - all purposes

WATER CHEMISTRY:

Sample No.:	14/2006	Date sampled:	20060112	Depth sampl. [m]:	0	Comment:	
Main Parameters:				Calculated Parameters:		Bacteriol. Parameters:	
pH:	7.91	Na:		Cl:	68.1	Langel.:	E.Coli:
EC: [mS/m]	116 †	K:		NO3 as N:	2.6	Aggr-Ind:	8.31
TDS:	762 †	Si:		SO4:	22.1	Ion-bal:	-100.00
T. Alk.:		Al:		F:	2.4 ‡	CaCO3:	SPC:
Ca:		Fe:	0.05	Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption			
Mg:		Mn:	0.05	† Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit			
				‡ Value exceeds recommended minimum limit ‡ Value exceeds minimum allowable limit			

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield[l/s]	Method meas.	Aquifer type	Comment
0.00	0.00	2.40	Notch (V- or U-notch)		PUMP SUCTION

CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]: Length Width	Hor. Dist.	Vert. Dist.
0.00	9.97	155	Steel					

TESTING DETAILS:

Description	Date	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recovery %	[min]	T [m ² /d]	Storage	Comment
MULTI STEP 1	20060111	60	26.85	0.56	13.33					
MULTI STEP 2	20060111	60	26.85	1.34	17.79					
MULTI STEP 3	20060111	60	26.85	2.40	26.75	10.54	99	120		
CONSTANT RATE	20060112	1440	26.85	2.16	23.83	10.49	99	1440		

RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality description	Dyn. water level [m]	Crit. water level [m]
1		30.00		10	0.77			

Note:

2

30.00

24

0.50 CLASS 3

24.00

Note: FC PRIORITY 2



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Summary

Main

H04-0053

Method	Sustainable yield (l/s)	Std Dev	Early T (m ² /d)	Late T (m ² /d)	S	AI used
Basic FC	0.44	0.27	15	5.0	1.68E-03	13.0
Advanced FC	0.53		15	5.0	1.00E-03	13.0
FC inflection point	0.36	0.24				12.5
Cooper-Jacob	0.36	0.23		5.0	2.80E-03	13.0
FC Non-Linear	0.37	0.32	5.0		1.00E-03	13.0
Barker	0.50	0.33	K _f = 100	S _s =	1.06E-03	13.0
Average Q sust (l/s)	0.43	0.08	b = 0.20	Fractal dimension n =	1.90	

Recommended abstraction rate (L/s) **0.50** for 24 hours per day

Hours per day of pumping **10** 0.77 L/s for 10 hours per day
0.91/s for 8 hours/day
 Amount of water allowed to be abstracted per month 1296 m³ **0.71/s for 12 hours/day**

Borehole could satisfy the basic human need of 1728 persons

Is the water suitable for domestic use (Yes/No) **Yes**

Comments

This double porosity aquifer is characterised by a fracture network, consisting of fractures with good extent.
 Skin effects and well losses have an influence on early time data.
 Linear flow dominated drawdown levels for the first 10 minutes before the fracture network was encountered at approximately 13m drawdown.
 Water was still drawn from this network when the test was terminated after 24 hours with no sign of dewatering of the aquifer in the recovery data.

The T-value of the formation is in the order of 5.
 According to the step drawdown test, the maximum yield of the borehole is 2.4l/s

The aim of the recommended maximum safe yield is to prevent the fracture network encountered during the test from dewatering.

Recommended depth of pump = 30m
 Critical depth = 24m (fracture network encountered during test)
 Static water level used during test = 10.5m
 Casing depth = 10m

Assumptions
 One no-flow boundary at 200m
 No rainfall recharge
 No other production boreholes in the same aquifer

MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION: Site Identifier: 2329CDV3016 Number: H04-0057 Site type: Borehole

Distr./Farm No.: LPLS606 Site Name/Descr.: MALIETZIES/MADIKOTI

Latitude [°]:	23.754169	Alt. No. 1:	Diam. [mm]:	165	Water lev. [m]:	30.58
Longitude [°]:	29.316390	Alt. No. 2:	Depth [m]:	41.62	WL status:	Static
Altitude [m]:	1280.00	Rep. inst.: VSA	Col. ht. [m]:	0.04	Date WL meas.:	20051212

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:			
Type of Inst.:	Mono-type pump	Pulley Diam. [mm]:	300
Manufacturer:	STEWARDS & LLOYDS	Depth to Intk. [m]:	34.50
Engine:			
Manufacturer:	MONO	Power Rating [kW]	
Type of Power:	Diesel engine	Pulley Diam. [mm]:	300

USE APPLICATION:

Site Status: In use
 Purpose: Production (water supply)
 Consumer:
 Application: Domestic - all purposes

WATER CHEMISTRY:

Sample No.:	2/2006	Date sampled:	20051212	Depth sampl. [m]:	0	Comment:	
Main Parameters:				Calculated Parameters:		Bacteriol. Parameters:	
pH:	7.22	Na:		Cl:	35.2	Langel.:	E.Coli:
EC: [mS/m]	46	K:		NO3 as N:	9	Aggr-Ind:	7.62
TDS:	324	Si:		SO4:	19.7	Ion-bal:	-100.00
T. Alk.:		Al:		F:	1	CaCO3:	
Ca:		Fe:	0.05	Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption			
Mg:		Mn:	0.05	† Value exceeds recommended maximum limit; ‡ Value exceeds maximum allowable limit			
				! Value exceeds recommended minimum limit; § Value exceeds minimum allowable limit			

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield [l/s]	Method meas.	Aquifer type	Comment
0.00	0.00	0.00	Notch (V- or U-notch)		TO TEST

CASING DETAILS:

Depth to Top [m] to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]:		Hor. Dist.	Vert. Dist.
					Length	Width		
0.00	5.30	165 Steel	2					

TESTING DETAILS:

Description	Date	Durat. [min]	Depth to intk. [m]	Disch. rate [l/s]	Drawd. [m]	Recovery %	[min]	T [m³/d]	Storage	Comment
MULTI STEP 1	20051211	60	36.50	0.41	19.68					
MULTI STEP 2	20051211	60	36.50	0.91	23.96					
MULTI STEP 3	20051211	30	36.50	1.90	35.07	16.00	99	120		
CONSTANT	20051211	1440	36.50	1.41	30.58	15.97	100	1440		

RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality description	Dyn. water level [m]	Crit. water level [m]
1		36.00		10	0.62			
Note:								
2		36.00		24	0.40	CLASS 2		30.00
Note: FC PRIORITY 2								



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Summary

Main

H04-0057

Method	Sustainable yield (l/s)	Std Dev	Early T (m ² /d)	Late T (m ² /d)	S	AD used
Basic FC	0.44	0.22	6	5.1	2.20E-03	14.7
Advanced FC	0.52		6	5.1	1.00E-03	14.7
FC inflection point	0.34	0.20				14.6
Cooper-Jacob	0.41	0.26		5.2	2.27E-03	14.7
FC Non-Linear	0.29	0.25	5.0		1.00E-03	14.7
Barker	0.38	0.16	K _f = 100	S _s =	1.06E-03	14.7
Average Q sust (l/s)	0.39	0.08	b = 0.20	Fractal dimension n =	1.83	

Recommended abstraction rate (L/s)	0.40	for 24 hours per day
Hours per day of pumping	10	0.62 L/s for 10 hours per day 0.71/s for 8 hours/day 0.61/s for 12 hours/day
Amount of water allowed to be abstracted per month	1036.8	m ³
Borehole could satisfy the basic human need of	1382	persons
Is the water suitable for domestic use (Yes/No)		

Comments

This double porosity aquifer is characterised by a fracture network, consisting of fractures with limited extent.
 Skin effects and well losses have an influence on early time data.
 Linear flow dominated drawdown levels for the first 40 minutes before the fracture network was encountered at approximately 13m - 15m drawdown.
 The test was terminated after 24 hours with no sign of dewatering of the aquifer in the recovery data.

The T-value of the formation is in the order of 5.1
 According to the step drawdown test, the maximum yield of the borehole is 1.6l/s

The aim of the recommended maximum safe yield is to prevent the fracture network encountered during the test from dewatering.

Recommended depth of pump = 36m
 Critical depth = 30m (fracture network encountered during test)
 Static water level used during test = 15.8m
 Casing depth = 5.3m

Assumptions
 One no-flow boundary at 200m
 No rainfall recharge
 No other production boreholes in the same aquifer

MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION: Site Identifier: 2431CBV0001 Number: H04-1114 Site type: Borehole

Distr./Farm No.: LPLS606 Site Name/Descr.: MALIETZIES/MABUKELELE

Latitude [°]: 23.776000	Alt. No. 1: G45313	Diam. [mm]: 165	Water lev. [m]: 11.06
Longitude [°]: 29.334806	Alt. No. 2:	Depth [m]: 150.95	WL status: Static
Altitude [m]:	Rep. inst.: VSA	Col. ht. [m]: 0.36	Date WL meas.: 20051209

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:		Pulley Diam. [mm]:	
Type of Inst.: No equipment		Depth to Intk. [m]:	
Manufacturer:			
Engine:		Power Rating [kW]	
Manufacturer:		Pulley Diam. [mm]:	
Type of Power:			

USE APPLICATION:

Site Status: In use
 Purpose: Production (water supply)
 Consumer: Non-urban
 Application: Agricultural and domestic use

WATER CHEMISTRY:

Sample No.: 3/2006	Date sampled: 20051213	Depth sampl. [m]: 0	Comment:
Main Parameters:		Calculated Parameters:	
pH: 7.58	Na:	Cl: 170	Langel.: E.Coli:
EC: [mS/m] 116 †	K:	NO3 as N: 11.8 †	Aggr-Ind: 7.98 Faec. co:
TDS: 696 †	Si:	SO4: 31	Ion-bal: -100.00 Total Co:
T. Alk.:	Al:	F: 0.4	CaCO3: SPC:
Ca:	Fe: 0.05	Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption	
Mg:	Mn: 0.05	† Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit	
		! Value exceeds recommended minimum limit Value exceeds minimum allowable limit	

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield [l/s]	Method meas.	Aquifer type	Comment
0.00	0.00	9.47	Notch (V- or U-notch)		PUMP SUCTION

CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]: Length Width	Hor. Dist.	Vert. Dist.
0.00	30.77	165	Steel	2				

TESTING DETAILS:

Description	Date	Durat. [min]	Depth to intk. [m]	Disch. rate [l/s]	Drawd. [m]	Recovery %	[min]	T [m ² /d]	Storage	Comment
MULTI STEP 1	20051209	60	93.65	0.61	12.26					
MULTI STEP 2	20051209	60	93.65	1.40	13.24					
MULTI STEP 3	20051209	60	93.65	4.14	17.34					
MULTI STEP 4	20051209	60	93.65	9.47	38.03	11.89	99	240		
CONSTANT RATE	20051211	2880	93.65	8.18	43.62	12.10	98	2880		

RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality description	Dyn. water level [m]	Crit. water level [m]
1		48.00		10	3.87			
Note:								
2		48.00		24	2.50	CLASS 2		35.00
Note: FC PRIORITY 2								



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Summary

Main

H04-1114

Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m ² /d)	Late T (m ² /d)	S	AI used
	Basic FC	2.27	0.99	#NUM!	17.6	2.20E-03	23.0
	Advanced FC	2.45		#NUM!	17.6	1.00E-03	23.0
	FC inflection point	2.36	1.24				22.9
	Cooper-Jacob	2.12	1.37		17.6	1.69E-03	23.0
	FC Non-Linear	2.49	2.20	18.0		1.00E-03	23.0
	Barker	2.02	0.78	K ₁ = 500		S _s = 1.06E-03	23.0
	Average Q_{sust} (l/s)	2.29	0.19	b = 0.20	Fractal dimension n =	1.80	

Recommended abstraction rate (L/s) **2.50** for 24 hours per day

Hours per day of pumping **10** 3.87 L/s for 10 hours per day
3.5l/s for 12 hours/day

Amount of water allowed to be abstracted per month **6480 m³** **4.5l/s for 8 hours/day**

Borehole could satisfy the basic human need of **8640** persons

Is the water suitable for domestic use (yes/no)

Comments

This double porosity aquifer is characterised by a good fracture network, consisting of fractures with good extent.
 After well losses for the first 10 minutes of the test, the fracture network was encountered at approximately 18m - 23m drawdown.
 After approximately 1680 minutes in the test, the influence of two parallel no-flow boundaries could be detected in the drawdown levels.
 The test was terminated after 48 hours with no sign of dewatering of the aquifer in the recovery data.

The T-value of the formation is in the order of 17.

The aim of the recommended maximum safe yield is to prevent the fracture network encountered during the test from dewatering. The limits of the network are however unknown from the test data. A best possible recommendation is made from aquifer characteristics revealed from available data.

Recommended depth of pump = 48m
 Critical depth = 35m (fracture network encountered during test)
 Static water level used during test = 11.7m
 Casing depth = 30.8m

Assumptions

- Two no-flow boundaries at 200m
- No rainfall recharge
- No other production boreholes in the same aquifer

MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION: Site Identifier: 2329CBV3039 Number: H04-1699 Site type: Borehole

Distr./Farm No.: LPLS606 Site Name/Descr.: MALIETZIES/MMADIKOTI

Latitude [°]:	23.731194	Alt. No. 1:	Diam. [mm]:	155	Water lev. [m]:	11.70
Longitude [°]:	29.317333	Alt. No. 2:	Depth [m]:	66.85	WL status:	Static
Altitude [m]:	1340.00	Rep. inst.: VSA	Col. ht. [m]:	0.50	Date WL meas.:	20060120

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:
 Type of Inst.: Mono-type pump Pulley Diam. [mm]:
 Manufacturer: MONOMEESTER Depth to Intk. [m]:

Engine:
 Manufacturer: Power Rating [kW]
 Type of Power: Diesel engine Pulley Diam. [mm]:

USE APPLICATION:

Site Status:

Purpose:

Consumer:

Application:

WATER CHEMISTRY:

Sample No.:	19/2006	Date sampled:	20060122	Depth sampl. [m]:	0	Comment:	
Main Parameters:				Calculated Parameters:		Bacteriol. Parameters:	
pH:	6.98	Na:		Cl:	91.6	Langel.:	E.Coli:
EC: [mS/m]	94 †	K:		NO3 as N:	36.1 ‡	Aggr-Ind:	7.38
TDS:	678 †	Si:		SO4:	28.9	Ion-bal:	-100.00
T. Alk.:		Al:		F:	1.2 †	CaCO3:	
Ca:		Fe:	0.05	Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption			
Mg:		Mn:	0.05	† Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit			
				! Value exceeds recommended minimum limit Value exceeds minimum allowable limit			

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield [l/s]	Method meas.	Aquifer type	Comment
0.00	0.00	3.80	Notch (V- or U-notch)		PUMP SUCTION

CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]: Length Width	Hor. Dist.	Vert. Dist.
0.00	4.86	155	Steel					

TESTING DETAILS:

Description	Date	Durat. [min]	Depth to intk. [m]	Disch. rate [l/s]	Drawd. [m]	Recovery [m] %	[min]	T [m³/d]	Storage	Comment
MULTI STEP 1	20060120	60	50.50	0.52	16.30					
MULTI STEP 2	20060120	60	50.50	1.12	20.31					
MULTI STEP 3	20060120	60	50.50	2.15	26.85					
MULTI STEP 4	20060120	60	50.50	3.80	50.20	12.90	91	240		
CONSTANT RATE	20060121	1440	50.50	3.42	43.31	12.47	99	1440		

RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality description	Dyn. water level [m]	Crit. water level [m]
1		42.00		10	1.24			

Note:

2

42.00

24

0.80 CLASS 3

38.00

Note: FC PRIORITY 2



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Summary

Main

H04-1699

Method	Sustainable yield (l/s)	Std. Dev	Early T (m ² /d)	Late T (m ² /d)	S	AD used
Basic FC	0.93	0.46	7	6.6	2.20E-03	25.5
Advanced FC	1.10		7	6.6	1.00E-03	25.5
FC inflection point	0.87	0.49				25.4
Cooper-Jacob	0.90	0.58		6.5	2.30E-03	25.5
FC Non-Linear	0.57	0.50	6.0		1.00E-03	25.5
Barker	0.80	0.33	K _f = 100	S _s =	1.06E-03	25.5
Average Q sust (l/s)	0.86	0.17	b = 0.20	Fractal dimension n =	1.85	

Recommended abstraction rate (L/s) **0.80** for 24 hours per day

Hours per day at pumping **10** 1.24 L/s for 10 hours per day
1.5l/s for 8 hours/day

Amount of water allowed to be abstracted per month 2073.6 m³ **1.2l/s for 12 hours/day**

Borehole could satisfy the basic human need of 2765 persons

Is the water suitable for domestic use (Yes/No)

Comments

This double porosity aquifer is characterised by a good fracture network, consisting of fractures with limited extent.

Skin effects and well losses have an influence on early time data.

Linear flow dominated drawdown levels for the first 20 minutes before the fracture network was encountered at approximately 25.5m drawdown.

Water was drawn from this network until, after approximately 1000 minutes in the test, the influence of one no-flow boundary could be detected in the drawdown levels.

The test was terminated after 24 hours with no sign of dewatering of the aquifer in the recovery data.

The T-value of the formation is in the order of 6.6

According to the step drawdown test, the maximum yield of the borehole is 3.8l/s.

The aim of the recommended maximum safe yield is to prevent the fracture network encountered during the test from dewatering.

Recommended depth of pump = 42m

Critical depth = 38m (inflection point)

Static water level used during test = 12.2m

Casing depth = 4.8m

Assumptions

One no-flow boundary at 200m

No rainfall recharge

No other production boreholes in the same aquifer

MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION: Site Identifier: 2329CBV1017 Number: H04-1702 Site type: Borehole

Distr./Farm No.: LPLS606 Site Name/Descr.: MALIETZIES/MABOTSA 2

Latitude [°]:	23.726861	Alt. No. 1: 5245	Diam. [mm]:	165	Water lev. [m]:	5.90
Longitude [°]:	29.370333	Alt. No. 2: G45795	Depth [m]:	76.72	WL status:	Static
Altitude [m]:	1210.00	Rep. inst.: VSA	Col. ht. [m]:	0.25	Date WL meas.:	20060111

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:
 Type of Inst.: No equipment Pulley Diam. [mm]:
 Manufacturer: Depth to Intk. [m]:

Engine:
 Manufacturer: Power Rating [kW]
 Type of Power: Pulley Diam. [mm]:

USE APPLICATION:

Site Status: Unused
 Purpose: Standby
 Consumer: Non-urban
 Application:

WATER CHEMISTRY:

Sample No.:	15/2006	Date sampled:	20060114	Depth sampl. [m]:	0	Comment:	
Main Parameters:				Calculated Parameters:		Bacteriol. Parameters:	
pH:	7.81	Na:		Cl:	84.5	Langel.:	E.Coli:
EC: [mS/m]	93 †	K:		NO3 as N:	2.9	Aggr-Ind:	8.21
TDS:	610 †	Si:		SO4:	20.3	Ion-bal:	-100.00
T. Alk.:		Al:		F:	1.1 †	CaCO3:	SPC:
Ca:		Fe:	0.05	Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption			
Mg:		Mn:	0.05	† Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit			
				! Value exceeds recommended minimum limit Value exceeds minimum allowable limit			

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield [l/s]	Method meas.	Aquifer type	Comment
0.00	0.00	30.20	Notch (V- or U-notch)		TESTED

CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]: Length Width	Hor. Dist.	Vert. Dist.
0.00	24.00	165	Steel	2				

TESTING DETAILS:

Description	Date	Durat. [min]	Depth to intk. [m]	Disch. rate [l/s]	Drawd. [m]	Recovery %	[min]	T [m³/d]	Storage	Comment
MULTI STEP 1	20060111	60	48.65	5.18	10.60					
MULTI STEP 2	20060111	60	48.65	10.48	16.69					
MULTI STEP 3	20060111	60	48.65	21.69	27.63					
MULTI STEP 4	20060111	60	48.65	30.20	35.18	7.62	95	240		
CONSTANT RATE	20060111	3600	48.65	25.32	41.59	6.11	99	3600		

RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality description	Dyn. water level [m]	Crit. water level [m]
1		48.00		10	9.30			
Note:								
2		48.00		24	6.00	CLASS 2		41.00
Note: FC PRIORITY 2								



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Summary

Main

H04-1702

Method	Sustainable yield (l/s)	Std. Dev	Early T (m ² /d)	Late T (m ² /d)	S	AD used
Basic FC	7.23	3.59	33	35.5	2.20E-03	31.0
Advanced FC	7.50		33	35.5	1.00E-03	31.0
FC inflection point	5.05	3.12				31.0
Cooper-Jacob	6.72	4.35		36.0	2.02E-03	31.0
FC Non-Linear	4.16	3.67	39.0		1.00E-03	31.0
Barker	5.28	1.87	K _f = 2900	S _s =	1.02E-03	31.0
Average Q sust (l/s)	5.99	1.35	b = 0.20	Fractal dimension n =	1.71	

Recommended abstraction rate (L/s) **6.00** for 24 hours per day

Hours per day of pumping **10** 9.30 L/s for 10 hours per day
12l/s for 8 hours/day
 Amount of water allowed to be abstracted per month 15552 m³ **9l/s for 12 hours/day**

Borehole could satisfy the basic human need of 20736 persons

Is the water suitable for domestic use (Yes/No) **Yes**

Comments

This double porosity aquifer is characterised by a good fracture network, consisting of fractures with good extent. After well losses for the first 10 minutes of the test, linear flow dominated drawdown levels until, after 100 minutes in the test, the fracture network was encountered at approximately 31m drawdown. Water was still drawn from this network when the test was terminated after 60 hours with no sign of dewatering of the aquifer in the recovery data.

The T-value of the formation is in the order of 36. According to the step drawdown test, the maximum yield of the borehole is 20l/s.

The aim of the recommended maximum safe yield is to prevent the fracture network encountered during the test from dewatering.

Recommended depth of pump = 48m
 Critical depth = 41m (fracture network encountered during test)
 Static water level used during test = 6.36m
 Casing depth = 24m

Assumptions
 One no-flow boundary at 200m
 No rainfall recharge
 No other production boreholes in the same aquifer

MANAGEMENT RECOMMENDATIONS

BASIC SITE INFORMATION: Site Identifier: 2329CBV1015 Number: H04-1715 Site type: Borehole

Distr./Farm No.: LPLS606 Site Name/Descr.: MALIETZIES/MAKGODU

Latitude [°]:	23.729190	Alt. No. 1:	Diam. [mm]:	165	Water lev. [m]:	31.14
Longitude [°]:	29.390700	Alt. No. 2:	Depth [m]:	149.78	WL status:	Static
Altitude [m]:	1240.00	Rep. inst.: VSA	Col. ht. [m]:	0.38	Date WL meas.:	20051215

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

EXISTING EQUIPMENT:

Pump:		Pulley Diam. [mm]:	
Type of Inst.:	No equipment	Depth to Intk. [m]:	
Manufacturer:			
Engine:		Power Rating [kW]	
Manufacturer:		Pulley Diam. [mm]:	
Type of Power:			

USE APPLICATION:

Site Status: Unused
Purpose: Production (water supply)
Consumer: Urban
Application: Agricultural and domestic use

WATER CHEMISTRY:

Sample No.:	4/2006	Date sampled:	20051216	Depth sampl. [m]:	0	Comment:	
Main Parameters:				Calculated Parameters:		Bacteriol. Parameters:	
pH:	7.34	Na:	Cl:	20.2	Langel.:	E.Coli:	
EC: [mS/m]	39	K:	NO3 as N:	9.3	Aggr-Ind:	7.74	Faec. co:
TDS:	310	Si:	SO4:	8.5	Ion-bal:	-100.00	Total Co:
T. Alk.:		Al:	F:	0.3	CaCO3:		SPC:
Ca:		Fe:	0.05	Concentrations in [mg/l]; Bact. param. in counts/100ml; Chemistry Standard: SABS for human consumption † Value exceeds recommended maximum limit ‡ Value exceeds maximum allowable limit † Value exceeds recommended minimum limit ‡ Value exceeds minimum allowable limit			
Mg:		Mn:	0.05				

AQUIFER INFORMATION:

Depth to Top [m]	Depth to Bot. [m]	Yield[l/s]	Method meas.	Aquifer type	Comment
0.00	0.00	10.60	Notch (V- or U-notch)		PUMP SUCTION

CASING DETAILS:

Depth to Top [m]	to Bot. [m]	Diam. [mm]	Material	Thickn. [mm]	Type of openings	Openings [mm]:		Hor. Dist.	Vert. Dist.
						Length	Width		
0.00	11.84	165	Steel	2					

TESTING DETAILS:

Description	Date	Durat. [min]	Depth to intk. [m]	Disch. rate[l/s]	Drawd. [m]	Recovery [m]	%	[min]	T [m³/d]	Storage	Comment
MULTI STEP 1	20051215	60	89.60	2.05	35.60						
MULTI STEP 2	20051215	60	89.60	4.08	40.95						
MULTI STEP 3	20051215	60	89.60	9.07	66.13						
MULTI STEP 4	20051215	60	89.60	10.60	86.24	32.00	99	240			
CONSTANT RATE	20051216	2880	89.60	9.16	74.10	32.55	98	2880			

RECOMMENDATIONS:

Prior.	Rec. equipm.	Depth to intk. [m]	Type of power	Duty cyc. [hrs]	Disch. rate [l/s]	Water quality description	Dyn. water level [m]	Crit. water level [m]
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1		84.00		10	4.65			
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Note:

2		84.00		24	3.00	CLASS 1		72.00
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Note: FC PRIORITY 2



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Summary

Main

H04-1715

Applicable	Method	Sustainable yield (l/s)	Std Dev	Early T (m ² /d)	Late T (m ² /d)	S	AD used
	Basic FC	3.39	1.43	18	16.0	2.20E-03	39.0
	Advanced FC	3.65		18	16.0	1.00E-03	39.0
	FC inflection point	3.10	1.50				40.0
	Cooper-Jacob	3.13	2.02		16.0	1.86E-03	39.0
	FC Non-Linear	2.29	2.02	16.0		1.00E-03	39.0
	Barker	2.86	1.01	K _f = 400	S _s =	1.06E-03	39.0
	Average Q _{sust} (l/s)	3.07	0.47	b = 0.20	Fractal dimension n =	1.80	

Recommended abstraction rate (L/s) **3.00** for 24 hours per day

Hours per day of pumping **10** 4.65 L/s for 10 hours per day
4.2l/s for 12 hours/day

Amount of water allowed to be abstracted per month 7776 m³ **5.2l/s for 8 hours/day**

Borehole could satisfy the basic human need of 10368 persons

Is the water suitable for domestic use (Yes/No) **Yes**

Comments

This double porosity aquifer is characterised by a good fracture network, consisting of fractures with good extent.
 After well losses for the first 10 minutes, the fracture network was encountered at 36m - 40m drawdown.
 At late times in the test, the influence of one no-flow boundary could be detected in the drawdown levels.
 The test was terminated after 48 hours with no sign of dewatering of the aquifer in the recovery data.

The T-value of the formation is in the order of 16.
 According to the step drawdown test, the maximum yield of the borehole is 10l/s.

The aim of the recommended maximum safe yield is to prevent the fracture network encountered during the test from dewatering.

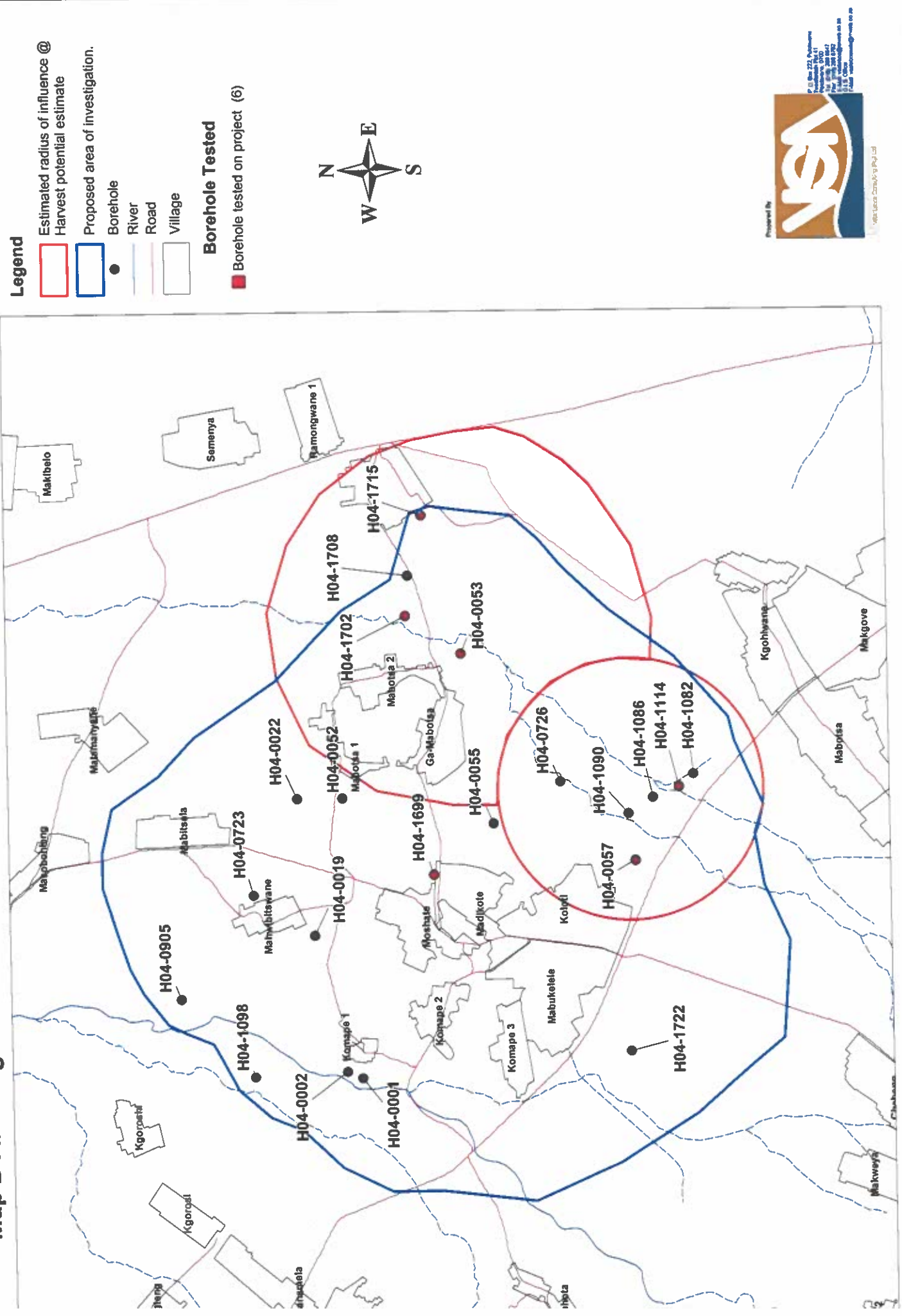
Recommended depth of pump = 84m
 Critical depth = 72m (fracture network encountered during test)
 Static water level used during test = 31.8m
 Casing depth = 11.8m

Assumptions

- One no-flow boundary at 200m
- No rainfall recharge
- No other production boreholes in the same aquifer

Maps

Map B : Investigation area with proposed production borehole positions with the radius of influence.



Legend

- Estimated radius of influence @ Harvest potential estimate
- Proposed area of investigation.
- Borehole
- River
- Road
- Village
- Borehole Tested**
- Borehole tested on project (6)





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