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ZIMBABWE

British Geological Survey

OVERSEAS DEVELOPMENT ADMINISTRATION

SMALL SCALE IRRIGATION USING COLLECTOR WELLS PILOT PROJECT - ZIMBABWE

SITES REPORT

D.M. Thompson, C.J. Lovell,
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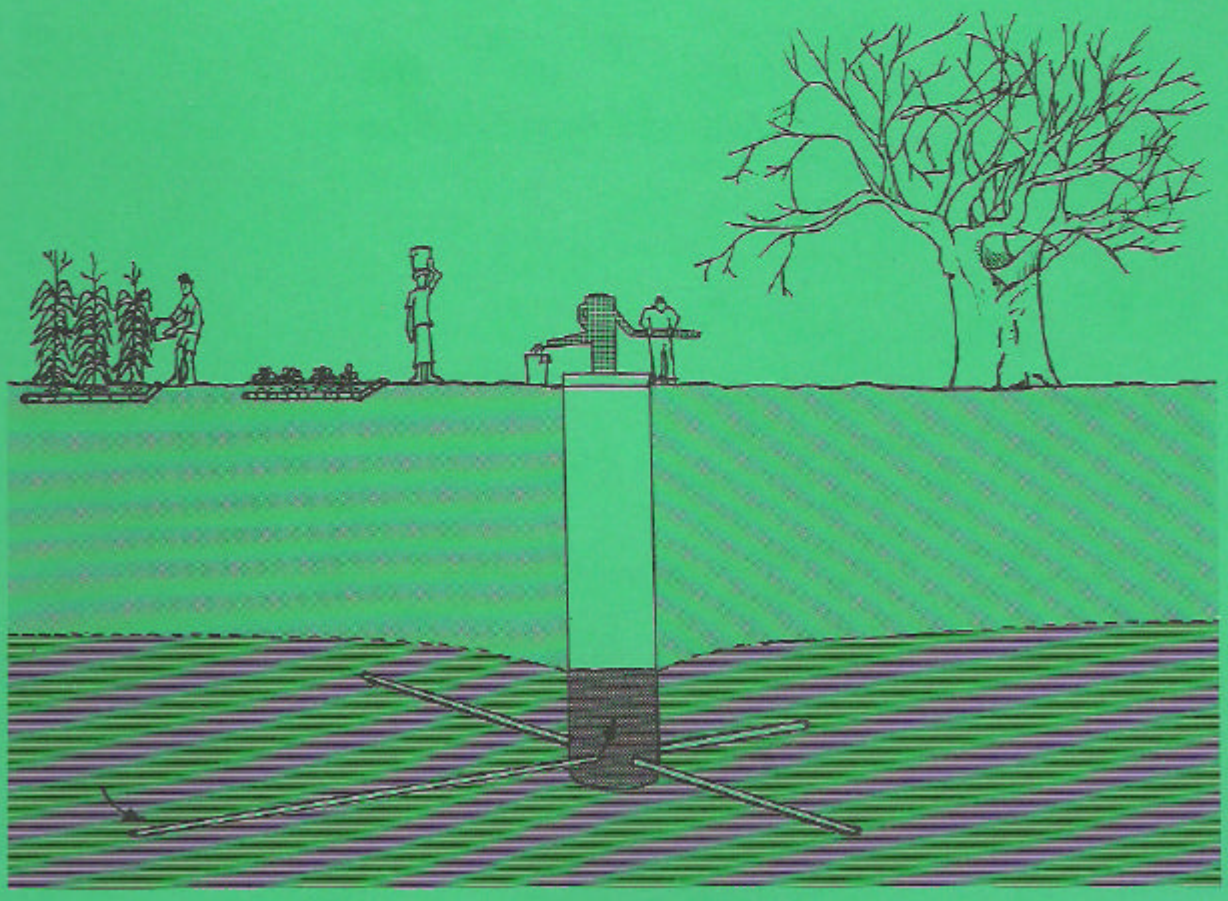

BRITISH GEOLOGICAL SURVEY

TECHNICAL REPORT
Overseas Geology Series

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BGS Technical Report WC/95/75

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BRITISH GEOLOGICAL SURVEY

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Executive Summary

The "Small scale irrigation using collector wells" project has been undertaken to assess the feasibility of using shallow weathered hard-rock aquifers as a source of water for irrigated gardens of up to one hectare. Eight schemes have been established in the Lowveld of south-east Zimbabwe: six funded by the Overseas Development Administration (ODA) and located on Pre-cambrian crystalline basement; and two funded by the NGO, Plan International, located on Karoo basalts. A collector well is a large-diameter dug well (in this project, 2.1 m diameter and up to 16 m deep) with 4-6 boreholes drilled laterally from the base. At the six sites located on crystalline basement and site 8 on the basalt, collector wells have been constructed to provide water; at site 7 on the basalts the yield from the large-diameter well was sufficient for garden and domestic requirements and so laterals were not drilled. The project is assessing the potential of collector wells in particular, but also includes a component comparing other well types. As part of this comparison a series of pumping-tests were carried out.

This report documents the drilling, construction, testing and monitoring activities at each of the eight sites. The function of this report is to present the data for future reference. Analysis and discussion of this data is to be found in progress and final reports for the project (Lovell *et al.* 1995, Lovell *et al.* 1996).

Contents

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List of Tables

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1. Introduction

The "Small scale irrigation using collector wells" project has been undertaken to assess the feasibility of using shallow weathered hard-rock aquifers as a source of water for irrigated gardens of up to one hectare. Eight schemes have been initiated in the Lowveld of south-east Zimbabwe; six funded by the Overseas Development Administration (ODA) and located on Pre-cambrian crystalline basement; and two funded by the NGO Plan International, located on Karoo basalts. The project is assessing the potential of collector wells in particular, but also includes a component comparing other well types. As part of this comparison a series of pumping-test were carried out. This report documents the drilling, construction, testing and monitoring activities at each of the eight sites. The function of these reports is to present the data for future reference. Analysis and discussion of this data is to be found in the progress and final reports for the project.

2. Background information and non-specific site details

The specific details for each site are contained within chapter 3. Background information and non-specific site details are presented in this chapter.

2.1 Regional geology and climate

The geology of the region of the Lowveld within the project area (Figure 2.1) is primarily metamorphic rock of Precambrian age formed within the northern marginal zone of the Limpopo Mobile Belt It also includes to the north the granites and greenstones of the Zimbabwe Craton and to the south the Karoo basalts. A gradual transition exists from the granite-greenstone craton to the high-grade metamorphic rocks of the marginal zone.

The metamorphic rocks are mainly granulite gneisses. These have a north-east to south-west trend. Both the gneisses and the granites are characterised by small catchments (2 km to 10 km in length) bounded by large tree covered hills and gneiss kopjes, drained by sand choked streams that run through low lying agricultural land: in comparison the area underlain by the Karoo basalts is very flat. The regolith of the basement rock is typically less than 20 m thick (Wright, 1989) but is generally thicker in the gneisses than in the granites (Barker et al., 1992). The principal clay mineral is kaolinite.

The Lowveld has a semi-arid climate. Rainfall occurs as heavy storms in the period October to April. The rainfall is significantly spatially variable though estimates have been made of the long-term mean annual rainfall at each collector well garden site (given in chapter 3).

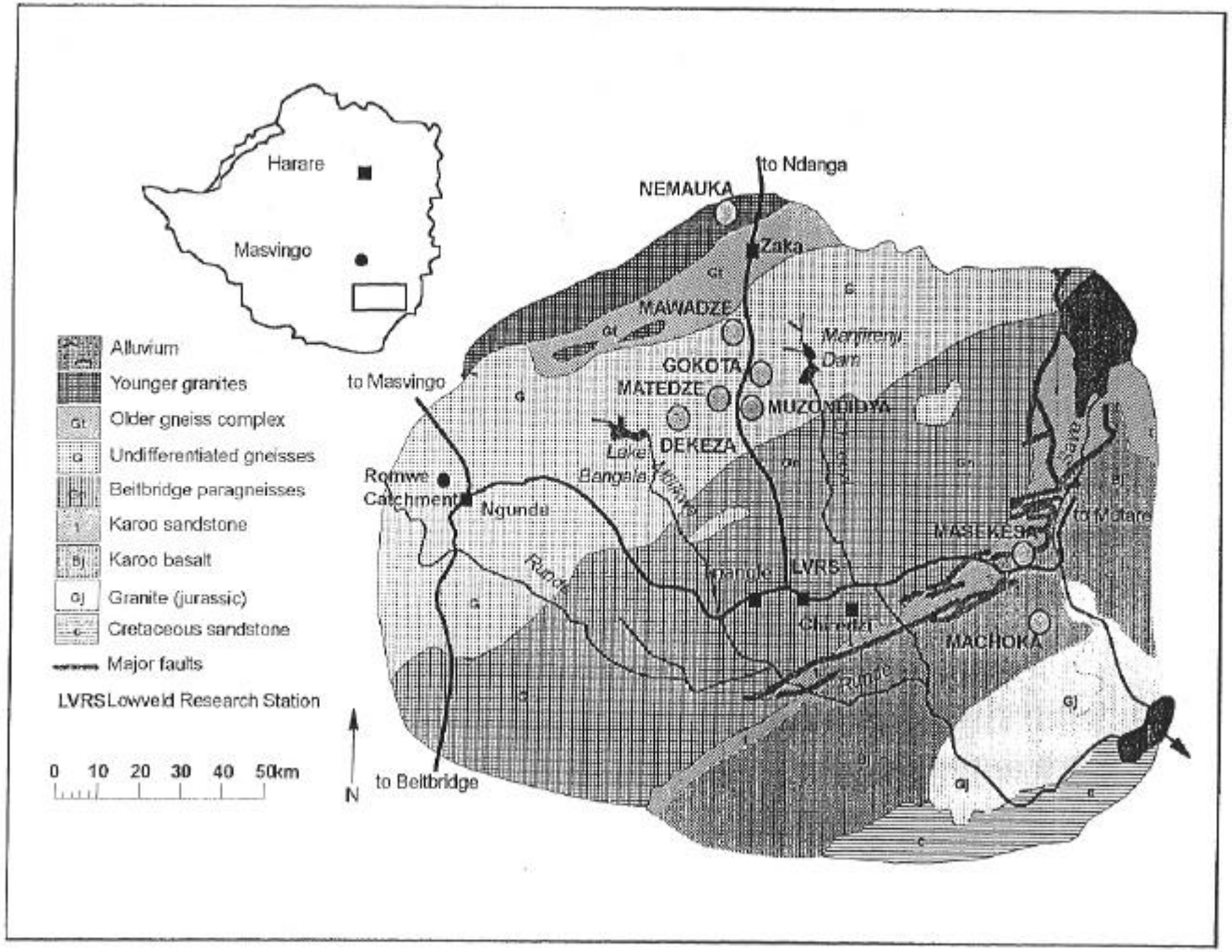


Figure 2.1 Regional geology and location of collector well garden schemes

2.2 Siting and construction of collector wells

Much of the procedure of siting and constructing collector wells at each site was replicated. This will be described here while the site-specific construction and siting details will be covered in chapter 3.

Exploratory drilling

At each site a number of exploratory holes were drilled to find a suitable site for the collector well. At sites 1-6 the holes were of 4" diameter and were drilled by the BGS contract driller with a lightweight air-rig; at sites 7 and 8 the holes were 6" diameter and were drilled by the Department of Water Development, Zimbabwe. The locations of these drill sites are shown in the relevant figures quoted in chapter 3; the drilling details are given in tabular form. Siting methodology is described in the final report of the collector well report (Lovell et al., 1995) and pumping-test manual (Thompson and Lovell, 1995).

Well shaft digging and headworks construction

Diagrams showing the completed well shaft and headworks are referred to in chapter 3. The shafts are up to approximately 16 m deep with a diameter of 2.1 m. The shaft was hand dug by local people under the instruction of a foreman. Digging with shovels, picks and a pneumatic pavement breaker, a team of one or two men worked down the well on rotating shifts of approximately an hour. The spoil was removed in a 60 l kibble, lifted on a wire rope attached by a pulley to a square gantry. The rope was wound-in using a pneumatic winch mounted on the side of the gantry. At sites 1-6 the well was lined during digging by bolting on 0.45 m sections of steel Armco lining above ground and lowering the increasing tower of casing down into the shaft as digging progressed. Each 0.45 m depth of casing comprises of six circumferential pieces. At sites 7 and 8 the steel Armco lining was in 1 m sections comprising of two half cylinders.

The well shaft was dewatered using a pneumatic diaphragm pump. Access to the well bottom was gained by lowering individuals on a personnel frame using the pneumatic, wire rope winch.

On completion of digging, the cavity between the casing and the shaft was backfilled with 0.015 m gravel to 2 m below ground level. The top 2 m were filled with concrete to make a sanitary seal. A concrete area of 4 x 5 x 0.1 m was laid around the well. A five course brick wall was then built around each well and plastered. The provision for waste water varied from site to site and will be described in chapter 3.

The concrete well lid was cast on site in two halves of 0.1 m thickness. Both halves were reinforced with two layers of steel reinforcing mesh, both had two lifting handles inset. One half of the lid had two pieces of 0.125 m diameter, 0.45 m long casing inset to hold the two bushpumps. The two sections of casing each had four 0.40 m lengths of angle iron welded radially onto the outside of the casing 0.05 m from the bottom, to key into the concrete. For ease of replication, in future schemes the two pieces of casing will be manufactured as part of a steel reinforcing structure around which the lid will be formed from concrete.

A 6 m high, 3 m wide gantry was erected directly above the the pump mounting casing for installing and removing the pumps. These are made from 50 mm galvanized pipe. The Type B bushpumps were installed by members of the community as part of the pump maintenance training day (described later in this section). Finally the well lids were sealed with sand/cement mix.

One of the pump outlets discharges into a water tank, 0.5 m x 0.6 m x 0.5 m. During periods of intense garden activity this tank can be kept full by constant pumping allowing gardening water to be collected quickly by dipping buckets into the tank. The other bushpump outlet has been left open for domestic water collection. At all sites, apart from site 8, two extra tanks have been built to house a water meter for each bushpump to monitor the abstraction from the well (the water use is not monitored at site 8). The meters must run full which requires some relatively complex pipework. In future, when monitoring is not required, the pipework will be a lot simpler. Also for the purposes of monitoring, a lockable steel box was mounted on top of the lid to hold a munro water-level recorder. A hole in the concrete lid below the steel box allows access to the well. The steel box is sealed to the well lid with plaster to prevent water running off the lid into the well. Munro water-level recorders have been installed at sites 1-6.

The digging crews at sites 1-4 were paid Z$10 per day: the crews at sites 5-8 were not paid. The foreman of the site will be able to recommend those from the crew suitable for work in the future.

Lateral drilling

Between 4 and 6 laterals were drilled by the BGS contract driller at each site apart from site 7, using the light air-rig in horizontal mode. The pumping-test at site 7 indicated it was unnecessary to convert the large-diameter well to a collector well as the performance was already adequate. The direction of the laterals and the drilling logs are shown in figures and tables in chapter 3.

2.3 Pumping-test programme

The yield improvement due to lateral drilling was assessed by performing pumping-tests on the large-diameter well and the collector well. In addition, to assess the economic viability of collector wells, an evaluation was carried out to examine the costs and sustainable yields of various well types. A number of short, constant-rate pumping-tests were performed on suitable wells and boreholes in the vicinity of each collector well. Details of all tests are given in chapter 3; these are summarised in Table 2.1.

Table 2.1 Pumping-tests performed at collector well garden sites

Well type	Pumping rate (litres/sec)	Pumping time (mins)	Site
LDW + CW low discharge	0.65	120	1,2
LDW + CW high discharge	4.5	120	1,2
	2.65	240	3,4
LDW + CW medium discharge	1	300	5,6,8 (no CW at 7)
SEB	0.4	60	1,2,4,5,6,7
DEB	0.6	240	1,2,5,8
DCB	0.6	60	1,3,5

LDW - large-diameter well
CW - collector well
SEB - shallow exploratory borehole
DEB - deep exploratory borehole
DCB - deep communal borehole

The tests were analysed using a BGS in-house computer package, BGSPT (Barker, 1989). These analyses gave estimates for aquifer parameters for the shallow weathered layer and the deeper bedrock (Table 2.2). Based on the sum of the errors of the fit to the test data, the consistency of the tests at each site and the comparison of predicted well drawdown with monitored drawdown, a confidence level was given to the values of parameters estimated.

With these values the sustainable yields were predicted for each well type (Table 2.3) using the BGSPT package. This used a daily pumping pattern of 1.5 m^3/d for 5 hours in the morning (06:00 to 11:00) and 5 hours in the afternoon (13:00 to 18:00), for a period of 240 days. Abstraction volumes and water-levels were monitored for many of the tested wells to validate the predictions. The full analyses of pumping-tests at the eight sites are documented in Lovell *et al.* (1995a) and Macdonald *et al.* (1995). Practical pumping-test considerations concerning equipment and field techniques are documented in a separate report (Thompson and Lovell, 1995).

Table 2.2 Pumping-test results for shallow and deep aquifers at collector well garden sites

	SHALLOW AQUIFER					DEEP AQUIFER				
Site	Depth (m)	T (m^2/d)	S	CL	Source of data	Depth (m)	T (m^2/d)	S	CL	Source of data
1	15	0.8	0.005	4	LDW	48	32.0	2e-6	4	DCB
						40	4.48	5e-3	4	DEB
2	15	1.4	0.008	4	LDW	30	2.4	8e-3	4	DEB
3	15	2.9	0.007	1	LDW	43	118.0	7e-3	4	DCB
4	15	2.9	0.010	3	SEB	25	0.9	1e-3	2	DCB
5	14	3.1	0.007	3	LDW	33	5.6	9e-4	3	DEB
						33	0.8	7e-3	2	DCB
6	10	2.5	0.077	4	LDW	-	-	-	-	-
7	9	30.2	0.565	3	LDW	18	206	2e-3	3	DEB
8	18	9.8	0.004	3	LDW	30	9.8	1e-6	2	DEB

T - transmissivity
S - storativity
CL - confidence level

Table 2.3 Maximum sustainable yield of wells tested at collector well garden sites, for a simulated period of 240 days

	LDW		CW			TW		DCB cased in WZ		DEB screened in WZ		DEB cased in WZ	
Site	Q	CL	Q	CL	%imp	Q	CL	Q	CL	Q	CL	Q	CL
1	11.5	4	18.0	4	56	-	-	200	2	43	2	35	2
2	16.7	4	17.1	4	2	-	-	na		26	2	6	2
3	26.1	3	34.1	3	31	-	-	768	2	-	-	-	-
4	24.1	3	40.2	3	67	2.1	3	2	2	-	-	-	-
5	22.3	3	34.7	2	56	2.9	2	1.4	2	37	3	25	3
6	12.4	4	18.3	4	48	-	-	-	-	-	-	-	-
7	47.0	3	na	na	na	-	-	-	-	-	2	347	2
8	66.3	4	62.5	4	13	-	-	-	-	-	2	<2	2

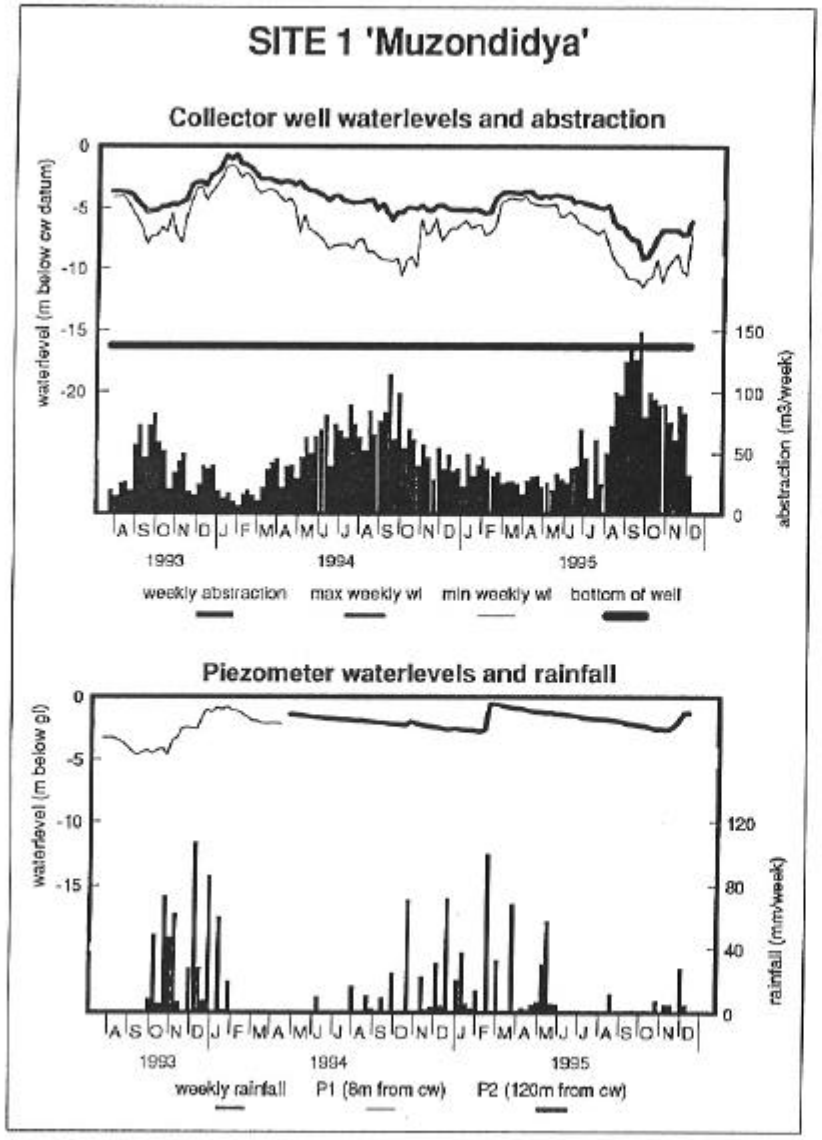
WZ - weathered zone
Q - simulated 240 day maximum sustainable yield

2.4 Monitoring of well performance

Apart from at site 8, the water-levels in the collector wells are presently monitored

by Munro water-level recorders and the domestic and garden abstraction volumes are measured by two Kent flow meters. Details of the other wells and boreholes in the vicinity that are being monitored will be given in chapter 3. Daily rainfall is also being measured at each site. This data is being collected and collated monthly by Mr Godwin Mutetwa (Lowveld Research Station, Chiredzi). The data collected to December 1995 for sites 1-6 is presented in Figures 2.2 a-f.

Baseline water quality analysis for the ten collector wells in south east Zimbabwe can be found in Table 2.4. The water quality will continue to be monitored.



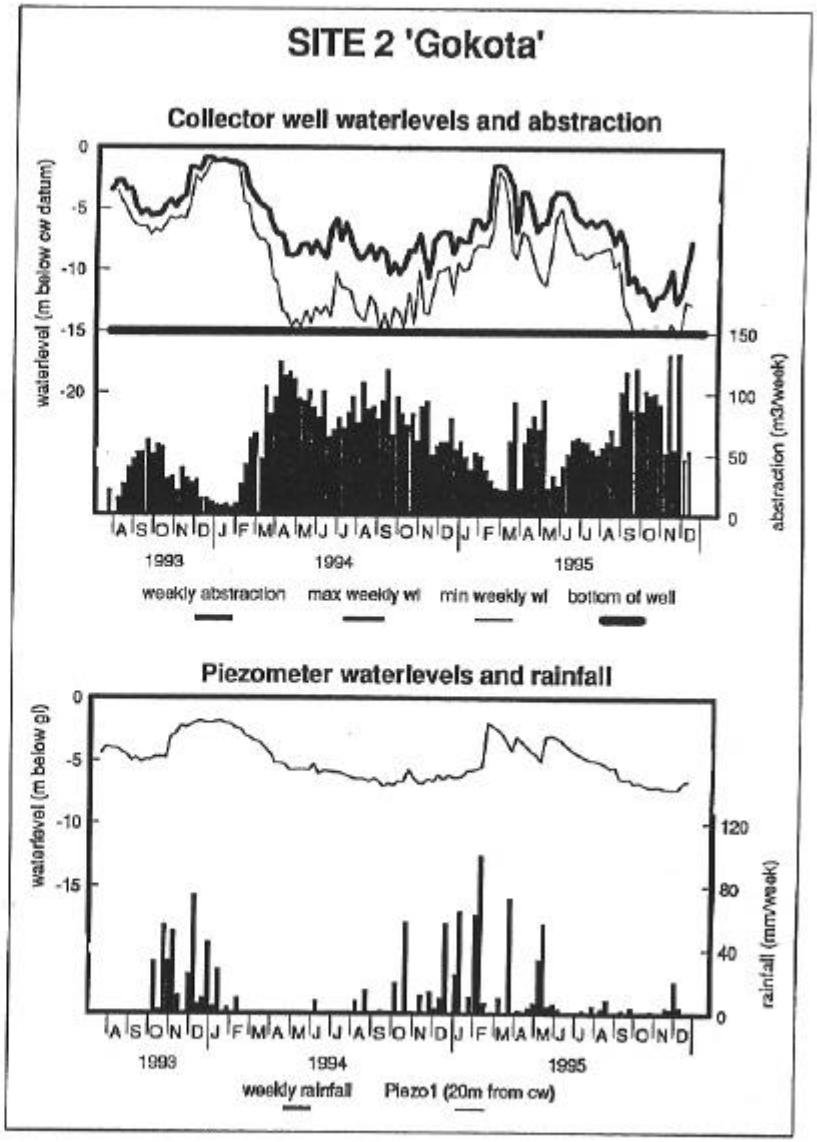


Figure 2.2 a & b Monitoring data for collector well sites 1 and 2, to December 1995

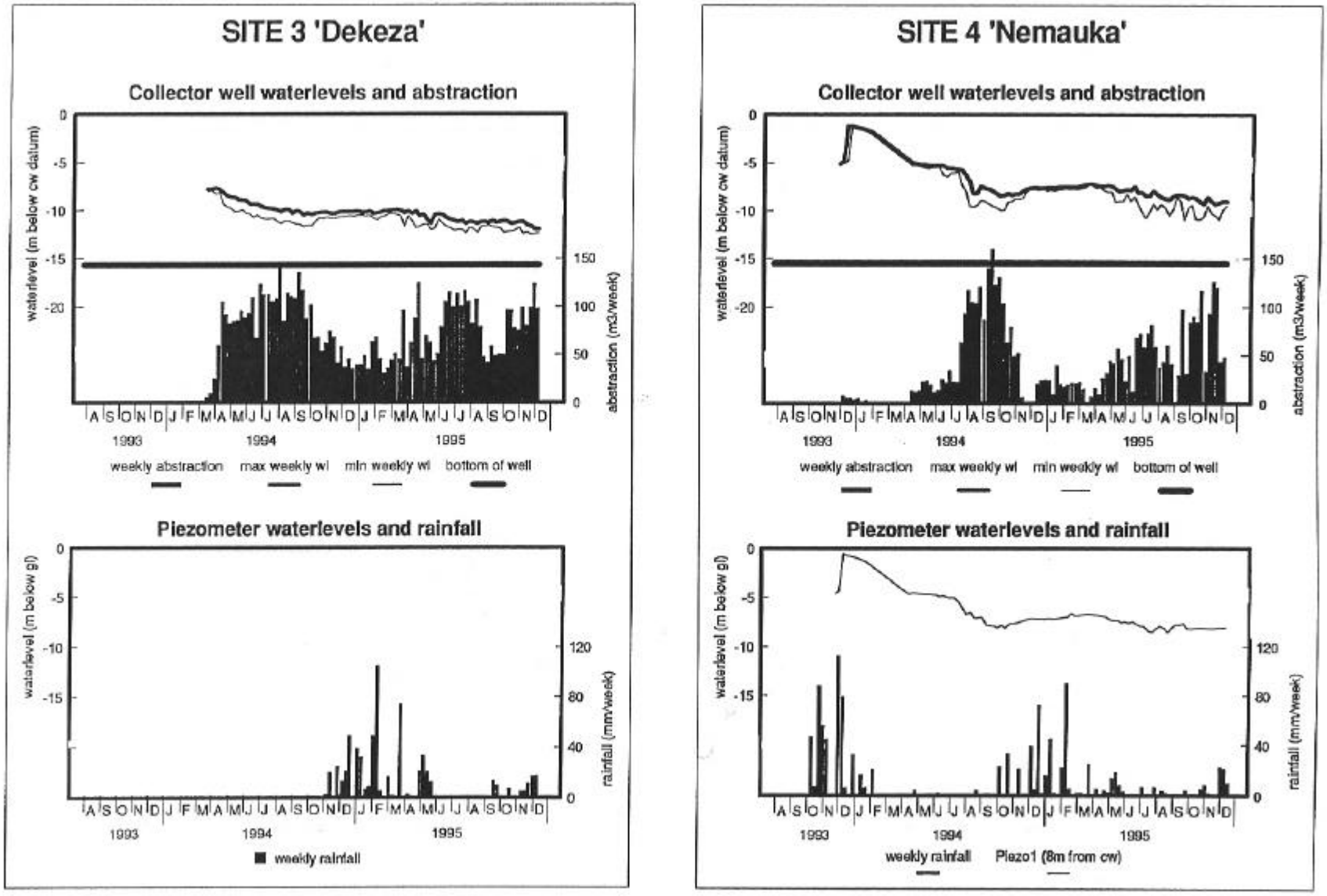
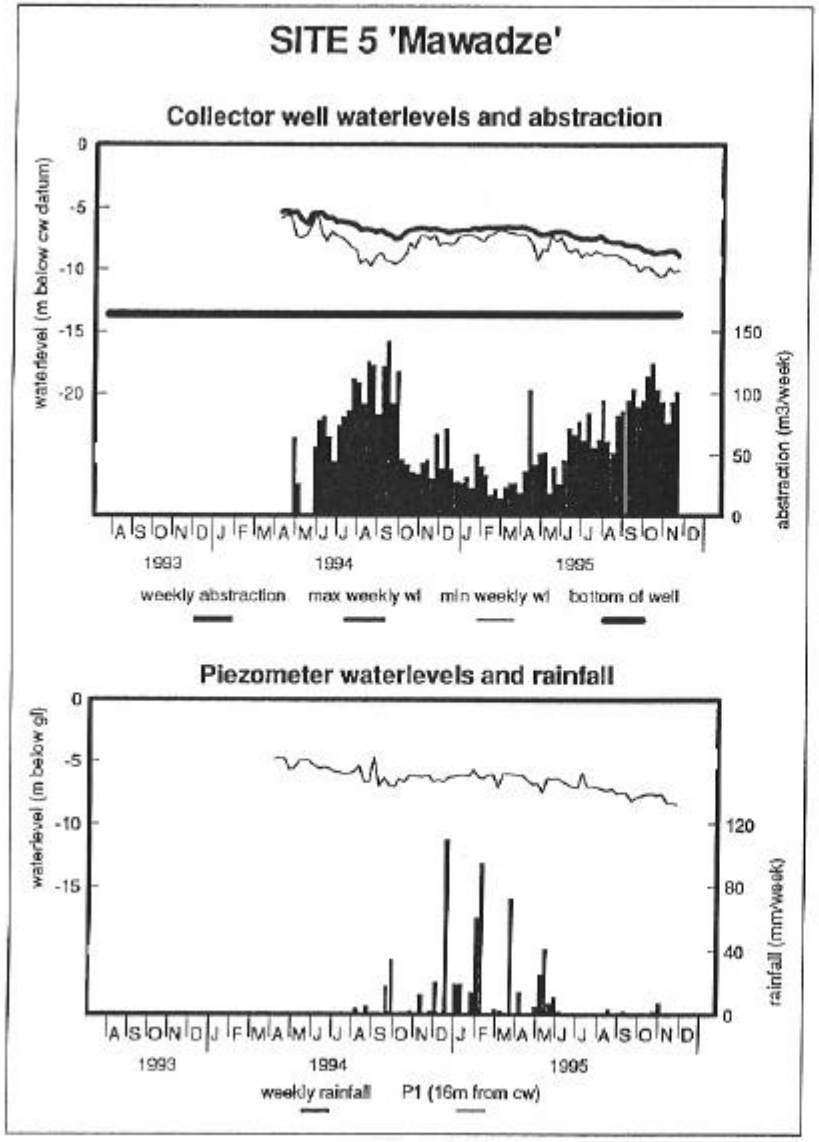


Figure 2.2 c & d Monitoring data for collector well sites 3 and 4, to December 1995



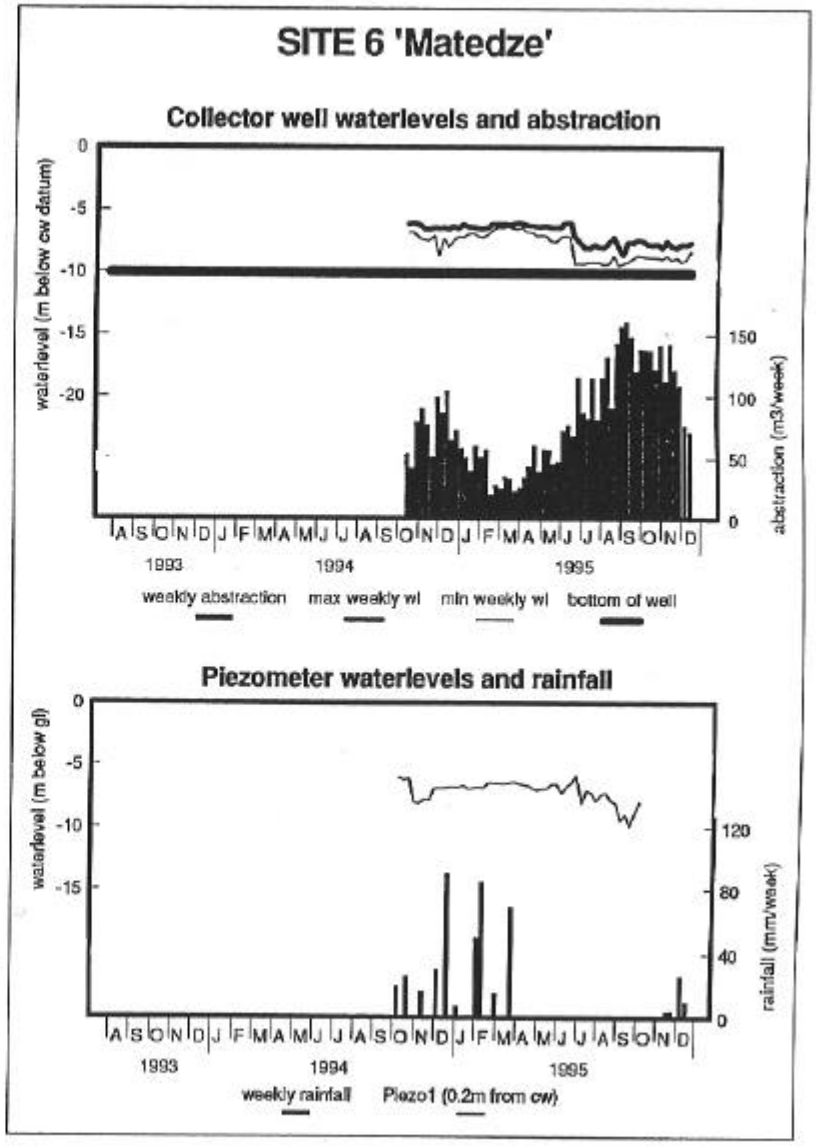


Figure 2.2 e & f Monitoring data for collector well sites 5 and 6, to December 1995

Table 2.4 Baseline water quality analyses for all collector well sites in south-east Zimbabwe

	Date sampled	pH	EC ms/cm	Na	K	Ca	Mg	HCO_3	SO_4	Cl	NO_3-N	Si	P-Tot	B	FE_{Tot}	F	SAR meq/l	RSC meq/l	Faecal E-coli/100 ml
Guidelines:																			
Human Cons				200					400	250	10.0			0.3	1.0	2			<2.5
Irrigation		8.50	0.70	900	2.0	400	60	600	900	500	10.0		2.0	2.00	20.0	15	15.00	<2.5	
Lowveld	3/6/89	8.08	0.99	79	0.7	73	59	651	26	33	4.8	27.5	<0.5	0.14	0.02	0.9	1.66	2.1	-
Research	1/7/93	8.08	0.99	91	<0.5	88	85	599	25	152	8.4	31.3	<0.5	0.14	<0.02	0.9	1.65	-1.7	-
Station																			
Romwe	25/4/91	7.73	0.35	32	<0.5	26	19	253	9	42	1.1	37.7	<0.5	0.03	<0.02	0.3	1.14	1.2	-
	1/7/93	7.74	0.35	31	<0.5	25	18	202	4	19	3.7	38.0	<0.5	0.03	<0.02	0.3	1.13	0.5	-
Site 1	16/3/93	8.14	0.37	21	1.4	45	21	273	1	11	<0.4	26.8	<0.5	0.03	0.06	0.3	0.66	0.5	1.0
Site 2	1/4/93	8.19	0.29	23	1.6	32	12	203	2	9	<0.4	35.7	<0.5	0.03	<0.02	0.2	0.86	0.7	0.0
Site 3	2/8/93	7.41	0.35	15	<0.5	22	18	175	1	13	<0.4	38.2	<0.5	0.3	0.37	0.6	0.56	0.3	5.0
Site 4	17/6/93	8.06	0.44	54	2.3	37	13	301	1	16	0.9	30.4	<0.5	0.03	0.10	0.9	1.96	2.1	3.0
Site 5	10/12/93	8.47	0.69	114	<0.5	27	12	320	1	61	<0.3	29.4	<0.5	0.03	<0.02	0.6	4.59	2.9	25.0
Site 6	2/5/94	8.34	0.42	18	0.8	25	29	211	25	10	<0.3	34.5	<0.5	0.03	<0.02	0.3	0.56	-0.2	50.0
Site 7	6/5/94	8.56	1.11	66	<0.5	9	106	455	8	89	23.1	36.9	<0.5	0.10	<0.02	0.4	1.33	-1.8	-
Site 8	5/5/94	8.61	1.22	57	0.7	48	113	585	4	58	25.8	37.7	<0.5	0.07	<0.02	0.9	1.01	-2.2	-

All units are in mg/l unless otherwise shown

SAR = sodium adsorption ratio - $Na^{+} / ((CA^{2+} + Mg^{2+}) / 2)^{0.5}$

RSC = residual sodium carbonate - $(CO_3^{2-} + HCO_3^{-}) - (Ca^{2+} + Mg^{2+})$

2.5 Pump maintenance workshop

A one-day pump maintenance workshop was held at each site. The pump installation was the core activity of the workshop. The two bushpumps were installed by a team selected from the local community by the garden committee members. A full description of all activities undertaken in the workshop are listed below. (Nb. subsequent trials of the locally designed and manufactured SIWIL Pipe Lifter, which lifts the rising main using the Bush Pump mechanism, have shown it has significant advantages over a gantry system and would be used in future schemes.)

Pump maintenance workshop activities

All activities were performed by members of the team, under minimal instruction, following a short demonstration.

1. Introductions.
2. Briefly outline the importance of self-sufficiency in pump maintenance.
3. Demonstrate tools and workshop manual. Equipment provided:
   - Gantry
   - 18" pipe wrench (x2)
   - 10" shifting spanner
   - 20m rope
   - 2" pipe clamp
   - 2" lifting plug
   - workshop manual for Type B bushpump
4. Clean threads on rods and rising main, lay out components.
5. Strip one cylinder (explain that the brass components and threads must be treated carefully with the steel pipe wrenches to avoid damage); demonstrate operation of three non-return valves; remove and replace rubbers (ensuring they are the correct way round and not damaged on re-assembly); ensure that each team member is able to assemble the cylinder on their own.
6. Demonstrate the lifting action of the cylinder in a bucket of water.
7. Demonstrate the locking nuts that join the rod sections and the nipples that join the rising main sections.
8. Itemise the usual causes of pump failure:-
   - non-return valves stuck, worn or dirty
   - foot-valve comes undone
   - rubbers worn out
   - piston comes undone
   - rods connections come undone or rod breaks
9. Install the first pump and rising main with some supervision.
10. Demonstrate the following points on the above ground components:-
    - the piston and string of rods should hang form the rubber bush, not sit on the bottom of the cylinder. This is achieved by initially making the rod string the correct length and on subsequent removals ensuring the rod connections are fully tight.
    - the pivot block must have a clear stroke. ie the handle retaining bolts must not catch on the top end of the rods during operation. This

will bend the rod and cause it to break.
- the main pins and other nuts must be tightened weekly.

11. Allow the team to check the cylinder and install the second pump unaided.
12. Questions. Although these may be dealt with during the day a brief session at the end is useful.
13. Hand the tools to an appointed keeper (who lives close by).
14. Ensure the team recognised it is now their responsibility to maintain the pump.

3. Site-specific information

Specific information on the eight sites is given in this chapter. The description of tables and figures is given here. Replace the * with the number of the site. Not all figures and tables are relevant for each site; where this is the case an entry is made under the figure or table title.

Figures

3.*.1 Map of the location of the collector well site
3.*.2 Map of the vicinity of the collector well and garden
3.*.3 Collector well and headworks construction

Tables

3.*.1 Diary of activities
3.*.2 Drilling logs of exploratory boreholes
3.*.3 Geological description of collector well digging samples
3.*.4 Lateral drilling logs
3.*.5 Pumping-tests performed
3.*.6 Pumping-test data from tests completed on large-diameter well before and after laterals
3.*.7 Attendees of pump maintenance workshop
3.*.8 Communal water points in the region of the collector well
3.*.9 Details of monitored wells and boreholes

Notes on figures and tables

1. The numbers marked beside the location of water points in Figures 3.*.1, 3.*.2 and 3.*.3 refer to those used in Table 3.*.8. Labels marked beside the location of exploratory boreholes refer to those used in Table 3.*.2.

2. An indication of the relative yield of collector well laterals obtained by the driller during construction are given in Figure 3.*.3 and in Table 3.*.3.

3. An attempt was made to compare the relative yield of those water points given in Table 3.*.8 by asking the users. This is included as perceived yield.

Site 1 - Muzondidya

Site description

Geology:	granulite gneiss
Location:	approx. 60 km north of Chiredzi Research Station, on the east side of the main Zaka road in the valley bottom 1 km north of Muzondiya school.
Access:	along a small track that turns east off the tar road 500 m south of the 86 km peg (km peg measured in a southerly direction from the Zaka turn-off on the Masvingo to Mutare road).
Annual rainfall:	780 mm

Exploratory drilling

Drilling:	BGS contract driller
No. of exploratory holes:	11
Comments:	Collector well subsequently dug 8 m from bh11

Specific construction details

Foreman:	Peter Msanu
Depth of well shaft:	15.8 m
Time to dig shaft:	11 weeks
No. of laterals:	5
Length of laterals:	15, 30, 30, 30, 30 m
Comments:	-

A concrete lip was set along the lower edge of the slab which channelled waste water into a stone filled trench dug from the well to the valley bottom.

Monitoring of well performance

Mr Tynos Nhondova is to change the munro recorder charts and read the meters at 0600 every Sunday morning. He will also dip an unused bucket well (w1), DDF borehole and piezometer bh11.

20°38'13.06"S 31°25'54.46"E.
36K 336608.56m E 7712 7241.83m S.
good phdo.
elevation 622m.

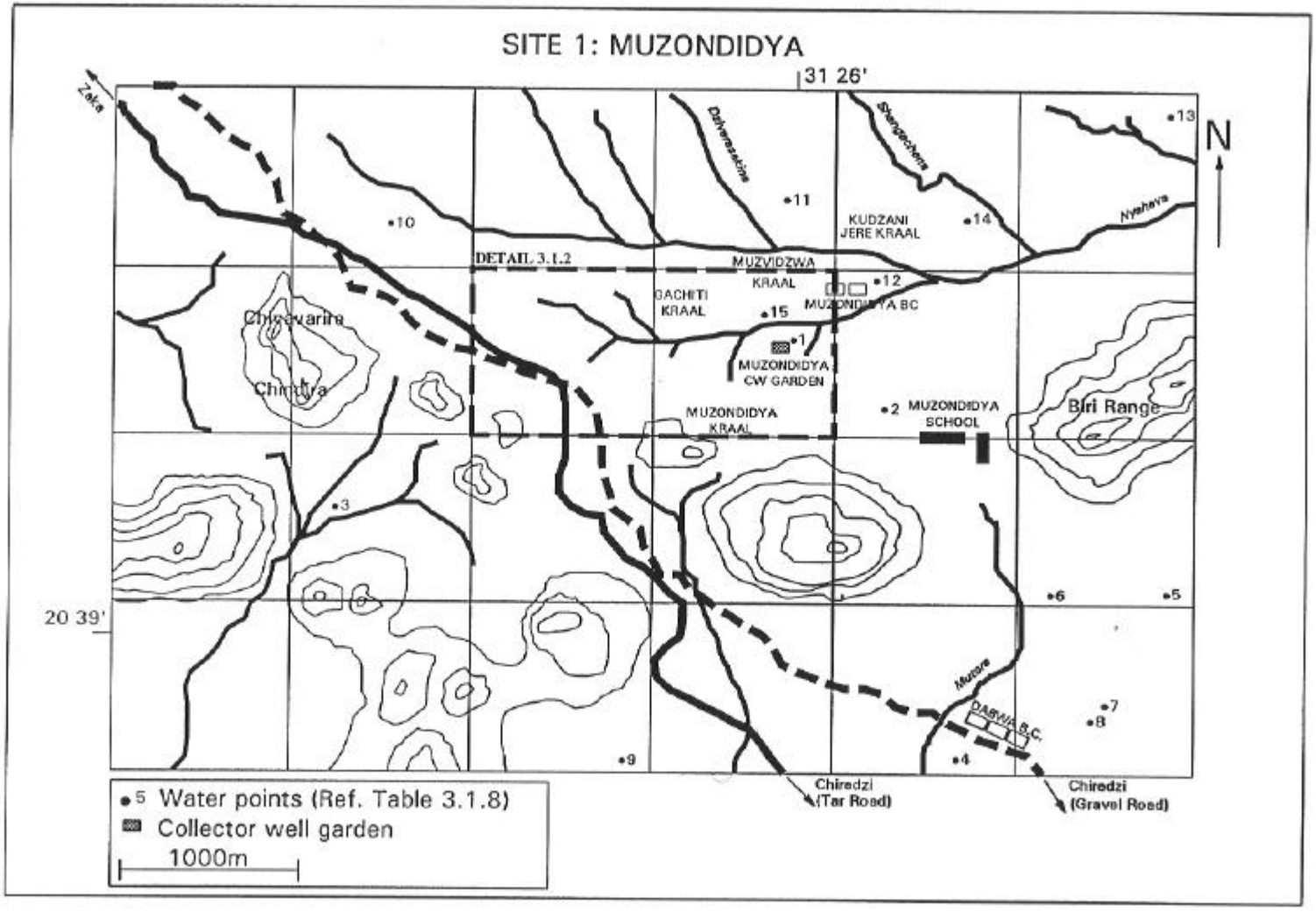


Figure 3.1.1 Map of location of collector well garden and local water points

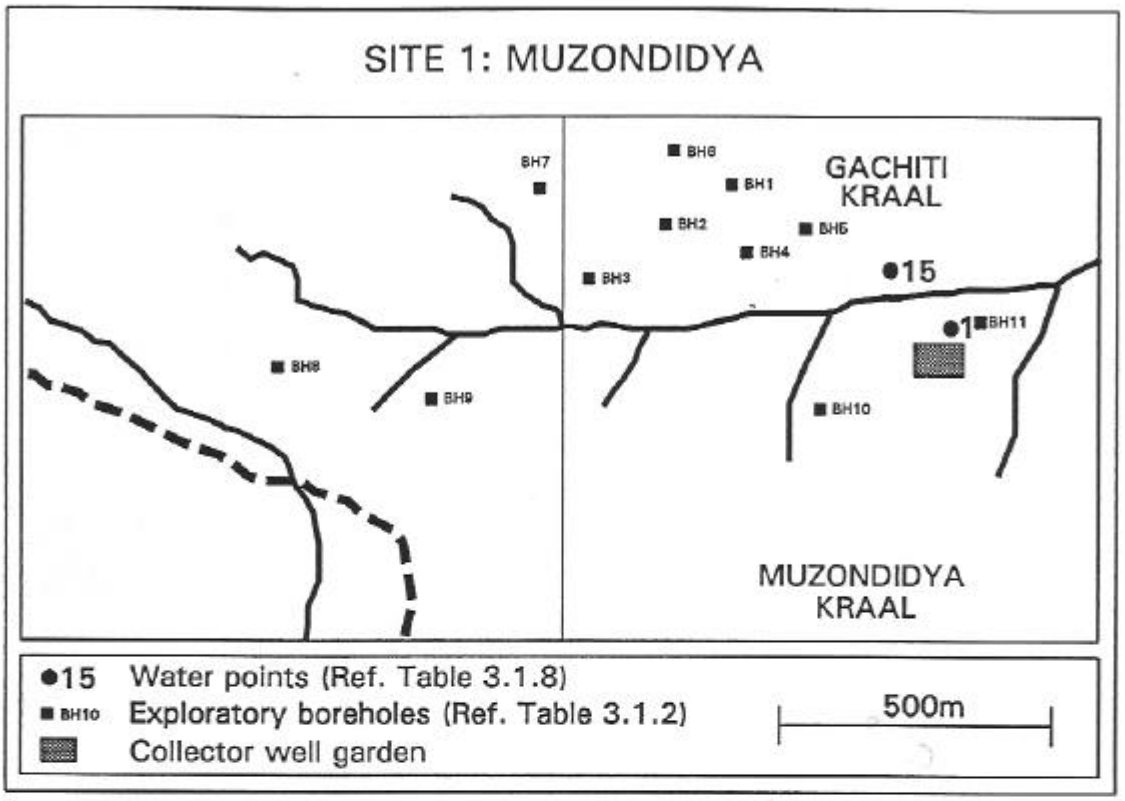


Figure 3.1.2 Detail showing location of exploratory boreholes

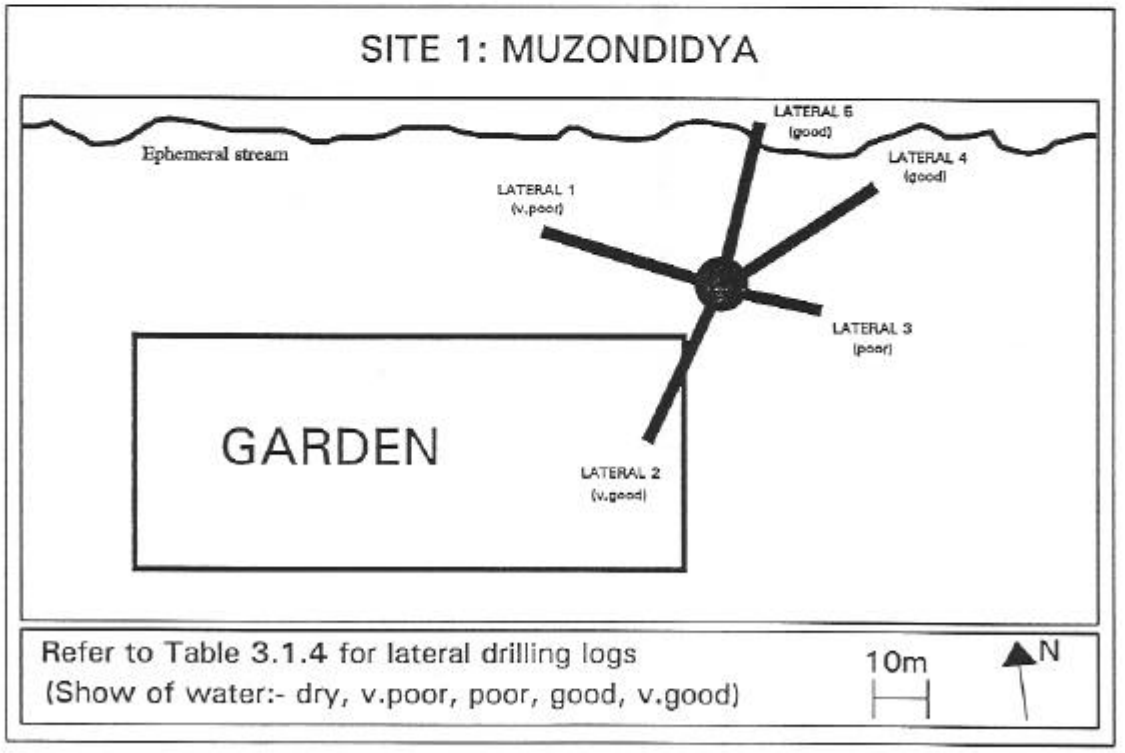


Figure 3.1.3 Map of vicinity of collector well showing direction of laterals

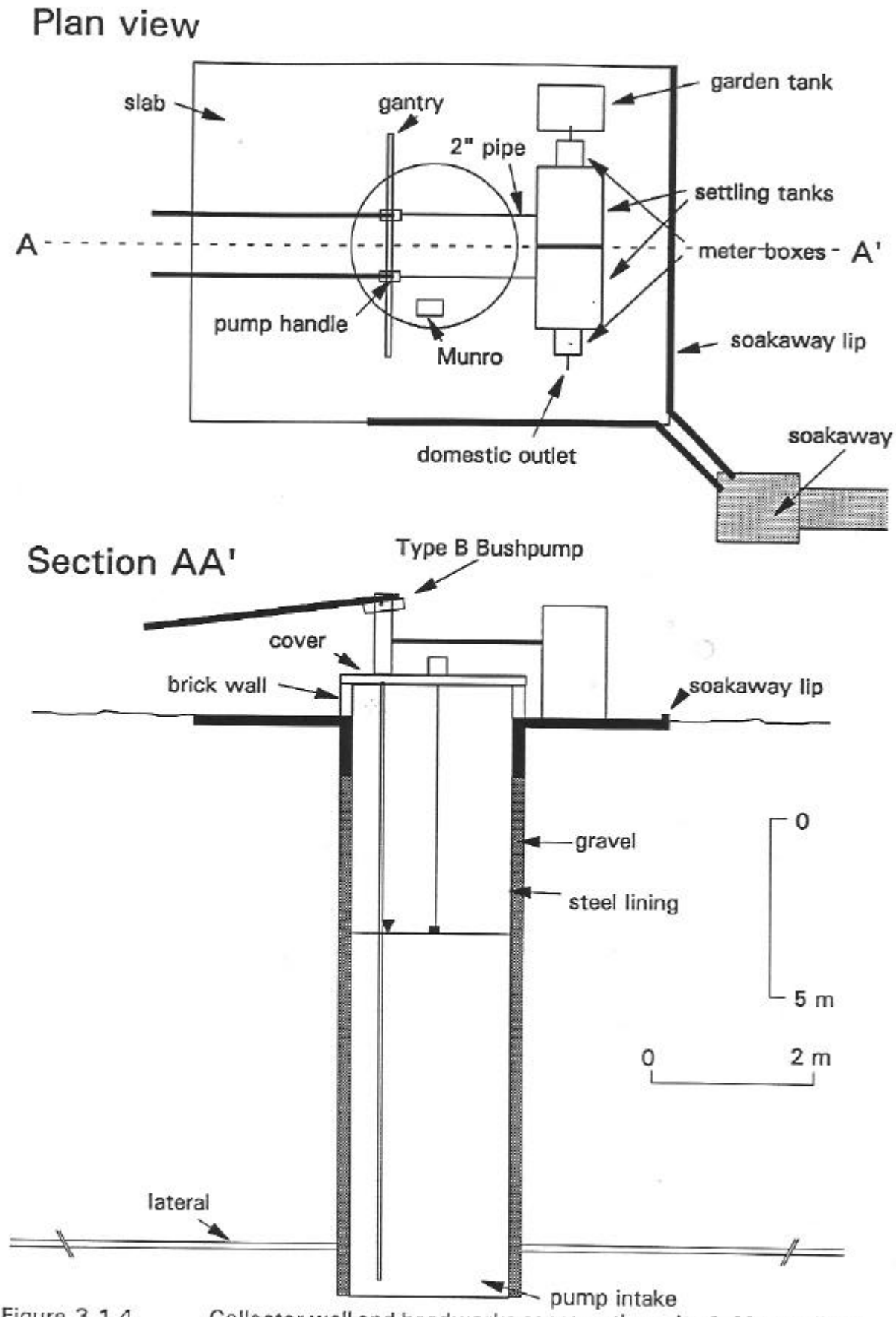


Figure 3.1.4 Collector well and headworks construction, site 1, Muzondidya

Table 3.1.1 Diary of activities at site 1, Muzondidya

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
drill eleven exploratory holes	15/3/93 (14 days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 600l drill bits ?
establish degree of need and potential community commitment	(3 days)	sociologist economist	none	none
pumptest exploratory hole bh11 (5 tests)	30/3/93 (5 days)	ptest engineer site assistant	Pump and associated equipment	petrol 20l
dig well shaft to 15.8m, backfill with gravel, concrete in sanitary seal, build and plaster head wall	14/6/93 (84 days)	construction manager site foreman 5 labourers	compressor pump + hoses wire rope + winch gantry kibble personnel steps 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helmets jackhammer cement mixer shifting spanner 27mm spanner torch foreman's tent foreman's bed foreman's stove	cement 26 bags bricks 200 river sand 4 cum 19mm gravel 10 cum diesel(comp) 3600 l steel casing 16 m jh points 2 pump rubbers 2 hydraulic oil 15 l engine oil 5l gumboots 6 prs paraffin 15l gas 6 kg
lateral drilling (five laterals)	05/07/93 (6 days)	driller crane operator 1 labourer	air rig and associated equipment	diesel 1100l
complete headworks, well covers, water tank, settling tank, soakaway, gantry	10/07/93 (4 days)	construction manager site foreman 5 labourers	formwork level trowel wheelbarrow cement mixer	bricks 160 cement 7 bags sand/gravel 1 cum 6"steel casing 2 m pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15 m 50mm elbows 2 50mm nipples 2
pump test collector well 2 before lats x 2 after lats, 7 day test.	10/08/93 (11days)	ptest engineer site assistant	pump and associated equipment	petrol 70l

Table 3.1.1 Diary of activities at site 1, Muzondidya (continued)

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
install bushpumps with community as part of pump maintenance workshop	5/11/93 (1 day)	instructor translator 6 trainees	thread cutter for 50mm pipe and 19mm rods	50mm galv pipe 30 m 50mm nipples 8 pump cylinder 2 17mm rods 30 m type B bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20 m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for collector well, unused bucket well, DDF borehole and piezometer:- bh11	10/8/93 (2 days)	ptest engineer foreman monitor man	munro wl recorder 2 water meters	bricks 300 cement 6 bags munro box 1 padlock 1 50mm galv pipe 6 m 50mm elbows 8 50mm unionjoint 2 w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	15/7/93 (2 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20 bags steel posts 13 steel stays 10 steel standards 36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer. vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a separate cw interim rpt.
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenance and attending to minor breakdowns.

Table 3.1.2 Drilling logs of exploratory boreholes at site 1, Muzondidya

EXPLORATORY BH NUMBER	DRILLERS DESCRIPTION (P.Rastall)
BH1	clay to 1m, hard to 5m. Dry.
BH2	clay to 1m, hard to 3m, clay to 8m, fairly soft to 15m. Water struck at 8m, RWL = 2.7m (2/93).
BH3	clay to 1m, weathered to 8m, fairly soft to 15m. Water struck at 8m, RWL = 2.6m (2/93).
BH4	clay to 1m, weathered to 8m, hard to 12m. Water struck at 8m, RWL = ??
BH5	clay to 1m, weathered to 3m, hard to 8m.
BH6	clay to 1m, sludge to 3m, hard to 6m. Dry.
BH7	clay to 2m, weathered to 5m, hard to 8m. Dry.
BH8	clay to 1m, weathered to 8m, hard/soft bands to 12m. reasonable show of water, RWL = 1.2m (3/93).
BH9	clay to 1m, weathered to 9m, hard/soft bands to 15m. reasonable show of water, RWL = 1.5m (3/93).
BH10	clay to 1m, weathered to 8m. Dry.
BH11	clay to 1m, weathered to 7m, hard/soft bands to 15m reasonable show of water, hard to 31m with soft bands at 17m, 20m and 24m good show of water in the bands, change in colour of chippings from 31m to 40m with soft bands at 35m and 39m, very good show of water in bands especially at 35m. RWL = 0.88m (3/93).

Table 3.1.3 Geological descriptions of collector well digging samples, site 1, Muzondidya

MUZONDIDYA (SITE ONE) GEOLOGICAL DESCRIPTION OF COLLECTOR WELL DIGGING SAMPLES	
DEPTH	**Description**
1m	Large fragments of very weathered pale buff rock, a few reddish iron staining. Small quartz grains to 2 mm.
2m	Soft, pale buff crumbling fragments of weathered biotite gneiss, lots of iron staining on joint faces.
3m	Soft, white to buff, crumbling fragments of weathered, ?kaolinised gneiss, with iron staining on broken faces. Also angular fragments of yellowish-buff, thinly banded/foliated, weathered rock, iron stained black on some joint faces.
4m	Angular pieces of massively crystalline weathered gneiss, some quartz, white feldspar and biotite, others pinkish. Brown staining on joint faces and broken fragments.
5m	Rounded lumps of very weathered gneiss coated with buffish clay and sand particles, some clayey lumps of aggregated sand grains of quartz and other minerals. Some more angular lumps of gneiss with similar coating.
6m	Angular fragments of weathered gneiss showing crystalline structure, bright orange iron staining on foliation faces. Some small pieces very black iron staining.
7m	Angular pieces of weathered gneiss, with coating of buff sandy and silty dust. Iron staining on foliations. Some pink fragments, some white containing ferromagnesian minerals.
8m	Soft, rounded lumps of weathered gneiss, break to show original texture, biotites and foliation. Also angular pieces of buff-yellowish weathered gneiss, breaking along foliation.
9m	Small, soft rounded pieces (and sand) of weathered gneiss.
10m	Soft, friable, rounded fragments of weathered gneiss which crumble to show grain texture. Some angular fragments of harder, pinkish gneiss, some coated with fine buff material.
11m	Angular fragments of weathered gneiss, some breaking along foliations, heavily iron stained brown patches on some broken faces. Biotite in some pieces, hornblende? in others.
12m	As above, but larger fragments. Some heavily iron stained on joints, some showing shiny micas.
13m	Angular pieces of harder weathered gneiss, some heavily iron stained, some showing bright micas. Some fine coating.
14m	Angular pieces of weathered gneiss, becoming harder than above. Crystalline structure well seen. Some pieces pinkish, others with white feldspars.
15m	Angular pieces of crystalline gneiss, showing quartz grains, pinkish feldspars and few biotites, and some ferromagnesian minerals. Mostly clean and fresh, some finely coated.

Table 3.1.4 Lateral drilling logs from site 1, Muzondidya

MUZONDIDYA (SITE 1) LATERAL LOGS (Drilled 1/7/93 to 6/7/93 by P. Rastall)		
LATERAL NUMBER	**SUMMARY DETAILS**	DRILLING DESCRIPTION
1	Direction WNW (300deg) Inclination -0degrees Length 30m water inflow very poor	dry and hard to 24m, small show of water to 25m, broken softer and dry to 29m, hard and dry to 30m.
2	Direction SSW (210deg) Inclination -5degrees Length 30m water inflow very good	dry and hard to 25m, good show of water to 27m, soft and wet to 30m.
3	Direction ENE (120deg) Inclination -5degrees Length 15m water inflow poor	dry and hard to 1m, damp and soft to 2.5m, dry and hard to 15m.
4	Direction NNW (340deg) Inclination -5degrees Length 30m water inflow good	wet and soft to 15m, hard and dry to 19m.
5	Direction NNE (015deg) Inclination -5degrees Length 30m water inflow good	hard and dry to 2m, soft and dry to 12m, soft/hard banded and wet to 30m.

Table 3.1.5 Pumping-tests performed at site 1, Muzondidya

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIP.	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL (mbgl)	REC. TIME (min)	COMMENTS
1	06/23/83	LOW DISCH B.LATS	DT/JC	0.70	120	3.85	5.31	<3.85	1560	prate +-15% not at rwl
2	06/26/83	HIGH DISCH B.LATS	DT/JC	4.00	100	4.58	8.58	<3.85	4320	prate +-15% not at rwl
3	07/21/83	LOW DISCH A. LATS	DT	0.78	150	2.95	4.59	<2.95	1200	prate accurate +-3% close to r
4	07/22/83	HIGH DISCH A. LATS	DT	4.40	120	3.55	11.23	<2.71	8040	prate +-10% close to rwl
5A	06/06/83	REC AFTER DIGGING	DT/EM	NA	NA	NA	NA	<4.00	24480	-different dewatering times
5B	07/06/83	REC AFTER LATERALS	DT/EM	NA	NA	NA	NA	<3.35	16200	-careful when comparing
6	06/03/83	SEVEN DAY TEST	DT/EM	0.19	7DAYS	3.21	7.46	<3.21	NA	good accurate test
7	05/17/84	TEST1OF3 HIGH WL	DT	1.01	300	2.38	7.02	<2.88	2880	prate +-3%

WELL DESCRIPTION_____ BH11

TEST No	DATE	DESCRIP.	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL (mbgl)	REC. TIME (min)	COMMENTS
1	03/16/83	T1 15m expl bh	PR	0.44	7	0.87	8.87	<0.87	90	rate not const
2	03/17/83	T2 15m expl bh	PR	0.10	100	1.05	3.83	<1.05	70	rate not const
3	03/22/83	T3 15m expl bh	PR/DM	0.20	60	0.88	8.85	<0.88	60	rate better
4	03/27/83	T4 40m bh	PR	0.37	400	0.64	6.12	<0.64	100	rate better
5	03/30/83	T5 40m bh	PR	0.38	400	0.65	6.26	<0.65	100	similar to test 4 ??
6	07/30/83	T6 40m bh (cw dug)	DT/EM	1.10	100	2.02	25.85	<2.02	60	rate const. effected by cw

WELL DESCRIPTION_____ DDF SCHOOL BH

TEST No	DATE	DESCRIP.	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL (mbgl)	REC. TIME (min)	COMMENTS
1	05/20/84	T1 using bushpump	DT	0.58	60	8.27	11.18	<8.16	48	rate +-10%

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya

SITE	one	WELL DIAMETER (m)	2.10	
TEST	T1, ldbl	WELL DEPTH (mbgl)	15.80	
DATE	06/23/93	WELL SCREEN	steel	
TESTER	DT/PR/JC			

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs	2.00	AV PUMP RATE (l/s)	0.70
START VOL (m3)	NA	DRAWDOWN (m)	1.45
END VOL. (m3)	NA	DEWATERED VOL (m3)	5.022
START WL. (mbmd)	4.36	PUMPED VOL (m3)	5.040
END WL. (mbmd)	5.81	'LAMDA'	1.00
ORIFICE DIA (mm)	NA		
PRESS. DIFF (m)	NA		
CW DATUM	monro		
DATUM ELEV. (magl	0.51		
BH DATUM	NA		
DATUM ELEV.(magl)	NA		

RECOVERY DATA CW				RECOVERY DATA BH	
T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)	WL (mbmd)	WL (mbgl)
0.00		4.36	3.85	NA	NA
1.00		5.06	4.55	NA	NA
2.00	0.00	5.81	5.30	NA	NA
3.00	1.00	5.75	5.24	NA	NA
4.00	2.00	5.71	5.20	NA	NA
5.00	3.00	5.68	5.17	NA	NA
6.00	4.00	5.65	5.14	NA	NA
7.00	5.00	5.62	5.11	NA	NA
8.00	6.00	5.60	5.09	NA	NA
9.00	7.00	5.58	5.07	NA	NA
10.00	8.00	5.55	5.04	NA	NA
12.00	10.00	5.50	4.99	NA	NA
14.00	12.00	5.45	4.94	NA	NA
16.00	14.00	5.40	4.89	NA	NA
18.00	16.00	5.35	4.84	NA	NA
20.00	18.00	5.31	4.80	NA	NA
22.00	20.00	5.27	4.76	NA	NA
24.00	22.00	5.24	4.73	NA	NA
26.00	24.00	5.21	4.70	NA	NA
28.00	26.00	5.18	4.67	NA	NA

NOTES
-RWL is less than 3.85 mbgl. the regional wl was still recovering from dewatering during digging at the time of this test.
-The pump rate is not accurate due to poor measuring equipment. This is demonstrated by Lamda = 1.00, this should be less than 1, about 0.9. This is improved in later tests.

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

SITE	one	WELL DIAMETER (m)	2.10
TEST	T2, hdbl	WELL DEPTH (mbgl)	15.80
DATE	06/25/93	WELL SCREEN	steel
TESTER	DT/PR/JC		

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs)	1.66	AV PUMP RATE (l/s)	4.00
START VOL (m3)	NA	DRAWDOWN (m)	5.00
END VOL. (m3)	NA	DEWATERED VOL (m3	17.318
START WL. (mbmd)	5.09	PUMPED VOL (m3)	23.904
END WL. (mbmd)	10.09	'LAMDA'	0.72
ORIFICE DIA (mm)	NA		
PRESS. DIFF (m)	NA		
CW DATUM	monro		
DATUM ELEV. (magl)	0.51		
BH DATUM	NA		
DATUM ELEV.(magl)	NA		

RECOVERY DATA CW				RECOVERY DATA BH	
T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)	WL (mbmd)	WL (mbgl)
0.00		5.09	4.58	NA	NA
1.00		8.79	8.28	NA	NA
1.66	0.00	10.09	9.58	NA	NA
3.66	2.00	9.92	9.41	NA	NA
5.66	4.00	9.77	9.26	NA	NA
7.66	6.00	9.59	9.08	NA	NA
9.66	8.00	9.48	8.97	NA	NA
11.66	10.00	9.35	8.84	NA	NA
13.66	12.00	9.23	8.72	NA	NA
15.66	14.00	9.11	8.60	NA	NA
17.66	16.00	9.00	8.49	NA	NA
21.66	20.00	8.77	8.26	NA	NA
25.66	24.00	8.57	8.06	NA	NA
37.66	36.00	8.00	7.49	NA	NA
49.66	48.00	7.47	6.96	NA	NA
61.66	60.00	6.97	6.46	NA	NA
73.66	72.00	6.50	5.99	NA	NA

NOTES
-RWL is less than 3.85 mbgl. the regional wl was still recovering from dewatering during digging and from T1 LDBL two days before.
-The pump rate is not accurate due to poor measuring equipment. It slows down towards the end of pumping, the pump started to sieze and the intended two hour test was reduced to 1.66 hours.

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

SITE	one	WELL DIAMETER (m)	2.10
TEST	T3, Idal	WELL DEPTH (mbgl)	15.80
DATE	07/21/93	WELL SCREEN	steel
TESTER	DT		

PUMPING DATA

PUMPING TIME (hrs)	2.50
START VOL (m3)	6.256
END VOL. (m3)	13.361
START WL. (mbmd)	3.46
END WL. (mbmd)	5.10
ORIFICE DIA (mm)	NA
PRESS. DIFF (m)	NA
CW DATUM	monro
DATUM ELEV. (magl	0.51
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	0.79
DRAWDOWN (m)	1.64
DEWATERED VOL (	5.680
PUMPED VOL (m3)	7.105
'LAMDA'	0.80

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		3.46	2.95
1.00		4.15	3.64
2.50	0.00	5.10	4.59
4.50	2.00	4.96	4.45
6.50	4.00	4.80	4.29
8.50	6.00	4.66	4.15
10.50	8.00	4.54	4.03
12.50	10.00	4.43	3.92
14.50	12.00	4.33	3.82
16.50	14.00	4.23	3.72
18.50	16.00	4.16	3.65
20.50	18.00	4.12	3.61
22.50	20.00	4.06	3.55

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES
-RWL is less than 3.46 mbgl. the regional wl was still recovering from dewatering during lat. drilling at the time of this test.
-The average pump rate is accurate and fairly constant (+-10%)

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

SITE	one	WELL DIAMETER (m)	2.10
TEST	T4, hdal	WELL DEPTH (mbgl)	15.80
DATE	07/22/93	WELL SCREEN	steel
TESTER	DT		

PUMPING DATA

PUMPING TIME (hrs)	2.00
START VOL (m3)	NA
END VOL. (m3)	NA
START WL. (mbmd)	4.06
END WL. (mbmd)	11.74
ORIFICE DIA (mm)	NA
PRESS. DIFF (m)	NA
CW DATUM	monro
DATUM ELEV. (magl)	0.51
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	4.40
DRAWDOWN (m)	7.68
DEWATERED VOL (m3)	26.600
PUMPED VOL (m3)	31.680
'LAMDA'	0.84

RECOVERY DATA CW				RECOVERY DATA BH	
T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)	WL (mbmd)	WL (mbgl)
0.00		4.06	3.55	NA	NA
1.00		8.02	7.51	NA	NA
2.00	0.00	11.74	11.23	NA	NA
4.00	2.00	11.07	10.56	NA	NA
6.00	4.00	10.46	9.95	NA	NA
8.00	6.00	9.90	9.39	NA	NA
10.00	8.00	9.39	8.88	NA	NA
12.00	10.00	8.97	8.46	NA	NA
14.00	12.00	8.49	7.98	NA	NA
16.00	14.00	8.09	7.58	NA	NA
18.00	16.00	7.72	7.21	NA	NA
22.00	20.00	7.09	6.58	NA	NA
26.00	24.00	6.57	6.06	NA	NA
38.00	36.00	5.37	4.86	NA	NA
50.00	48.00	4.60	4.09	NA	NA
62.00	60.00	4.14	3.63	NA	NA
74.00	72.00	3.97	3.46	NA	NA
86.00	84.00	3.86	3.35	NA	NA
110.00	108.00	3.68	3.17	NA	NA
134.00	132.00	3.58	3.07	NA	NA

NOTES
-RWL is less than 3.07 mbgl.
-The pump rate is not accurate (+- 15%) due to poor measuring equipment. this is improved in subsequent tests

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

TEST 5(A) MUZONDIDYA RECOVERY AFTER DIGGING
DIGGING STARTED LATE MA DIGGING STOPPED 7/6/93
DEWATERED EACH DAY AS DIGGING PROGRESSED FOR APPROX 9 WEEKS
RECOVERY FROM 15.8 M BELOW GROUND LEVEL

TIME(HRS	WL (M)	PLOT
0	15.80	-15.8
24	14.50	-14.5
48	13.20	-13.2
72	12.00	-12
96	10.90	-10.9
120	9.90	-9.9
144	8.90	-8.9
168	8.00	-8
192	7.10	-7.1
216	6.30	-6.3
240	5.70	-5.7
264	5.15	-5.15
288	4.80	-4.8
312	4.50	-4.5
336	4.30	-4.3
360	4.15	-4.15
384	4.10	-4.1
408	4.00	-4

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

TEST 5(B) MUZONDIDYA RECOVERY AFTER LATERAL DRILLING
DRILLING STARTED 29/6/93 DIGGING STOPPED 5/7/93
DEWATERED TO BOTTOM (15.8M) FOR 7 DAYS
RECOVERY FROM 15.8 M BELOW GROUND LEVEL

TIME(HRS	WL (M)	
0	15.8	-15.8
10	12.85	-12.85
20	10.65	-10.65
30	9.5	-9.5
40	7.7	-7.7
50	6.65	-6.65
60	5.7	-5.7
70	5.15	-5.15
80	4.7	-4.7
90	4.3	-4.3
100	4.1	-4.1
110	3.9	-3.9
120	3.8	-3.8
130	3.7	-3.7
140	3.65	-3.65
150	3.6	-3.6
160	3.57	-3.57
170	3.55	-3.55
180	3.53	-3.53
190	3.51	-3.51
200	3.49	-3.49
210	3.47	-3.47
220	3.45	-3.45
230	3.43	-3.43
240	3.41	-3.41
250	3.39	-3.39
260	3.37	-3.37
270	3.35	-3.35

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

SITE 1 T6/CW7DAY	MUZONDIDYA COLLECTOR WELL			
TEST DATE	3/8/93 TO 9/8/93			
TOTAL DEPTH(M)	16.30	BELOW DATUM		
PUMP SET AT(M)	14.00	BELOW DATUM		
PUMPING RATE (L/S)	0.19			
WELL DATUM	MUNRO	HEIGHT ABOVE GL(M)		0.50
BH DATUM	TOC	HEIGHT ABOVE GL(M)		0.50
TESTER D.THOMPSON / E.MAFUNGI				

DATE	Tpstart (HRS)	COLLECTOR WELL WL (M DATUM	WL (m BGL)	BH11 WL (M DATUM)	WL (m BGL)
3/8	0.0	3.71	3.21	2.61	2.11
	2.0	4.96	4.46	2.96	2.46
	5.0	4.65	4.15	3.03	2.53
	7.0	5.91	5.41	3.35	2.85
	10.0	5.44	4.94	3.29	2.79
	12.0	6.62	6.12	3.60	3.10
4/8	24.0	4.94	4.44	3.18	2.68
	26.0	6.16	5.66	3.48	2.98
	29.0	5.67	5.17	3.51	3.01
	31.0	6.84	6.34	3.80	3.30
	34.0	6.25	5.75	3.70	3.20
	36.0	7.34	6.84	3.95	3.45
5/8	48.0	5.37	4.87	3.41	2.91
	50.0	6.60	6.10	3.73	3.23
	53.0	6.07	5.57	3.73	3.23
	55.0	7.20	6.70	4.00	3.50
	58.0	6.59	6.09	3.90	3.40
	60.0	7.62	7.12	4.15	3.65
6/8	72.0	5.59	5.09	3.56	3.06
	74.0	6.78	6.28	3.85	3.35
	77.0	6.24	5.74	3.84	3.34
	79.0	7.33	6.83	4.10	3.60
	82.0	6.74	6.24	4.00	3.50
	84.0	7.79	7.29	4.23	3.73
7/8	96.0	5.70	5.20	3.65	3.15
	98.0	6.88	6.38	3.92	3.42
	101.0	6.36	5.86	3.89	3.39
	103.0	7.46	6.96	4.16	3.66
	106.0	6.84	6.34	4.07	3.57
	108.0	7.87	7.37	4.30	3.80
8/8	120.0	5.77	5.27	3.71	3.21
	122.0	6.95	6.45	3.98	3.48
	125.0	6.40	5.90	3.93	3.43
	127.0	7.48	6.98	4.21	3.71
	130.0	6.89	6.39	4.12	3.62
	132.0	7.91	7.41	4.35	3.85
9/8	144.0	5.82	5.32	3.75	3.25
	146.0	7.00	6.50	4.02	3.52
	149.0	6.43	5.93	3.97	3.47
	151.0	7.54	7.04	4.25	3.75
	154.0	6.92	6.42	4.17	3.67
	156.0	7.96	7.46	4.42	3.92
10/8	168.0	5.84	5.34	3.78	3.28

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

SITE	one	WELL DIAMETER (m)	2.10
TEST	T7, 1of3	WELL DEPTH (mbgl)	15.80
DATE	05/17/94	WELL SCREEN	steel
TESTER	DT		

PUMPING DATA

PUMPING TIME (hrs	5.00
START VOL (m3)	255.476
END VOL. (m3)	273.601
START WL. (mbmd)	2.88
END WL. (mbmd)	7.02
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.23
CW DATUM	monro
DATUM ELEV. (magl	0.5
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	1.01
DRAWDOWN (m)	4.14
DEWATERED VOL (m3)	14.339
PUMPED VOL (m3)	18.125
'LAMDA'	0.79

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		2.88	2.38
1.00		3.76	3.26
2.00		4.62	4.12
3.00		5.46	4.96
4.00		6.27	5.77
5.00	0.00	7.02	6.52
7.00	2.00	6.63	6.13
9.00	4.00	6.19	5.69
11.00	6.00	5.85	5.35
13.00	8.00	5.53	5.03
15.00	10.00	5.25	4.75
17.00	12.00	4.99	4.49
19.00	14.00	4.74	4.24
21.00	16.00	4.52	4.02
25.00	20.00	4.23	3.73
29.00	24.00	4.00	3.50
41.00	36.00	3.52	3.02
53.00	48.00	3.27	2.77

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES

-RWL is less than 3.38 mbgl. The well was still recovering.
From attached diagram estimated RWL = 1.3m (+-.3m)

-The average pumping rate was accurate and remained constant (+- 1%).

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

LOCATION	MUZONDIDYA BH11		
TEST DATE	22/3/93		
TOTAL DEPTH(M)	15.00		
PUMP SET AT(M)	12.00		
PUMPING RATE (L/	0.20		
EC (uS)			
DATUM	GL	HEIGHT ABOVE GL(M)	0.00
TESTER	P.RASTALL		

Tpstart (min)	Tpstop (min)	WL (M DATUM)	WL (m FGL)	SC (L/S/M)	NOTES
0.0		0.88	0.88		
0.5		1.05	1.05	1.176	
1.0		1.15	1.15	0.741	
1.5		1.22	1.22	0.588	
2.0		1.31	1.31	0.465	
2.5		1.40	1.40	0.385	
3.0		1.58	1.58	0.286	
3.5		1.60	1.60	0.278	
4.0		1.63	1.63	0.267	
4.5		1.71	1.71	0.241	
5.0		1.81	1.81	0.215	
6.0		2.08	2.08	0.167	
7.0		2.28	2.28	0.143	
8.0		2.47	2.47	0.126	
9.0		2.66	2.66	0.112	
10.0		2.86	2.86	0.101	
12.0		3.10	3.10	0.090	
14.0		3.42	3.42	0.079	
16.0		3.71	3.71	0.071	
18.0		3.97	3.97	0.065	
20.0		4.27	4.27	0.059	
22.0		4.55	4.55	0.054	
24.0		4.48	4.48	0.056	
26.0		5.09	5.09	0.048	
28.0		5.35	5.35	0.045	
30.0		5.57	5.57	0.043	
32.0		5.81	5.81	0.041	
35.0		6.15	6.15	0.038	
40.0		6.72	6.72	0.034	
45.0		7.47	7.47	0.030	
50.0		8.25	8.25	0.027	
60.0	0	9.85	9.85	0.022	
60.5	0.5	9.40	9.40		
61.0	1	9.10	9.10		
61.5	1.5	8.83	8.83		
62.0	2	8.41	8.41		
62.5	2.5	8.18	8.18		
63.0	3	7.88	7.88		
63.5	3.5	7.66	7.66		
64.0	4	7.44	7.44		
64.5	4.5	7.11	7.11		
65.0	5	6.97	6.97		
66.0	6	6.65	6.65		
67.0	7	6.40	6.40		
68.0	8	6.12	6.12		
69.0	9	5.86	5.86		
70.0	10	5.63	5.63		

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

72.0	12	5.20	5.20
74.0	14	4.81	4.81
76.0	16	4.45	4.45
78.0	18	4.09	4.09
80.0	20	3.81	3.81
82.0	22	3.58	3.58
84.0	24	3.34	3.34
86.0	26	3.17	3.17
88.0	28	3.00	3.00
90.0	30	2.82	2.82
92.0	32	2.66	2.66
95.0	35	2.45	2.45
100.0	40	2.21	2.21
105.0	45	2.03	2.03
110.0	50	1.88	1.88
120.0	60	1.70	1.70

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

LOCATION	MUZONDIDYA BH11		
TEST DATE	27/3/93		
TOTAL DEPTH(M)	40.00		
PUMP SET AT(M)	37.00		
PUMPING RATE (L/S)	0.38		
EC (uS)	336.00		
DATUM	GL	HEIGHT ABOVE GL(M)	0.00
TESTER	P.RASTALL		

Tpstart (min)	Tpstop (min)	WL (M DATUM)	WL (m FGL)	DD (m)	SC (L/S/M)	NOTES
0.0		0.54	0.54	0.00		
0.5		0.89	0.89	0.35	1.086	
1.0		1.10	1.10	0.56	0.679	
1.5		1.23	1.23	0.69	0.551	
2.0		1.45	1.45	0.91	0.418	
2.5		1.75	1.75	1.21	0.314	
3.0		1.95	1.95	1.41	0.270	
3.5		2.04	2.04	1.50	0.253	
4.0		2.12	2.12	1.58	0.241	
4.5		2.33	2.33	1.79	0.212	
5.0		2.51	2.51	1.97	0.193	
6.0		2.86	2.86	2.32	0.164	
7.0		3.03	3.03	2.49	0.153	
8.0		3.20	3.20	2.66	0.143	
9.0		3.35	3.35	2.81	0.135	
10.0		3.48	3.48	2.94	0.129	
12.0		3.65	3.65	3.11	0.122	
14.0		3.78	3.78	3.24	0.117	
16.0		3.90	3.90	3.36	0.113	
18.0		4.09	4.09	3.55	0.107	
20.0		4.20	4.20	3.66	0.104	
22.0		4.26	4.26	3.72	0.102	
24.0		4.32	4.32	3.78	0.101	
26.0		4.40	4.40	3.86	0.098	
28.0		4.45	4.45	3.91	0.097	
30.0		4.53	4.53	3.99	0.095	
32.0		4.60	4.60	4.06	0.094	
35.0		4.65	4.65	4.11	0.092	
40.0		4.69	4.69	4.15	0.092	
45.0		4.66	4.66	4.12	0.092	
50.0		4.66	4.66	4.12	0.092	
60.0		4.78	4.78	4.24	0.090	
70.0		4.81	4.81	4.27	0.089	
80.0		5.04	5.04	4.50	0.084	
90.0		5.20	5.20	4.66	0.082	
100.0		5.27	5.27	4.73	0.080	
120.0		5.41	5.41	4.87	0.078	
140.0		5.52	5.52	4.98	0.076	
160.0		5.67	5.67	5.13	0.074	
180.0		5.86	5.86	5.32	0.071	
200.0		5.82	5.82	5.28	0.072	
220.0		5.87	5.87	5.33	0.071	

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

240.0		5.77	5.77	5.23	0.073
260.0		5.90	5.90	5.36	0.071
280.0		5.59	5.59	5.05	0.075
300.0		5.64	5.64	5.10	0.075
320.0		5.68	5.68	5.14	0.074
350.0		6.08	6.08	5.54	0.069
400.0	0	6.12	6.12	5.58	0.068
400.5	0.5	5.65	5.65		
401.0	1.0	5.36	5.36		
401.5	1.5	5.11	5.11		
402.0	2.0	4.80	4.80		
402.5	2.5	4.61	4.61		
403.0	3.0	4.40	4.40		
403.5	3.5	4.23	4.23		
404.0	4.0	4.04	4.04		
404.5	4.5	3.87	3.87		
405.0	5.0	3.73	3.73		
406.0	6.0	3.53	3.53		
407.0	7.0	3.32	3.32		
408.0	8.0	3.15	3.15		
409.0	9.0	3.00	3.00		
410.0	10.0	2.89	2.89		
412.0	12.0	2.62	2.62		
414.0	14.0	2.41	2.41		
416.0	16.0	2.27	2.27		
418.0	18.0	2.15	2.15		
420.0	20.0	2.06	2.06		
422.0	22.0	1.98	1.98		
424.0	24.0	1.91	1.91		
426.0	26.0	1.85	1.85		
428.0	28.0	1.79	1.79		
430.0	30.0	1.73	1.73		
432.0	32.0	1.69	1.69		
435.0	35.0	1.64	1.64		
440.0	40.0	1.56	1.56		
445.0	45.0	1.51	1.51		
450.0	50.0	1.46	1.46		
460.0	60.0	1.4	1.40		
470.0	70.0	1.33	1.33		
480.0	80.0	1.28	1.28		
490.0	90.0	1.22	1.22		
500.0	100.0	1.18	1.18		

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

LOCATION	MUZONDIDYA BH11		
TEST DATE	30/7/93		
TOTAL DEPTH(M)	40.00		
PUMP SET AT(M)	36.00		
PUMPING RATE (L/S	1.08		
EC (uS)			
DATUM	TOC	HEIGHT ABOVE GL(M)	0.50
TESTER	D.THOMPSON, E.MAFUNGI		

Tpstart (min)	Tpstop (min)	WL (M DATUM	WL (m FGL)	DD (m)	SC (L/S/M)	NOTES
0.0		2.52	2.02	0.00		
0.5		3.65	3.15	1.13	0.956	
1.0		4.44	3.94	1.92	0.562	
1.5		5.35	4.85	2.83	0.382	
2.0		6.15	5.65	3.63	0.298	
2.5		7.12	6.62	4.60	0.235	
3.0		7.93	7.43	5.41	0.200	
3.5		8.77	8.27	6.25	0.173	
4.0		9.63	9.13	7.11	0.152	
4.5		10.42	9.92	7.90	0.137	
5.0		11.05	10.55	8.53	0.127	
6.0		12.53	12.03	10.01	0.108	
7.0		13.79	13.29	11.27	0.096	
8.0		15.00	14.50	12.48	0.087	
9.0		15.91	15.41	13.39	0.081	
10.0		16.78	16.28	14.26	0.076	
12.0		18.53	18.03	16.01	0.067	
14.0		19.82	19.32	17.30	0.062	
16.0		20.75	20.25	18.23	0.059	
18.0		21.60	21.10	19.08	0.057	
20.0		22.32	21.82	19.80	0.055	
22.0		22.86	22.36	20.34	0.053	
24.0		23.32	22.82	20.80	0.052	
26.0		23.69	23.19	21.17	0.051	
28.0		24.00	23.50	21.48	0.050	
30.0		24.23	23.73	21.71	0.050	
32.0		24.42	23.92	21.90	0.049	
35.0		24.54	24.04	22.02	0.049	
40.0		24.79	24.29	22.27	0.048	
45.0		24.96	24.46	22.44	0.048	
50.0		25.12	24.62	22.60	0.048	
60.0		25.36	24.86	22.84	0.047	
70.0		25.52	25.02	23.00	0.047	
80.0		25.75	25.25	23.23	0.046	
90.0		25.91	25.41	23.39	0.046	
100.0	0	25.95	25.45	23.43	0.046	
100.5	0.5	23.68	23.18			
101.0	1.0	21.56	21.06			
101.5	1.5	19.90	19.40			
102.0	2.0	18.06	17.56			
102.5	2.5	16.49	15.99			
103.0	3.0	15.00	14.50			

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

103.5	3.5	13.67	13.17
104.0	4.0	12.52	12.02
104.5	4.5	11.52	11.02
105.0	5.0	10.69	10.19
106.0	6.0	9.29	8.79
107.0	7.0	8.18	7.68
108.0	8.0	7.43	6.93
109.0	9.0	6.80	6.30
110.0	10.0	6.30	5.80
112.0	12.0	5.81	5.31
114.0	14.0	5.47	4.97
116.0	16.0	5.12	4.62
118.0	18.0	4.85	4.35
120.0	20.0	4.60	4.10
122.0	22.0	4.45	3.95
124.0	24.0	4.31	3.81
126.0	26.0	4.13	3.63
128.0	28.0	4.10	3.60
130.0	30.0	4.02	3.52
132.0	32.0	3.93	3.43
135.0	35.0	3.82	3.32
140.0	40.0	3.68	3.18
145.0	45.0	3.57	3.07
150.0	50.0	3.48	2.98
160.0	60.0	3.33	2.83

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

SITE	one	Muzondidyia BH near school			
TEST	T1	MEASURED DATA	DEPTH (mbgl)		48.00
DATE	05/20/94	TESTER DT	NUMBER OF 3m RO		8.00

BH DATA FROM MINISTRY OF WATER RECORDS ref:-

NAME	muzondidya school	WATER FIRST STRIKE (m)	12
NUMBER		MAIN STRIKE (m)	25.5
GRID REF		REST WATER LEVEL (m)	9
DATE DRILLED		BLOWING YIELD (m3/h)	7.40
DEPTH (m)	60.00	CASED	
DIAMETER (m)	0.15	SCREENED	
		OPEN	

PUMPING DATA

PUMPING TIME (hrs	1.00
START VOL (m3)	273.614
END VOL. (m3)	275.744
START WL. (mbmd)	8.80
END WL. (mbmd)	11.76
BH DATUM	toc
DATUM ELEV.(magl)	0.61

CALCULATED DATA

AV PUMP RATE (l/s)	0.59
DRAWDOWN (m)	2.96
DEWATERED VOL (m	0.052
PUMPED VOL (m3)	2.130
'LAMDA'	0.025

TEST DATA CW

T pstart (min)	T pstop (min)	WL (mbmd)	WL (mbgl)
0.00		8.88	8.27
1.00		10.24	9.63
2.00		10.87	10.26
3.00		11.22	10.61
4.00		11.42	10.81
5.00		11.48	10.87
6.00		11.63	11.02
7.00		11.67	11.06
8.00		11.69	11.08
9.00		11.69	11.08
10.00		11.78	11.17
12.00		11.90	11.29
14.00		11.90	11.29
16.00		11.90	11.29
18.00		11.60	10.99
20.00		11.69	11.08
22.00		11.76	11.15
24.00		11.76	11.15
26.00		11.70	11.09
28.00		11.75	11.14
30.00		11.94	11.33
32.00		11.91	11.30
34.00		11.96	11.35
36.00		11.98	11.37
38.00		11.87	11.26
40.00		11.77	11.16
42.00		11.65	11.04

PUMPING RATE DATA

MINUTE	PUMPED VOL (L)	AVERAG RATE (l/s)
1	37.00	0.62
2	37.00	0.62
3	37.00	0.62
4	36.00	0.60
5	34.00	0.57
6	35.00	0.58
7	36.00	0.60
8	35.00	0.58
9	33.00	0.55
10	35.00	0.58
11	40.00	0.67
12	35.00	0.58
13	35.00	0.58
14	35.00	0.58
15	36.00	0.60
16	33.00	0.55
17	30.00	0.50
18	28.00	0.47
19	27.00	0.45
20	29.00	0.48
21	31.00	0.52
22	37.00	0.62
23	37.00	0.62
24	35.00	0.58
25	34.00	0.57
26	31.00	0.52
27	33.00	0.55

Table 3.1.6 Pumping-test data from tests completed at site 1, Muzondidya (continued)

44.00		11.75	11.14
46.00		11.77	11.16
48.00		11.65	11.04
50.00		11.74	11.13
52.00		11.76	11.15
54.00		11.74	11.13
56.00		11.75	11.14
58.00		11.79	11.18
60.00	0.00	11.76	11.15
60.50	0.50	10.98	10.37
61.00	1.00	10.49	9.88
61.50	1.50	10.17	9.56
62.00	2.00	9.94	9.33
62.50	2.50	9.79	9.18
63.00	3.00	9.67	9.06
63.50	3.50	9.59	8.98
64.00	4.00	9.51	8.90
64.50	4.50	9.46	8.85
65.00	5.00	9.41	8.80
66.00	6.00	9.34	8.73
67.00	7.00	9.29	8.68
68.00	8.00	9.24	8.63
69.00	9.00	9.21	8.60
70.00	10.00	9.18	8.57
72.00	12.00	9.13	8.52
74.00	14.00	9.10	8.49
76.00	16.00	9.07	8.46
78.00	18.00	9.05	8.44
80.00	20.00	9.03	8.42
82.00	22.00	9.02	8.41
84.00	24.00	9.01	8.40
86.00	26.00	9.00	8.39
88.00	28.00	8.98	8.37
90.00	30.00	8.97	8.36
92.00	32.00	8.96	8.35
94.00	34.00	8.96	8.35
96.00	36.00	8.94	8.33
98.00	38.00	8.93	8.32
100.00	40.00	8.92	8.31
102.00	42.00	8.90	8.29
104.00	44.00	8.89	8.28
106.00	46.00	8.88	8.27
108.00	48.00	8.87	8.26

28	36.00	0.60
29	38.00	0.63
30	37.00	0.62
31	38.00	0.63
32	38.00	0.63
33	31.00	0.52
34	39.00	0.65
35	39.00	0.65
36	38.00	0.63
37	37.00	0.62
38	38.00	0.63
39	33.00	0.55
40	38.00	0.63
41	31.00	0.52
42	36.00	0.60
43	36.00	0.60
44	37.00	0.62
45	35.00	0.58
46	35.00	0.58
47	36.00	0.60
48	32.00	0.53
49	35.00	0.58
50	35.00	0.58
51	36.00	0.60
52	33.00	0.55
53	33.00	0.55
54	34.00	0.57
55	36.00	0.60
56	35.00	0.58
57	36.00	0.60
58	34.00	0.57
59	34.00	0.57
60	34.00	0.57

Table 3.1.7 Attendees of pump maintenance workshop site 1, Muzondidya

NAME
Mr Magodo
Mr Chauke
Mr Cement
Mr Misheck
Mr Tynos Nhondova

Table 3.1.8 Water points in the region of collector well site 1, Muzondidya

Well no.	Builder/owner	Kraal	Date	Diameter (m)	Depth (m)	Water-level			Perceived yield	Water use	Dries-up	
						depth (m)	time	date			Every year	1992
1	ODA/ community	Muzondidya	1993	2.0	16.8				Excellent Max. 21 m^3/d Av. 7 m^3/d	Garden (G) Domestic (D)	No	na
2	DDF/ community	Muzondidya		0.16	48	10.2			Excellent	D School (S)	No	No
3	DDF/ community	Njovo	1993	0.16	68				Excellent	D	No	NA
4	WH&Jack/ community	Dabwa	1981	0.16					V. Good	D	No	No
5	DDF/ community	Mzvidzwa	1961	0.16		8.06			Excellent	D	No	No
6	WH&Jack	Mzvidzwa	1989		> 16	4.7			Good	D	No	No
7	Community	Dabwa	1984	3.0	2.6	1			Poor	G	Yes	Yes
8	Community	Dabwa	1983	2.0	2.4	1.2			Poor	G	Yes	Yes
9	Charovedza	Dzamwaneka	1987	0.16					V. Good	D	No	No
10	DDF/ community	Chivambo	1995	0.16		> 16			Poor	D	Yes	Yes
11	WH&Jack	Rukavi	1986	0.16					V. Good	D,G	No	No
12	Muzondidya	Muzondidya	1990	1.7	9	2.48			Good	D,G	No	No
13	WH&Jack	Mzvidzwa	1993	> 16		16			V. Good	D	No	No
14	Jere	Jere	1993	1.6	4.6	4			Poor	D,G	na	na
15	Chauke	Gachiti	1990	1.3	16	1.3			Poor	D,G	Yes	Yes

Table 3.1.9 Wells and boreholes monitored for water-level at site 1, Muzondidya

WELL NUMBER	DATUM DESCRIPTION		DEPTH (m)	DIA (m)
	ELEV (magl)	ELEV (masawd)		
1	0.50	+0.00	15.8	2.0
BH11	0.60	-0.86	40.0	0.15
W1 unused well	0.20	+0.86	4.0	1.0
2	0.60	na	48.0	0.15

Site 2 - Gokota

Site description

Geology:	granulite gneiss
Location:	approx. 60 km north of Chiredzi Research Station, on the east side of the main Zaka tar road
Access:	from the road at the 77 km peg (km peg measured in a southernly direction from the Zaka turn-off on the Masvingo to Mutare road).
Annual rainfall:	790 mm

Exploratory drilling

Drilling:	BGS contract driller
No. of exploratory holes:	4
Comments:	collector well dug at bh6

Specific construction details

Foreman:	Timothy Chiunye
Depth of well shaft:	15 m
Time to dig shaft:	11 weeks
No. of laterals:	4
Length of laterals:	30, 30, 30, 30 m
Comments:	-

The garden committee constructed a concrete lined soakaway trench around the lower end of the slab. The waste water runs to a small pond from which cattle drink. The people at this site take great care to keep the soakaway and well area clean.

Monitoring of well performance

Mr Lucas Chikwera will change the munro recorder charts and read the meters at 0600 every Sunday morning. He will also dip piezometers bh7, bh8 and bh9.

20° 34' 37.27"S 31° 24' 15.02"E
36K 333668.33mE 7723648.97mS
good photo! elevation 713m

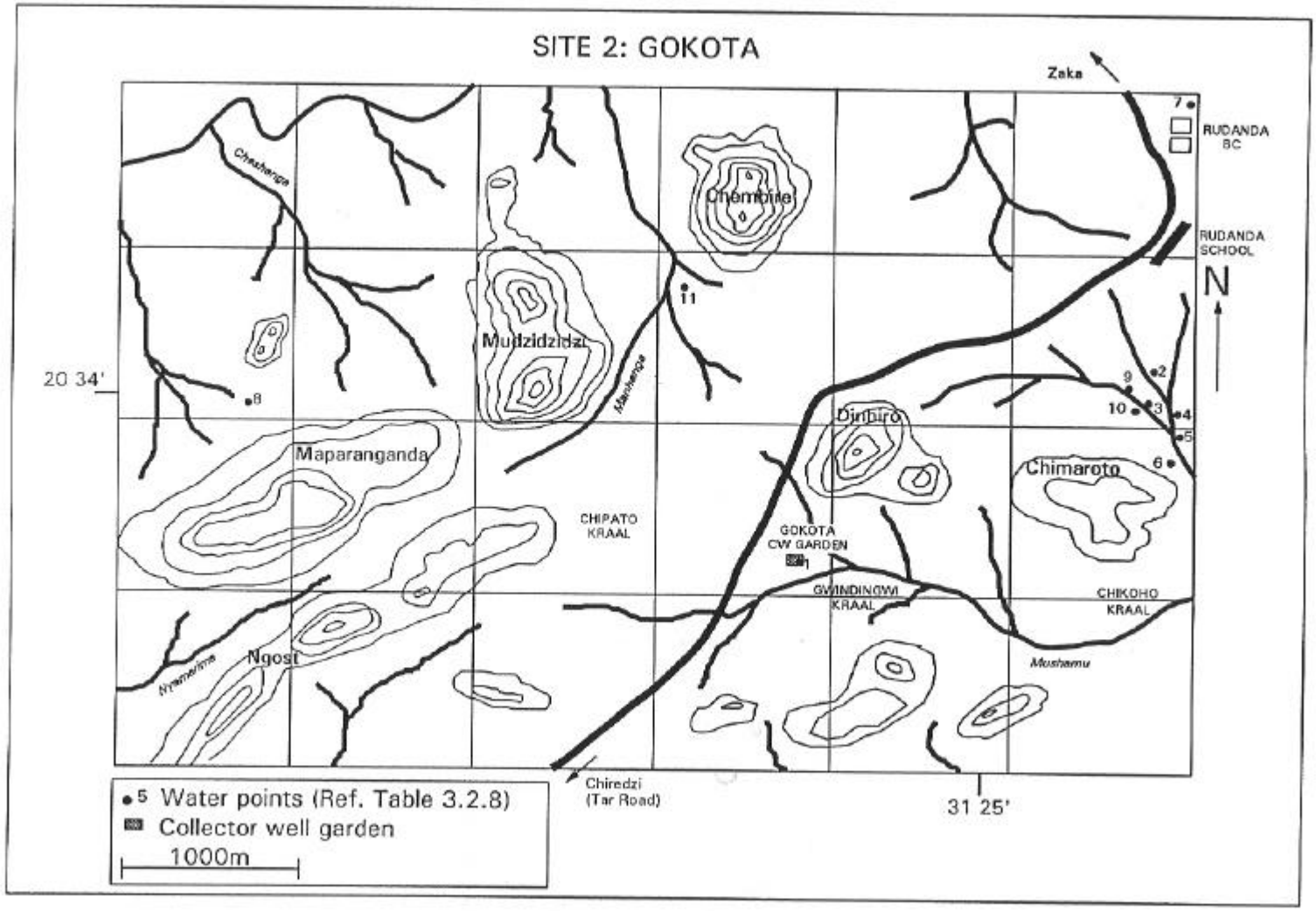


Figure 3.2.1 Map of location of collector well garden and local water points

not necessary

Figure 3.2.2 Detail showing location of exploratory boreholes

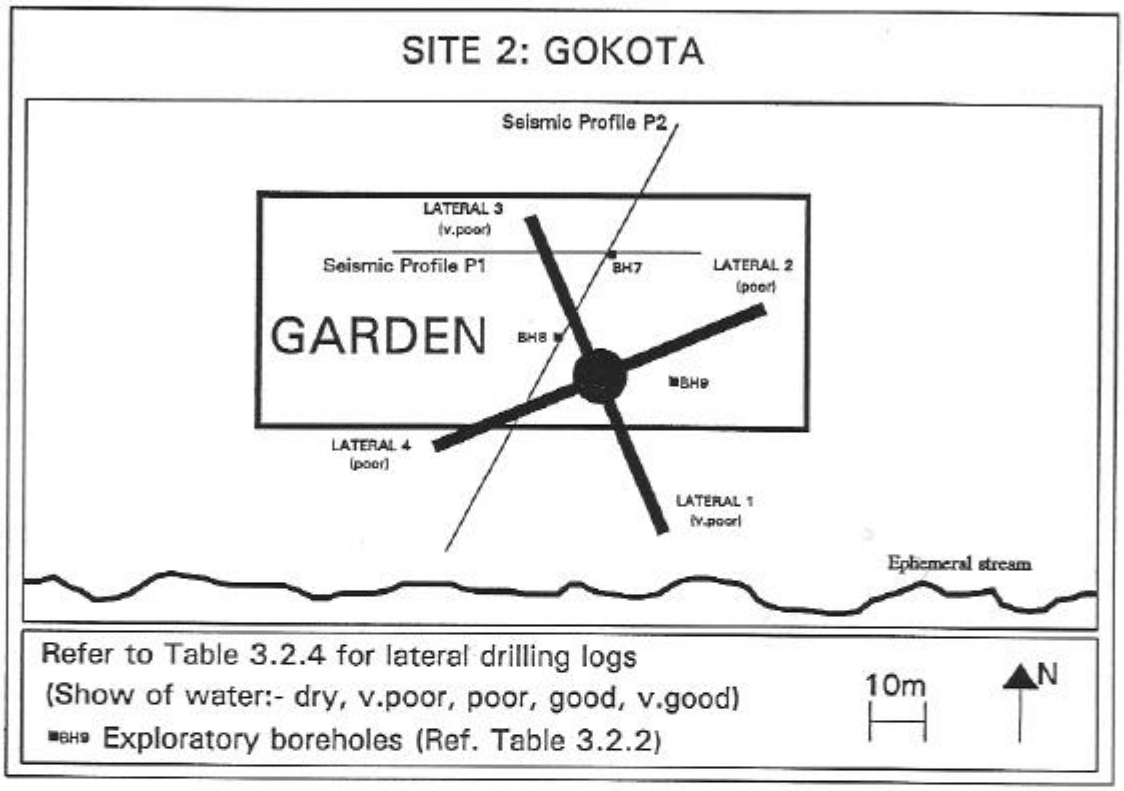
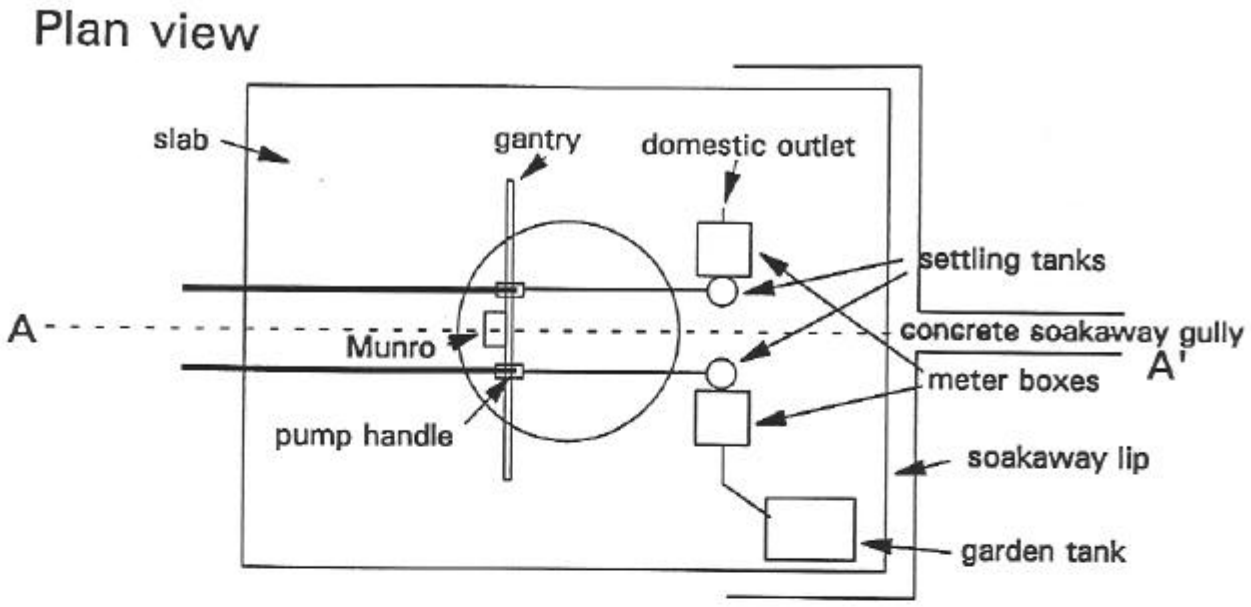


Figure 3.2.3 Map of vicinity of collector well showing direction of laterals



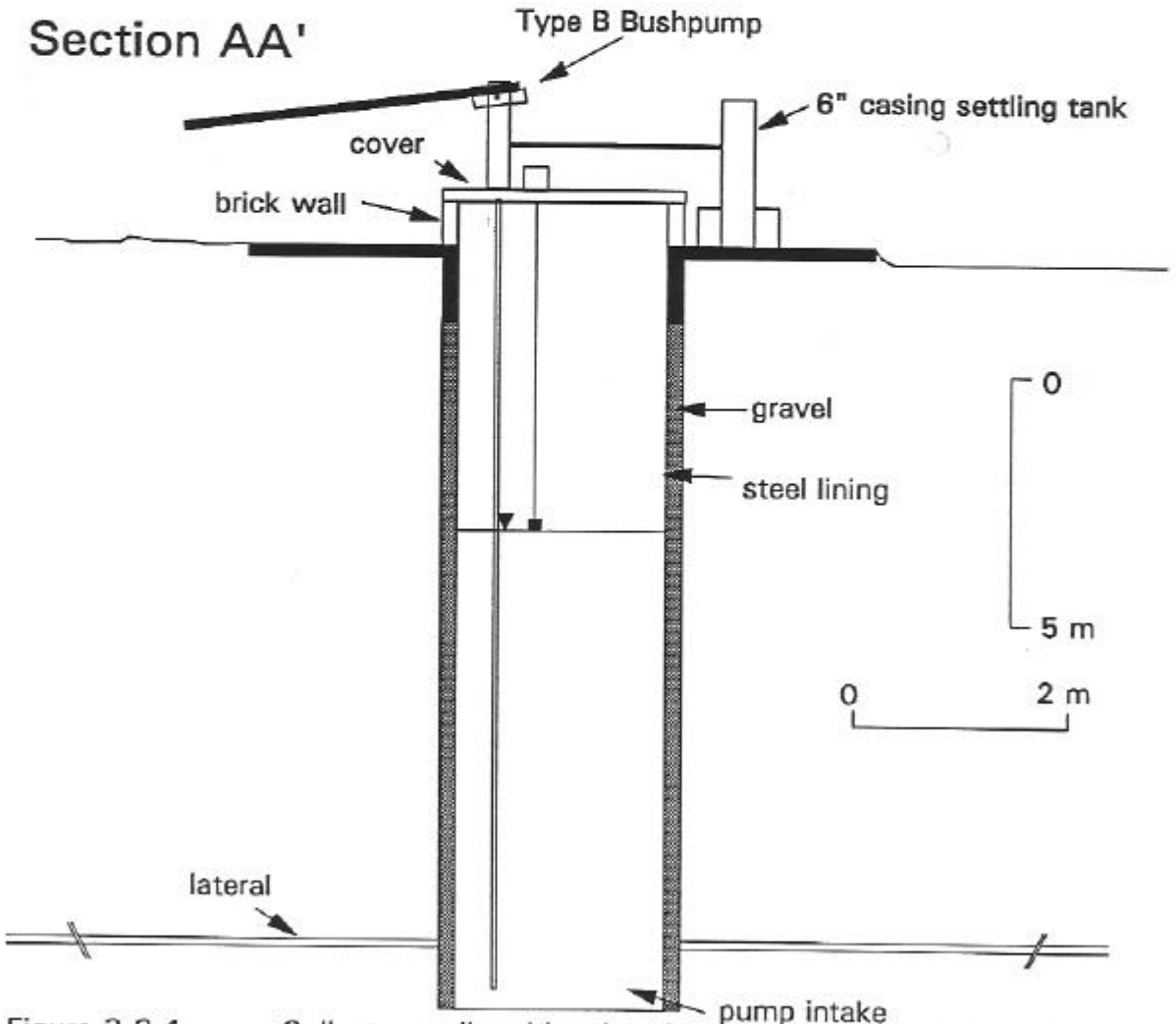


Figure 3.2.4 Collector well and headworks construction, site 2 , Gokota

Table 3.2.1 Diary of activities at site 2, Gokota

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
drill four exploratory holes	14/4/93 (4 days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 600l drill bits ??
establish degree of need and potential community commitment	(3 days)	sociologist economist	none	none
pumptest exploratory hole bh9	17/4/93 (4 days)	ptest engineer site assistant	Pump and associated equipment	petrol 20l
dig well shaft to 15m, backfill with gravel, concrete in sanitary seal, build and plaster head well	12/7/93 (85 days)	construction manager site foreman 5 labourers	compressor pump + hoses chain winch gantry kibble personnel steps 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helmets jackhammer cement mixer shifting spanner 27mm spanner torch foreman's tent foreman's bed foreman's stove	cement 26bags bricks 200 river sand 4cum 19mm gravel 10cum diesel(comp) 3000l steel casing 15m jh points 2 pump rubbers 2 hydraulic oil 15l engine oil 5l gumboots 6prs paraffin 15l gas 6kg
lateral drilling (four laterals)	25/07/93 (6 days)	driller crane operator 1 labourer	air rig and associated equipment	diesel 1200l
complete headworks, well covers, water tank, settling tank, soakaway, gantry	29/07/93 (4 days)	construction manager site foreman 5 labourers	formwork level trowel wheelbarrow cement mixer	bricks 160 cement 7bags sand/gravel 1cum 6"steel casing 2m pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15m 50mm elbows 2 50mm nipples 2
pump test collector well 2 before lats x 2 after lats, 7 day test.	17/08/93 (11days)	ptest engineer site assistant	pump and associated equipment	petrol 70l

Table 3.2.1 Diary of activities at site 2, Gokota (continued)

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
install bushpumps with community as part of pump maintenance workshop	5/11/93 (1 day)	instructor translator 6 trainees	thread cutter for 50mm pipe and 19mm rods	50mm galv pipe 30m 50mm nipples 8 pump cylinder 2 17mm rods 30m type B bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for collector well and piezometers:- bh7, bh8 and bh9.	18/8/93 (2 days)	ptest engineer foreman monitor man	munro wl recorder 2 water meters	bricks 100 cement 3bags munro box 1 padlock 1 50mm galv pipe 6m 50mm elbows 8 50mm unionjoint 2 w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	5/8/93 (2 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20bags steel posts 13 steel stays 10 steel standards36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer. vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a separate report Thompson (1994).
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenance and attending to minor breakdowns.

Table 3.2.2 Drilling logs of exploratory boreholes at site 2, Gokota

EXPLORATORY BH NUMBER	DRILLERS DESCRIPTION (P.Rastall)
BH6	clay to 2m, weathered to 15m, lots of water RWL = 0.90m. (4/94) COLLECTOR WELL SITE
BH7	clay to 2m, hard and weathered to 11m. No water until 11m. RWL = 0.90m (4/94)
BH8	clay to 2m, weathered and hard to 9m. dry. RWL = 0.90m (4/94)
BH9	clay to 2m, weathered (lots of water) to 15m, hard to 18m, hard and broken (lots of water) to 29m, hard to 30m. RWL = 0.90m (4/94)

Table 3.2.3 Geological descriptions of collector well digging samples, site 2, Gokota

GOKOTA (SITE TWO) GEOLOGICAL DESCRIPTION OF COLLECTOR WELL DIGGING SAMPLES	
DEPTH	Description
1m	Pale grey clay in lumps, some iron staining, some coarse sand-size grains of quartz and black iron minerals. Pieces of weathered rock covered with clay which also contains sand of quartz. Rock is slightly banded and quartz rich.
2m	Rounded lumps of grey clay and soft weathered rock.
3m	Greyish and grey-buff rounded lumps of clay and soft weathered clayey rock. No large quartz grains or pieces.
4m	Angular fragments of weathered dark gneissic rock <15 mm across, coated with buff silt and clay. Some with pinkish feldspars. A few clay lumps with rock fragments in them.
6m	Large angular fragments of weathered rock coated with yellowish-buff clay. Iron staining on joint faces. Fresh faces show quartz and some pinkish tinge to feldspars and dark minerals. Feldspar is more pink on joint faces where weathered, and dark minerals become more greenish also.
7m	Angular fragments of weathered rock coated with some buff clay and silt. Some fragments quartz rich. Others pink and green banded.
8m	Rounded lumps of weathered rock mostly containing pinkish feldspars and quartz. Few mafic minerals.
9m	Rounded lumps of soft, weathered rock, containing pinkish and greenish minerals and some quartz, some reddish-orange iron staining spots.
10m	Angular fragments of weathered rock with thin coating of buff clay and silt. Some fragments with pinkish feldspars, clear quartz and dark mafic minerals. Similar to 8m.
12m	Angular fragments of dark rock with coating of buff silt and clay. No pinkish pieces. Some dark iron staining.
14m	Angular fragments of rock, some pinkish, some much darker with iron straining.
15m	As above. Angular fragments of weathered rock and some fresher rock, some dark, some pinkish.

Table 3.2.4 Lateral drilling logs from site 2, Gokota

GOKOTA (SITE 2) LATERAL LOGS (Drilled 19/7/93 to 25/7/93 by P. Rastall)		
LATERAL NUMBER	**SUMMARY DETAILS**	**DRILLING DESCRIPTION**
1	Direction SSE (160deg) Inclination -5degrees Length 30m water inflow very poor	30m of hard dry rock. A little water dribbled in after drilling stopped.
2	Direction NEE (070deg) Inclination -5degrees Length 30m water inflow very poor	dry and hard to 26m, soft with a little water to 29m, dry and hard to 30m.
3	Direction NNW (340deg) Inclination -5degrees Length 30m water inflow poor	dry and hard to 4m, damp and soft to 14m, wet and soft to 21m, damp and hard to 30m.
4	Direction SWW (250deg) Inclination -5degrees Length 30m water inflow very poor	dry with hard and soft bands to 15m, small inflow of water to 18m, hard and dry to 30m.

Table 3.2.5 Pumping-tests performed at site 2, Gokota

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL EST. (mbgl)	REC. TIME (min)	COMMENTS
1	07/15/93	LOW DISCH B.LATS	DT/JC	0.67	120	2.72	4.03	<2.72	1200	poor, prate innac, not rwl
2	07/16/93	HIGH DISCH B.LATS	DT/JC	5.00	120	3.25	11.12	<2.72	3600	poor, prate innac, not rwl
3	07/30/93	LOW DISCH A. LATS	DT	0.70	120	4.00	5.25	<3.00	2520	poor, prate better, not rwl
4	08/01/93	HIGH DISCH A. LATS	DT	5.00	120	3.24	11.50	<3.24	5760	poor, prate innac, not rwl
5A	07/04/93	REC AFTER DIGGING	DT/EM	NA	NA	NA	NA	<4.49	11520	-different dewatering times
5B	07/26/93	REC AFTER LATERALS	DT/EM	NA	NA	NA	NA	<3.36	6940	-careful when comparing
6	08/10/93	SEVEN DAY TEST	DT/EM	NA	NA	NA	NA	NA	NA	good test

WELL DESCRIPTION_____ EXPLORATORY BH8, DEEPENED TO MAKE BH9

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL (mbgl)	REC. TIME (min)	COMMENTS
1	04/12/93	BH8 (15m deep)	PR	0.33	40	0.89	6.70	<0.88	140	rate not const.
2	04/16/93	BH9 (30m deep)	PR	2	14	0.90	22.10	<0.88	140	rate not const.
3	04/17/93	BH9 (30m deep)	PR	0.8	240	0.90	21.95	<0.88	60	rate not const. best test
4	07/28/93	BH9 (30m deep)	DT	0.33	100	4.75	12.33	<4.50	100	CW dug 5m away spoils test

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota

SITE	two	WELL DIAMETER (m)	2.10
TEST	T1, ldbl	WELL DEPTH (mbgl)	14.85
DATE	07/15/93	WELL SCREEN	steel
TESTER	DT/PR/JC		

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs)	2.00	AV PUMP RATE (l/s)	0.67
START VOL (m3)	NA	DRAWDOWN (m)	1.31
END VOL. (m3)	NA	DEWATERED VOL (m3)	4.537
START WL. (mbmd)	3.35	PUMPED VOL (m3)	4.824
END WL. (mbmd)	4.66	'LAMDA'	0.94
ORIFICE DIA (mm)	NA		
PRESS. DIFF (m)	NA		
CW DATUM	monro		
DATUM ELEV. (magl	0.63		
BH DATUM	NA		
DATUM ELEV.(magl)	NA		

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		3.35	2.72
0.50		3.66	3.03
1.00		4.00	3.37
1.50		4.34	3.71
2.00	0.00	4.66	4.03
4.00	2.00	4.54	3.91
6.00	4.00	4.46	3.83
8.00	6.00	4.43	3.80
10.00	8.00	4.35	3.72
12.00	10.00	4.26	3.63
14.00	12.00	4.18	3.55
16.00	14.00	4.09	3.46
18.00	16.00	4.00	3.37
20.00	18.00	3.94	3.31
22.00	20.00	3.90	3.27

NOTES
-RWL is less than 3.25 mbgl. the regional wl was still recovering from dewatering during digging.
-The pump rate is not accurate due to poor measuring equipment.

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

SITE	two	WELL DIAMETER (m	2.10
TEST	T2, hdbl	WELL DEPTH (mbgl)	14.85
DATE	07/16/93	WELL SCREEN	steel
TESTER	DT/PR/JC		

PUMPING DATA

PUMPING TIME (hrs	2.00
START VOL (m3)	0.000
END VOL. (m3)	NA
START WL. (mbmd)	3.88
END WL. (mbmd)	11.75
ORIFICE DIA (mm)	NA
PRESS. DIFF (m)	NA
CW DATUM	monro
DATUM ELEV. (magl	0.63
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	5.00
DRAWDOWN (m)	7.87
DEWATERED VOL (m3)	27.259
PUMPED VOL (m3)	36.000
'LAMDA'	0.76

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		3.88	3.25
1.00		7.90	7.27
2.00	0.00	11.75	11.12
4.00	2.00	11.38	10.75
6.00	4.00	11.07	10.44
8.00	6.00	10.80	10.17
10.00	8.00	10.50	9.87
12.00	10.00	10.23	9.60
14.00	12.00	9.96	9.33
16.00	14.00	9.69	9.06
18.00	16.00	9.44	8.81
22.00	20.00	8.96	8.33
26.00	24.00	8.59	7.96
38.00	36.00	7.45	6.82
50.00	48.00	6.55	5.92
62.00	60.00	5.78	5.15

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES

-RWL is less than 3.25 mbgl. the regional wl was still recovering from dewatering during digging and from T1 LDBL the day before.

-The pump rate is not accurate due to poor measuring equipment.

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

SITE	two	WELL DIAMETER (m)	2.10
TEST	T3, Idal	WELL DEPTH (mbgl)	14.85
DATE	07/30/93	WELL SCREEN	steel
TESTER	DT/EM		

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs)	2.00	AV PUMP RATE (l/s)	0.70
START VOL (m3)	NA	DRAWDOWN (m)	1.25
END VOL. (m3)	NA	DEWATERED VOL (m3	4.330
START WL. (mbmd)	4.60	PUMPED VOL (m3)	5.040
END WL. (mbmd)	5.85	'LAMDA'	0.86
ORIFICE DIA (mm)	NA		
PRESS. DIFF (m)	NA		
CW DATUM	monro		
DATUM ELEV. (magl	0.63		
BH DATUM	NA		
DATUM ELEV.(magl)	NA		

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		4.60	3.97
0.50		4.96	4.33
1.00		5.29	4.66
1.50		5.57	4.94
2.00	0.00	5.85	5.22
4.00	2.00	5.69	5.06
6.00	4.00	5.54	4.91
8.00	6.00	5.4	4.77
10.00	8.00	5.28	4.65
12.00	10.00	5.17	4.54
14.00	12.00	5.07	4.44
16.00	14.00	4.97	4.34
18.00	16.00	4.88	4.25
20.00	18.00	4.8	4.17
22.00	20.00	4.72	4.09
26.00	24.00	4.56	3.93
32.00	30.00	4.34	3.71
38.00	36.00	4.14	3.51
44.00	42.00	3.97	3.34

NOTES
-RWL is less than 3.25 mbgl. the regional wl was still recovering from dewatering during digging.
-The pump rate is not accurate due to poor measuring equipment.

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

SITE	two	WELL DIAMETER (m	2.10
TEST	T4, hdal	WELL DEPTH (mbgl)	14.85
DATE	08/01/93	WELL SCREEN	steel
TESTER	DT		

PUMPING DATA

PUMPING TIME (hrs	2.00
START VOL (m3)	NA
END VOL. (m3)	NA
START WL. (mbmd)	3.87
END WL. (mbmd)	12.13
ORIFICE DIA (mm)	NA
PRESS. DIFF (m)	NA
CW DATUM	monro
DATUM ELEV. (magl	0.63
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	5.00
DRAWDOWN (m)	8.27
DEWATERED VOL (m3	28.627
PUMPED VOL (m3)	36.000
'LAMDA'	0.80

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		3.87	3.24
1.00		8.40	7.77
2.00	0.00	12.13	11.50
4.00	2.00	11.71	11.08
6.00	4.00	11.37	10.74
8.00	6.00	10.96	10.33
10.00	8.00	10.68	10.05
12.00	10.00	10.37	9.74
14.00	12.00	10.07	9.44
16.00	14.00	9.77	9.14
18.00	16.00	9.50	8.87
22.00	20.00	8.96	8.33
26.00	24.00	8.49	7.86
38.00	36.00	7.25	6.62
50.00	48.00	6.24	5.61
62.00	60.00	5.44	4.81
74.00	72.00	4.80	4.17
86.00	84.00	4.31	3.68
98.00	96.00	3.96	3.33

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES

-RWL is less than 3.24 mbgl.

-The pump rate is not accurate (+- 15%) due to poor measuring equipment this is improved in subsequent tests

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

GOKOTA RECOVERY AFTER DIGGING
DIGGING STARTED 17/4/93
DIGGING STOPPED 2/7/93
DEWATERED EACH DAY AS DIGGING PROGRESSED FOR APPROX 10 WEEKS

RECOVERY FROM 14.85 M BELOW GROUND LEVEL

TIME(HRS	WL (M)
0	14.62
24	11.95
48	9.75
72	7.76
94	6.46
99	6.13
114	5.68
118	5.60
139	5.17
141	5.04
147.5	5.13
152.5	5.11
165	4.73
174	4.83
192	4.49

GOKOTA RECOVERY AFTER LATERAL DRILLING
DRILLING STARTED 19/7/93
DRILLING STOPPED 25/7/93
DEWATERED TO BOTTOM (14.85M) FOR 7 DAYS

RECOVERY FROM 14.85 M BELOW GROUND LEVEL

TIME(HRS	WL (M)
0	14.85
24	10.92
48	8.09
72	5.95
96	4.2
114	3.35

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

LOCATION	GOKOTA COLLECTOR WELL		
TEST DATE	10/8/93 TO 17/8/93		
TOTAL DEPTH(M)	15.35 BELOW DATUM		
PUMP SET AT(M)	14.00 BELOW DATUM		
PUMPING RATE (L/S	0.19		
EC (uS)			
DATUM	MUNRO	HEIGHT ABOVE GL(M	0.50
TESTER	D.THOMPSON / E.MAFUNGI		

DATE	Tpstart (HRS)	WL (M DATU	WL (m BGL)	NOTES
10/8	0.0	2.88	2.38	
	2.0	4.17	3.67	
	5.0	4.03	3.53	
	7.0	5.30	4.80	
	10.0	5.07	4.57	
	12.0	6.31	5.81	
11/8	24.0	5.29	4.79	
	26.0	6.53	6.03	
	29.0	6.23	5.73	
	31.0	7.43	6.93	
	34.0	7.07	6.57	
	36.0	8.20	7.70	
12/8	48.0	6.80	6.30	
	50.0	7.97	7.47	
	53.0	7.60	7.10	
	55.0	8.70	8.20	
	58.0	8.30	7.80	
	60.0	9.37	8.87	
13/8	72.0	7.85	7.35	
	74.0	8.95	8.45	
	77.0	8.45	7.95	
	79.0	9.61	9.11	
	82.0	9.20	8.70	
	84.0	10.25	9.75	
14/8	96.0	8.59	8.09	
	98.0	9.66	9.16	
	101.0	9.25	8.75	
	103.0	10.31	9.81	
	106.0	9.86	9.36	
	108.0	10.88	10.38	
15/8	120.0	9.14	8.64	
	122.0	10.20	9.70	
	125.0	9.77	9.27	
	127.0	10.81	10.31	
	130.0	10.34	9.84	
	132.0	11.35	10.85	
16/8	144.0	9.55	9.05	
	146.0	10.62	10.12	
	149.0	10.39	9.89	
	151.0	11.21	10.71	
	154.0	10.74	10.24	
	156.0	11.73	11.23	
17/8	168.0	10.00	9.50	

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

LOCATION	GOKOTA BH6		
TEST DATE	12/4/93		
TOTAL DEPTH(M)	15.00		
PUMP SET AT(M)	9.00		
PUMPING RATE (L/S	0.33		
EC (uS)			
DATUM	GL	HEIGHT ABOVE GL(M	0.00
TESTER	P.RASTALL		

Tpstart (min)	Tpstop (min)	WL (M DATUM	WL (m FGL)	SC (L/S/M)	NOTES
0.0		0.89	0.89		
0.5		1.07	1.07	1.833	
1.0		1.22	1.22	1.000	
1.5		1.38	1.38	0.673	
2.0		1.50	1.50	0.541	
2.5		1.68	1.68	0.418	
3.0		1.84	1.84	0.347	
3.5		1.99	1.99	0.300	
4.0		2.12	2.12	0.268	
4.5		2.24	2.24	0.244	
5.0		2.33	2.33	0.229	
6.0		2.50	2.50	0.205	
7.0		2.66	2.66	0.186	
8.0		2.86	2.86	0.168	
9.0		3.00	3.00	0.156	
10.0		3.10	3.10	0.149	
12.0		3.23	3.23	0.141	
14.0		3.35	3.35	0.134	
16.0		3.46	3.46	0.128	
18.0		3.67	3.67	0.119	
20.0		4.04	4.04	0.105	
22.0		4.56	4.56	0.090	
24.0		4.94	4.94	0.081	
26.0		5.40	5.40	0.073	
28.0		5.80	5.80	0.067	
30.0		6.04	6.04	0.064	
32.0		6.25	6.25	0.062	
35.0		6.52	6.52	0.059	
40.0	0.0	6.70	6.70	0.057	
40.5	0.5	6.58	6.58		
41.0	1.0	6.55	6.55		
41.5	1.5	6.52	6.52		
42.0	2.0	6.50	6.50		
42.5	2.5	6.46	6.46		
43.0	3.0	6.42	6.42		
43.5	3.5	6.38	6.38		
44.0	4.0	6.35	6.35		
44.5	4.5	6.31	6.31		
45.0	5.0	6.28	6.28		
46.0	6.0	6.21	6.21		
47.0	7.0	6.12	6.12		
48.0	8.0	6.05	6.05		

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

49.0	9.0	5.98	5.98
50.0	10.0	5.90	5.90
52.0	12.0	5.74	5.74
54.0	14.0	5.52	5.52
56.0	16.0	5.27	5.27
58.0	18.0	5.03	5.03
60.0	20.0	4.86	4.86
62.0	22.0	4.73	4.73
64.0	24.0	4.60	4.60
66.0	26.0	4.47	4.47
68.0	28.0	4.34	4.34
70.0	30.0	4.15	4.15
72.0	32.0	3.94	3.94
75.0	35.0	3.82	3.82
80.0	40.0	3.65	3.65
85.0	45.0	3.55	3.55
90.0	50.0	3.48	3.48
100.0	60.0	3.34	3.34
110.0	70.0	3.21	3.21
120.0	80.0	3.10	3.10
130.0	90.0	2.96	2.96
140.0	100.0	2.70	2.70
160.0	120.0	2.39	2.39
180.0	140.0	2.10	2.10

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

LOCATION GOKOTA BH9
TEST DATE 16/4/93
TOTAL DEPTH 29.5M
PUMP SET AT 25.0M
PUMPING RATE :- 10SEC = 20L (2.0L/S) 2
EC =
DATUM :- GROUND LEVEL
TESTER :- P.RASTAL

Tpstart (min)	Tpstop (min)	WL (m)	DD (m)	SC (L/S/M)	NOTES
0.0		0.90	0		
0.5		2.27	1.37	1.460	
1.0		3.00	2.1	0.952	
1.5		3.76	2.86	0.699	
2.0		4.48	3.58	0.559	
2.5		5.35	4.45	0.449	
3.0		6.30	5.4	0.370	
3.5		7.38	6.48	0.309	
4.0		8.50	7.6	0.263	
4.5		10.07	9.17	0.218	
5.0		11.35	10.45	0.191	
6.0		13.40	12.5	0.160	
7.0		15.24	14.34	0.139	
8.0		16.90	16	0.125	
9.0		17.75	16.85	0.119	
10.0		19.05	18.15	0.110	
12.0		21.00	20.1	0.100	
14.0	0.0	22.10	21.2	0.094	
14.5	0.5	19.50			
15.0	1.0	18.00			
15.5	1.5	17.65			
16.0	2.0	17.22			
16.5	2.5	16.80			
17.0	3.0	16.18			
17.5	3.5	15.60			
18.0	4.0	15.11			
18.5	4.5	14.66			
19.0	5.0	14.00			
20.0	6.0	13.45			
21.0	7.0	12.35			
22.0	8.0	11.60			
23.0	9.0	10.90			
24.0	10.0	10.14			
26.0	12.0	9.40			
28.0	14.0	8.77			
30.0	16.0	7.42			
32.0	18.0	6.68			
34.0	20.0	6.32			
36.0	22.0	5.86			
38.0	24.0	5.45			
40.0	26.0	5.10			
42.0	28.0	4.80			

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

44.0	30.0	4.52
46.0	32.0	4.35
49.0	35.0	4.17
54.0	40.0	3.92
59.0	45.0	3.63
64.0	50.0	3.24
74.0	60.0	3.05
84.0	70.0	2.60
94.0	80.0	2.28
104.0	90.0	2.04
114.0	100.0	1.85
134.0	120.0	1.72
154.0	140.0	1.53
174.0	160.0	1.40

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

LOCATION GOKOTA BH9
TEST DATE 17/4/93
TOTAL DEPTH 29.5M
PUMP SET AT 27.0M
PUMPING RATE :- 25SEC = 20L (0.8L/S) 0.8
EC = 360uS/M
DATUM :- GROUND LEVEL
TESTER :- P.RASTAL

Q (min)	Tpstop (min)	WL (m)	DD (m)	SC (L/S/M)	NOTES
0.0		0.90	0		
0.5					
1.0		2.10	1.2	0.667	
1.5		2.50	1.6	0.500	
2.0		2.90	2	0.400	
2.5		3.17	2.27	0.352	
3.0		3.56	2.66	0.301	
3.5		3.82	2.92	0.274	
4.0		4.18	3.28	0.244	
4.5		4.40	3.5	0.229	
5.0		4.73	3.83	0.209	
6.0		5.49	4.59	0.174	
7.0		6.22	5.32	0.150	
8.0		6.81	5.91	0.135	
9.0		7.65	6.75	0.119	
10.0		8.65	7.75	0.103	
12.0		10.40	9.5	0.084	
14.0		11.70	10.8	0.074	
16.0		12.79	11.89	0.067	
18.0		13.88	12.98	0.062	
20.0		14.79	13.89	0.058	
22.0		15.35	14.45	0.055	
24.0		15.96	15.06	0.053	
26.0					
28.0		16.92	16.02	0.050	
30.0		17.20	16.3	0.049	
32.0		17.40	16.5	0.048	
35.0		17.89	16.99	0.047	
40.0		18.75	17.85	0.045	
45.0		19.36	18.46	0.043	
50.0		19.84	18.94	0.042	
60.0		20.46	19.56	0.041	
70.0		20.84	19.94	0.040	
80.0		21.18	20.28	0.039	
90.0		21.45	20.55	0.039	
100.0		21.62	20.72	0.039	
120.0		22.01	21.11	0.038	
140.0		22.22	21.32	0.038	
160.0		22.44	21.54	0.037	
180.0		22.88	21.98	0.036	
200.0		21.60	20.7	0.039	there was no proble
220.0		21.80	20.9	0.038	with pumping rate

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

240.0	0.0	21.95	21.05
240.5	0.5	20.53	
241.0	1.0	19.84	
241.5	1.5	19.19	
242.0	2.0	18.58	
242.5	2.5	17.97	
243.0	3.0	17.60	
243.5	3.5	17.35	
244.0	4.0	17.13	
244.5	4.5		
245.0	5.0	16.48	
246.0	6.0	15.58	
247.0	7.0	15.00	
248.0	8.0	14.38	
249.0	9.0	13.77	
250.0	10.0	13.02	
252.0	12.0	11.82	
254.0	14.0	10.89	
256.0	16.0	10.04	
258.0	18.0	9.22	
260.0	20.0	8.66	
262.0	22.0	8.15	
264.0	24.0	7.60	
266.0	26.0	7.27	
268.0	28.0	6.86	
270.0	30.0	6.68	
272.0	32.0	6.41	
275.0	35.0	6.21	
280.0	40.0	5.66	
285.0	45.0	5.26	
290.0	50.0	4.49	
300.0	60.0	4.17	

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

LOCATION GOKOTA BH9
TEST DATE 27/7/93
TOTAL DEPTH 29.5M
PUMP SET AT 26.5M
PUMPING RATE :- 0.32 l/s 0.32
EC =
DATUM :- TOP OF CASING 0.4 M ABOVE GL
TESTER :- D.THOMPSON

Tpstart (min)	Tpstop (min)	WL (M DATU	WL (m FGL)	DD (m)	SC (L/S/M)	NOTES
0.0		4.75	4.35	0		
0.5		5.30	4.90	0.55	0.582	
1.0		5.50	5.10	0.75	0.427	
1.5		5.68	5.28	0.93	0.344	
2.0		5.91	5.51	1.16	0.276	
2.5		6.06	5.66	1.31	0.244	
3.0		6.21	5.81	1.46	0.219	
3.5		6.39	5.99	1.64	0.195	
4.0		6.55	6.15	1.8	0.178	
4.5		6.66	6.26	1.91	0.168	
5.0		6.76	6.36	2.01	0.159	
6.0		6.95	6.55	2.2	0.145	
7.0		7.18	6.78	2.43	0.132	
8.0		7.45	7.05	2.7	0.119	
9.0		7.80	7.40	3.05	0.105	
10.0		8.00	7.60	3.25	0.098	
12.0		8.57	8.17	3.82	0.084	
14.0		9.07	8.67	4.32	0.074	
16.0		9.57	9.17	4.82	0.066	
18.0		10.09	9.69	5.34	0.060	
20.0		10.45	10.05	5.7	0.056	
22.0		10.75	10.35	6	0.053	
24.0		11.01	10.61	6.26	0.051	
26.0		11.16	10.76	6.41	0.050	
28.0		11.28	10.88	6.53	0.049	
30.0		11.40	11.00	6.65	0.048	
32.0		11.47	11.07	6.72	0.048	
35.0		11.62	11.22	6.87	0.047	
40.0		11.82	11.42	7.07	0.045	
45.0		11.98	11.58	7.23	0.044	
50.0		12.08	11.68	7.33	0.044	
60.0		12.21	11.81	7.46	0.043	
70.0		12.30	11.90	7.55	0.042	
80.0		12.32	11.92	7.57	0.042	
90.0		12.32	11.92	7.57	0.042	
100.0	0.0	12.33	11.93	7.58	0.042	
100.5	0.5	11.89	11.49			
101.0	1.0	11.51	11.11			
101.5	1.5	11.30	10.90			
102.0	2.0	11.01	10.61			
102.5	2.5	10.70	10.30			
103.0	3.0	10.40	10.00			

Table 3.2.6 Pumping-test data from tests completed at site 2, Gokota (continued)

103.5	3.5	10.26	9.86
104.0	4.0	9.98	9.58
104.5	4.5	9.96	9.56
105.0	5.0	9.42	9.02
106.0	6.0	9.09	8.69
107.0	7.0	8.73	8.33
108.0	8.0	8.35	7.95
109.0	9.0	8.09	7.69
110.0	10.0	7.95	7.55
112.0	12.0	7.57	7.17
114.0	14.0	7.24	6.84
116.0	16.0	7.04	6.64
118.0	18.0	6.89	6.49
120.0	20.0	6.77	6.37
122.0	22.0	6.66	6.26
124.0	24.0	6.52	6.12
126.0	26.0	6.37	5.97
128.0	28.0	6.22	5.82
130.0	30.0	6.11	5.71
132.0	32.0	6.04	5.64
135.0	35.0	5.91	5.51
140.0	40.0	5.70	5.30
145.0	45.0	5.57	5.17
150.0	50.0	5.46	5.06
160.0	60.0	5.30	4.90
170.0	70.0	5.15	4.75
180.0	80.0	5.07	4.67
190.0	90.0	5.02	4.62
200.0	100.0	4.98	4.58

Table 3.2.7 Attendees at pump maintenance workshop site 2, Gokota

NAME
Lucas Chikwera
June Nhenjana
Chikumbo Karauone
Mwisai Gwati
Zex Ngirazi
Gibson Vaviri

Table 3.2.8 Water points in the region of collector well site 2, Gokota

Well no.	Builder/owner	Kraal	Date	Diameter (m)	Depth (m)	Water-level			Perceived yield	Water use	Dries-up	
						depth (m)	time	date			Every year	1992
1	ODA/ Community	Gwindigwi	1993	2.0	15				Excellent Max. 18 m^3/d Av. 8 m^3/d	Domestic (D) Garden (G)	No	na
2	WH&Jack	Maroyi	1987	0.15					Poor	D	Yes	Yes
3	Community	Maroyi							Excellent	D,G	No	No
4	Chaminu	Maroyi	1995						new	-	new	new
5	WH&Jack	Maroyi	1987						Poor	D,G	Yes	No
6	WH&Jack	Maroyi	1992	collapsed					na	na	na	na
7	WH&Jack	Maroyi	1987	0.15	25	22.6			Poor	D	Yes	Yes
8	WH&Jack	Taruving	1987	0.15	37	> 30			Poor	D	Yes	Yes
9	Community	Maroyi	1990	0.6	4.2	1.5			Good	D	No	No
10	E.Maroi	Maroyi	1990	1.5	6.7	6.0			Poor	G	Yes	Yes
11	DDF	Guvanye	1987	1.4	8.5				Good	D,G	No	No

Table 3.2.9 Wells and boreholes monitored for water-levels at site 2, Gokota

WELL NUMBER	DATUM DESCRIPTION		DEPTH (m)	DIA (m)
	ELEV (magl)	ELEV (macwd)		
BH7	0.08	-0.28	15.0	0.10
BH8	0.17	+0.51	11.0	0.10
BH9	0.30	-0.28	9.0	0.15
1	0.63	+0.00	15.0	2.0

Site 3 - Dekeza

Site description

Geology:	granulite gneiss
Location:	approx. 70 km north of Chiredzi Research Station, just east of Dekeza secondary school
Access:	for Dekeza school turn east off the main Zaka tar road onto a dirt road that passes the police camp, follow this road for about 9 km. The well is sited on the valley side approximately 100 m from a sand stream.
Annual rainfall:	780 mm

Exploratory drilling

Drilling:	BGS contract driller
No. of exploratory holes:	3
Comments:	collector well dug at bh2

Specific construction details

Foreman:	Peter Msanu
Depth of well shaft:	15 m
Time to dig shaft:	11.5 weeks
No. of laterals:	5
Length of laterals:	8, 9, 25, 27, 28 m
Comments:	-

The garden committee planned to construct a soakaway channel that incorporated irrigation channels to supply the garden.

Monitoring of well performance

Mr Mahiya is to change the munro recorder chart and read the meters at 0600 every Sunday morning. He will also dip the DDF borehole. Borehole abstraction volume will be quantified every six months.

20° 38' 50.00"S 31° 20' 41.69"E.
36K 327570.99mE 7716015.97mS. elevation 600m

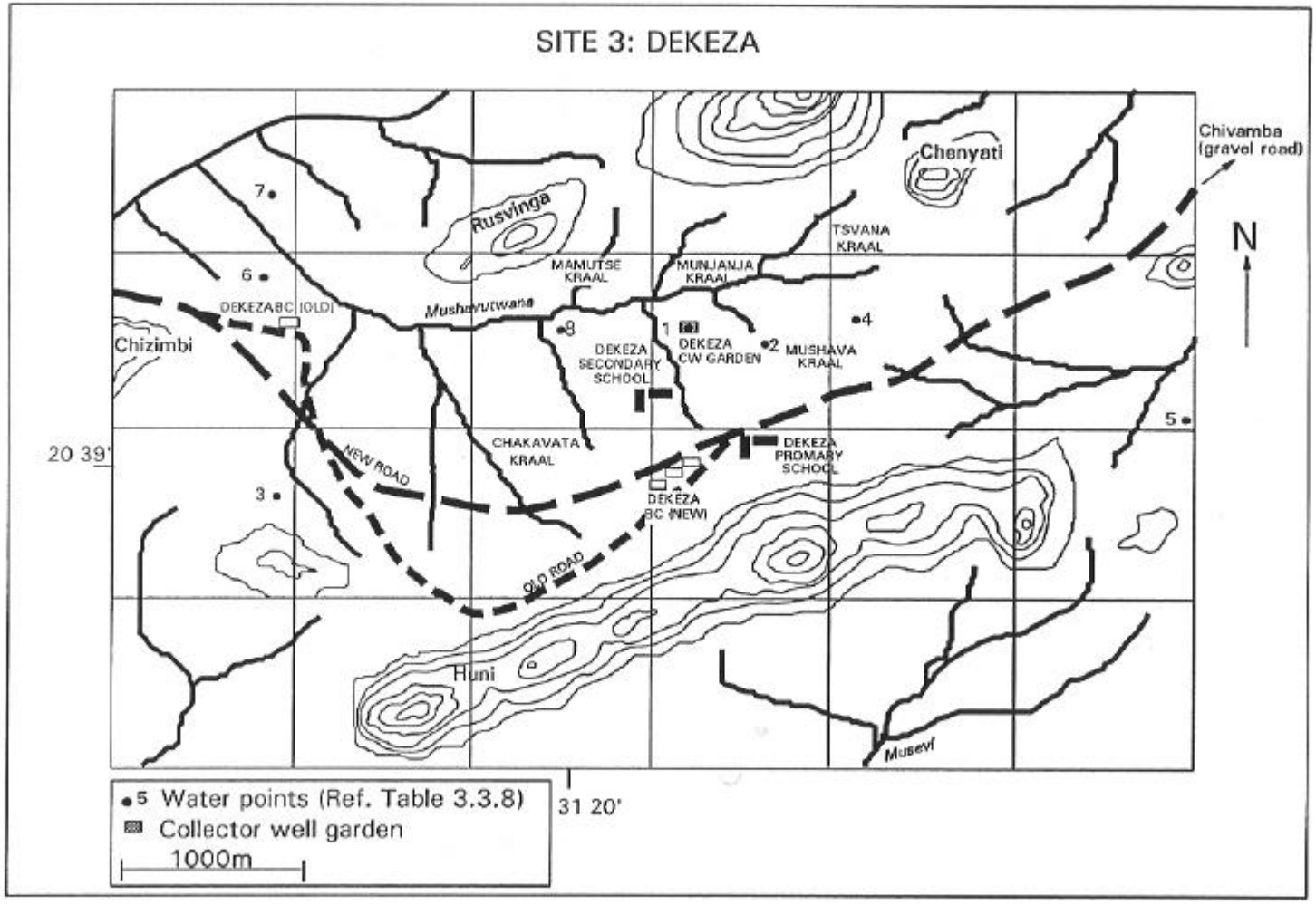


Figure 3.3.1 Map of location of collector well garden and local water points

not necessary

Figure 3.3.2 Detail showing location of exploratory boreholes

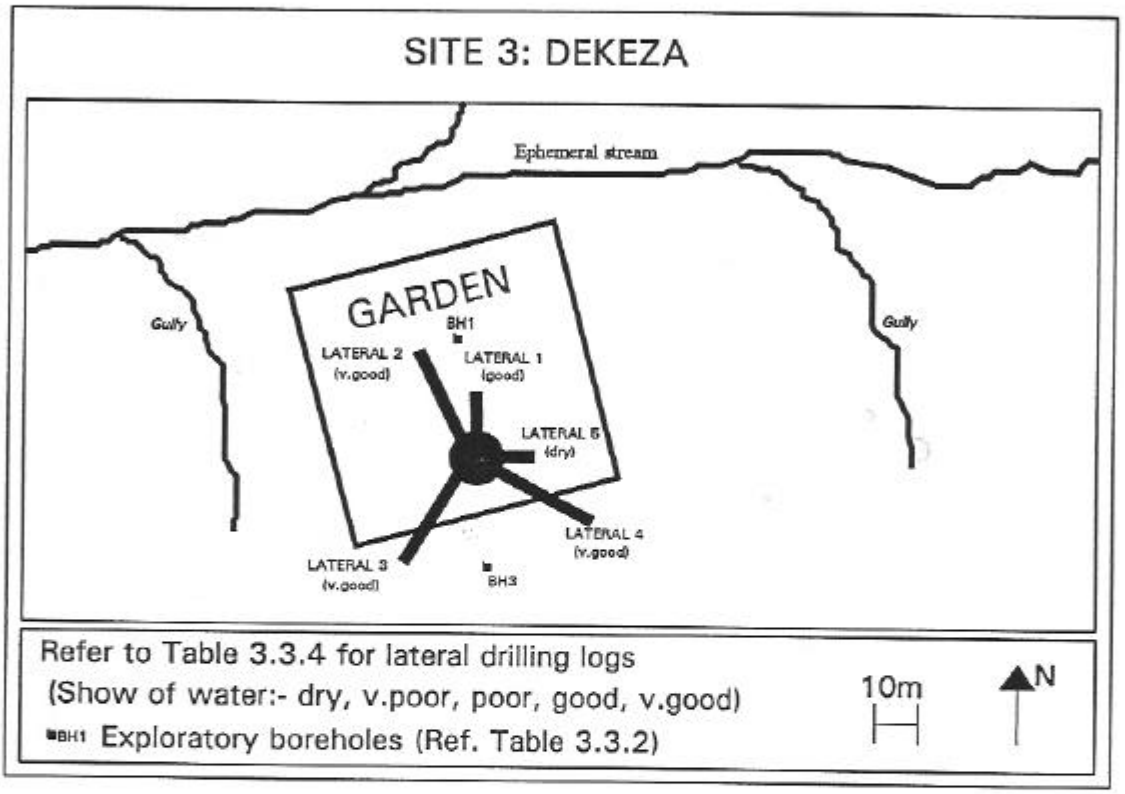


Figure 3.3.3 Map of vicinity of collector well showing direction of laterals

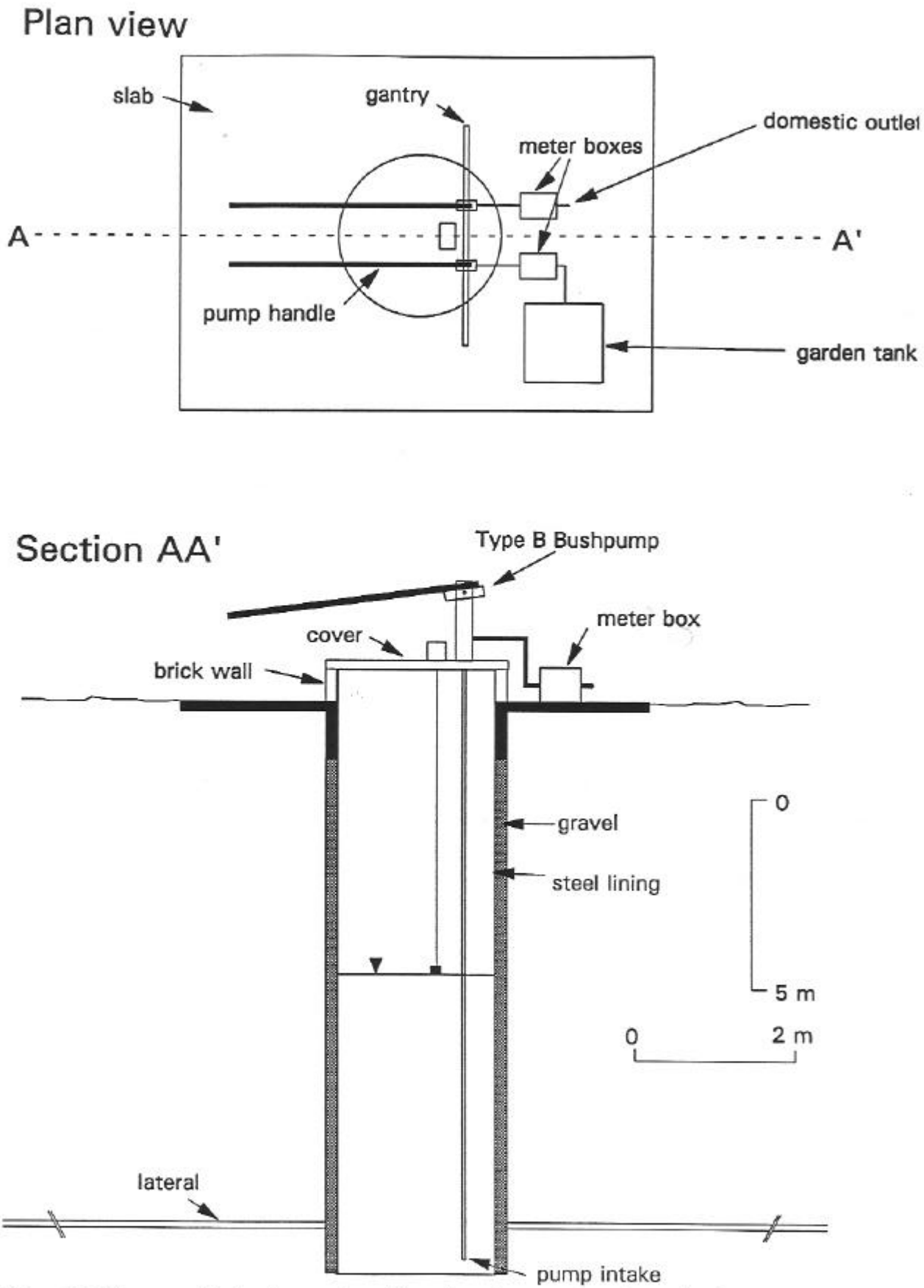


Figure 3.3.4 Collector well and headworks construction, site 3, Dekeza

Table 3.3.1 Diary of activities at site 3, Dekeza

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
drill three exploratory holes	28/5/93 (4 days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 150l drill bits ??
establish degree of need, and potential community commitment	(3 days)	sociologist economist	none	none
pumptest expl. hole	not tested	ptest engineer site assistant	Pump and associated equipment	petrol na
dig well shaft to 15m, backfill with gravel, concrete in sanitary seal, build and plaster head wall	28/9/93 (80 days)	construction manager site foreman 5 labourers	compressor pump + hoses hand winch wire rope gantry kibble personnel steps 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helmets jackhammer cement mixer shifting spanner 27mm spanner torch foreman's tent foreman's bed foreman's stove	cement 26bags bricks 200 river sand 4cum 19mm gravel 10cum diesel(comp) 3000l steel casing 15m jh points 2 pump rubbers 2 hydraulic oil 15l engine oil 5l gumboots 6prs paraffin 15l gas 6kg
lateral drilling (five laterals)	3/03/94 (10 days)	driller crane operator 1 labourer	air rig and associated equipment	diesel 1200l
complete headworks, well covers, water tank, soakaway, gantry	30/3/94 (4 days)	construction manager site foreman 5 labourers	formwork level trowel wheelbarrow cement mixer	bricks 100 cement 5bags sand/gravel 1cum pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15m 50mm elbows 2 50mm nipples 2
pump test collector well before laterals x 2 after laterals x 2	24/03/94 (6 days)	ptest engineer site assistant	pump and associated equipment	petrol 30l

Table 3.3.1 Diary of activities at site 3, Dekeza (continued)

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
install bushpumps with community as part of pump maintenance workshop	30/3/94 (1 day)	instructor translator 9 trainees	thread cutter for 50mm pipe and 19mm rods	50mm galv pipe 30m 50mm nipples 8 pump cylinder 2 17mm rods 30m type B bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for collector well, DDF bh, piezometer 'bh4' and 11 traditional wells in the catchment	30/3/94 (2 days)	ptest engineer foreman monitor man	munro wl recorder 2 water meters	bricks 100 cement 3bags munro box 1 padlock 1 50mm galv pipe 6m 50mm elbows 8 50mm unionjoint 2 w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	3/2/94 (4 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20bags steel posts 13 steel stays 10 steel standards36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer. vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a separate report Thompson (1994).
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenance and attending to minor breakdowns.

Table 3.3.2 Drilling logs of exploratory boreholes at site 3, Dekeza

EXPLORATORY BH NUMBER	DRILLERS DESCRIPTION (P.Rastall)
BH1	weathered to 17m. Banded. very little water
BH2	weathered to 12m then hard but broken. Lots of water (Ec = 0.24mS/cm). Rwl = 6.9m. COLLECTOR WELL SITE
BH3	weathered to 15m. dry

Table 3.3.3 Geological descriptions of collector well digging samples, site 3, Dekeza

DEKEZA (SITE THREE) GEOLOGICAL DESCRIPTION OF COLLECTOR WELL DIGGING SAMPLES	
DEPTH	Description
1m	Grey soil with some sand grains, white feldspars < 3 mm, reddish and black iron staining.
2m	Reddish, yellow, buff clay with quartz grains and black iron minerals. Also some lumps of greyish clay as above.
3m	Soft, rounded lumps of pale grey clayey, crumbly, weathered rock. Some hard pieces coated with grey clay.
4m	Brown rounded pieces of weathered rock, some black banded angular fragments of iron-rich weathered, stained rock, smaller angular pieces of pale coloured weathered rock which also break in the hand. Some lumps when broken show original texture of rock.
5m	Soft, more rounded lumps of weathered rock, pale buff-grey colour, some banding, showing yellowish iron-rich and clear quartz bands. Also dust of weathered rock.
6m	Smaller, angular pieces of weathered rock, some hard and clear quartz-rich, others reddish stained, banded and showing traces of micas.
7m	Pale white-buff dust of quartz and angular fragments of quartz, with few angualr hard black pieces of ferro-magnesian minerals showing iron staining.
8m	Small angular pieces of weathered rock, mostly dark with iron staining, some coated with buff fines, not much quartz. Completely different to above.
9m	Soft pieces of weathered rock, mostly dark with pale buff coatings of fine material.
10m	Soft reddish brown, mostly rounded and subangular fragments of weathered rock, break in hand to show original texture. Mostly dark and iron-rich, yellowish inside fragments and some flakes of mica up to 2-3 mm. Some black joint faces, and black streaks through rock.
11m	Angular fragments of weathered dark rock, up to 10 mm, smaller than above, and dust of weathered rock.
12m	Angular fragments of weathered dark rock, up to 15 mm, with fine coating of buff clay particles, and some fragments also of lighter, quartz-containing rock, and some soft, more rounded lumps of weathered biotite-rich rock.
13m	Angular fragments of weathered rock, biotite rich pieces soft and crumbling, others harder. Red, reddish-brown and black pieces with iron staining along weathered fractures.
14m	Rounded lumps of soft weathered, biotite-rich material and some lumps of clay. No hard, angular pieces.

Table 3.3.4 Lateral drilling logs from site 3, Dekeza

DEKEZA (SITE THREE) COLLECTOR WELL LATERAL DRILLING LOGS					
	LATERAL 1	LATERAL 2	LATERAL 3	LATERAL 4	LATERAL 5
DRILLER DIRECTION ELEVATION LENGTH COMPLETED WATER FLOW	P.Rastall north -5 degrees 12rods, 9m 22/2/94 good	P.Rastall NNW -5 degrees 33rods,25m 25/3/94 very good	P.Rastall SSW -5 degrees 35rods,27m 1/3/94 very good	P.Rastall SW -5 degrees 38rods,28m 2/3/94 very good	P.Rastall west -5 degrees 10rods,8m 3/3/94 dry
ROD NUMBER (0.75m rods)	COMMENT	COMMENT	COMMENT	COMMENT	COMMENT
1	hard	hard	hard	hard	hard
2	hard	hard	hard	hard	hard
3	hard	hard	hard	hard	hard
4	hard	hard	hard	hard	hard
5	hard	hard	hard	hard	hard
6	hard	hard	hard	hard	hard
7	hard	hard	hard	hard	hard
8	hard	hard	hard	hard	hard
9	hard	hard	hard	hard	hard
10	weathered	hard	hard	hard	hard
11	weathered	hard	hard	hard	
12	FWS	broken gneiss	FWS	hard	breakdown
13	broken gneiss	FWS	broken	hard	
14		clay	broken	hard	
15	hole would	clay	broken	hard	
16	not stay open	gravel	hard	weathered(FW	
17		gravel	hard	S)	
18		gravel	hard	weathered	
19		gravel	hard	weathered	
20		gravel	hard	weathered	
21		hard	hard	hard	
22		hard	hard	gravel(MWS)	
23		hard	hard	hard	
24		hard	gravel	hard	
25		gravel	gravel	gravel	
26		hard	gravel	weathered	
27		gravel	hard	hard	
28		hard	hard	weathered	
29		gravel	hard	hard	
30		gravel	hard	banded	
31		gravel	hard	banded	
32		gravel	hard	banded	
33		gravel	hard	banded	
34			hard	banded	
35		breakdown	hard	banded	
36				banded	
37			stopped since	banded	
38			flow from 1 and	banded	
39			2 was reducing	banded	
40					

Table 3.3.5 Pumping-tests performed at site 3, Dekeza

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	01/11/94	CWT1LDBL	DT/EM	0.64	135	7.18	8.13	<7.18	1065	RATE+-3%
2	01/12/94	CWT2HDBL	DT/TC	2.62	240	7.32	13.13	<7.32	5040	RATE+-3%
3	03/24/94	CWT3LDAL	DT/TC	1.02	300	7.49	9.14	<7.32	2880	RATE+-3%
4	03/21/94	CWT4HDAL	DT/TC	2.66	240	7.32	11.85	<7.32	3600	RATE+-3%
5A	09/23/94	REC AFTER DIGGING	NA	NA	NA	NA	NA	NA	NA	NONE

WELL DESCRIPTION_____ DDF GARDEN BH

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	05/20/94	T1 USING BUSHPUMP	DT	0.69	60	8.27	11.18	<8.15	48	GOOD ACCURATE TEST

Table 3.3.6 Pumping-test data from tests completed at site 3, Dekeza

SITE	three	Dekeza BH at old garden			
TEST	T1 (1 of 3)	MEASURED DATA		DEPTH (mbgl)	43.40
DATE	05/11/94	TESTER	DT	NUMBER OF 3m ROD	8.00

BH DATA FROM MINISTRY OF WATER RECORDS ref:-

NAME	Dekeza School	WATER FIRST STRIKE (m)	10
NUMBER		MAIN STRIKE (m)	35
GRID REF		REST WATER LEVEL (m)	10
DATE DRILLED		BLOWING YIELD (m3/h)	4.50
DEPTH (m)	50.00	CASED	
DIAMETER (m)	0.15	SCREENED	
		OPEN	

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs	1.00	AV PUMP RATE (l/s)	0.45
START VOL (m3)	252.732	DRAWDOWN (m)	0.43
END VOL. (m3)	254.339	DEWATERED VOL (m3	0.008
START WL. (mbmd)	13.02	PUMPED VOL (m3)	1.607
END WL. (mbmd)	13.45	'LAMDA'	0.005
BH DATUM	toc		
DATUM ELEV.(magl	0.35		

TEST DATA CW

T pstart (min)	T pstop (min)	WL (mbmd)	WL (mbgl)
0.00		13.02	12.67
1.00		13.32	12.97
2.00		13.32	12.97
3.00		13.33	12.98
4.00		13.33	12.98
5.00		13.36	13.01
6.00		13.40	13.05
7.00		13.40	13.05
8.00		13.34	12.99
9.00		13.40	13.05
10.00		13.37	13.02
12.00		13.38	13.03
14.00		13.40	13.05
16.00		13.39	13.04
18.00		13.41	13.06
20.00		13.40	13.05
22.00		13.43	13.08
24.00		13.41	13.06
26.00		13.45	13.10
28.00		13.42	13.07
30.00		13.43	13.08
32.00		13.42	13.07
34.00		13.42	13.07
36.00		13.44	13.09
38.00		13.42	13.07
40.00		13.39	13.04
42.00		13.45	13.10

PUMPING RATE DATA

MINUTE	PUMPED VOL (L)	AVERAG RATE (l/s)
1	25.00	0.42
2	25.00	0.42
3	24.00	0.40
4	23.00	0.38
5	27.00	0.45
6	29.00	0.48
7	28.00	0.47
8	21.00	0.35
9	27.00	0.45
10	25.00	0.42
11	26.00	0.43
12	25.00	0.42
13	26.00	0.43
14	28.00	0.47
15	26.00	0.43
16	24.00	0.40
17	23.00	0.38
18	29.00	0.48
19	28.00	0.47
20	26.00	0.43
21	26.00	0.43
22	29.00	0.48
23	29.00	0.48
24	28.00	0.47
25	29.00	0.48
26	30.00	0.50
27	27.00	0.45

Table 3.3.6 Pumping-test data from tests completed at site 3, Dekeza (continued)

44.00		13.44	13.09
46.00		13.44	13.09
48.00		13.43	13.08
50.00		13.45	13.10
52.00		13.44	13.09
54.00		13.44	13.09
56.00		13.47	13.12
58.00		13.45	13.10
60.00	0.00	13.45	13.10
60.50	0.50	13.21	12.86
61.00	1.00	13.17	12.82
61.50	1.50	13.15	12.80
62.00	2.00	13.14	12.79
62.50	2.50	13.13	12.78
63.00	3.00	13.12	12.77
63.50	3.50	13.12	12.77
64.00	4.00	13.12	12.77
64.50	4.50	13.115	12.77
65.00	5.00	13.11	12.76
66.00	6.00	13.105	12.76
67.00	7.00	13.1	12.75
68.00	8.00	13.095	12.75
69.00	9.00	13.095	12.75
70.00	10.00	13.09	12.74
72.00	12.00	13.085	12.74
74.00	14.00	13.08	12.73
76.00	16.00	13.08	12.73
78.00	18.00	13.075	12.73
80.00	20.00	13.07	12.72
82.00	22.00	13.07	12.72
84.00	24.00	13.0675	12.72
86.00	26.00	13.0675	12.72
88.00	28.00	13.0675	12.72
90.00	30.00	13.07	12.72
92.00	32.00	13.07	12.72
95.00	35.00	13.07	12.72
100.00	40.00	13.06	12.71
105.00	45.00	13.06	12.71
110.00	50.00	13.06	12.71
120.00	60.00	13.05	12.70
150.00	90.00	13.04	12.69

28	25.00	0.42
29	27.00	0.45
30	26.00	0.43
31	23.00	0.38
32	26.00	0.43
33	28.00	0.47
34	25.00	0.42
35	26.00	0.43
36	29.00	0.48
37	26.00	0.43
38	27.00	0.45
39	24.00	0.40
40	24.00	0.40
41	26.00	0.43
42	29.00	0.48
43	29.00	0.48
44	27.00	0.45
45	31.00	0.52
46	27.00	0.45
47	28.00	0.47
48	25.00	0.42
49	26.00	0.43
50	26.00	0.43
51	26.00	0.43
52	26.00	0.43
53	28.00	0.47
54	27.00	0.45
55	31.00	0.52
56	29.00	0.48
57	26.00	0.43
58	27.00	0.45
59	25.00	0.42
60	25.00	0.42

Table 3.3.6 Pumping-test data from tests completed at site 3, Dekeza (continued)

SITE THREE LARGE DIA WELL LOW DISCH BEFORE LATERALS (11/1/94)

PUMPING DATA

SITE	three
DATE	11/1/94
TEST	ldbl
TESTER	dt/em
PUMPING TIME (hrs	2.25
START VOL (m3)	108.923
END VOL. (m3)	114.110
START WL. (mbmd)	7.78
END WL. (mbmd)	8.73
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	0.54
DATUM	munro
DATUM ELEV. (mag	0.6

CALCULATED DATA

AV PUMP RATE (l/s)	0.64
DRAWDOWN (m)	0.95
DEWATERED VOL (m3	3.290
PUMPED VOL (m3)	5.187
'LAMDA'	0.63
25% rec. @ (mbmd)	8.49
50% rec. @ (mbmd)	8.26
75% rec. @ (mbmd)	8.02

DATA READ FROM GRAPH

25% rec. time (hr)
50% rec. time (hr)
75% rec. time (hr)

RECOVERY DATA

T pstart (hrs)	T pstop (hrs)	WL (mbd)	WL (mbgl)
0.00		7.78	7.18
1.00		8.30	7.7
2.25	0.00	8.73	8.13
4.00	1.75	8.43	7.83
6.00	3.75	8.27	7.67
8.00	5.75	8.17	7.57
10.00	7.75	8.11	7.51
12.00	9.75	8.07	7.47
14.00	11.75	8.02	7.42
16.00	13.75	7.99	7.39
18.00	15.75	7.96	7.36
20.00	17.75	7.94	7.34

Table 3.3.6 Pumping-test data from tests completed at site 3, Dekeza (continued)

SITE	three	WELL DIAMETER (m)	2.10
TEST	T2, hdbl	WELL DEPTH (mbgl)	15.10
DATE	01/12/94	WELL SCREEN	steel
TESTER	dt/tc		

PUMPING DATA

PUMPING TIME (hrs	4.00
START VOL (m3)	114.111
END VOL. (m3)	151.846
START WL. (mbmd)	7.92
END WL. (mbmd)	13.75
ORIFICE DIA (mm)	31.00
PRESS. DIFF (m)	0.74
CW DATUM	monro
DATUM ELEV. (magl	0.6
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	2.62
DRAWDOWN (m)	5.83
DEWATERED VOL (m3)	20.193
PUMPED VOL (m3)	37.735
'LAMDA'	0.54

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		7.92	7.32
1.00		10.00	9.40
2.00		11.44	10.84
3.00		12.69	12.09
4.00	0.00	13.73	13.13
6.00	2.00	12.12	11.52
8.00	4.00	11.17	10.57
10.00	6.00	10.63	10.03
12.00	8.00	10.21	9.61
14.00	10.00	9.89	9.29
16.00	12.00	9.63	9.03
18.00	14.00	9.43	8.83
20.00	16.00	9.26	8.66
22.00	18.00	9.13	8.53
24.00	20.00	9.00	8.40
28.00	24.00	8.82	8.22
40.00	36.00	8.51	7.91
52.00	48.00	8.31	7.71
64.00	60.00	8.18	7.58
76.00	72.00	8.07	7.47
88.00	84.00	8.01	7.41

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES
-RWL is approx 7.32 mbgl, this agrees with rwl in 'T2 HDBL'
-The pump rate is accurate and constant +- 1%. Achieved using an orifice plate flowmeter. The pumped vol is accurate to about +-1%, measured by a kent flowmeter.

Table 3.3.6 Pumping-test data from tests completed at site 3, Dekeza (continued)

SITE THREE LARGE DIA WELL LOW DISCH AFTER LATERALS

PUMPING DATA

SITE	three
DATE	03/24/94
TEST	Idal
TESTER	dt/em
PUMPING TIME (hrs)	5.00
START VOL (m3)	104.404
END VOL. (m3)	122.777
START WL. (mbmd)	8.09
END WL. (mbmd)	9.74
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.30
DATUM	munro
DATUM ELEV. (magl	0.6

CALCULATED DATA

AV PUMP RATE (l/s)	1.02
DRAWDOWN (m)	1.65
DEWATERED VOL (m3	5.715
PUMPED VOL (m3)	18.373
'LAMDA'	0.31
25% rec. @ (mbmd)	9.33
50% rec. @ (mbmd)	8.92
75% rec. @ (mbmd)	8.50

RECOVERY DATA

T pstart (hrs)	T pstop (hrs)	WL (mbd)	WL (mbgl)
0.00		8.09	7.49
1.00		8.67	8.07
2.00		9.04	8.44
3.00		9.32	8.72
4.00		9.54	8.94
5.00	0	9.74	9.14
7.00	2	9.13	8.53
9.00	4	8.89	8.29
11.00	6	8.73	8.13
13.00	8	8.63	8.03
15.00	10	8.55	7.95
17.00	12	8.49	7.89
19.00	14	8.45	7.85
21.00	16	8.40	7.8
23.00	18.00	8.35	7.75
25.00	20.00	8.31	7.71
29.00	24.00	8.26	7.66
35.00	30.00	8.2	7.6
41.00	36.00	8.16	7.56
53.00	48.00	8.08	7.48

Table 3.3.6 Pumping-test data from tests completed at site 3, Dekeza (continued)

SITE	three	WELL DIAMETER (m	2.10
TEST	T4, hdal	WELL DEPTH (mbgl)	15.10
DATE	03/21/93	WELL SCREEN	steel
TESTER	dt/tc		

PUMPING DATA

PUMPING TIME (hrs	4.00
START VOL (m3)	66.126
END VOL. (m3)	104.405
START WL. (mbmd)	7.96
END WL. (mbmd)	12.45
ORIFICE DIA (mm)	31.00
PRESS. DIFF (m)	0.71
CW DATUM	monro
DATUM ELEV. (mag	0.6
BH DATUM	NA
DATUM ELEV.(magl	NA

CALCULATED DATA

AV PUMP RATE (l/s)	2.66
DRAWDOWN (m)	4.49
DEWATERED VOL (m3)	15.552
PUMPED VOL (m3)	38.279
'LAMDA'	0.41

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		7.92	7.32
1.00		9.37	8.77
2.00		10.42	9.82
3.00		11.17	10.57
4.00	0.00	11.84	11.24
6.00	2.00	10.36	9.76
8.00	4.00	9.80	9.20
10.00	6.00	9.46	8.86
12.00	8.00	9.24	8.64
14.00	10.00	9.06	8.46
16.00	12.00	8.92	8.32
18.00	14.00	8.81	8.21
20.00	16.00	8.72	8.12
22.00	18.00	8.66	8.06
24.00	20.00	8.60	8.00
28.00	24.00	8.50	7.90
40.00	36.00	8.33	7.73
52.00	48.00	8.23	7.63
64.00	60.00	8.16	7.56

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES
-RWL is approx 7.32 mbgl, this agrees with rwl in 'T2 HDBL'
-The pump rate is accurate and constant +- 1%. Achieved using an orifice plate flowmeter. The pumped vol is accurate to about +-1%, measured by a kent flowmeter.

Table 3.3.6 Pumping-test data from tests completed at site 3, Dekeza **(continued)**

DEKEZA RECOVERY AFTER DIGGING
DIGGING STARTED 10/7/93
DIGGING STOPPED 23/9/93
DEWATERED EACH DAY AS DIGGING PROGRESSED FOR APPROX 10 WEEKS

RECOVERY FROM 14.70 M BELOW GROUND LEVEL
DATUM ELEVATION (MAGL) 0.3

TIME(HRS	WL (MBD	WL (MGL)
0	15.00	14.7
6	12.50	12.2
12	11.80	11.5
18	11.30	11
24	10.90	10.6
30	10.60	10.3
36	10.36	10.06
42	10.18	9.88
48	10.04	9.74
60	9.82	9.52
72	9.65	9.35
84	9.61	9.31
96	9.39	9.09
108	9.28	8.98
120	9.19	8.89
132	9.11	8.81
144	9.04	8.74
156	8.98	8.68

Table 3.3.7 Attendees of pump maintenance workshop site 3, Dekeza

NAME
Solomon Mahiya
Shenjere Maringire
Fambisai Mahiya
Makota Mundingi
Mrs Manjiru
Lucia Chibako
Enelia Mubhimi
Tsungirirai Mushava
Solomon Mushava

Table 3.3.8 Water points in the region of collector well site 3, Dekeza

Well no.	Builder/owner	Kraal	Date	Diameter (m)	Depth (m)	Water-level			Perceived yield	Water use	Dries-up	
						depth (m)	time	date			Every year	1992
1	ODA/ community	Munjanja	1994		15	10.3			Excellent Max. 21 m^3/d Av. 11 m^3/d	Domestic (D) Garden (G) School (S)	No	No
2	DDF/ community	Tavana	1986		45	13.8			Excellent Av. 10 m^3/d	D,G,S	No	No
3	WH&Jack	Makwever	1985	0.15	64	1.33			Excellent	D,G,T	No	No
4	DDF/ community	Mamutse	1990	0.60	15.7	10.4			abandoned	-	-	-
5	WH&Jack	Tanyanyi	1986	0.15	48	4.97			V. Good	D,G	No	No
6	DDF/ community	Makwever	1990	1.5	> 30	12.43			Good	D	Yes	Yes
7	Community	Mamutse	1990	1.5	> 30				-	-	-	-
8	DDF/ community	Chakavat	1990	1.5					Poor	D	Yes	Yes

Table 3.3.9 Wells and boreholes monitored for water-levels at site 3, Dekeza

WELL NUMBER	DATUM DESCRIPTION		DEPTH (m)	DIA (m)
	ELEV (magl)	ELEV (macwd)		
2	0.35	+10.74	43.0	0.15
1	0.60	+0.00	15.0	2.0

Site 4 - Nemauka

Site description

Geology:	granite
Location:	approx. 100 km north of Chiredzi Research Station, in Nemauka business centre about 2 km north of Muchechetere school.
Access:	from the tar road, about 3 km south of Zaka turn west onto a dirt road sign posted to an army training camp, Nemauka Business Centre is about 25 km along this road, 2 km after the sign to Muchechetere school.
Annual rainfall:	? mm

Exploratory drilling

Drilling:	BGS contract driller
No. of exploratory holes:	4
Comments:	exploratory bh4 was enlarged to 150 mm and pump tested. The collector well was subsequently dug 5 m from bh4.

Specific construction details

Foreman:	Timothy Chiunye
Depth of well shaft:	15 m
Time to dig shaft:	16 weeks
No. of laterals:	4
Length of laterals:	18, 30, 30, 30 m
Comments:	construction was slow due to poor community organisation

A soakaway gully (0.5m wide, 0.5m deep) was dug on two sides of the slab to collect waste water and a further trench dug to drain the waste water away down slope. These trenches were lined with pieces of hard rock the size of a fist to create a French drain.

Monitoring of well performance

Mr Tirivashoma Tinarwo is to change the munro recorder charts and read the meters at 0600 every Sunday morning. He will also dip bh4, the DDF borehole and 11 traditional wells in the catchment.

20°18'17.21"S 31°22'16.67"E .
36K 329945.92m E 7753969.39m S. elevation 814m.

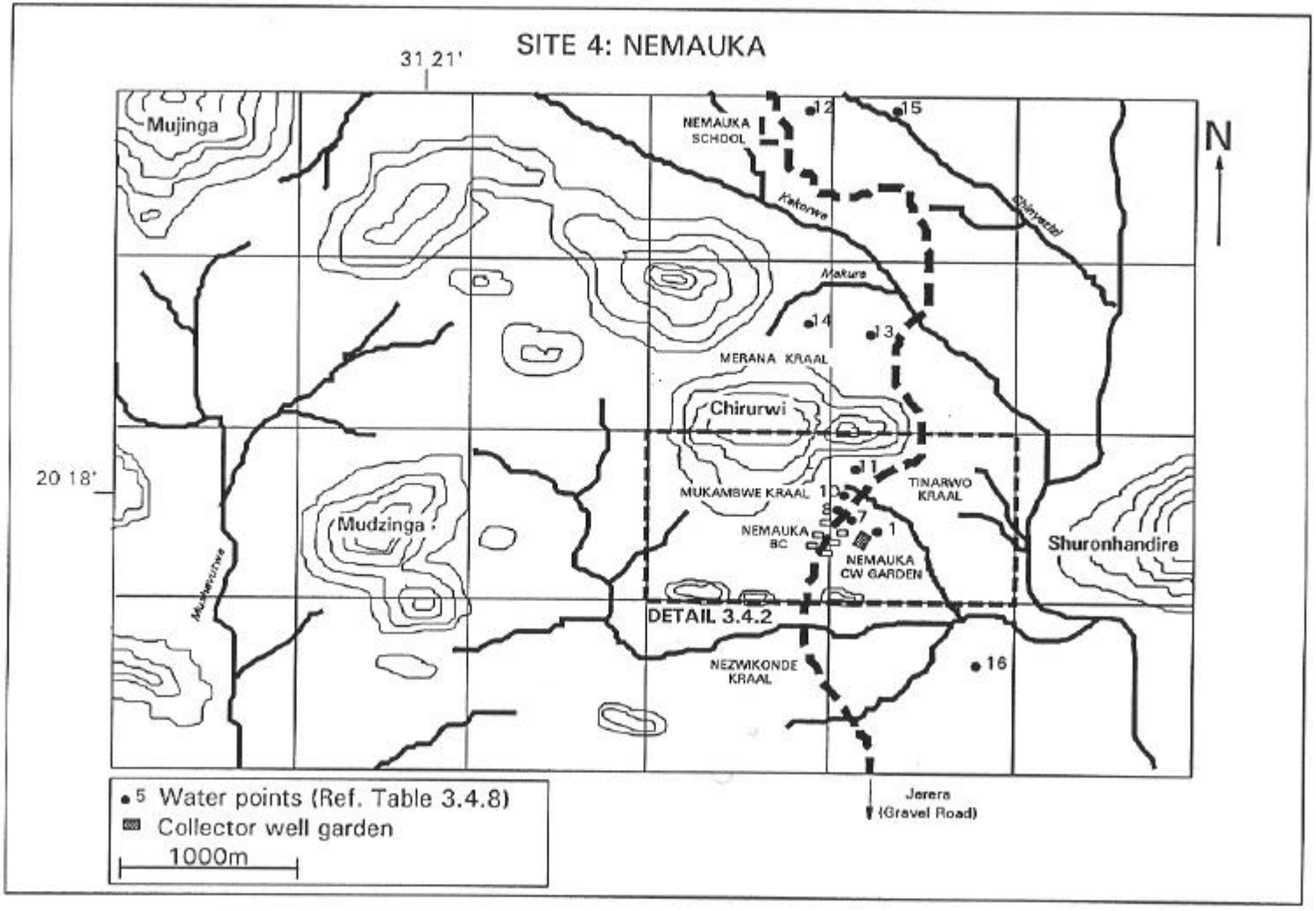


Figure 3.4.1 Map of location of collector well garden and local water points

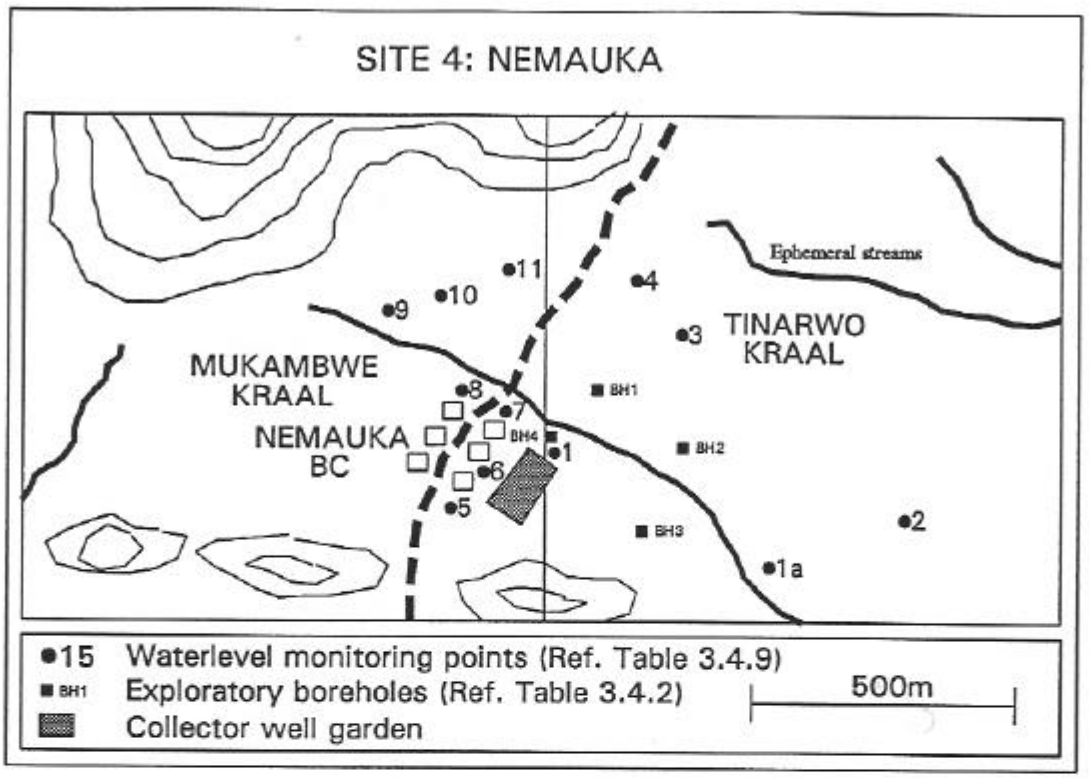


Figure 3.4.2 Detail showing location of exploratory boreholes

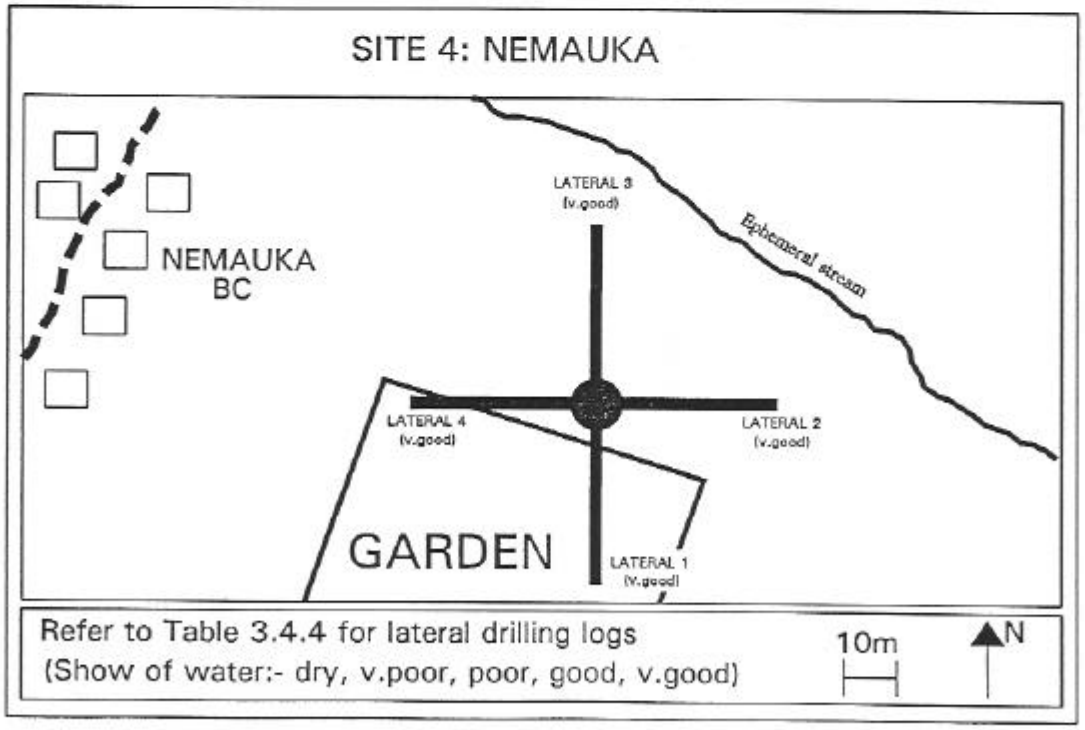


Figure 3.4.3 Map of vicinity of collector well showing direction of laterals

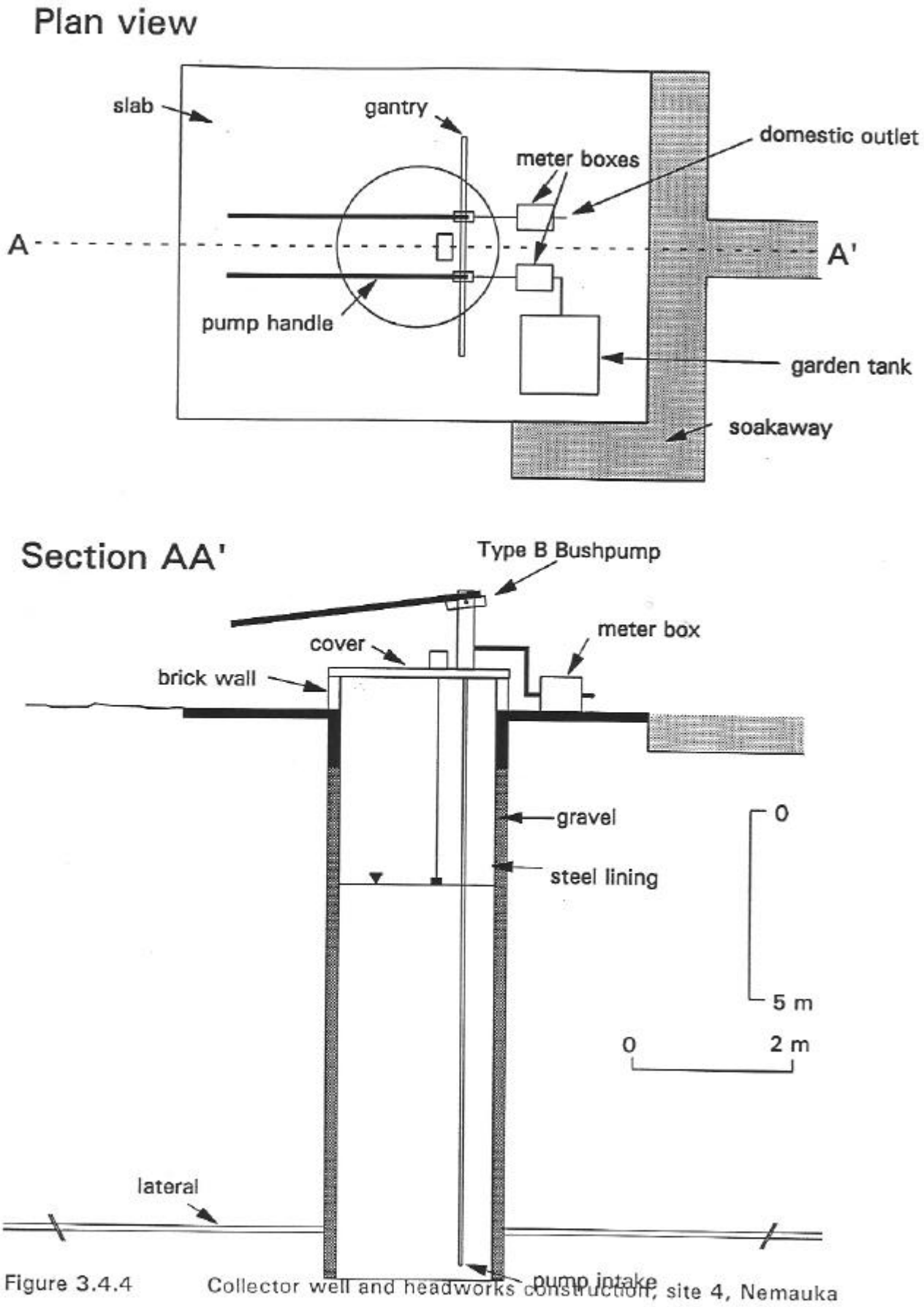


Figure 3.4.4 Collector well and headworks construction, site 4, Nemauka

Table 3.4.1 Diary of activities at site 4, Nemauka

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
drill four exploratory holes	15/6/93 (4 days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 150l drill bits ??
establish degree of need, and potential community commitment	(3 days)	sociologist economist	none	none
pumptest BH4 (two tests)	17/6/93 (2 days)	ptest engineer site assistant	Pump and associated equipment	petrol 15l
dig well shaft to 15m, backfill with gravel, concrete in sanitary seal, build and plaster head wall	20/11/93 (116 days)	construction manager site foreman 5 labourers	compressor pump + hoses hand winch wire rope gantry kibble personnel steps 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helmets jackhammer cement mixer shifting spanner 27mm spanner torch foreman's tent foreman's bed foreman's stove	cement 26bags bricks 200 river sand 4cum 19mm gravel 10cum diesel(comp) 2200l steel casing 15m jh points 2 pump rubbers 2 hydraulic oil 15l engine oil 5l gumboots 6prs paraffin 15l gas 6kg
lateral drilling (four laterals)	26/03/94 (5 days)	driller crane operator 1 labourer	air rig and associated equipment	diesel 1200l
complete headworks, well covers, water tank, soakaway, gantry	18/12/93 (6 days)	construction manager site foreman 5 labourers	formwork level trowel wheelbarrow cement mixer	bricks 100 cement 5bags sand/gravel 1cum pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15m 50mm elbows 2 50mm nipples 2
pump test collector well before laterals x 2 after laterals x 2	04/05/94 (6 days)	ptest engineer site assistant	pump and associated equipment	petrol 30l

Table 3.4.1 Diary of activities at site 4, Nemauka (continued)

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
install bushpumps with community as part of pump maintenance workshop	16/12/93 (1 day)	instructor translator 17 locals	thread cutter for 50mm pipe and 19mm rods	50mm galv pipe 30m 50mm nipples 8 pump cylinder 2 17mm rods 30m type B bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for collector well, DDF bh, piezometer 'bh4' and 11 traditional wells in the catchment	17/12/93 (4 days)	ptest engineer foreman monitor man	munro wl recorder 2 water meters	bricks 100 cement 3bags munro box 1 padlock 1 50mm galv pipe 6m 50mm elbows 8 50mm unionjoint 2 w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	17/12/93 (2 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20bags steel posts 13 steel stays 10 steel standards 36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer. vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a separate report Thompson (1994).
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenance and attending to minor breakdowns.

Table 3.4.2 Drilling logs of exploratory boreholes at site 4, Nemauka

EXPLORATORY DRILLING AT NEMAUKA (COLLECTOR WELL SITE 4)				
	Exploratory bh 'BH1' Drilled 1/6/93 BGS light air rig diameter = 100mm, depth = 10m first strike = dry	Exploratory bh 'BH2' Drilled 2/6/93 BGS light air rig diameter = 100mm, depth = 7m little bit of water an bottom of hole	Exploratory bh 'BH3' Drilled 2/6/93 BGS light air rig diameter = 100mm depth = 3m first strike = dry	Exploratory bh 'BH4' Drilled 15/6/93 BGS light air rig diameter = 150mm, depth = 18m first strike = 5.0m rwl = 4.77m
	Note:- Drilled with 0.75m rods, the description is for each rod. Penetration rates were not available.			
Rod Number	Comment	Comment	Comment	Comment
1	weathered	weathered	weathered	weathered
2	weathered	weathered	weathered	weathered
3	weathered	weathered	hard	weathered
4	weathered	weathered		weathered
5	weathered	weathered		weathered
6	weathered	weathered		weathered
7	weathered	weathered		weathered
8	weathered	weathered		weathered
9	weathered	weathered		weathered
10	weathered	weathered		weathered
11	weathered			weathered
12	hard			soft
13	hard			weathered
14				soft
15				weathered
16				soft
17				banded
18				banded
19				banded
20				banded
21				banded
22				banded
23				banded
24				banded

Table 3.4.3 Geological descriptions of collector well digging samples, site 4, Nemauka

NEMAUKA (SITE FOUR) GEOLOGICAL DESCRIPTION OF DIGGING SAMPLES FROM THE COLLECTOR WELL	
DEPTH (m)	**Description**
0.5	Reddish-buff clayey topsoil, lateritic nodules and pieces of concretionary lateritic ironstone containing quartz fragments up to 2-3 mm.
1.0	Paler buff soil with some quartz fragments up to 10 mm, a few platy feldspar grains up to 5 mm long and some iron-rich nodules, some containing quartz fragments.
1.5	Pale buff clayey subsoil containing small, angular fragments of feldspar and quartz up to 2-3 mm and few larger fragments of quartz up to 10-12 mm. Less iron staining.
2.0	Angular fragments of weathered rock, including quartz pieces, some white feldspars up to 10 mm and lumps of grey, clayey material with smaller white feldspar grains 2-3 mm across. Also some black, biotite-rich lumps of rock.
2.5	Angular fragments of quartz up to 15 mm covered in buff clayey material, and small greyish lumps of weathered material with small feldspar and quartz fragments.
3.0	Lumps of weathered rock, black, brownish-buff and some greenish colours in each piece, more biotite-rich than above, not so many quartz fragments.
3.5	Greenish-grey fragments of weathered rock, more fine material, and small pieces of quartz up to 5 mm, some angular and tabular white feldspars up to 6-8 mm.
4.0	Buff angular fragments of quartz, some with biotite attached. When washed, buff clayey material is removed. Also few angular white feldspars, smaller.
4.5	Flaky, fresh biotite pieces up to 10 mm. Brownish pieces of coated quartz, one very large quartz and mica piece. Small (0.5 mm) white columnar feldspars.
5.0	Lumps of weathered, clay-rich material with angular fragments of quartz up to 10 mm and white feldspar (to 4 mm) and few, smaller greenish pieces of ?weathered mica.
5.5	Large angular pieces of quartz up to 20 mm, coated with greyish clayey and silty weathered material, containing small feldspars and few very small black fragments of ferric minerals, and bright micas.
6.0	Much smaller fragments of quartz coated with grey clayey material containing small white feldspars (0.5 mm) and very small mica flakes (0.1 mm). Some pieces with pure, grey clay streaks.
6.5	Small, up to 10 mm pieces of quartz coated with buff-brownish fine material.

Table 3.4.3 Geological descriptions of collector well digging samples, site 4, Nemauka (continued)

NEMAUKA (SITE FOUR) GEOLOGICAL DESCRIPTION OF DIGGING SAMPLES FROM THE COLLECTOR WELL	
DEPTH (m)	**Description**
7.0	Soft friable pieces of weathered rock, showing traces of original banding by iron staining and weathering of micas, the first in this hole to do so.
7.5	Much smaller pieces, up to 10 mm, mostly of quartz with mica attached, coated with greyish-buff clay and silt and very fine sand of quartz and mica. No lumps of weathered rock.
8.0	Clay coated quartz fragments up to 10 mm. Some tabular or columnar white feldspars up to 8 mm long. No weathered rock.
8.5	Angular fragments of quartz and biotite up to 10 mm across, coated with grey-buff clay and silt. Angular fragments have more biotite than previously, some of the micas are weathered and break when washed. A few small white feldspars < 5mm.
9.0	Angular quartz grains < 10to15mm across, with thin coating of grey-buff weathered material, containing mica flakes up to 2-3 mm. Some clayey material with small feldspars and micas.
9.5	Smaller pieces of clay coated biotite-rich weathered rock.
10.0	As above with less biotite. Angular quartz < 10to12mm across, small mica flakes, quartz fragments with micas in them.
10.5	Angular pieces of rock 10-15 mm across, mostly quartz with micas attached, less clay coating than above.
11.0	Fresher pieces of mostly quartz and mica <10mm. Some fragments contain white feldspar. Much less clay coating.
11.5	Angular lumps of weathered rock <25to30mm, showing original texture, and breaking to show iron staining on cracks and green, chlorite weathering of micas.
12.0	As above with smaller fragments of rock. Some rock dust.
12.5	Few angular fragments of granitic rock up to 15 mm, mostly dust of rock with quartz and feldspar grains up to 3-4 mm.
13.0	Angular fresh rock up to 10-12 mm, with some rock dust.
13.5	Soft lumps of weathered rock (more weathered than above), containing white feldspars and quartz grains.
14.0	Harder, smaller, angular fragments of rock up to 10 mm.
14.5	Small fragments of fresh rock, brownish dust and coatings on some fragments.
15.0	Angular fragments of fresh rock with coating of brownish dust.

Table 3.4.4 Lateral drilling logs from site 4, Nemauka

NEMAUKA (SITE FOUR) COLLECTOR WELL LATERAL DRILLING LOGS				
	LATERAL 1	LATERAL 2	LATERAL 3	LATERAL 4
DRILLER DIRECTION ELEVATION LENGTH COMPLETED WATER FLOW	P.Rastall south -5 degrees 40rods, 30m 22/3/94 very good	P.Rastall east -5 degrees 40rods,30m 23/3/94 very good	P.Rastall north -5 degrees 23rods,18m 24/3/94 ????	P.Rastall west -5 degrees 40rods,30m 26/3/94 very good
ROD NUMBER (0.75m rods)	COMMENT	COMMENT	COMMENT	COMMENT
1	weathered granite	weathered granite	clay	weathered granite
2	weathered FWS	weathered granite	clay	weathered
3	weathered	FWS	clay	weathered
4	granite	weathered	weathered	granite FWS
5	weathered granite	granite	granite	weathered granite
6	weathered granite	weathered granite	FWS	weathered granite
7	weathered	weathered granite	weathered	weathered
8	quartz fault	weathered	granite	granite
9	weathered granite	granite	weathered clay seam	weathered granite
10	weathered granite	weathered	weathered granite	weathered granite
11	weathered	granite	weathered	weathered
12	granite	clay seam granite	granite	granite
13	weathered granite	weathered	weathered	weathered granite
14	weathered granite	granite	granite	weathered granite
15	weathered	weathered granite	weathered granite	weathered
16	granite	clay seam granite	weathered	granite
17	weathered granite	weathered	granite	weathered granite
18	weathered granite	granite	weathered granite	weathered granite
19	weathered	weathered granite	weathered	weathered
20	granite	weathered	granite	granite
21	weathered quartz	granite		weathered granite
22	fault	weathered quartz		weathered granite
23	weathered granite	fault		weathered
24	weathered	weathered granite		granite
25	granite	weathered		weathered granite
26	weathered granite	granite		weathered
27	weathered	weathered granite		granite
28	granite	weathered		
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

Table 3.4.5 Pumping-tests performed at site 4, Nemauka

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	01/21/94	CWT1LDBL	DT/TC	0.85	135	0.95	1.24	<0.95	2025	RATE+-3%, HIGH RWL
2	01/24/94	CWT2HDBL	DT/TC	2.68	240	0.95	6.29	<0.95	5040	RATE+-3%, HIGH RWL
3	04/28/94	CWT3LDAL	DT/TC	1.00	300	4.21	6.42	<4.21	1140	RATE+-3%, MUCH LOWER RWL THAN T1
4	04/29/94	CWT4HDAL	DT/TC	2.60	240	4.70	9.52	<4.70	3600	RATE+-3%, MUCH LOWER RWL THAN T2
5A	11/18/94	REC AFTER DIGGING	NA	NA	NA	NA	NA	NA	NA	NONE

WELL DESCRIPTION_____ BH4 (EXPLORATORY BH)

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	06/16/93	HIGH DISCH	DT/PM	0.77	18	4.47	11.40	<4.47	70	RATE+-10%
2	06/17/93	LOW DISCH	DT/PM	0.44	60	4.48	11.30	<4.48	70	RATE+-10%

WELL DESCRIPTION_____ DDF BH

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	06/04/94	T1 USING BUSHPUMP	DT/PM	0.43	40	8.79	24.26	<9.64	1400	GOOD ACCURATE TEST

WELL DESCRIPTION_____ MAI CHIPATO'S HAND DUG WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	34461	T1 HDW	DT/TC	0.97	60	6.87	10.65	<6.87	78	WELL DIA. VARIABLE, NOT AT RWL.

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka

SITE	four	WELL DIAMETER (m)	2.10
TEST	T2, ldbl	WELL DEPTH (mbgl)	15.00
DATE	01/21/94	WELL SCREEN	steel
TESTER	dt/tc		

PUMPING DATA

PUMPING TIME (hrs	2.25
START VOL (m3)	155.621
END VOL. (m3)	160.892
START WL. (mbmd)	1.40
END WL. (mbmd)	1.79
ORIFICE DIA (mm)	31.00
PRESS. DIFF (m)	0.55
CW DATUM	monro
DATUM ELEV. (magl	0.6
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	0.65
DRAWDOWN (m)	0.39
DEWATERED VOL (m3	1.347
PUMPED VOL (m3)	5.271
'LAMDA'	0.26

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		1.40	0.80
1.00		1.71	1.11
2.00		1.77	1.17
2.25	0.00	1.79	1.19
3.00	0.75	1.55	0.95
4.00	1.75	1.48	0.88
5.00	2.75	1.45	0.85
6.00	3.75	1.44	0.84
7.00	4.75	1.43	0.83
8.00	5.75	1.43	0.83
9.00	6.75	1.42	0.82
10.00	7.75	1.42	0.82
12.00	9.75	1.41	0.81
14.00	11.75	1.41	0.81
16.00	13.75	1.40	0.80
18.00	15.75	1.40	0.80
20.00	17.75	1.40	0.80
22.00	19.75	1.40	0.80
24.00	21.75	NA	NA
30.00	27.75	NA	NA
36.00	33.75	NA	NA

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES

-RWL is approx. 1.40mbgl. This falls fast at the end of the rainy season T3 HDAL is performed with a rwl approx 5.00mbgl. Comparison of T1 and is difficult.

-The pump rate is accurate and constant +- 1%. Achieved using an orifice plate flowmeter. The pumped vol is accurate to about +-1%, measured by a kent flowmeter.

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

SITE	four	WELL DIAMETER (m	2.10
TEST	T2, hdbl	WELL DEPTH (mbgl)	15.00
DATE	01/24/94	WELL SCREEN	steel
TESTER	dt/tc		

PUMPING DATA

PUMPING TIME (hrs)	4.00
START VOL (m3)	160.891
END VOL. (m3)	199.635
START WL. (mbmd)	1.45
END WL. (mbmd)	6.89
ORIFICE DIA (mm)	31.00
PRESS. DIFF (m)	0.74
CW DATUM	monro
DATUM ELEV. (magl	0.6
BH DATUM	NA
DATUM ELEV.(magl)	NA

CALCULATED DATA

AV PUMP RATE (l/s)	2.69
DRAWDOWN (m)	5.44
DEWATERED VOL (m3	18.849
PUMPED VOL (m3)	38.744
'LAMDA'	0.49

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		1.45	0.85
1.00		2.96	2.36
2.00		4.47	3.87
3.00		5.78	5.18
4.00	0.00	6.89	6.29
6.00	2.00	4.22	3.62
8.00	4.00	2.83	2.23
10.00	6.00	1.96	1.36
12.00	8.00	1.69	1.09
14.00	10.00	1.61	1.01
16.00	12.00	1.57	0.97
18.00	14.00	1.55	0.95
20.00	16.00	1.53	0.93
22.00	18.00	1.52	0.92
24.00	20.00	1.51	0.91
28.00	24.00	1.49	0.89
40.00	36.00	1.47	0.87
52.00	48.00	1.46	0.86
64.00	60.00	NA	NA
76.00	72.00	NA	NA
88.00	84.00	NA	NA

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

NOTES

-RWL is approx. 0.90mbgl. This falls fast at the end of the rainy season T4 HDAL is performed with a rwl approx 5.00mbgl. Comparison of T2 and is difficult. I may repeat T4 HDAL in Jan '95 to compare with this test.

-The pump rate is accurate and constant +- 1%. Achieved using an orifice plate flowmeter. The pumped vol is accurate to about +-1%, measured by a kent flowmeter.

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

SITE	four	WELL DIAMETER (m)	2.10
TEST	T3, Idal	WELL DEPTH (mbgl)	15.10
DATE	04/28/94	WELL SCREEN	steel
TESTER	dt/tc		

PUMPING DATA

PUMPING TIME (hrs	5.00
START VOL (m3)	183.567
END VOL. (m3)	201.576
START WL. (mbmd)	4.81
END WL. (mbmd)	7.02
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.27
CW DATUM	monro
DATUM ELEV. (magl	0.6
BH DATUM	toc
DATUM ELEV.(magl)	0.7

CALCULATED DATA

AV PUMP RATE (l/s)	1.00
DRAWDOWN (m)	2.21
DEWATERED VOL (m3)	7.655
PUMPED VOL (m3)	18.009
'LAMDA'	0.43

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		4.81	4.21
1.00		5.66	5.06
2.00		6.10	5.50
3.00		6.50	5.90
4.00		6.79	6.19
5.00	0	7.02	6.42
6.00	1	6.42	5.82
8.00	3	5.92	5.32
10.00	5	5.63	5.03
20.00	15	5.22	4.62
22.00	17	5.20	4.60
24.00	19	5.18	4.58

RECOVERY DATA BH

WL (mbd)	WL (mbgl)	WL (mbmd)
5.15	4.45	4.92
5.30	4.60	5.07
5.50	4.80	5.27
5.80	5.10	5.57
6.04	5.34	5.81
6.25	5.55	6.02
6.30	5.60	6.07
5.95	5.25	5.72
5.86	5.16	5.63
5.60	4.90	5.37
5.55	4.85	5.32
5.54	4.84	5.31

NOTES
-RWL is approx 4.70 mbgl, see note on 'T2 HDBL' for lateral effects
-The pump rate is accurate and constant +- 1%. Achieved using an orifice plate flowmeter. The pumped vol is accurate to about +-1%, measured by a kent flowmeter.

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

SITE	four	WELL DIAMETER (m)	2.10
TEST	T4, hdal	WELL DEPTH (mbgl)	15.10
DATE	04/29/94	WELL SCREEN	steel
TESTER	dt/tc		

PUMPING DATA

PUMPING TIME (hrs	4.00
START VOL (m3)	202.268
END VOL. (m3)	239.761
START WL. (mbmd)	5.30
END WL. (mbmd)	10.12
ORIFICE DIA (mm)	31.00
PRESS. DIFF (m)	0.74
CW DATUM	monro
DATUM ELEV. (magl	0.6
BH DATUM	toc
DATUM ELEV.(magl)	0.7

CALCULATED DATA

AV PUMP RATE (l/s)	2.60
DRAWDOWN (m)	4.82
DEWATERED VOL (m3)	16.695
PUMPED VOL (m3)	37.493
'LAMDA'	0.45

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		5.30	4.70
1.00		7.19	6.59
2.00		8.46	7.86
3.00		9.49	8.89
4.00	0.00	10.12	9.52
6.00	2.00	7.92	7.32
8.00	4.00	7.11	6.51
10.00	6.00	6.68	6.08
12.00	8.00	6.42	5.82
14.00	10.00	6.25	5.65
16.00	12.00	6.12	5.52
18.00	14.00	6.02	5.42
20.00	16.00	5.95	5.35
22.00	18.00	5.89	5.29
24.00	20.00	5.85	5.25
28.00	24.00	5.76	5.16
40.00	36.00	5.61	5.01
52.00	48.00	5.43	4.83
64.00	60.00	NA	NA

RECOVERY DATA BH

WL (mbd)	WL (mbgl)	WL (mbmd)
5.53	4.83	5.30
6.00	5.30	5.77
6.60	5.90	6.37
7.10	6.40	6.87
7.55	6.85	7.32
7.76	7.06	7.53
7.40	6.70	7.17
NA	NA	NA
NA	NA	NA
NA	NA	NA
NA	NA	NA
6.29	5.59	6.06
6.22	5.52	5.99
6.16	5.46	5.93
6.10	5.40	5.87
5.90	5.20	5.67
5.84	5.14	5.61
5.73	5.03	5.50
NA	NA	NA

NOTES
-RWL is approx 4.70 mbgl, see note on 'T2 HDBL' for lateral effects
-The pump rate is accurate and constant +- 1%. Achieved using an orifice plate flowmeter. The pumped vol is accurate to about +-1%, measured by a kent flowmeter.

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

SITE #4 DIGGING DATA

DIGGING STARTED	29-Jul-93
DIGGING FINISHED	19-Nov-93
TOTAL DIGGING TIME	16.1 WEEKS

DATUM DESCRIPTION	HEIGHT ABOVE GROUND LEVEL (m)
Top of casing	0.10
Top of wall	0.50
Munro datum (Top of slab)	0.60

DEPTH OF WELL 15.00 mbgl

RECOVERY AFTER DIGGING

DATE	TIME (of day)	REC. TIME (hrs)	WL (mbtoc)	activity during preceding 24hrs
11/19	15:00	0.00	15.50	dewatering to 15m
11/20	07:00	16.00	10.65	recovery
11/21	07:00	40.00	9.07	gravel fill, Abstract 500 L
11/22	07:00	64.00	8.55	abstract 200l
11/23	07:00	88.00	7.05	abstract 200l
11/24	07:00	112.00		

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

SITE	four	Nemauka			
TEST	Expl. BH T1	MEASURED DATA	DEPTH (mbgl)		14.00
DATE	06/16/93	TESTER DT	PUMP SET AT		12.20

BH DATA FROM MINISTRY OF WATER RECORDS ref:- NA

NAME	Nemauka	WATER FIRST STRIKE (m)	9
NUMBER	NA	MAIN STRIKE (m)	NA
GRID REF	NA	REST WATER LEVEL (m)	4.77
DATE DRILLED	06/15/93	BLOWING YIELD (m3/h)	NA
DRILLED BY	DWD Mr Chikuni	CASED	---
DEPTH (m)	18.00	SCREENED	---
DIAMETER (m)	0.15	OPEN	0 to 18

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs	0.30	AV PUMP RATE (l/s)	0.77
START VOL (m3)	NA	DRAWDOWN (m)	6.93
END VOL. (m3)	NA	DEWATERED VOL (m3)	0.122
START WL. (mbd)	4.77	PUMPED VOL (m3)	0.231
END WL. (mbd)	11.70	'LAMDA'	0.531
BH DATUM	toc		
DATUM ELEV.(magl)	0.30		

TEST DATA BH

T pstart (min)	T pstop (min)	WL (mbd)	WL (mbgl)
0.00		4.77	4.47
0.50		5.50	5.20
1.00		6.00	5.70
1.50		6.30	6.00
2.00		6.50	6.20
2.50		6.72	6.42
3.00		6.90	6.60
3.50		7.04	6.74
4.00		7.15	6.85
4.50		7.30	7.00
5.00		7.45	7.15
6.00		7.75	7.45
7.00		8.00	7.70
8.00		8.25	7.95
9.00		8.49	8.19
10.00		8.77	8.47
12.00		9.28	8.98
14.00		10.16	9.86
16.00		10.90	10.60
18.00	0.00	11.70	11.40
18.50	0.50	11.30	11.00
19.00	1	11.00	10.70
19.50	1.5	10.74	10.44
20.00	2	10.50	10.20
20.50	2.5	10.30	10.00
21.00	3	10.11	9.81
21.50	3.5	9.85	9.55

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

22.00	4	9.66	9.36
22.50	4.5	9.44	9.14
23.00	5	9.30	9.00
24.00	6	9.11	8.81
25.00	7	8.97	8.67
26.00	8	8.80	8.50
27.00	9	8.63	8.33
28.00	10.00	8.48	8.18
30.00	12.00	8.25	7.95
32.00	14.00	8.03	7.73
34.00	16.00	7.83	7.53
36.00	18.00	7.65	7.35
38.00	20.00	7.45	7.15
40.00	22.00	7.30	7.00
42.00	24.00	7.15	6.85
44.00	26.00	7.03	6.73
46.00	28.00	6.90	6.60
48.00	30.00	6.77	6.47
50.00	32.00	6.60	6.30
53.00	35.00	6.42	6.12
58.00	40.00	6.14	5.84
63.00	45.00	5.85	5.55
68.00	50.00	5.62	5.32
78.00	60.00	5.32	5.02
88.00	70.00	5.13	4.83

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

SITE	four	Nemauka			
TEST	Expl. BH T2	MEASURED DATA	DEPTH (mbgl)		14.00
DATE	06/17/93	TESTER DT	PUMP SET AT		12.20

BH DATA FROM MINISTRY OF WATER RECORDS ref:- NA

NAME	Nemauka	WATER FIRST STRIKE (m)	9
NUMBER	NA	MAIN STRIKE (m)	NA
GRID REF	NA	REST WATER LEVEL (m)	4.77
DATE DRILLED	06/15/93	BLOWING YIELD (m3/h)	NA
DRILLED BY	DWD Mr Chikuni	CASED	---
DEPTH (m)	18.00	SCREENED	---
DIAMETER (m)	0.15	OPEN	0 to 18

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs	1.00	AV PUMP RATE (l/s)	0.44
START VOL (m3)	NA	DRAWDOWN (m)	6.82
END VOL. (m3)	NA	DEWATERED VOL (m3	0.121
START WL. (mbd)	4.78	PUMPED VOL (m3)	0.440
END WL. (mbd)	11.60	'LAMDA'	0.274
BH DATUM	toc		
DATUM ELEV.(magl)	0.30		

TEST DATA BH

T pstart (min)	T pstop (min)	WL (mbd)	WL (mbgl)
0.00		4.78	4.48
0.50		5.02	4.72
1.00		5.32	5.02
1.50		5.61	5.31
2.00		5.87	5.57
2.50		6.04	5.74
3.00		6.21	5.91
3.50		6.33	6.03
4.00		6.44	6.14
4.50		6.55	6.25
5.00		6.65	6.35
6.00		6.85	6.55
7.00		7.02	6.72
8.00		7.13	6.83
9.00		7.25	6.95
10.00		7.39	7.09
12.00		7.67	7.37
14.00		7.90	7.60
16.00		8.11	7.81
18.00		8.29	7.99
20.00		8.49	8.19
22.00		8.70	8.40
24.00		8.91	8.61
26.00		9.08	8.78
28.00		9.25	8.95
30.00		9.42	9.12
32.00		9.74	9.44

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

35.00		10.06	9.76
40.00		10.48	10.18
45.00		10.81	10.51
50.00		11.14	10.84
60.00	0	11.60	11.30
60.50	0.5	11.30	11.00
61.00	1	11.00	10.70
61.50	1.50	10.76	10.46
62.00	2.00	10.57	10.27
62.50	2.50	10.37	10.07
63.00	3.00	10.17	9.87
63.50	3.50	9.97	9.67
64.00	4.00	9.79	9.49
64.50	4.50	9.58	9.28
65.00	5.00	9.41	9.11
66.00	6.00	9.20	8.90
67.00	7.00	9.06	8.76
68.00	8.00	8.91	8.61
69.00	9.00	8.76	8.46
70.00	10.00	8.60	8.30
72.00	12.00	8.35	8.05
74.00	14.00	8.16	7.86
76.00	16.00	7.97	7.67
78.00	18.00	7.79	7.49
80.00	20.00	7.62	7.32
82.00	22.00	7.44	7.14
84.00	24.00	7.29	6.99
86.00	26.00	7.16	6.86
88.00	28.00	7.05	6.75
90.00	30.00	6.94	6.64
92.00	32.00	6.81	6.51
95.00	35.00	6.62	6.32
100.00	40.00	6.34	6.04
105.00	45.00	6.10	5.80
110.00	50.00	5.83	5.53
120.00	60.00	5.44	5.14
130.00	70.00	5.26	4.96

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

SITE	four	Nemauka			
TEST	T1	MEASURED DATA	DEPTH (mbgl)		25.00
DATE	05/04/94	TESTER DT	NUMBER OF 3m RODS		8.00

BH DATA FROM MINISTRY OF WATER RECORDS ref:- EEC159B

NAME	Nezviconde dip	WATER FIRST STRIKE (m)	NA
NUMBER		MAIN STRIKE (m)	NA
GRID REF		REST WATER LEVEL (m)	6.75
DATE DRILLED	11/28/89	BLOWING YIELD (m3/h)	1.84
DEPTH (m)	44.40	CASED	
DIAMETER (m)	0.15	SCREENED	
		OPEN	

PUMPING DATA

PUMPING TIME (hrs)	0.67
START VOL (m3)	240.670
END VOL. (m3)	241.708
START WL. (mbmd)	9.64
END WL. (mbmd)	25.10
BH DATUM	toc
DATUM ELEV.(magl)	0.85

CALCULATED DATA

AV PUMP RATE (l/s)	0.43
DRAWDOWN (m)	15.46
DEWATERED VOL (m3)	0.273
PUMPED VOL (m3)	1.038
'LAMDA'	0.263

TEST DATA CW

T pstart (min)	T pstop (min)	WL (mbmd)	WL (mbgl)
0.00		9.64	8.79
1.00		10.89	10.04
2.00		11.32	10.47
3.00		11.56	10.71
4.00		12.21	11.36
5.00		12.69	11.84
6.00		13.10	12.25
7.00		13.45	12.60
8.00		13.85	13.00
9.00		14.09	13.24
10.00		14.19	13.34
12.00		15.08	14.23
14.00		15.76	14.91
16.00		16.50	15.65
18.00		17.14	16.29
20.00		17.72	16.87
22.00		18.64	17.79
24.00		19.05	18.20
26.00		19.74	18.89
28.00		20.33	19.48
30.00		20.74	19.89
32.00		20.90	20.05
34.00		22.00	21.15
36.00		23.00	22.15
38.00		23.94	23.09
40.00	0.00	25.10	24.25
41.00	1.00	22.53	21.68

PUMPING RATE DATA

MINUTE	PUMPED VOL (L)	AVERAG RATE (l/s)
1	26.00	0.43
2	26.00	0.43
3	26.00	0.43
4	26.00	0.43
5	26.00	0.43
6	26.00	0.43
7	26.00	0.43
8	25.00	0.42
9	26.00	0.43
10	20.00	0.33
11	25.00	0.42
12	26.00	0.43
13	26.00	0.43
14	28.00	0.47
15	27.00	0.45
16	27.00	0.45
17	26.00	0.43
18	27.00	0.45
19	26.00	0.43
20	26.00	0.43
21	29.00	0.48
22	31.00	0.52
23	26.00	0.43
24	26.00	0.43
25	27.00	0.45
26	27.00	0.45
27	26.00	0.43

Table 3.4.6 Pumping-test data from tests completed at site 4, Nemauka (continued)

42.00	2.00	21.74	20.89
43.00	3.00	21.21	20.36
44.00	4.00	20.85	20.00
45.00	5.00	20.52	19.67
46.00	6.00	20.29	19.44
47.00	7.00	20.01	19.16
48.00	8.00	19.86	19.01
49.00	9.00	19.70	18.85
50.00	10.00	19.56	18.71
52.00	12.00	19.28	18.43
54.00	14.00	19.04	18.19
56.00	16.00	18.79	17.94
58.00	18.00	18.58	17.73
60.00	20.00	18.38	17.53
62.00	22.00	18.18	17.33
64.00	24.00	18.00	17.15
66.00	26.00	17.82	16.97
68.00	28.00	17.65	16.80
70.00	30.00	17.49	16.64
72.00	32.00	17.34	16.49
75.00	35.00	17.19	16.34
80.00	40.00	16.80	15.95
85.00	45.00	16.53	15.68
90.00	50.00	16.25	15.40
100.00	60.00	15.76	14.91
110.00	70.00	15.32	14.47
120.00	80.00	14.92	14.07
130.00	90.00	14.59	13.74
140.00	100.00	14.25	13.40
160.00	120.00	13.85	13.00
180.00	140.00	13.33	12.48
200.00	160.00	12.92	12.07
220.00	180.00	12.54	11.69
240.00	200.00	12.25	11.40
260.00	220.00	11.89	11.04
280.00	240.00	11.68	10.83
300.00	260.00	11.51	10.66
320.00	280.00	11.36	10.51
340.00	300.00	11.22	10.37
360.00	320.00	11.12	10.27
380.00	340.00	10.97	10.12
400.00	360.00	10.87	10.02
420.00	380.00	10.79	9.94
440.00	400.00	10.71	9.86
460.00	420.00	10.64	9.79
1440.00	1400.00	9.29	8.44

28	24.00	0.40
29	24.00	0.40
30	21.00	0.35
31	24.00	0.40
32	27.00	0.45
33	26.00	0.43
34	26.00	0.43
35	24.00	0.40
36	24.00	0.40
37	28.00	0.47
38	28.00	0.47
39	24.00	0.40
40	28.00	0.47

Table 3.4.7 Attendees at pump maintenance workshop site 4, Nemauka

NAME	REPRESENTED IN GARDEN BY:-
Muvavi (Joseph)	self
Nhubu (Nemia)	self
Gonese (Calistos)	wife
Chindunye (Costani)	mother
Muvavi (Frank)	mother
Matimba (David)	mother
Bungu (Jacob)	mother
Marasha (Norman)	mother
Chituni (Pedlisai)	self
Manatasa (Sodson)	wife
Kutombwa (Addmore)	mother
Chafidzia (John)	mother
Mangezi (Murambiwa)	mother
Poterai (Poterai)	mother

Table 3.4.8 Communal water points in the region of collector well site 4, Nemauka

Well no.	Builder/owner	Kraal	Date	Diameter (m)	Depth (m)	Water-level			Perceived yield	Water use	Dries-up	
						depth (m)	time	date			Every year	1992
1	ODA/ community	Tinarwo	1984		15	7.83	10:50	13/4/95	Excellent Max. 22 m^3/d Av. 7 m^3/d	Domestic (D) Garden (G)	No	No
10	DDF/ community	Tinarwo	1987	0.15	24.2	8.10	09:10	13/4/95	Poor Av. 1.5 m^3/d	D	No	Yes
7	Chipato	Mukambwe	1987	0.9	12.72	8.9		13/4/95	Good	D,G	Yes	Yes
8	Benji	Mukambwe	1988	1.0	8.47	8.2		13/4/95	Poor	D,G	Yes	Yes
11	Muvavi	Mukambwe	1984	1.4	6.55	4.75		13/4/95	Good	G	No	No
12	WH&Jack	Merana	1985		> 30	7.7		13/4/95	Excellent	D School (S)	No	No
13	Chikwan	Merana	1990		9.2	7.7		13/4/95	Good	D,G	No	No
14	Makwand	Merana	1986		7.5	7.4		13/4/95	Poor	D	Yes	Yes
15	School,Clinic	Merana	1984	0.15					Excellent	S,D Clinic (C)	No	No
16	Chikamb	Chikamba	1990		> 30				Good	D	Yes	Yes

Table 3.4.9 Details of monitored wells and boreholes at site 4, Nemauka

WELL No.	Owners name	Datum description		Date	Depth (m)	Diameter (m)	Abstraction (m^3/day)	
		elev (masl)	elev (mscwd)				wet season	dry season
1a	Muchabe	0.00	- 7.02	1993	1.55	0.80	200	dry
2	Muchabe	0.10	- 6.88	1990	4.90	1.0	660	660
3	Tinarwo	0.48	+ 2.79	1985	6.20	0.60	600	600
4	Tinarwo	0.23	+ 4.48	1990	9.56	0.80	1000	600
5	Chingunye	0.00	+ 1.80	1991	8.50	0.80	1200	200
6	Bwacha	0.22	+ 2.08	1986	6.50	0.85	na	na
7	Chipato	0.11	+ 2.10	1987	12.72	0.90	1800	1800
8	Benjamin	0.24	+ 3.81	1989	8.47	1.0	1200	1200
9	Community	0.16	+ 8.72	1982	5.15	0.75	none	none
10	DDF (bh)	0.43	+ 9.53	1987	24.2	0.15		
11	Community	0.19	+ 15.01	1984	6.55	1.40	400	400
BH4	Expl. bh	0.47	+ 0.30	1993	14.0	0.15	none	none
1	Community	0.60	0.00	1993	15.0	2.0		

Site 5 - Mawadze

Site description

Geology:	granulite gneiss
Location:	approx. 80 km north of Chiredzi Research Station, 1 km NNE of Vudzi Primary School on the main Zaka road.
Access:	-
Annual rainfall:	820 mm

Exploratory drilling

Drilling:	BGS contract driller
No. of exploratory holes:	2
Comments:	a six inch hole, bh3, was drilled 5 m from exploratory hole bh2 and tested. The collector well was subsequently dug at bh2.

Specific construction details

Foreman:	Timothy Chiunye
Depth of well shaft:	13 m
Time to dig shaft:	12 weeks
No. of laterals:	4
Length of laterals:	14, 16, 28, 30 m
Comments:	-

A soakaway gully (0.3m wide, 0.1m deep) was dug on two sides of the slab to collect wastewater and a further gully dug to drain the waste water away down slope. These trenches were lined with concrete so they could be kept clean. This soakaway has proved difficult to keep clean, the community intends to replace it with a French drain style soakaway.

Monitoring of well performance

Mr Mawadze is to change the chart and read the meters at 0600 every Sunday morning. He will also dip the DDF well, piezometer bh3, Vudzi School borehole and measure daily rainfall.

BH1 20° 29' 23.24" S 31° 26' 45.91" E elevation 773m.
36K 337934.95mE 7733527.73mS.

CW. 20° 29' 36.41" S 31° 26' 43.31" E elevation 782m.
36K 337874.55m E 7733078.84mS.

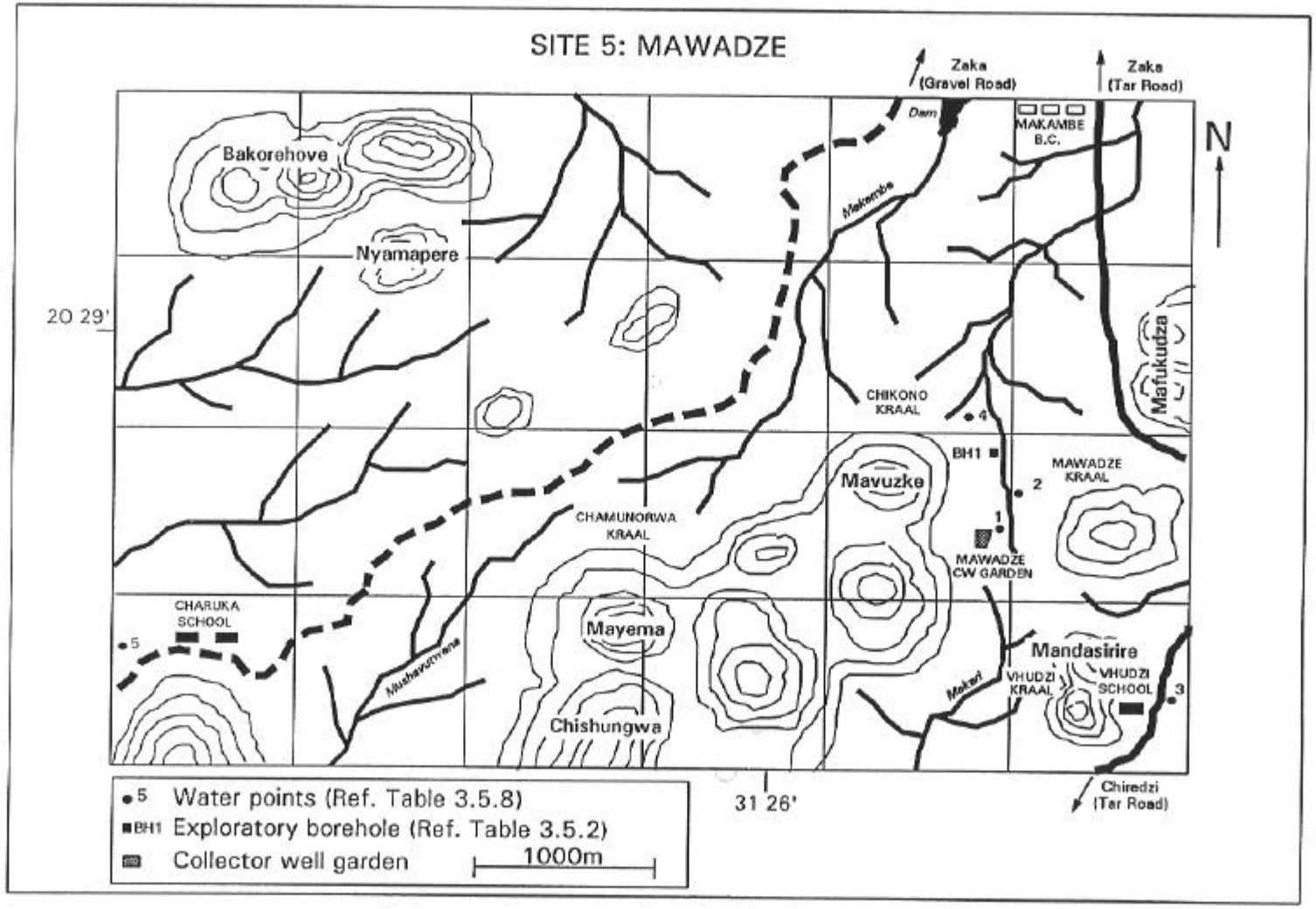


Figure 3.5.1 Map of location of collector well garden and local water points

not necessary

Figure 3.5.2 Detail showing location of exploratory boreholes

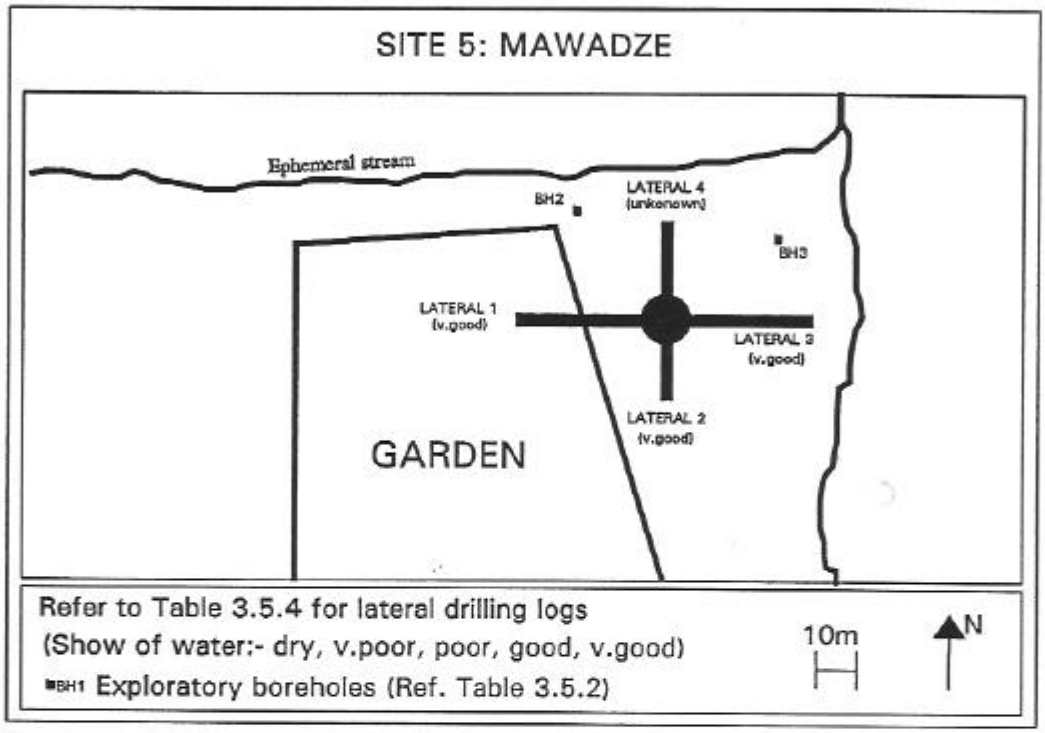
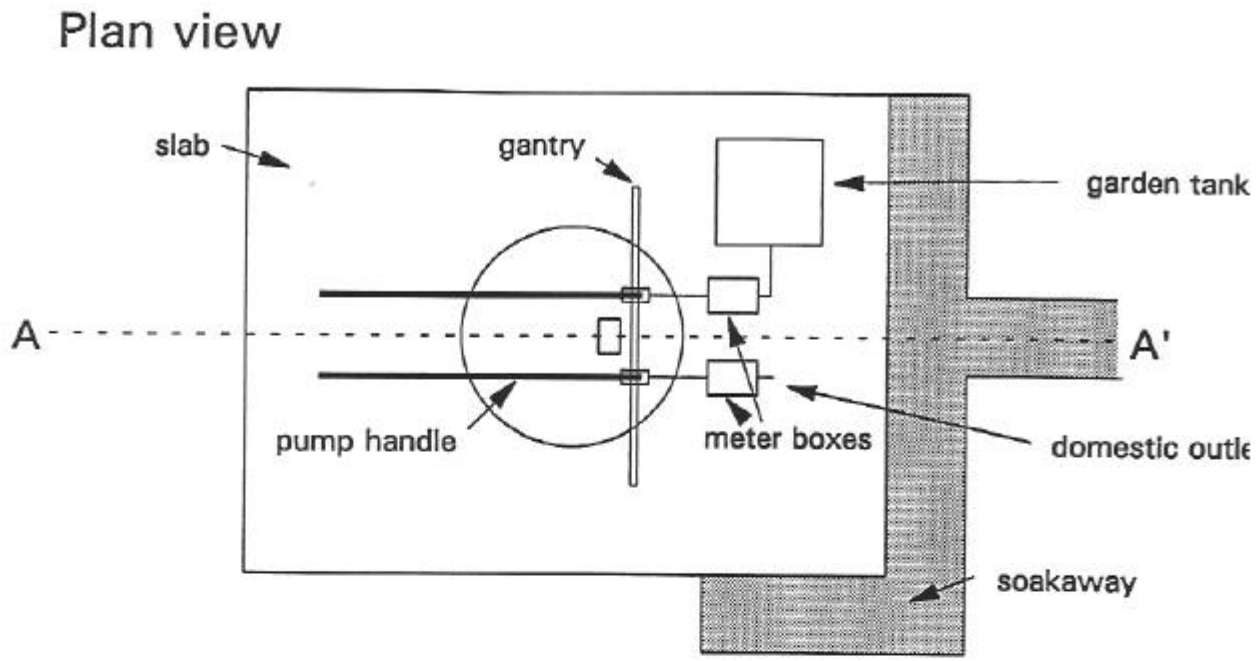


Figure 3.5.3 Map of vicinity of collector well showing direction of laterals



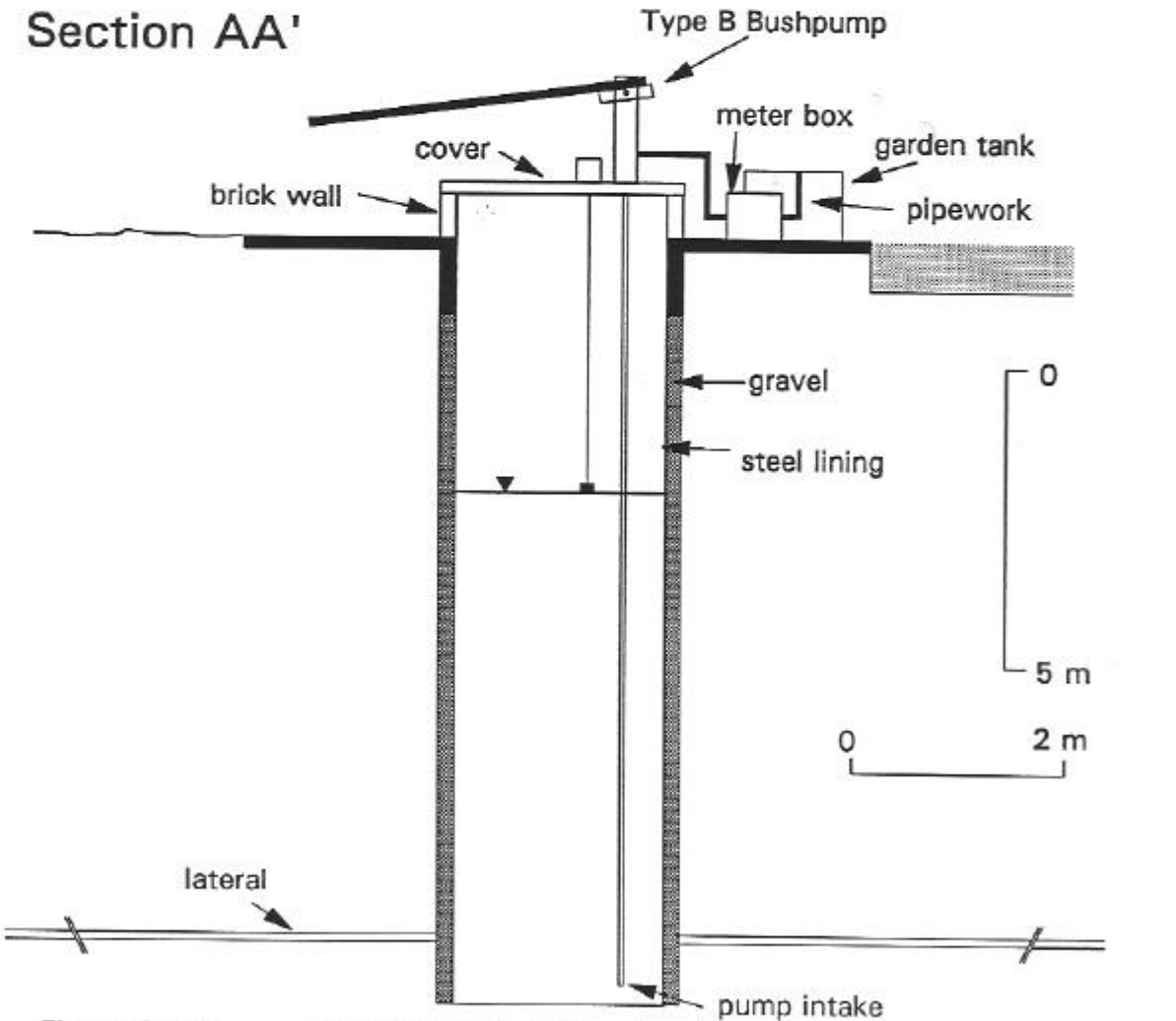


Figure 3.5.4 Collector well and headworks construction, site 5, Mawadze

Table 3.5.1 Diary of activities at site 5, Mawadze

Activity	Completion date (duration)	Personnel Required	Equipment Required	Materials Used
identify site	16/11/93 (? days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel ?? drill bits ??
drill three exploratory holes	23/11/93 (4 days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 100l drill bits ??
pumptest BH3 (four tests)	11/12/93 (4 days)	ptest engineer site assistant	Pump and associated equipment	petrol 20l
dig well shaft to 13m, backfill with gravel, concrete in sanitary seal, build and plaster head wall	11/03/94 (83 days)	construction manager site foreman 6 labourers	compressor pump + hoses winch + hoses wire rope gantry kibble personnel frame 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helmets 2 ear protectors jackhammer cement mixer shifting spanner 27mm spanner torch foreman's tent foreman's bed foreman's stove	cement 26bags bricks 200 river sand 4cum 19mm gravel 10cum diesel(comp) 2000l steel casing 13m jh points 3 pump rubbers 2 hydraulic oil 15l engine oil 5l gumboots 6prs paraffin 15l gas 6kg pump fitting 1
lateral drilling (four laterals)	10/04/94 (5 days)	driller crane operator 1 labourer	air rig and associated equipment	diesel 1400l
complete headworks, well covers, water tank, soakaway, gantry	14/04/94 (6 days)	construction manager site foreman 5 labourers	formwork level trowel wheelbarrow cement mixer	bricks 100 cement 5bags sand/gravel 1cum pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15m 50mm elbows 2 50mm nipples 2
pump test collector well before laterals x 2 after laterals x 2	20/04/94 (6 days)	ptest engineer site assistant	pump and associated equipment	petrol 30l

Table 3.5.1 Diary of activities at site 5, Mawadze (continued)

Activity	Completion date (duration)	Personnel Required	Equipment required	Materials Used
install bushpumps with community as part of pump maintenance workshop	22/04/94 (1 day)	instructor translator 8 local people	thread cutter for 50mm pipe and 19mm rods	50mm galv pipe 25m 50mm nipples 8 pump cylinder 2 17mm rods 25m type 8 bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for collector well, Vudzi school borehole, DDF traditional well and piezometer 'bh3'	19/04/94 (2 days)	ptest engineer foreman monitor man	munro wl recorder 2 water meters	bricks 100 cement 3bags munro box 1 padlock 1 50mm galv pipe 6m 50mm elbows 8 50mm unionjoint 2 w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	29/04/94 (3 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20bags steel posts 13 steel stays 10 steel standards 36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer. vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a separate report Thompson (1994).
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenance and attending to minor breakdowns.

Table 3.5.2 Drilling logs of exploratory boreholes at site 5, Mawadze

EXPLORATORY DRILLING AT MAWADZE (COLLECTOR WELL SITE 5)

	Exploratory borehole BH1 Drilled 16/11/93 BGS light air rig diameter = 100mm, depth = 8m first strike = NA	Exploratory borehole BH2 Drilled 16/11/93 BGS light air rig diameter = 100mm, depth = 11m first strike = 6m rwl(16/11/93) = 3.70m	Exploratory borehole BH3 Drilled 23/11/93 BGS light air rig diameter = 150mm, depth = 34m first strike = 4.5m
	Note:- Drilled with 0.75m rods, the description is for each rod. Penetration is given in min/m for each rod when using the drag bit or air hammer drilling (DHH).		

Rod Number	Penetration rate(min/m)	Comment	Penetration rate(min/m)	Comment	Penetration rate(min/m)	Comment
1	1.33	clay	2.66	weathered	1.33	weathered
2	4.00	clay	2.66	weathered	2.66	weathered
3	4.00	clay	2.66	weathered	2.66	weathered
4	2.66	weathered	2.66	weathered	2.66	weathered
5	2.66	weathered	2.66	weathered	2.66	weathered
6	2.66	weathered	2.66	weathered	2.66	weathered
7	2.66	weathered	2.66	weathered	2.66	weathered
8	4.00	weathered	2.66	weathered	2.66	weathered
9	DHH 9.33	hard/soft	2.66	weathered	2.66	weathered
10	DHH 9.33	banded	2.66	weathered	2.66	weathered
11	DHH 20.00	banded	DHH 5.33	weathered	2.66	weathered
12			DHH 5.33	weathered	DHH 5.33	hard/soft
13			DHH 5.33	weathered	DHH 5.33	banded
14			DHH 5.33	weathered	DHH 6.66	banded
15					DHH 6.66	banded
16					DHH 8.00	banded
17					DHH 9.33	banded
18					DHH 10.66	banded
19					DHH 10.66	banded
20					DHH 6.66	banded
21					DHH 12.00	banded
22					DHH 9.33	banded
23					DHH 8.00	banded
24					DHH 4.00	banded
25					DHH 3.00	banded
26					DHH 10.66	banded
27					DHH 4.00	banded
28					DHH 4.00	banded
29					DHH 6.33	banded
30					DHH 12.00	banded
31					DHH 10.66	banded
32					DHH 6.66	banded
33		BH3 cont..			DHH 6.66	banded
34			Penetration		DHH 10.66	banded
35					DHH 6.66	banded
36		Rod Number	DHH 13.33	Comment	DHH 9.33	banded
37			DHH 13.33		DHH 9.33	banded
38			DHH 18.66		DHH 9.33	banded
39		41	DHH 21.33	banded	DHH 10.66	banded
40		42	DHH 24.00	softer	DHH 12.00	banded
		43		softer		
		44		softer		
		45		softer		

Table 3.5.3 Geological descriptions of collector well digging samples, site 5, Mawadze.

MAWADZE (SITE FIVE) GEOLOGICAL DESCRIPTION OF DIGGING SAMPLES FROM THE COLLECTOR WELL	
DEPTH (m)	Description
0 to 1	Pale grey lumps of clayey soil with sand grains of quartz and some few small fragments (sand size) of ferro-magnesian minerals.
1 to 2	Very pale grey, rounded lumps of weathered rock, sandy feel, clay material and sand grains of quartz adhering to surfaces. Iron staining.
2 to 3	Angular pieces of weathered, banded rock. Iron staining and some pink and black on joint faces. Very thin bands picked out by black minerals. Some fragments much harder, with bright pink feldspars, quartz, black mineral (not biotite, maybe hornblende). No clay.
3 to 4	Angular pieces of weathered gneiss, some massively crystalline. Banded, pale, quartzite-like rock in large angular pieces. Some reddish-brown iron staining on joint faces, few dark minerals in the rock itself. No clay.
4 to 5	Angular pieces of weathered, banded gneiss, showing plenty of iron staining. Fragments soft to hard, but crumble in hand. Some fragments contain plenty of pink feldspars, along with quartz and weathering biotite.
5 to 6	Angular fragments of weathered gneiss, some strongly banded and more weathered, iron-stained and soft, others quartz-rich, harder and paler.
6 to 7	Very soft, crumbling fragments of highly weathered rock coated with clay and silt.
7 to 8	Lumps of weathered gneiss, pale, quartz and feldspar rich, coated with grey silty and clayey matter.
8 to 9	Small, angular pieces up to 10 mm of soft and hard, banded pale gneiss. Hard pieces are quartz-rich, but containing brownish, iron-stained minerals. Some of the angular pieces containing pink feldspars.
9 to 10	Angular pieces of weathered gneiss, the more quartz-rich ones bigger and harder, coated with grey-buff clay, silt and sand.
10 to 11	Angular fragments of iron-stained weathered gneiss, less fines coating the fragments.
11 to 12	Angular fragments of gneiss, iron staining penetrates along minor joint and fracture surfaces. Some pink feldspars.
12 to 13	Fresher, smaller angular pieces of gneiss. Some coating of fines. Iron stained. Some pieces with pink feldspars, especially close to joint faces.

Table 3.5.4 Lateral drilling logs from site 5, Mawadze

MAWADZE (SITE FIVE) COLLECTOR WELL LATERAL DRILLING LOGS

	LATERAL 1	LATERAL 2	LATERAL 3	LATERAL 4
DRILLER DIRECTION ELEVATION LENGTH COMPLETED WATER FLOW	P.Rastall west -5 degrees 40rods, 30m 8/4/94 very good	P.Rastall south -5 degrees 19rods,14m 8/4/94 very good	P.Rastall east -5 degrees 38rods,28.5m 9/4/94 very good	P.Rastall north -5 degrees 22rods,16.5m 10/4/94 ???
ROD NUMBER (0.75m rods)	COMMENT	COMMENT	COMMENT	COMMENT
1	hard gneiss	hard	weathered	hard
2	hard gneiss	hard	banded with clay	hard
3	hard gneiss	weathered	"	hard
4	hard gneiss	weathered	"	hard
5	hard gneiss	weathered	"	clay
6	hard gneiss	weathered	"	weathered
7	hard gneiss	weathered	"	weathered
8	hard gneiss	clay	"	weathered
9	hard gneiss	clay	"	weathered
10	hard gneiss	clay	"	weathered
11	hard gneiss	clay	"	weathered
12	hard gneiss	clay	"	weathered
13	hard gneiss	clay	"	weathered
14	hard gneiss	clay	"	weathered
15	hard gneiss	clay	"	weathered
16	hard gneiss	clay	"	weathered
17	hard gneiss	clay	"	weathered
18	hard gneiss	clay	"	weathered
19	hard gneiss	clay	"	hard
20	hard gneiss		"	hard
21	clay band		"	hard
22	weathered		"	hard
23	hard/soft		"	hard
24	weathered		"	
25	banded		"	
26	banded		"	
27	banded		"	
28	banded		"	
29	banded		"	
30	banded		"	
31	banded		"	
32	banded		"	
33	banded		"	
34	banded		"	
35	banded		"	
36	banded		"	
37	banded		hard	
38	banded			
39	banded			
40	banded			

Table 3.5.5 Pumping-tests performed at site 5, Mawadze

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	03/16/94	CWT1LDBL	DT/TC	1.00	300	4.07	7.76	<4.07	1020	RATE+-3%,
2	03/17/94	CWT2HDBL	DT/TC	2.65	180	5.18	11.64	<4.07	2700	RATE+-3%,
3	04/20/94	CWT3LDAL	DT/TC	1.00	300	4.73	7.27	<4.73	1980	RATE+-3%, SIMILAR RWL TO T1
4	04/15/94	CWT4HDAL	DT/TC	2.62	180	4.98	8.83	<4.73	2700	RATE+-3%, SIMILAR RWL TO T2

WELL DESCRIPTION_____ BH3 (EXPLORATORY BH)

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	11/23/83	STEPDD (TD=14.5M)	DT/AT	NOTE *	NOTE *	3.50	8.88	<3.50	40	* 24/40/40MINS, .21/.37/.61 l/s
2	12/09/83	CONST Q (TD=33M)	DT/AT	0.41	300	3.32	7.45	<3.32	400	RATE+-10%
3	12/10/83	CONST Q (TD=33M)	DT/AT	0.8	140	3.34	27.03	<3.34	400	RATE+-10%
4	12/11/94	CONST Q (TD=33M)	DT/AT	0.62	500	3.34	28.98	<3.34	1050	RATE+-10% BEST TEST

WELL DESCRIPTION_____ DDF BH VUDZI SCHOOL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	05/12/94	T1 USING BUSHPUMP	DT	0.27	70	17.61	23.47	<17.61	1200	GOOD TEST

WELL DESCRIPTION_____ DDF HAND DUG WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	04/26/94	T1	DT/TC	1.00	180	4.33	14.30	<4.33	3120	GOOD TEST

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze

SITE FIVE LARGE DIA WELL LOW DISCH BEFORE LATERALS (16/3/94)

PUMPING DATA

SITE	five
DATE	16/3/94
TEST	ldbl
TESTER	dt/tc
PUMPING TIME (hrs)	5.00
START VOL (m3)	19.305
END VOL. (m3)	37.466
START WL. (mbmd)	4.66
END WL. (mbmd)	8.35
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.30
CW DATUM	munro
DATUM ELEV. (magl)	0.59
BH DATUM	toc
DATUM ELEV.(magl)	0.62

CALCULATED DATA

AV PUMP RATE (l/s)	1.01
DRAWDOWN (m)	3.69
DEWATERED VOL (m3)	12.781
PUMPED VOL (m3)	18.161
'LAMDA'	0.70

COLLECTOR WELL DATA

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		4.66	4.07
1.00		5.46	4.87
2.00		6.13	5.54
3.00		6.89	6.30
4.00		7.59	7.00
5.00	0.00	8.35	7.76
6.00	1.00	8.05	7.46
7.00	2.00	7.86	7.27
8.00	3.00	7.65	7.06
9.00	4.00	7.45	6.86
10.00	5.00	7.25	6.66
12.00	7.00	6.90	6.31
14.00	9.00	6.65	6.06
16.00	11.00	6.42	5.83
18.00	13.00	6.20	5.61
20.00	15.00	6.05	5.46
22.00	17.00	5.89	5.30

PIEZO DATA

WL (mbmd)	WL (mbgl)
3.73	3.11
3.82	3.20
3.95	3.33
4.15	3.53
4.33	3.71
4.48	3.86
4.63	4.01
4.70	4.08
4.71	4.09
4.71	4.09
4.71	4.09
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
4.43	3.81

NOTES

-The BH (dia 0.15m) was 15M from the well (dia 2.10m)
-The gl at the bh was about 1.2m lower than the gl at the well
-Full recovery was not possible as the high disch test followed.
-Prior to pumping the wl was still recovering at 0.10m in 24 hrs this was considered as near enough to rwl.

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

SITE FIVE LARGE DIA WELL HIGH DISCH BEFORE LATERALS (17/3/94)

PUMPING DATA

SITE	five
DATE	17/3/94
TEST	hdbl
TESTER	dt/tc
PUMPING TIME (hrs)	3.00
START VOL (m3)	37.468
END VOL. (m3)	66.076
START WL. (mbmd)	5.77
END WL. (mbmd)	12.23
ORIFICE DIA (mm)	31.00
PRESS. DIFF (m)	0.71
CW DATUM	munro
DATUM ELEV. (magl	0.59
BH DATUM	toc
DATUM ELEV.(magl)	0.62

CALCULATED DATA

AV PUMP RATE (l/s)	2.65
DRAWDOWN (m)	6.46
DEWATERED VOL (m3)	22.375
PUMPED VOL (m3)	28.608
'LAMDA'	0.78

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		5.77	5.18
1.00		8.00	7.41
2.00		10.10	9.51
3.00	0.00	12.23	11.64
4.00	1.00	11.81	11.22
5.00	2.00	11.36	10.77
6.00	3.00	10.98	10.39
7.00	4.00	10.68	10.09
8.00	5.00	10.40	9.81
9.00	6.00	10.12	9.53
10.00	7.00	9.82	9.23
12.00	9.00	9.22	8.63
14.00	11.00	8.78	8.19
16.00	13.00	8.38	7.79
18.00	15.00	7.94	7.35
20.00	17.00	7.68	7.09
22.00	19.00	7.39	6.80
24.00	21.00	7.20	6.61
28.00	25.00	6.80	6.21
32.00	29.00	6.50	5.91
36.00	33.00	6.30	5.71
40.00	37.00	6.14	5.55
44.00	41.00	6.03	5.44
48.00	45.00	5.95	5.36

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
4.37	3.75
4.49	3.87
4.77	4.15
5.05	4.43
5.22	4.60
5.32	4.70
5.36	4.74
5.39	4.77
5.40	4.78
5.43	4.81
5.39	4.77
5.39	4.77
NA	NA
NA	NA
NA	NA
5.18	4.56
5.09	4.47
5.02	4.40
4.90	4.28
4.79	4.17
4.67	4.05
NA	NA
4.54	3.92
4.45	3.83

NOTES

-The BH (dia 0.15m) was 15M from the well (dia 2.10m)
-The gl at the bh was about 1.2m lower than the gl at the well
-When pumping started well was not at rwl. Rwl is approx. 4 mbgl. pumping for this test started before full recovery from the low disch. test performed the day before. This needs to be adjusted for.

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

SITE FIVE LARGE DIA WELL LOW DISCH AFTER LATERALS (20/4/94)

PUMPING DATA

SITE	five
DATE	04/20/94
TEST	ldbl
TESTER	dt/tc
PUMPING TIME (hrs	5.00
START VOL (m3)	150.965
END VOL. (m3)	168.955
START WL. (mbmd)	5.32
END WL. (mbmd)	7.86
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.30
CW DATUM	munro
DATUM ELEV. (magl	0.59
BH DATUM	toc
DATUM ELEV.(magl)	0.62

CALCULATED DATA

AV PUMP RATE (l/s)	1.00
DRAWDOWN (m)	2.54
DEWATERED VOL (m3)	8.798
PUMPED VOL (m3)	17.990
'LAMDA'	0.49

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		5.32	4.73
1.00		6.05	5.46
2.00		6.60	6.01
3.00		7.09	6.50
4.00		7.50	6.91
5.00	0.00	7.86	7.27
6.00	1.00	7.40	6.81
7.00	2.00	7.10	6.51
8.00	3.00	6.84	6.25
9.00	4.00	6.62	6.03
10.00	5.00	6.47	5.88
12.00	7.00	6.26	5.67
14.00	9.00	6.09	5.50
16.00	11.00	5.96	5.37
18.00	13.00	5.88	5.29
20.00	15.00	5.82	5.23
22.00	17.00	5.76	5.17
24.00	19.00	5.71	5.12
30.00	25.00	5.60	5.01
36.00	31.00	5.48	4.89

RECOVERY DATA BH

WL (mbmd)	WL (mbgl)
4.20	3.58
4.37	3.75
4.60	3.98
4.85	4.23
5.07	4.45
5.50	4.88
5.36	4.74
5.33	4.71
5.24	4.62
5.20	4.58
NA	NA
NA	NA
NA	NA
NA	NA
4.70	4.08
NA	NA
NA	NA
4.53	3.91
4.43	3.81
NA	NA

NOTES
-The BH (dia 0.15m) was 15M from the well (dia 2.10m)
-The gl at the bh was about 1.2m lower than the gl at the well
-Full recovery was not possible as the high disch test followed.

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

SITE FIVE LARGE DIA WELL HIGH DISCH AFTER LATERALS (15/4/94)

PUMPING DATA

SITE	five
DATE	15/4/94
TEST	HDAL
TESTER	dt/tc
PUMPING TIME (hrs)	3.00
START VOL (m3)	122.696
END VOL. (m3)	150.966
START WL. (mbmd)	5.55
END WL. (mbmd)	10.52
ORIFICE DIA (mm)	31.00
PRESS. DIFF (m)	0.71
CW DATUM	munro
DATUM ELEV. (magl)	0.59
BH DATUM	toc
DATUM ELEV.(magl)	0.62

CALCULATED DATA

AV PUMP RATE (l/s)	2.62
DRAWDOWN (m)	4.97
DEWATERED VOL (m3)	17.214
PUMPED VOL (m3)	28.270
'LAMDA'	0.61

COLLECTOR WELL DATA

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		5.55	4.96
1.00		7.56	6.97
2.00		9.13	8.54
3.00	0.00	10.52	9.93
4.00	1.00	9.03	8.44
5.00	2.00	8.57	7.98
6.00	3.00	8.11	7.52
7.00	4.00	7.78	7.19
8.00	5.00	7.52	6.93
9.00	6.00	7.29	6.70
10.00	7.00	7.06	6.47
12.00	9.00	6.77	6.18
14.00	11.00	6.55	5.96
16.00	13.00	6.37	5.78
18.00	15.00	6.24	5.65
20.00	17.00	6.15	5.56
22.00	19.00	6.07	5.48
24.00	21.00	6.01	5.42
28.00	25.00	5.90	5.31
32.00	29.00	5.83	5.24
36.00	33.00	5.76	5.17
40.00	37.00	5.71	5.12
44.00	41.00	5.66	5.07
48.00	45.00	5.62	5.03

PIEZO DATA

WL (mbmd)	WL (mbgl)
4.42	3.80
4.83	4.21
5.41	4.79
6.00	5.38
9.53	8.91
9.94	9.32
9.61	8.99
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
6.52	5.90
6.37	5.75
6.26	5.64
6.17	5.55
NA	NA
5.96	5.34
NA	NA
NA	NA
NA	NA
5.68	5.06
NA	NA

NOTES
-The BH (dia 0.15m) was 15M from the well (dia 2.10m)
-The gl at the bh was about 1.2m lower than the gl at the well
-When pumping started well not at rwl. Rwl is approx. 4 mbgl. pumping started before full recovery from the low disch. test performed the day before.

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

LOCATION MAWADZE BH3
TEST DATE 23/11/93
TOTAL DEPTH 14.5M
PUMP SET AT 12.0M
PUMPING RATE :- 1ST RATE = 0.21l/s, 2ND = 0.37l/s, 3RD = 0.61l
EC = 559uS/M
DATUM :- GROUND LEVEL
TESTER :- D.THOMPSON

Tpstart (min)	Trate (min)	WL (m)	DD (m)	rate (l/s)
0.00	0.00	3.58	0.00	0.21
1.00	1.00	4.10	0.52	0.21
2.00	2.00	4.36	0.78	0.21
3.00	3.00	4.48	0.90	0.21
4.00	4.00	4.56	0.98	0.21
5.00	5.00	4.61	1.03	0.21
6.00	6.00	4.65	1.07	0.21
7.00	7.00	4.68	1.10	0.21
8.00	8.00	4.69	1.11	0.21
9.00	9.00	4.69	1.11	0.21
10.00	10.00	4.70	1.12	0.21
12.00	12.00	4.71	1.13	0.21
14.00	14.00	4.72	1.14	0.21
16.00	16.00	4.74	1.16	0.21
19.00	19.00	4.89	1.31	0.21
20.00	20.00	4.95	1.37	0.21
22.00	22.00	5.00	1.42	0.21
24.00	24.00	5.03	1.45	0.21
25.00	1.00	5.37	1.79	0.37
26.00	2.00	5.63	2.05	0.37
27.00	3.00	5.75	2.17	0.37
28.00	4.00	5.89	2.31	0.37
29.00	5.00	NA	NA	0.37
30.00	6.00	6.07	2.49	0.37
31.00	7.00	6.16	2.58	0.37
32.00	8.00	6.25	2.67	0.37
33.00	9.00	6.33	2.75	0.37
34.00	10.00	6.39	2.81	0.37
36.00	12.00	6.51	2.93	0.37
38.00	14.00	6.57	2.99	0.37
40.00	16.00	6.64	3.06	0.37
42.00	18.00	6.68	3.10	0.37
44.00	20.00	6.73	3.15	0.37
46.00	22.00	6.79	3.21	0.37
48.00	24.00	6.84	3.26	0.37
50.00	26.00	6.89	3.31	0.37
52.00	28.00	6.92	3.34	0.37
54.00	30.00	6.96	3.38	0.37
56.00	32.00	7.00	3.42	0.37
59.00	35.00	7.06	3.48	0.37
60.00	1.00	7.47	3.89	0.61
61.00	2.00	7.76	4.18	0.61

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

62.00	3.00	8.00	4.42	0.61
63.00	4.00	8.22	4.64	0.61
64.00	5.00	8.39	4.81	0.61
65.00	6.00	8.56	4.98	0.61
66.00	7.00	8.68	5.10	0.61
67.00	8.00	8.79	5.21	0.61
68.00	9.00	8.90	5.32	0.61
69.00	10.00	9.00	5.42	0.61
71.00	12.00	9.29	5.71	0.61
73.00	14.00	9.49	5.91	0.61
75.00	16.00	9.58	6.00	0.61
77.00	18.00	9.62	6.04	0.61
79.00	20.00	9.67	6.09	0.61
81.00	22.00	9.72	6.14	0.61
83.00	24.00	9.77	6.19	0.61
85.00	26.00	9.81	6.23	0.61
87.00	28.00	9.88	6.30	0.61
89.00	30.00	9.94	6.36	0.61
91.00	32.00	9.96	6.38	0.61
93.00	34.00	9.98	6.40	0.61
94.00	1.00	9.00	5.42	0.00
95.00	2.00	8.41	4.83	0.00
96.00	3.00	7.81	4.23	0.00
97.00	4.00	7.21	3.63	0.00
98.00	5.00	6.76	3.18	0.00
99.00	6.00	6.39	2.81	0.00
100.00	7.00	6.10	2.52	0.00
101.00	8.00	5.89	2.31	0.00
102.00	9.00	5.70	2.12	0.00
103.00	10.00	5.54	1.96	0.00
105.00	12.00	5.22	1.64	0.00
107.00	14.00	5.00	1.42	0.00
109.00	16.00	4.83	1.25	0.00
111.00	18.00	4.72	1.14	0.00
113.00	20.00	4.62	1.04	0.00
115.00	22.00	4.55	0.97	0.00
117.00	24.00	4.49	0.91	0.00
119.00	26.00	4.44	0.86	0.00
121.00	28.00	4.39	0.81	0.00
123.00	30.00	4.35	0.77	0.00
125.00	32.00	4.31	0.73	0.00
128.00	35.00	4.27	0.69	0.00
133.00	40.00	4.20	0.62	0.00

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

LOCATION	site 5	WELL NUMBER	bh3
TEST DATE	9/12/93	WELL DIA. (m)	0.15
TEST PERFORMED BY	D and A Thompson	TOTAL DEPTH (m)	33.00
Av.PUMP RATE (l/s)	0.407	SCREENED	
DATUM DESCRIPTION	toc	CASED	
DATUM ELEVN (magl)	0.05	OPEN	
EC (microS/cm)		PUMP SET AT (m)	32

local time	Tpstart (min)	Tpstop (min)	WL (mbd)	WL (mbgl)	DD (m)
06:18	0.00		3.32	3.27	0.00
06:19	1.00		3.95	3.90	0.63
06:20	2.00		4.32	4.27	1.00
06:21	3.00		4.53	4.48	1.21
06:22	4.00		4.75	4.70	1.43
06:23	5.00		4.94	4.89	1.62
06:24	6.00		5.16	5.11	1.84
06:25	7.00		5.39	5.34	2.07
06:26	8.00		5.51	5.46	2.19
06:27	9.00		5.60	5.55	2.28
06:28	10.00		5.68	5.63	2.36
06:30	12.00		5.75	5.70	2.43
06:32	14.00		5.74	5.69	2.42
06:34	16.00		5.74	5.69	2.42
06:36	18.00		5.73	5.68	2.41
06:38	20.00		5.70	5.65	2.38
06:40	22.00		5.72	5.67	2.40
06:42	24.00		5.79	5.74	2.47
06:44	26.00		5.84	5.79	2.52
06:46	28.00		5.87	5.82	2.55
06:48	30.00		5.96	5.91	2.64
06:50	32.00		6.12	6.07	2.80
06:53	35.00		6.27	6.22	2.95
06:58	40.00		6.29	6.24	2.97
07:03	45.00		6.27	6.22	2.95
07:08	50.00		6.30	6.25	2.98
07:18	60.00		6.37	6.32	3.05
07:28	70.00		6.43	6.38	3.11
07:38	80.00		6.57	6.52	3.25
07:48	90.00		6.64	6.59	3.32
07:58	100.00		6.68	6.63	3.36
08:18	120.00		6.74	6.69	3.42
08:38	140.00		6.80	6.75	3.48
08:58	160.00		7.10	7.05	3.78
09:18	180.00		7.17	7.12	3.85
09:38	200.00		7.22	7.17	3.90
09:58	220.00		7.23	7.18	3.91
10:18	240.00		7.29	7.24	3.97
10:38	260.00		7.35	7.30	4.03
10:58	280.00		7.40	7.35	4.08
11:18	300.00	0	7.45	7.40	4.13
11:19	301.00	1	6.88	6.83	3.56
11:20	302.00	2	6.48	6.43	3.16
11:21	303.00	3	6.14	6.09	2.82

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

11:22	304.00	4	5.92	5.87	2.60
11:23	305.00	5	5.73	5.68	2.41
11:24	306.00	6	5.56	5.51	2.24
11:25	307.00	7	5.40	5.35	2.08
11:26	308.00	8	5.26	5.21	1.94
11:27	309.00	9	5.15	5.10	1.83
11:28	310.00	10	5.05	5.00	1.73
11:30	312.00	12	4.92	4.87	1.60
11:32	314.00	14	4.83	4.78	1.51
11:34	316.00	16	4.75	4.70	1.43
11:36	318.00	18	4.69	4.64	1.37
11:38	320.00	20	4.64	4.59	1.32
11:40	322.00	22	4.60	4.55	1.28
11:42	324.00	24	4.57	4.52	1.25
11:44	326.00	26	4.54	4.49	1.22
11:46	328.00	28	4.51	4.46	1.19
11:48	330.00	30	4.48	4.43	1.16
11:50	332.00	32	4.46	4.41	1.14
11:53	335.00	35	4.42	4.37	1.10
11:58	340.00	40	4.38	4.33	1.06
12:03	345.00	45	4.34	4.29	1.02
12:08	350.00	50	4.30	4.25	0.98
12:18	360.00	60	4.24	4.19	0.92
12:28	370.00	70	4.19	4.14	0.87
12:38	380.00	80	4.15	4.10	0.83
12:48	390.00	90	4.12	4.07	0.80
12:58	400.00	100	4.07	4.02	0.75
13:18	420.00	120	4.02	3.97	0.70
13:38	440.00	140	3.97	3.92	0.65
13:58	460.00	160	3.94	3.89	0.62
14:18	480.00	180	3.90	3.85	0.58
14:38	500.00	200	3.87	3.82	0.55
14:58	520.00	220	3.84	3.79	0.52
15:18	540.00	240	3.82	3.77	0.50
15:38	560.00	260	3.80	3.75	0.48
15:58	580.00	280	3.78	3.73	0.46
16:18	600.00	300	3.76	3.71	0.44
16:38	620.00	320	3.75	3.70	0.43
17:08	650.00	350	3.72	3.67	0.40
17:58	700.00	400	3.69	3.64	0.37
05:30	1392.00	1092	3.38	3.33	0.06

NOTES
Rain between 17:50 and 05:30, did not run into borehole directly but may have had an effect on recovery.
Rate was not const (0.37 - 0.45) due to method of measurement/adjustment
Anomolies at 20 mins and 35 mins. are prob. due to rate adjustment.

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

LOCATION	site 5 (test2)	WELL NUMBER	bh2 obs. piezo
TEST DATE	9/12/93	WELL DIA. (m)	0.05
TEST PERFORMED BY	D and A Thompson	TOTAL DEPTH (m)	
Av.PUMP RATE (l/s)		DIST. FROM BH3(m	5.00
DATUM DESCRIPTION	toc		
DATUM ELEVN (magl)	0		
elev of gl at bh2(obs) from bhs(pumped) (m)			-1.00
EC (microS/cm)			

local time	Tpstart (min)	Tpstop (min)	WL (mbd)	WL (mbgl)	DD (m)
0.2625	0		3.42	3.42	0.00
0.263194	1		3.45	3.45	0.03
0.263889	2		3.46	3.46	0.04
0.264583	3		3.58	3.58	0.16
0.265278	4		3.62	3.62	0.20
0.265972	5		3.7	3.7	0.28
0.266667	6		3.77	3.77	0.35
0.267361	7		3.82	3.82	0.40
0.268056	8		3.89	3.89	0.47
0.26875	9		3.95	3.95	0.53
0.269444	10		4.03	4.03	0.61
0.270833	12		4.13	4.13	0.71
0.272222	14		4.21	4.21	0.79
0.273611	16		4.25	4.25	0.83
0.275	18		4.3	4.3	0.88
0.276389	20		4.35	4.35	0.93
0.277778	22		4.37	4.37	0.95
0.279167	24		4.4	4.4	0.98
0.280556	26		4.44	4.44	1.02
0.281944	28		4.475	4.475	1.06
0.283333	30		4.51	4.51	1.09
0.284722	32		4.55	4.55	1.13
0.286806	35		4.62	4.62	1.20
0.290278	40		4.725	4.725	1.31
0.29375	45		4.78	4.78	1.36
0.297222	50		4.83	4.83	1.41
0.304167	60		4.915	4.915	1.50
0.311111	70		4.99	4.99	1.57
0.318056	80		5.055	5.055	1.64
0.325	90		5.125	5.125	1.71
0.331944	100		5.18	5.18	1.76
0.345833	120		5.25	5.25	1.83
0.359722	140		5.31	5.31	1.89
0.373611	160		5.4	5.4	1.98
0.3875	180		5.47	5.47	2.05
0.401389	200		5.52	5.52	2.10
0.415278	220		5.55	5.55	2.13
0.429167	240		5.58	5.58	2.16
0.443056	260		5.61	5.61	2.19
0.456944	280		5.64	5.64	2.22
0.470833	300	0	5.67	5.67	2.25
0.471528	301	1	5.67	5.67	2.25
0.472222	302	2	5.65	5.65	2.23

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

0.472917	303	3	5.63	5.63	2.21
0.473611	304	4	5.585	5.585	2.17
0.474306	305	5	5.54	5.54	2.12
0.475	306	6	5.47	5.47	2.05
0.475694	307	7	5.42	5.42	2.00
0.476389	308	8	5.35	5.35	1.93
0.477083	309	9	5.285	5.285	1.87
0.477778	310	10	5.22	5.22	1.80
0.479167	312	12	5.13	5.13	1.71
0.480556	314	14	5.05	5.05	1.63
0.481944	316	16	4.98	4.98	1.56
0.483333	318	18	4.925	4.925	1.51
0.484722	320	20	4.88	4.88	1.46
0.486111	322	22	4.83	4.83	1.41
11:42	324.00	24.00	4.80	4.80	1.38
11:44	326.00	26.00	4.76	4.76	1.34
11:46	328.00	28.00	4.73	4.73	1.31
11:48	330.00	30.00	4.70	4.70	1.28
11:50	332.00	32.00	4.68	4.68	1.26
11:53	335.00	35.00	4.64	4.64	1.22
11:58	340.00	40.00	4.59	4.59	1.17
12:03	345.00	45.00	4.54	4.54	1.12
12:08	350.00	50.00	4.49	4.49	1.07
12:18	360.00	60.00	4.42	4.42	1.00
12:28	370.00	70.00	4.37	4.37	0.95
12:38	380.00	80.00	4.31	4.31	0.89
12:48	390.00	90.00	4.28	4.28	0.86
12:58	400.00	100.00	4.24	4.24	0.82
13:18	420.00	120.00	4.18	4.18	0.76
13:38	440.00	140.00	4.13	4.13	0.71
13:58	460.00	160.00	4.08	4.08	0.66
14:18	480.00	180.00	4.04	4.04	0.62
14:38	500.00	200.00	4.00	4.00	0.58
14:58	520.00	220.00	3.97	3.97	0.55
15:18	540.00	240.00	3.96	3.96	0.54
15:38	560.00	260.00	3.93	3.93	0.51
15:58	580.00	280.00	3.91	3.91	0.49
16:18	600.00	300.00	3.89	3.89	0.47
16:38	620.00	320.00	3.88	3.88	0.46
17:08	650.00	350.00	3.85	3.85	0.43
17:58	700.00	400.00	3.81	3.81	0.39
05:30	1392.00	1092.00	3.48	3.48	0.06

NOTES
Rain between 17:50 and 05:30, did not run into borehole directly but may have had an effect on recovery.
Rate was not const (0.37 - 0.45) due to method of measurement/adjustment
Anomolies at 20 mins and 35 mins. are prob. due to rate adjustment.

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

LOCATION	site 5	WELL NUMBER	bh3
TEST DATE	10/12/93 test 3	WELL DIA. (m)	0.15
TEST PERFORMED BY	D and A Thompson	TOTAL DEPTH (m)	33.00
PUMPING RATE (l/s)	0.8	SCREENED	
DATUM DESCRIPTION	toc	CASED	
DATUM ELEVN (magl)	0.05	OPEN	
EC (microS/cm)		PUMP SET AT (m)	32.00

local time	Tpstart (min)	Tpstop (min)	WL (mbd)	WL (mbgl)	DD (m)	RATE (l/s)	ACTION AT TAP	TIME 10l (mins)
06:30	0.00		3.38	3.38	0.00	0.56	open	18.00
06:31	1.00		4.65	4.65	1.27	0.59	open	17.00
06:32	2.00		5.24	5.24	1.86	0.67	open	15.00
06:33	3.00		5.80	5.80	2.42	0.71	open	14.00
06:34	4.00		6.45	6.45	3.07	0.89		11.19
06:35	5.00		6.91	6.91	3.53	0.88		11.37
06:36	6.00		7.35	7.35	3.97	0.85		11.79
06:37	7.00		7.60	7.60	4.22	0.83		12.06
06:38	8.00		7.82	7.82	4.44	0.81		12.29
06:39	9.00		8.05	8.05	4.67	0.80		12.45
06:40	10.00		8.28	8.28	4.90	0.81		12.33
06:42	12.00		8.61	8.61	5.23	0.82		12.24
06:44	14.00		8.81	8.81	5.43	0.76	open	13.20
06:46	16.00		9.19	9.19	5.81	0.83		12.02
06:48	18.00		9.75	9.75	6.37	0.75	open	13.40
06:50	20.00		10.20	10.20	6.82	0.87		11.54
06:52	22.00		10.96	10.96	7.58	0.82		12.18
06:54	24.00		11.55	11.55	8.17	0.82		12.14
06:56	26.00		11.98	11.98	8.60	0.81		12.29
06:58	28.00		12.29	12.29	8.91	0.82		12.13
07:00	30.00		12.60	12.60	9.22	0.82		12.19
07:02	32.00		12.96	12.96	9.58	0.81		12.41
07:05	35.00		13.41	13.41	10.03	0.81		12.41
07:10	40.00		14.28	14.28	10.90	0.81		12.35
07:15	45.00		15.19	15.19	11.81	0.78	open	12.74
07:20	50.00		17.35	17.35	13.97	0.85		11.75
07:30	60.00		19.72	19.72	16.34	0.78		12.83
07:40	70.00		21.05	21.05	17.67	0.75		13.25
07:50	80.00		22.80	22.80	19.42	NA		NA
08:00	90.00		24.02	24.02	20.64	0.77	open	13.05
08:10	100.00		25.32	25.32	21.94	0.76	open	13.15
08:30	120.00		27.03	27.03	23.65	0.74	open	13.60
08:50	140.00	0.00	31.20	31.20	27.82	0.75	open	13.25
08:51	141.00	1.00	27.30	27.30	23.92			
08:52	142.00	2.00	25.20	25.20	21.82			
08:53	143.00	3.00	22.20	22.20	18.82			
08:54	144.00	4.00	19.50	19.50	16.12			
08:55	145.00	5.00	16.77	16.77	13.39			
08:56	146.00	6.00	14.17	14.17	10.79			
08:57	147.00	7.00	12.13	12.13	8.75			
08:58	148.00	8.00	10.25	10.25	6.87			
08:59	149.00	9.00	9.00	9.00	5.62			
09:00	150.00	10.00	8.57	8.57	5.19			
09:02	152.00	12.00	7.70	7.70	4.32			

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

09:04	154.00	14.00	6.95	6.95	3.57
09:06	156.00	16.00	6.42	6.42	3.04
09:08	158.00	18.00	6.05	6.05	2.67
09:10	160.00	20.00	5.81	5.81	2.43
09:12	162.00	22.00	5.62	5.62	2.24
09:14	164.00	24.00	5.41	5.41	2.03
09:16	166.00	26.00	5.27	5.27	1.89
09:18	168.00	28.00	5.15	5.15	1.77
09:20	170.00	30.00	5.06	5.06	1.68
09:22	172.00	32.00	4.99	4.99	1.61
09:25	175.00	35.00	4.89	4.89	1.51
09:30	180.00	40.00	4.78	4.78	1.40
09:35	185.00	45.00	4.69	4.69	1.31
09:40	190.00	50.00	4.62	4.62	1.24
09:50	200.00	60.00	4.50	4.50	1.12
10:00	210.00	70.00	4.41	4.41	1.03
10:10	220.00	80.00	4.34	4.34	0.96
10:20	230.00	90.00	4.27	4.27	0.89
10:30	240.00	100.00	4.22	4.22	0.84
10:50	260.00	120.00	4.13	4.13	0.75
11:10	280.00	140.00	4.07	4.07	0.69
11:30	300.00	160.00	4.00	4.00	0.62
11:50	320.00	180.00	3.96	3.96	0.58
12:10	340.00	200.00	3.91	3.91	0.53
12:30	360.00	220.00	3.88	3.88	0.50
12:50	380.00	240.00	3.85	3.85	0.47
13:10	400.00	260.00	3.82	3.82	0.44
13:30	420.00	280.00	3.79	3.79	0.41
13:50	440.00	300.00	3.76	3.76	0.38
14:10	460.00	320.00	3.74	3.74	0.36
14:40	490.00	350.00	3.71	3.71	0.33
15:30	540.00	400.00	3.70	3.70	0.32

NOTES
Reached pump limit (tap fully open) at approx 0.75 l/s, 32m head.
Heavy rain after 400mins recovery :- stopped recovery measurement
Pumping rate not const. due to method of measuring and adjusting.

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

LOCATION	site 5	WELL NUMBER	bh2 obs. piezo
TEST DATE	10/12/93 test 3	WELL DIA. (m)	0.05
TEST PERFORMED BY	D and A Thompson	TOTAL DEPTH (m)	
PUMPING RATE (l/s)		DIST. FROM BH3 (	5
DATUM DESCRIPTION	toc		
DATUM ELEVN (magl)	0		
EC (microS/cm)			

local time	Tpstart (min)	Tpstop (min)	WL (mbd)	WL (mbgl)	DD (m)	RATE (l/s)	ACTION AT TAP	TIME 10I (mins)
06:30	0.00		3.48	3.48	0.00	0.56	open	18.00
06:31	1.00		3.50	3.50	0.02	0.59	open	17.00
06:32	2.00		3.53	3.53	0.05	0.67	open	15.00
06:33	3.00		3.60	3.60	0.12	0.71	open	14.00
06:34	4.00		3.68	3.68	0.20	0.89		11.19
06:35	5.00		3.77	3.77	0.29	0.88		11.37
06:36	6.00		3.86	3.86	0.38	0.85		11.79
06:37	7.00		3.95	3.95	0.47	0.83		12.06
06:38	8.00		4.04	4.04	0.56	0.81		12.29
06:39	9.00		4.14	4.14	0.66	0.80		12.45
06:40	10.00		4.23	4.23	0.75	0.81		12.33
06:42	12.00		4.38	4.38	0.90	0.82		12.24
06:44	14.00		4.53	4.53	1.05	0.76	open	13.20
06:46	16.00		4.65	4.65	1.17	0.83		12.02
06:48	18.00		4.78	4.78	1.30	0.75	open	13.40
06:50	20.00		4.88	4.88	1.40	0.87		11.54
06:52	22.00		4.98	4.98	1.50	0.82		12.18
06:54	24.00		5.08	5.08	1.60	0.82		12.14
06:56	26.00		5.16	5.16	1.68	0.81		12.29
06:58	28.00		5.23	5.23	1.75	0.82		12.13
07:00	30.00		5.32	5.32	1.84	0.82		12.19
07:02	32.00		5.39	5.39	1.91	0.81		12.41
07:05	35.00		5.47	5.47	1.99	0.81		12.41
07:10	40.00		5.59	5.59	2.11	0.81		12.35
07:15	45.00		5.70	5.70	2.22	0.78	open	12.74
07:20	50.00		5.79	5.79	2.31	0.85		11.75
07:30	60.00		5.92	5.92	2.44	0.78		12.83
07:40	70.00		6.01	6.01	2.53	0.75		13.25
07:50	80.00		6.08	6.08	2.60	NA		NA
08:00	90.00		6.13	6.13	2.65	0.77	open	13.05
08:10	100.00		6.17	6.17	2.69	0.76	open	13.15
08:30	120.00		6.21	6.21	2.73	0.74	open	13.60
08:50	140.00	0	6.24	6.24	2.76	0.75	open	13.25
08:51	141.00	1	6.24	6.24	2.76			
08:52	142.00	2	6.25	6.25	2.77			
08:53	143.00	3	6.25	6.25	2.77			
08:54	144.00	4	6.25	6.25	2.77			
08:55	145.00	5	6.25	6.25	2.77			
08:56	146.00	6	6.25	6.25	2.77			
08:57	147.00	7	6.25	6.25	2.77			
08:58	148.00	8	6.25	6.25	2.77			
08:59	149.00	9	6.25	6.25	2.77			
09:00	150.00	10	6.23	6.23	2.75			
09:02	152.00	12	6.21	6.21	2.73			

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

09:04	154.00	14	6.15	6.15	2.67
09:06	156.00	16	6.07	6.07	2.59
09:08	158.00	18	5.97	5.97	2.49
09:10	160.00	20	5.87	5.87	2.39
09:12	162.00	22	5.76	5.76	2.28
09:14	164.00	24	5.61	5.61	2.13
09:16	166.00	26	5.50	5.50	2.02
09:18	168.00	28	5.39	5.39	1.91
09:20	170.00	30	5.29	5.29	1.81
09:22	172.00	32	5.21	5.21	1.73
09:25	175.00	35	5.13	5.13	1.65
09:30	180.00	40	5.01	5.01	1.53
09:35	185.00	45	4.90	4.90	1.42
09:40	190.00	50	4.83	4.83	1.35
09:50	200.00	60	4.70	4.70	1.22
10:00	210.00	70	4.60	4.60	1.12
10:10	220.00	80	4.52	4.52	1.04
10:20	230.00	90	4.45	4.45	0.97
10:30	240.00	100	4.40	4.40	0.92
10:50	260.00	120	4.30	4.30	0.82
11:10	280.00	140	4.22	4.22	0.74
11:30	300.00	160	4.14	4.14	0.66
11:50	320.00	180	4.10	4.10	0.62
12:10	340.00	200	4.05	4.05	0.57
12:30	360.00	220	4.01	4.01	0.53
12:50	380.00	240	3.93	3.93	0.45
13:10	400.00	260	3.93	3.93	0.45
13:30	420.00	280	3.91	3.91	0.43
13:50	440.00	300	3.89	3.89	0.41
14:10	460.00	320	3.86	3.86	0.38
14:40	490.00	350	3.82	3.82	0.34
15:30	540.00	400	3.80	3.80	0.32

NOTES
Heavy rain after 400mins recovery :- stopped recovery measurement

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

LOCATION	site 5	WELL NUMBER	BH3
TEST DATE	11/12/93 test4	WELL DIA (m)	0.15
TEST PERFORMED BY	D and A Thompson	TOTAL DEPTH (m)	33.00
AV.PUMP RATE (l/s)	0.63	SCREENED	
DATUM DESCRIPTIO	toc	CASED	
DATUM ELEVN (magl)	0.05	OPEN	
EC (microS/cm)		PUMP SET AT (m)	32.00

local time	Tpstart (min)	Tpstop (min)	WL (mbd)	WL (mbgl)	DD (m)	RATE (l/s)	ACTION AT TAP	TIME 5l (min)
08:30	0.00		3.34	3.29	0.00	0.83	close	6.00
08:31	1.00		4.28	4.23	0.94	ERR		
08:32	2.00		4.60	4.55	1.26	0.44	open	11.40
08:33	3.00		4.95	4.90	1.61	0.50		9.95
08:34	4.00		5.30	5.25	1.96	0.49	open	10.29
08:35	5.00		5.50	5.45	2.16	ERR		
08:36	6.00		5.66	5.61	2.32	ERR		
08:37	7.00		5.79	5.74	2.45	0.53	open	9.43
08:38	8.00		5.99	5.94	2.65	0.53	open	9.40
08:39	9.00		6.20	6.15	2.86	0.69		7.27
08:40	10.00		6.48	6.43	3.14	0.64		7.79
08:42	12.00		6.87	6.82	3.53	0.60	open	8.35
08:44	14.00		7.25	7.20	3.91	0.64		7.84
08:46	16.00		7.55	7.50	4.21	0.64		7.87
08:48	18.00		7.72	7.67	4.38	0.62	open	8.10
08:50	20.00		8.05	8.00	4.71	0.78		6.39
08:52	22.00		8.45	8.40	5.11	0.74		6.80
08:54	24.00		8.72	8.67	5.38	0.72		6.90
08:56	26.00		8.89	8.84	5.55	0.72		6.93
08:58	28.00		9.38	9.33	6.04	0.71		7.06
09:00	30.00		9.70	9.65	6.36	0.71		7.04
09:02	32.00		9.95	9.90	6.61	0.70		7.17
09:05	35.00		10.20	10.15	6.86	0.70		7.15
09:10	40.00		10.30	10.25	6.96	0.67		7.47
09:15	45.00		10.50	10.45	7.16	0.62		8.07
09:20	50.00		10.70	10.65	7.36	0.61		8.17
09:30	60.00		11.18	11.13	7.84	0.66		7.63
09:40	70.00		11.60	11.55	8.26	0.65		7.67
09:50	80.00		12.28	12.23	8.94	0.60		8.28
10:00	90.00		12.40	12.35	9.06	0.63		7.92
10:10	100.00		12.68	12.63	9.34	0.62		8.12
10:30	120.00		13.97	13.92	10.63	0.63		7.92
10:50	140.00		14.77	14.72	11.43	0.61		8.20
11:10	160.00		15.41	15.36	12.07	0.60		8.30
11:30	180.00		16.42	16.37	13.08	0.63		7.95
11:50	200.00		16.77	16.72	13.43	0.61		8.20
12:10	220.00		17.25	17.20	13.91	0.60	open	8.32
12:30	240.00		18.43	18.38	15.09	0.61		8.26
12:50	260.00		18.95	18.90	15.61	0.61		8.22
13:10	280.00		19.35	19.30	16.01	0.60		8.29
13:30	300.00		19.48	19.43	16.14	0.60		8.28
13:50	320.00		21.00	20.95	17.66	0.62		8.13
14:20	350.00		21.60	21.55	18.26	0.60	open	8.30
15:10	400.00		22.52	22.47	19.18	0.60	open	8.31

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

16:00	450.00		25.65	25.60	22.31	0.59 open	8.50
16:50	500.00		28.88	28.83	25.54	0.61	8.24
17:00	510.00	0.00	28.95	28.90	25.61		
17:01	511.00	1.00	26.50	26.45	23.16		
17:02	512.00	2.00	23.80	23.75	20.46		
17:03	513.00	3.00	21.40	21.35	18.06		
17:04	514.00	4.00	19.10	19.05	15.76		
17:05	515.00	5.00	16.86	16.81	13.52		
17:06	516.00	6.00	14.69	14.64	11.35		
17:07	517.00	7.00	12.80	12.75	9.46		
17:08	518.00	8.00	11.10	11.05	7.76		
17:09	519.00	9.00	9.80	9.75	6.46		
17:10	520.00	10.00	9.05	9.00	5.71		
17:12	522.00	12.00	8.30	8.25	4.96		
17:14	524.00	14.00	7.62	7.57	4.28		
17:16	526.00	16.00	7.02	6.97	3.68		
17:18	528.00	18.00	6.63	6.58	3.29		
17:20	530.00	20.00	6.30	6.25	2.96		
17:22	532.00	22.00	6.09	6.04	2.75		
17:24	534.00	24.00	5.93	5.88	2.59		
17:26	536.00	26.00	5.78	5.73	2.44		
17:28	538.00	28.00	5.66	5.61	2.32		
17:30	540.00	30.00	5.57	5.52	2.23		
17:32	542.00	32.00	5.48	5.43	2.14		
17:35	545.00	35.00	5.35	5.30	2.01		
17:40	550.00	40.00	5.22	5.17	1.88		
17:45	555.00	45.00	5.11	5.06	1.77		
17:50	560.00	50.00	5.05	5.00	1.71		
18:00	570.00	60.00	4.92	4.87	1.58		
19:00	630.00	120.00	4.52	4.47	1.18		
10:30	1560.00	1050.00	3.55	3.50	0.21		

NOTES
Variable rate due to method of measuring and adjusting
no rainfall during test

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

LOCATION	site 5	WELL NUMBER	bh2 Obs. piezo
TEST DATE	11/12/93 test4	WELL DIA (m)	0.05
TEST PERFORMED BY	D and A Thompson	TOTAL DEPTH (m)	
AV.PUMP RATE (l/s)		DIST.FROM bh3 (m	5
DATUM DESCRIPTIO	toc		
DATUM ELEVN (magl)	0		
EC (microS/cm)			

local time	Tpstart (min)	Tpstop (min)	WL (mbd)	WL (mbgl)	DD (m)	RATE (l/s)	ACTION AT TAP	TIME 5l (min)
08:30	0.00		3.44	3.44	0.00	0.83	close	6.00
08:31	1.00		3.46	3.46	0.02	ERR		
08:32	2.00		3.52	3.52	0.08	0.44	open	11.4
08:33	3.00		3.57	3.57	0.14	0.50		9.95
08:34	4.00		3.66	3.66	0.23	0.49	open	10.29
08:35	5.00		3.74	3.74	0.31	ERR		
08:36	6.00		3.81	3.81	0.38	ERR		
08:37	7.00		3.89	3.89	0.45	0.53	open	9.43
08:38	8.00		3.95	3.95	0.52	0.53	open	9.40
08:39	9.00		4.02	4.02	0.59	0.69		7.27
08:40	10.00		4.08	4.08	0.65	0.64		7.79
08:42	12.00		4.23	4.23	0.80	0.60	open	8.35
08:44	14.00		4.36	4.36	0.93	0.64		7.84
08:46	16.00		4.47	4.47	1.03	0.64		7.87
08:48	18.00		4.60	4.60	1.17	0.62	open	8.10
08:50	20.00		4.70	4.70	1.27	0.78		6.39
08:52	22.00		4.80	4.80	1.37	0.74		6.80
08:54	24.00		4.88	4.88	1.45	0.72		6.90
08:56	26.00		4.98	4.98	1.55	0.72		6.93
08:58	28.00		5.04	5.04	1.61	0.71		7.06
09:00	30.00		5.11	5.11	1.67	0.71		7.04
09:02	32.00		5.18	5.18	1.74	0.70		7.17
09:05	35.00		5.26	5.26	1.82	0.70		7.15
09:10	40.00		5.39	5.39	1.95	0.67		7.47
09:15	45.00		5.48	5.48	2.05	0.62		8.07
09:20	50.00		5.57	5.57	2.14	0.61		8.17
09:30	60.00		5.71	5.71	2.28	0.66		7.63
09:40	70.00		5.83	5.83	2.39	0.65		7.67
09:50	80.00		5.91	5.91	2.48	0.60		8.28
10:00	90.00		5.98	5.98	2.54	0.63		7.92
10:10	100.00		6.02	6.02	2.59	0.62		8.12
10:30	120.00		6.12	6.12	2.69	0.63		7.92
10:50	140.00		6.18	6.18	2.75	0.61		8.20
11:10	160.00		6.22	6.22	2.79	0.60		8.30
11:30	180.00		6.25	6.25	2.82	0.63		7.95
11:50	200.00		6.27	6.27	2.84	0.61		8.20
12:10	220.00		6.30	6.30	2.87	0.60	open	8.32
12:30	240.00		6.32	6.32	2.89	0.61		8.26
12:50	260.00		6.35	6.35	2.91	0.61		8.22
13:10	280.00		6.37	6.37	2.94	0.60		8.29
13:30	300.00		6.39	6.39	2.96	0.60		8.28
13:50	320.00		6.41	6.41	2.98	0.62		8.13
14:20	350.00		6.44	6.44	3.01	0.60	open	8.30
15:10	400.00		6.48	6.48	3.05	0.60	open	8.31

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

16:00	450.00		6.51	6.51	3.08	0.59 open	8.50
16:50	500.00		6.55	6.55	3.12	0.61	8.24
17:00	510.00	0.00	6.55	6.55	3.12		
17:01	511.00	1.00	6.55	6.55	3.12		
17:02	512.00	2.00	6.56	6.56	3.12		
17:03	513.00	3.00	6.56	6.56	3.12		
17:04	514.00	4.00	6.56	6.56	3.12		
17:05	515.00	5.00	6.56	6.56	3.12		
17:06	516.00	6.00	6.56	6.56	3.12		
17:07	517.00	7.00	6.56	6.56	3.12		
17:08	518.00	8.00	6.56	6.56	3.12		
17:09	519.00	9.00	6.55	6.55	3.11		
17:10	520.00	10.00	6.54	6.54	3.10		
17:12	522.00	12.00	6.50	6.50	3.07		
17:14	524.00	14.00	6.45	6.45	3.01		
17:16	526.00	16.00	6.38	6.38	2.95		
17:18	528.00	18.00	6.31	6.31	2.88		
17:20	530.00	20.00	6.23	6.23	2.79		
17:22	532.00	22.00	6.13	6.13	2.70		
17:24	534.00	24.00	6.05	6.05	2.61		
17:26	536.00	26.00	5.99	5.99	2.55		
17:28	538.00	28.00	5.91	5.91	2.47		
17:30	540.00	30.00	5.84	5.84	2.41		
17:32	542.00	32.00	5.76	5.76	2.33		
17:35	545.00	35.00	5.66	5.66	2.22		
17:40	550.00	40.00	5.50	5.50	2.07		
17:45	555.00	45.00	5.42	5.42	1.99		
17:50	560.00	50.00	5.30	5.30	1.87		
18:00	570.00	60.00	5.16	5.16	1.73		
19:00	630.00	120.00	4.73	4.73	1.30		
10:30	1560.00	1050.00	3.67	3.67	0.23		

NOTES
Variable rate due to method of measuring and adjusting
no rainfall during test

Table 3.5.6 Pumping-test data from tests completed at site 5, Mawadze (continued)

SITE FIVE DDF HAND DUG WELL (25/4/94)

PUMPING DATA		CALCULATED DATA	
SITE	five	AV PUMP RATE (l/s)	1.00
DATE	04/25/94	DRAWDOWN (m)	9.97
TEST	T1	DEWATERED VOL (m3	9.475
TESTER	dt/tc	PUMPED VOL (m3)	10.805
PUMPING TIME (hrs	3.00	'LAMDA'	0.88
START VOL (m3)	169.246		
END VOL. (m3)	180.051		
START WL. (mbmd)	4.38		
END WL. (mbmd)	14.35		
ORIFICE DIA (mm)	31.00		
PRESS. DIFF (m)	0.71		
WELL DATUM	slab		
DATUM ELEV. (magl	0.05		
WELL DIAMETER(m)	1.1		

RECOVERY DATA CW

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		4.38	4.33
0.50		5.87	5.82
1.00		7.6	7.55
1.50		9.2	9.15
2.00		10.9	10.85
2.50		12.62	12.57
3.00	0	14.05	14.00
3.50	0.5	13.92	13.87
4.00	1	13.77	13.72
4.50	1.5	13.69	13.64
5.00	2	13.65	13.60
5.50	2.5	13.6	13.55
6.00	3	13.52	13.47
6.50	3.5	13.37	13.32
7.00	4	13.22	13.17
7.50	4.5	13.08	13.03
19.00	16	11.28	11.23
21.00	18	10.85	10.80
23.00	20	10.5	10.45
25.00	22	10.07	10.02
31.00	28	9.37	9.32
43.00	40	8.12	8.07
49.00	46	7.62	7.57
55.00	52	7.2	7.15

NOTES
-well diameter was difficult to measure and may be inaccurate +-10%
-this well stopped being used much when the cw was completed

Table 3.5.7 Attendees at pump maintenance workshop site 5, Mawadze

NAME
MAWADZE (Josaya)
MAWADZE (Betty)
MHINO (Petter)
RUTENDE (Chandiwira)
WHIKA (Alex)
MAUTA (Phillip)
MAUTA (Francis)
ZVANYA (Josaya)
MUTAKWA (Mrs)
NDANSA (Mrs)
PASEKA (Mrs)

Table 3.5.8 Water points in the region of collector well site 5, Mawadze

Well no.	Builder/owner	Kraal	Date	Diameter (m)	Depth (m)	Water-level			Perceived yield	Water use	Dries-up	
						depth (m)	time	date			Every Year	1992
1	ODA/ community	Mawadze	1993	2.0	18	6.7		13/4/96	Excellent Max. 21 m^3/d Av. 9 m^3/d	Domestic (D) Garden (G) School (S)	No	NA
2	DDF/ community	Mawadze	1993	1.0	17.8	5.0	16:45	13/4/96	Good	Washing	No	No
3	DDF/ community	Mawadze	1986	0.15	39				Poor Av. 1.5 m^3/d	D,S	Yes	Yes
4	Mhino	Chikono	1979	1.0	14.5	7.5	15:55	13/4/96	Good	D,G	No	No
5	Cheruke	Cheruke	1992	1.4	18.4	14.47	09:00	20/4/96	Poor	D,S	Yes	Yes

Table 3.5.9 Wells and boreholes monitored for water-levels at site 5, Mawadze

WELL NUMBER	DATUM DESCRIPTION		DEPTH (m)	DIA (m)
	ELEV (magl)	ELEV (macwd)		
2	0.22	-4.35	17.8	1.0
3	0.46		39	0.15
BH3	0.50	-1.19	34.0	0.15
1	0.70	0.00	13.0	2.0

Site 6 - Matedze

Site description

Geology:	granulite gneiss
Location:	approx. 70 km north of Chiredzi Research Station, 2 km west of Chivamba, a business centre situated on the main Zaka road.
Access:	-
Annual rainfall:	785 mm

Exploratory drilling

Drilling:	BGS contract driller
No. of exploratory holes:	2
Comments:	a 6" hole (bh3) was drilled 1 m from exploratory hole bh1 and a pumping-test carried out, the collector well was subsequently dug at bh3.

Specific construction details

Foreman:	Timothy Chiunye
Depth of well shaft:	9.5 m
Time to dig shaft:	14 weeks
No. of laterals:	5
Length of laterals:	2, 4, 8, 23, 30 m
Comments:	-

A soakaway trench (0.5m wide, 0.5m deep was dug on three sides of the slab to collect waste water and a further trench dug to drain the waste water away down slope. These trenches were filled with pieces of hard rock the size of a small fist to create a French drain.

Monitoring of well performance

Mr Munyaradzi Chekero is to change the munro recorder chart and read the meters at 0600 every Sunday morning. He will also dip piezometers bh1 and bh2 and measure daily rainfall.

20° 36' 39.46" S 31° 22' 31.76" E elevation 655m.

36K 330714.72 mE 7720062.66 mS.

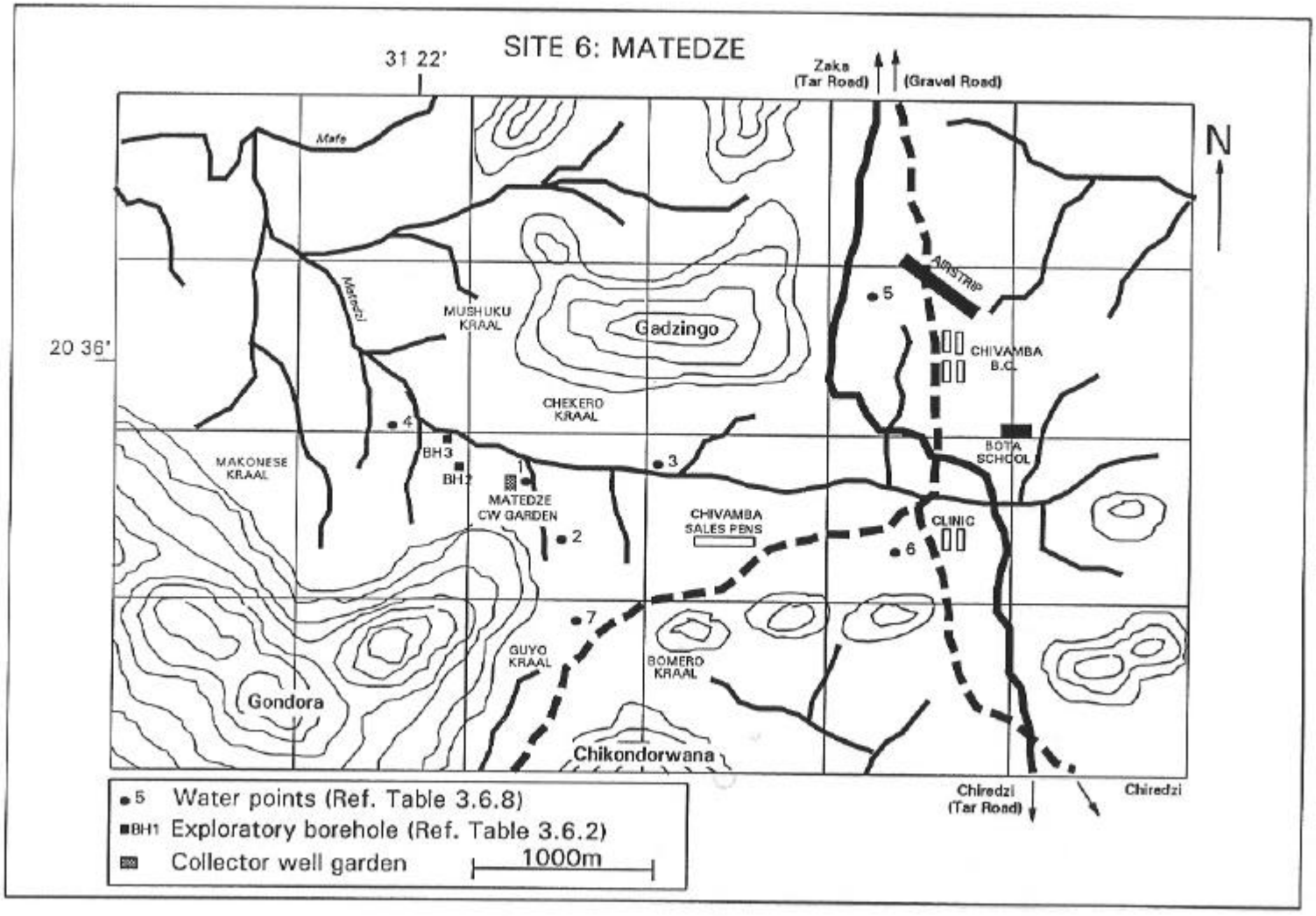


Figure 3.6.1 Map of location of collector well garden and local water points

not necessary

Figure 3.6.2 Detail showing location of exploratory boreholes

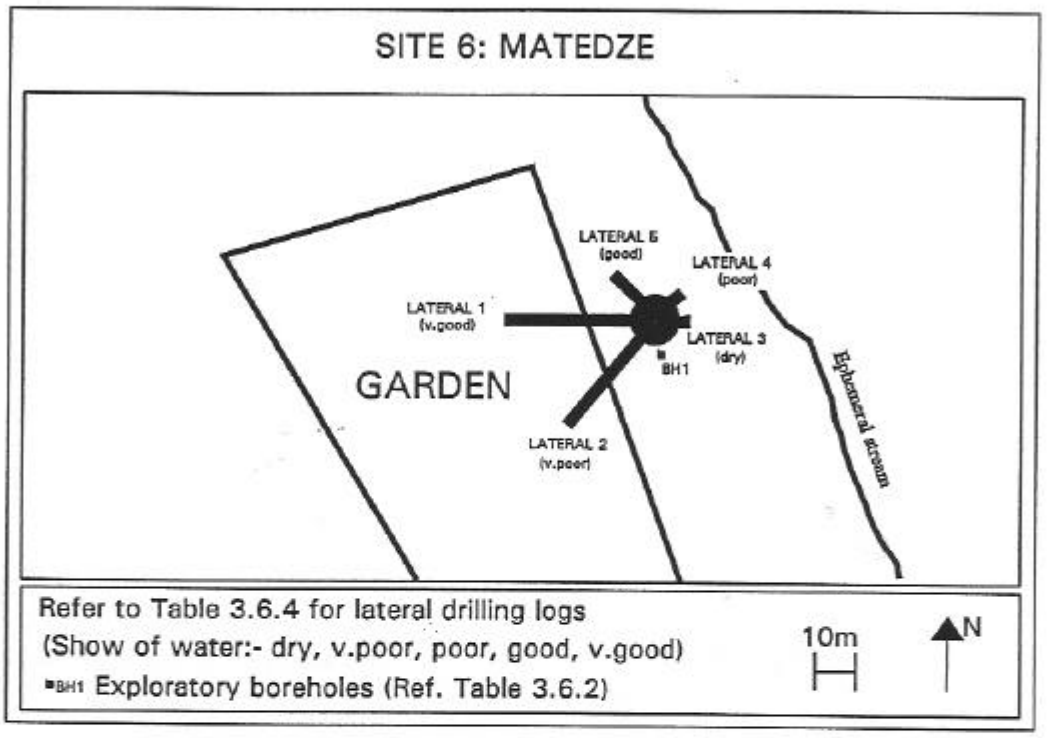
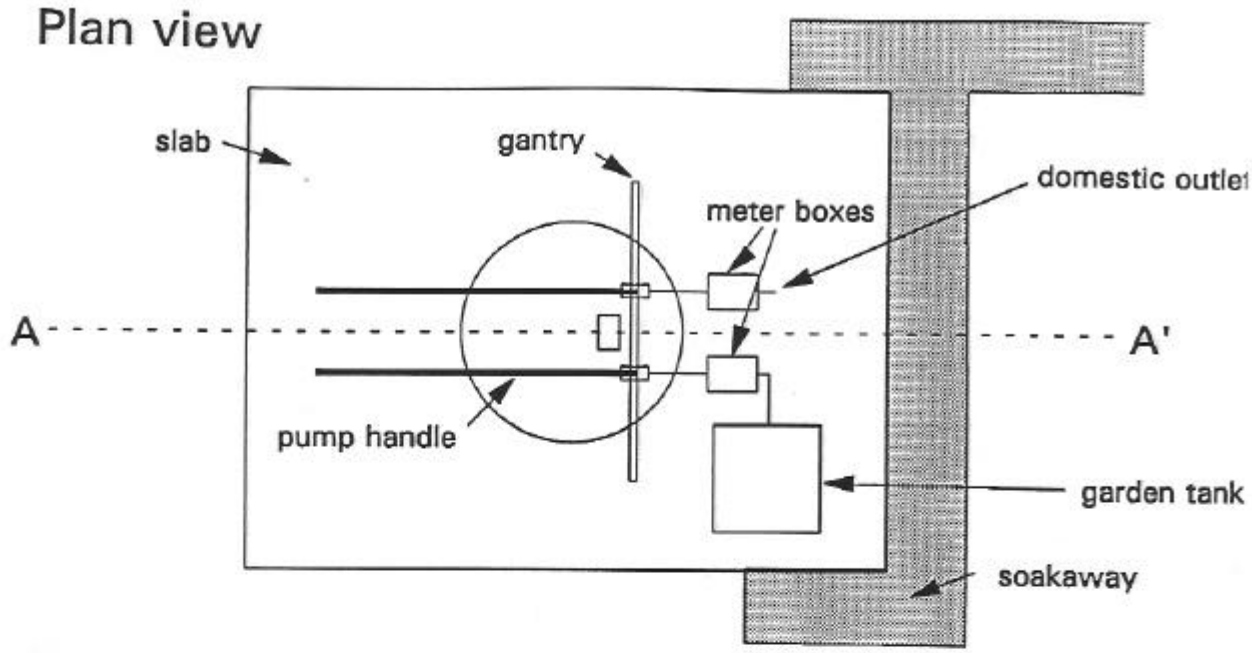


Figure 3.6.3 Map of vicinity of collector well showing dircetion of laterals



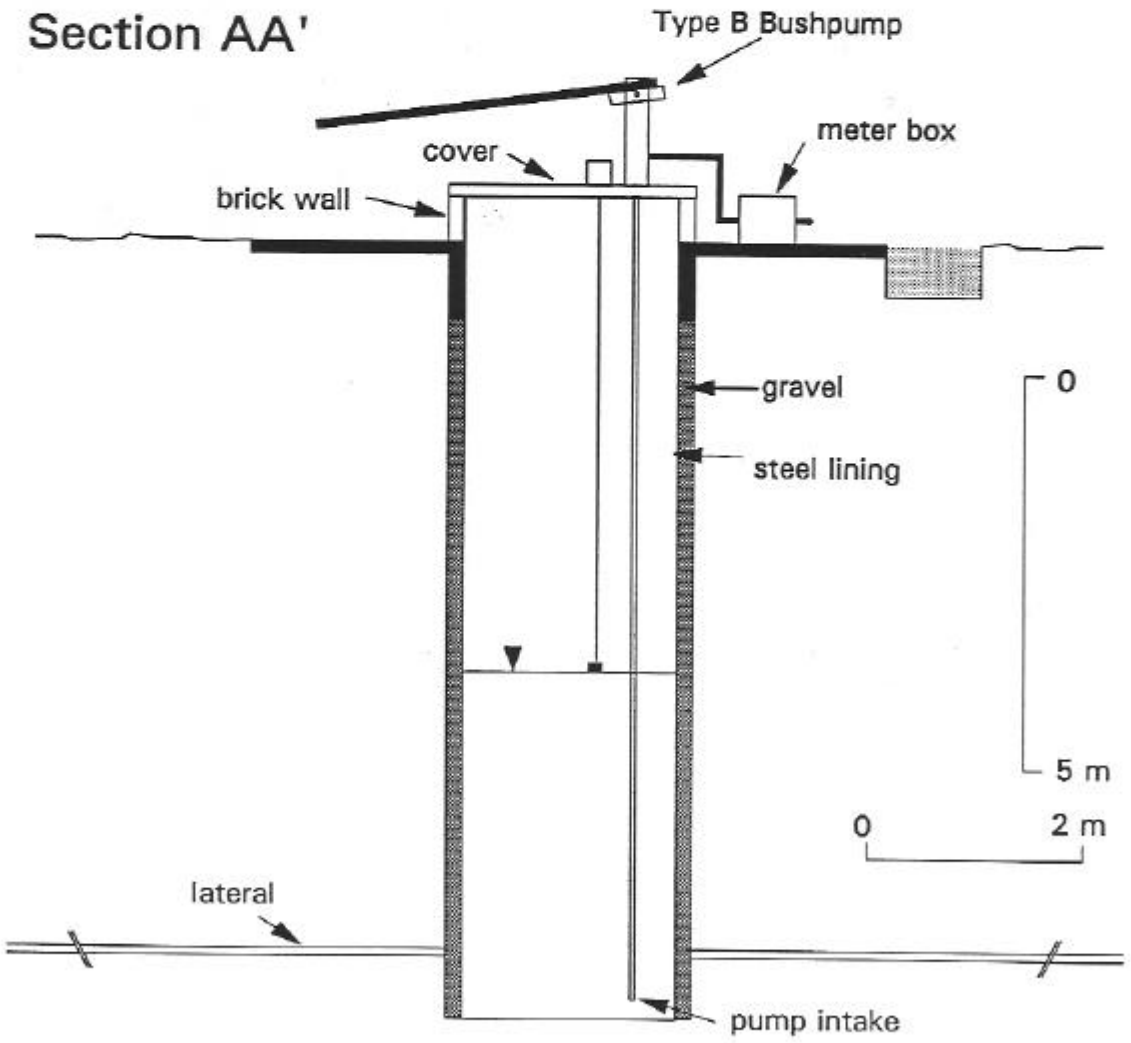


Figure 3.6.4 Collector well and headworks construction, site 6, Matedze

Table 3.6.1 Diary of activities at site 6, Matedze

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
identify site	14/04/94 (? days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel ?? drill bits ??
drill three exploratory holes	26/04/94 (4 days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 100l drill bits ??
pumptest BH3	02/05/94 (1 day)	ptest engineer site assistant	Pump and associated equipment	petrol 5l
dig well shaft to 9.5m, backfill with gravel, concrete in sanitary seal, build and plaster head wall	7/8/94 (96 days)	construction manager site foreman 5 labourers	compressor pump + hoses winch + hoses wire rope gantry kibble personnel frame 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helmets 2 ear protectors jackhammer cement mixer shifting spanner 27mm spanner torch foreman's tent foreman's bed foreman's stove	cement 26bags bricks 200 river sand 4cum 19mm gravel 10cum diesel(comp) 2800l steel casing 10m jh points 3 pump rubbers 4 hydraulic oil 10l engine oil 5l gumboots 6prs overalls 1set gloves 2prs paraffin 15l gas 5kg
lateral drilling (five laterals)	10/10/94 (9 days)	driller crane operator 1 labourer	air rig and associated equipment	diesel 1400l wire rope 15m masks 3
complete headworks, well covers, water tank, soakaway, gantry	19/10/94 (10 days)	construction manager site foreman 5 labourers	formwork level trowel wheelbarrow cement mixer	bricks 100 cement 5bags sand/gravel 1cum pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15m 50mm elbows 2 50mm nipples 2
pump test collector well before laterals x 1 after laterals x 1	14/10/94 (4 days)	ptest engineer site assistant	pump and associated equipment	petrol 15l

Table 3.6.1 Diary of activities at site 6, Matedze (continued)

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
install bushpumps with community as part of pump maintenance workshop	20/10/94 (1 day)	instructor translator 8 local people	thread cutter for 50mm pipe and 19mm rods	50mm galv pipe 18m 50mm nipples 6 pump cylinder 2 17mm rods 18m type 8 bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for large dia. well, DDF borehole, DDF well piezometer 'bh1'	20/10/94 (3 days)	ptest engineer foreman monitor man	munro wl recorder 2 water meters	bricks 100 cement 3bags munro box 1 padlock 1 50mm galv pipe 6m 50mm elbows 8 50mm unionjoint 2 w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	22/08/94 (3 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20bags steel posts 13 steel stays 10 steel standards 36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer. vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a separate report Thompson (1994).
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenance and attending to minor breakdowns.

Table 3.6.2 Drilling logs of exploratory boreholes at site 6, Matedze

EXPLORATORY DRILLING AT MATEDZE (COLLECTOR WELL SITE 6)

	Exploratory borehole BH1 Drilled 20/04/94 BGS light air rig diameter = 100mm, depth = 10.5m first strike = 6m 0.75m rods	Exploratory borehole BH2 Drilled 21/04/94 BGS light air rig diameter = 100mm, depth = 6.75m first strike = 6m 0.75m rods	Exploratory borehole BH3 Drilled 26/04/94 BGS light air rig diameter = 150mm, depth = 9.75m first strike = 7.5m 0.75m rods
	Note:- Drilled with 0.75m rods, the description is for each rod. Penetration is given in min/m for each rod when using the drag bit. No rate given for air hammer drilling (DHH).		

Rod Number	Penetration rate(min/m)	Comment	Penetration rate(min/m)	Comment	Penetration rate(min/m)	Comment
1	1.33	soil	1.33	clay	2.66	clay
2	1.33	clay	1.33	clay	2.66	clay
3	2.00	clay	1.33	clay	2.66	clay
4	2.00	soil	1.33	clay	2.66	clay
5	1.33	soil	1.33	clay	2.66	clay
6	1.33	soil	1.33	clay	2.66	boulders
7	1.33	soil	1.33	clay	2.66	boulders
8	1.33	soil	1.33	clay	2.66	boulders
9	1.33	boulders	12.50	hard granite	2.66	boulders
10	2.00	soil			2.66	saprock
11	2.66	boulders			5.33	saprock
12	2.66	boulders			DHH	hard
13	2.66	boulders			DHH	hard
14	2.66	boulders				
15	2.66	boulders				
16	2.66	hard				

Table 3.6.3 Geological descriptions of collector well digging samples, site 6, Matedze

MATEDZE (SITE SIX) GEOLOGICAL DESCRIPTION OF DIGGING SAMPLES FROM THE COLLECTOR WELL	
DEPTH (m)	Description
0 to 1	Dark grey-black clay soil with some brownish iron patches and some very black patches. Contains angular pieces of white quartz up to 10 mm. No sand.
1 to 2	As above. Grey clay with a few sand grains of quartz, iron staining patches and a few larger pieces of white and yellowish-buff quartz.
2 to 3	Soft, brown-yellow angular fragments of highly weathered rock. Strongly iron stained. Some black ferro-magnesian minerals. Some banding in larger pieces, and strong iron staining on joint faces which are reddish-brown and black. Also some rounded lumps of clay as at 2.0 m above. One larger piece of harder, quartz-rich rock with brown stained joint faces.
3 to 4	Black and reddish brown fragments of strongly weathered rock, showing some banding. Joint faces strongly iron stained. Some pieces showing shiny crystal faces of ?mica. No clay.
4 to 5	Large angular pieces of mainly pale banded rock, strong brown iron staining on joint faces.
5 to 6	Angular fragments of darker rock, veined rather than banded, strong brownish-red iron staining on joints.
6 to 7	As above. Very black broken faces of one piece showing shiny crystals. Large piece of dark grey-black hard, fine grained crystalline rock, weathered on joint faces only, where strongly iron stained.
7 to 8	Some rounded pieces of friable, crumbling coarsely crystalline weathered rock, showing original texture and crystalline structure. Heavily iron stained black.
8 to 9	Angular pieces of slightly weathered rock, iron staining on joint faces, but mainly greyish fresh rock in interior, with some quartz.
9 to 9.5	Angular pieces of fresh rock with weathering on joint faces only. Massive rock with quartz and grey mineral, some small, reddish iron stained, weathered ferro-magnesian minerals.

Table 3.6.4 Lateral drilling logs from site 6, Matedze

MATEDZE SITE SIX. COLLECTOR WELL LATERAL DRILLING LOGS					
	LATERAL 1	LATERAL 2	LATERAL 3	LATERAL 4	LATERAL 5
DRILLER **DIRECTION** **ELEVATION** **LENGTH** **COMPLETED** **WATER FLOW**	P.Rastall west -5 degrees 40rods,30m 4/10/94 very good	P.Rastall SSW -5 degrees 30rods,23m 5/10/94 very poor	P.Rastall east -5 degrees 2rods,1.5m 5/10/94 none	P.Rastall NNE -5 degrees 5rods,4m 6/10/94 reasonable	P.Rastall NNW -5 degrees 10rods,8m 10/10/94 good
ROD NUMBER (0.75m rods)	**COMMENT**	**COMMENT**	**COMMENT**	**COMMENT**	**COMMENT**
1	weathered	hard clay	soft	soft	soft
2	hard	hard	boulder too hard	soft	boulder
3	hard	hard	to drill	soft	boulder
4	weathered	hard		soft	loose granite
5	weathered	hard		boulder too hard	loose granite
6	weathered	hard		to drill	loose granite
7	weathered	hard			loose granite
8	weathered	hard			clay
9	weathered	brown clay			clay
10	red clay	brown clay			boulder too
11	red clay	weathered			hard to drill
12	red clay	weathered			
13	red clay	weathered			
14	red clay	hard			
15	hard	hard			
16	weathered	weathered			
17	weathered	weathered			
18	weathered	weathered			
19	weathered	weathered			
20	weathered	weathered			
21	weathered	weathered			
22	weathered	weathered			
23	weathered	weathered			
24	weathered	clay			
25	weathered	clay			
26	hard	clay			
27	weathered	weathered			
28	hard	weathered			
29	weathered	weathered			
30	hard	weathered			
31	banded				
32	banded				
33	banded				
34	banded				
35	banded				
36	banded				
37	banded				
38	banded				
39	banded				
40	banded				

Table 3.6.5 Pumping-tests performed at site 6, Matedze

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
2	08/09/94	CWT2HDBL	DT/TC	1.00	5.00	5.31	8.86	<5.31	3300	RATE+-3%
4	10/14/94	CWT4HDAL	DT/TC	1.00	5.00	5.67	7.68	<5.67	3300	RATE+-3%
5A	06/16/94	REC AFTER DIGGING	NA	NA	NA	NA	NA	NA	NA	NONE

WELL DESCRIPTION_____ BH3 (EXPLORATORY BH)

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	05/02/94	T1	DT/BG	0.63	26	4.48	7.94	<4.48	80	RATE+-3%

Table 3.6.6 Pumping-test data from tests completed at site 6, Matedze

SITE SIX LARGE DIA WELL HIGH DISCH BEFORE LATERALS (9/8/94)

PUMPING DATA		CALCULATED DATA	
SITE	six	AV PUMP RATE (l/s)	1.00
DATE	9/8/94	DRAWDOWN (m)	3.54
TEST	hdbl	DEWATERED VOL (m3)	12.261
TESTER	dt/tc	PUMPED VOL (m3)	18.001
PUMPING TIME (hrs	5.00	'LAMDA'	0.68
START VOL (m3)	286.309		
END VOL. (m3)	304.310		
START WL. (mbmd)	5.88		
END WL. (mbmd)	9.42		
ORIFICE DIA (mm)	19.00		
PRESS. DIFF (m)	1.30		
CW DATUM	munro		
DATUM ELEV. (mag	0.57		
BH DATUM	toc		
DATUM ELEV.(magl	0.15		

RECOVERY DATA CW				RECOVERY DATA PIEZO	
T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)	WL (mbd)	WL (mbgl)
0.00		5.88	5.31	5.46	5.31
1.00		6.79	6.22	6.26	6.11
2.00		7.54	6.97	6.98	6.83
3.00		8.21	7.64	7.57	7.42
4.00		8.84	8.27	8.13	7.98
5.00	0	9.42	8.85	8.6	8.45
6.00	1	9.09	8.52	8.36	8.21
7.00	2	8.76	8.19	8.13	7.98
8.00	3	8.49	7.92	7.9	7.75
9.00	4	8.27	7.70	ERR	ERR
10.00	5	8.07	7.50	NA	NA
12.00	7	7.75	7.18	ERR	ERR
14.00	9	7.50	6.93	ERR	ERR
16.00	11	7.30	6.73	ERR	ERR
18.00	13	7.15	6.58	6.66	6.51
20.00	15	7.02	6.45	6.54	6.39
24.00	19	6.80	6.23	6.34	6.19
30.00	25	6.58	6.01	6.12	5.97
36.00	31	6.44	5.87	ERR	ERR
42.00	37	6.32	5.75	5.89	5.74
48.00	43	6.25	5.68	5.79	5.64
60.00	55	6.12	5.55	5.65	5.50
72.00	67	NA	NA	NA	NA
84.00	79	NA	NA	NA	NA

NOTES
-The piezo (dia 0.06m) was 0.10M from the well (dia 2.10m)
-Well was at rwl at start of test
-piezo dippings adjusted to make well wl = piezo wl at start of test
-original piezo dippings were 0.10 m lower

Table 3.6.6 Pumping-test data from tests completed at site 6, Matedze (continued)

SITE SIX LARGE DIA WELL HIGH DISCH AFTER LATERALS (14/10/94)

PUMPING DATA

SITE	six
DATE	14/10/94
TEST	hdal
TESTER	dt/tc
PUMPING TIME (hrs)	5.00
START VOL (m3)	3.538
END VOL. (m3)	21.566
START WL. (mbmd)	6.24
END WL. (mbmd)	8.25
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.30
CW DATUM	munro
DATUM ELEV. (magl)	0.57
BH DATUM	toc
DATUM ELEV.(magl)	0.15

CALCULATED DATA

AV PUMP RATE (l/s)	1.00
DRAWDOWN (m)	2.01
DEWATERED VOL (m3)	6.962
PUMPED VOL (m3)	18.028
'LAMDA'	0.39

COLLECTOR WELL DATA

T pstart (hrs)	T pstop (hrs)	WL (mbmd)	WL (mbgl)
0.00		6.24	5.67
1.00		6.95	6.38
2.00		7.39	7.00
3.00		7.73	7.34
4.00		8.01	7.63
5.00	0	8.25	7.84
6.00	1	7.78	7.21
7.00	2	7.52	6.95
8.00	3	7.35	6.78
9.00	4	7.22	6.65
10.00	5	7.13	6.56
12.00	7	6.96	6.39
14.00	9	6.83	6.26
16.00	11	6.74	6.17
18.00	13	6.67	6.10
20.00	15	6.60	6.03
24.00	19	6.50	5.93
30.00	25	6.40	5.83
36.00	31	6.33	5.76
42.00	37	6.26	5.69
48.00	43	6.20	5.63
60.00	55	6.16	5.59
72.00	67	NA	NA
84.00	79	NA	NA

PIEZO DATA

WL (mbd)	WL (mbgl)
5.8	5.65
6.47	6.32
6.92	6.77
7.26	7.11
7.55	7.40
7.76	7.61
7.35	7.20
7.09	6.94
6.94	6.79
6.81	6.66
ERR	ERR
ERR	ERR
ERR	ERR
ERR	ERR
ERR	ERR
6.17	6.02
6.07	5.92
5.97	5.82
ERR	ERR
ERR	ERR
5.78	5.63
5.74	5.59
NA	NA
NA	NA

NOTES
-The piezo (dia 0.06m) was 0.10M from the well (dia 2.10m)
-Well was at rwl at start of test

Table 3.6.6 Pumping-test data from tests completed at site 6, Matedze (continued)

SITE	six	Matedze			
TEST	Expl. BH T1	MEASURED DATA	DEPTH (mbgl)		8.85
DATE	05/02/94	TESTER DT	PUMP SET AT		8.00

BH DATA FROM MINISTRY OF WATER RECORDS ref:- NA

NAME	Matedze	WATER FIRST STRIKE (m)	6
NUMBER	NA	MAIN STRIKE (m)	NA
GRID REF	NA	REST WATER LEVEL (m)	4.84
DATE DRILLED	04/25/94	BLOWING YIELD (m3/h)	NA
DRILLED BY	Mr Rastall	CASED	---
DEPTH (m)	9.00	SCREENE (saw cut pipe)	0 to 9m
DIAMETER (m)	0.15	OPEN	---

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs)	0.43	AV PUMP RATE (l/s	0.53
START VOL (m3)	239.812	DRAWDOWN (m)	3.00
END VOL. (m3)	240.632	DEWATERED VOL (	0.053
START WL. (mbd)	4.74	PUMPED VOL (m3)	0.820
END WL. (mbd)	7.74	'LAMDA'	0.065
BH DATUM	toc		
DATUM ELEV.(magl)	-0.10		
PIEZO DATUM	toc		
DATUM ELEV.(magl)	0.6		

TEST DATA BH		BOREHOLE		PIEZO	
T pstart (min)	T pstop (min)	WL (mbd)	WL (mbgl)	WL (mbd)	WL (mbgl)
0.00		4.74	4.84	5.44	4.84
0.50		NA	NA	NA	NA
1.00		5.64	5.74	5.60	5.00
1.50		NA	NA	NA	NA
2.00		5.98	6.08	5.78	5.18
2.50		NA	NA	NA	NA
3.00		6.30	6.40	5.95	5.35
3.50		NA	NA	NA	NA
4.00		6.50	6.60	6.13	5.53
4.50		NA	NA	NA	NA
5.00		6.73	6.83	6.30	5.70
6.00		6.82	6.92	6.48	5.88
7.00		6.87	6.97	6.62	6.02
8.00		6.92	7.02	6.74	6.14
9.00		6.97	7.07	6.83	6.23
10.00		7.02	7.12	6.92	6.32
12.00		7.13	7.23	7.04	6.44
14.00		7.23	7.33	7.18	6.58
16.00		7.31	7.41	7.28	6.68
18.00		7.40	7.50	7.36	6.76
20.00		7.47	7.57	7.44	6.84
22.00		7.55	7.65	7.52	6.92
24.00		7.62	7.72	7.60	7.00
26.00	0	7.74	7.84	7.72	7.12
26.50	0.5	NA	NA	NA	NA

Table 3.6.6 Pumping-test data from tests completed at site 6, Matedze (continued)

27.00	1	7.58	7.68	7.70	7.10
27.50	1.5	NA	NA	NA	NA
28.00	2	7.45	7.55	7.68	7.08
28.50	2.50	NA	NA	NA	NA
29.00	3	7.34	7.44	7.66	7.06
29.50	3.5	NA	NA	NA	NA
30.00	4	7.24	7.34	7.60	7.00
30.50	4.5	NA	NA	NA	NA
31.00	5	7.16	7.26	7.56	6.96
32.00	6	7.08	7.18	7.50	6.90
33.00	7	6.99	7.09	7.45	6.85
34.00	8	6.91	7.01	7.38	6.78
35.00	9	6.82	6.92	7.32	6.72
36.00	10	6.67	6.77	7.26	6.66
38.00	12	6.25	6.35	7.06	6.46
40.00	14	5.95	6.05	6.83	6.23
42.00	16	5.78	5.88	6.64	6.04
44.00	18	5.66	5.76	6.48	5.88
46.00	20	5.56	5.66	6.36	5.76
48.00	22	5.49	5.59	6.25	5.65
50.00	24	5.41	5.51	6.18	5.58
52.00	26	5.34	5.44	6.10	5.50
54.00	28	5.29	5.39	6.04	5.44
56.00	30	5.25	5.35	5.99	5.39
58.00	32	5.21	5.31	5.94	5.34
61.00	35	5.16	5.26	5.88	5.28
66.00	40	5.1	5.20	5.80	5.20
71.00	45	5.05	5.15	5.75	5.15
76.00	50	5	5.10	5.70	5.10
86.00	60	4.94	5.04	5.64	5.04
96.00	70	4.9	5.00	5.59	4.99
106.00	80	4.86	4.96	5.56	4.96
116.00	90	4.84	4.94	5.53	4.93

Table 3.6.7 Attendees at pump maintenance workshop site 6, Matedze

NAME	KRAAL
JANI (B)	Bomero
CHIKOSI (Mujere)	Guyo
MUDZINGWA (Loveness)	Makonese
MUDZINGWA (Banicha)	Makonese
MUCHINI (Cladios)	Makonese
CHISASA (Robart)	Mushuku
CHEKERO (Munyaradzi)	Chekero
RUVIZHO (Lucas)	Guyo
KWARAMBA (Lorraine)	Guyo
MUSHUKU (Sullen)	Mushuku

Table 3.6.8 Water points in the region of collector well site 6, Matedze

Well no.	Builder/owner	Kraal	Date	Diameter (m)	Depth (m)	Water-level			Perceived yield	Water use	Dries-up	
						depth (m)	time	date			Every year	1992
1	ODA/ community	Bomero	1994	2.0	9.5	6.11	14:49	19/4/95	Excellent Max. 23 m^3/d Av. 11 m^3/d	Domestic (D) Garden (G)	No	na
2	DDF/ community	Bomero	1992		17	16.7			Poor	D	Yes	Yes
3	DDF/ community	Chekero	1992		17	16.7	15:00	19/4/95	Poor	D	Yes	Yes
4	DDF/ community	Makonese	1992		18	12.12			Poor	D	Yes	Yes
5	Con. Ass	Chekero	1986		72				Excellent	D	No	No
6	Min. H20		1994						Excellent	D Clinic (C)	na	na
7	Kwaramb	Bomero	1994		16				Poor	D,G	Yes	Yes

Table 3.6.9 Wells and boreholes monitored for water-levels at site 6, Matedze

WELL NUMBER	DATUM DESCRIPTION		DEPTH (m)	DIA (m)
	ELEV (magl)	ELEV (macwd)		
1	0.68	0.00	9.50	2.0
BH1	0.35	-0.49	10.6	0.10
BH2	0.00	-2.55	6.6	0.10

Site 7 - Machoka

Site description

Geology:	basalt
Location:	approx. 60 km east of Chiredzi Research Station, 10 km west of the Save River, 5 km south of the main Ngundu to Mutare road.
Access:	-
Annual rainfall:	580 mm

Exploratory drilling

Drilling:	DWD rig and crew
No. of exploratory holes:	1
Comments:	-

Specific construction details

Foreman:	Eliah Mafunga/Peter Msanu
Depth of well shaft:	9.5 m
Time to dig shaft:	22 weeks
No. of laterals:	none
Length of laterals:	n/a
Comments:	digging was hard and progress was slow, hampered by poor community organisation.

A soakaway trench (0.5m wide, 0.5m deep was dug on three sides of the slab to collect waste water and a further trench dug to drain the waste water away down slope. These trenches were filled with pieces of hard rock the size of a small fist to create a French drain.

Monitoring of well performance

Mr Maxwell Chinaya is to change the Munro water-level recorder chart and read the meters at 0600 every Sunday morning. He will also dip the DDF borehole and the DDF well and measure daily rainfall.

21°01'02.27"S 32°06'57.19"E
36K 408120.06mE 7675683.67mS. elevation 393m

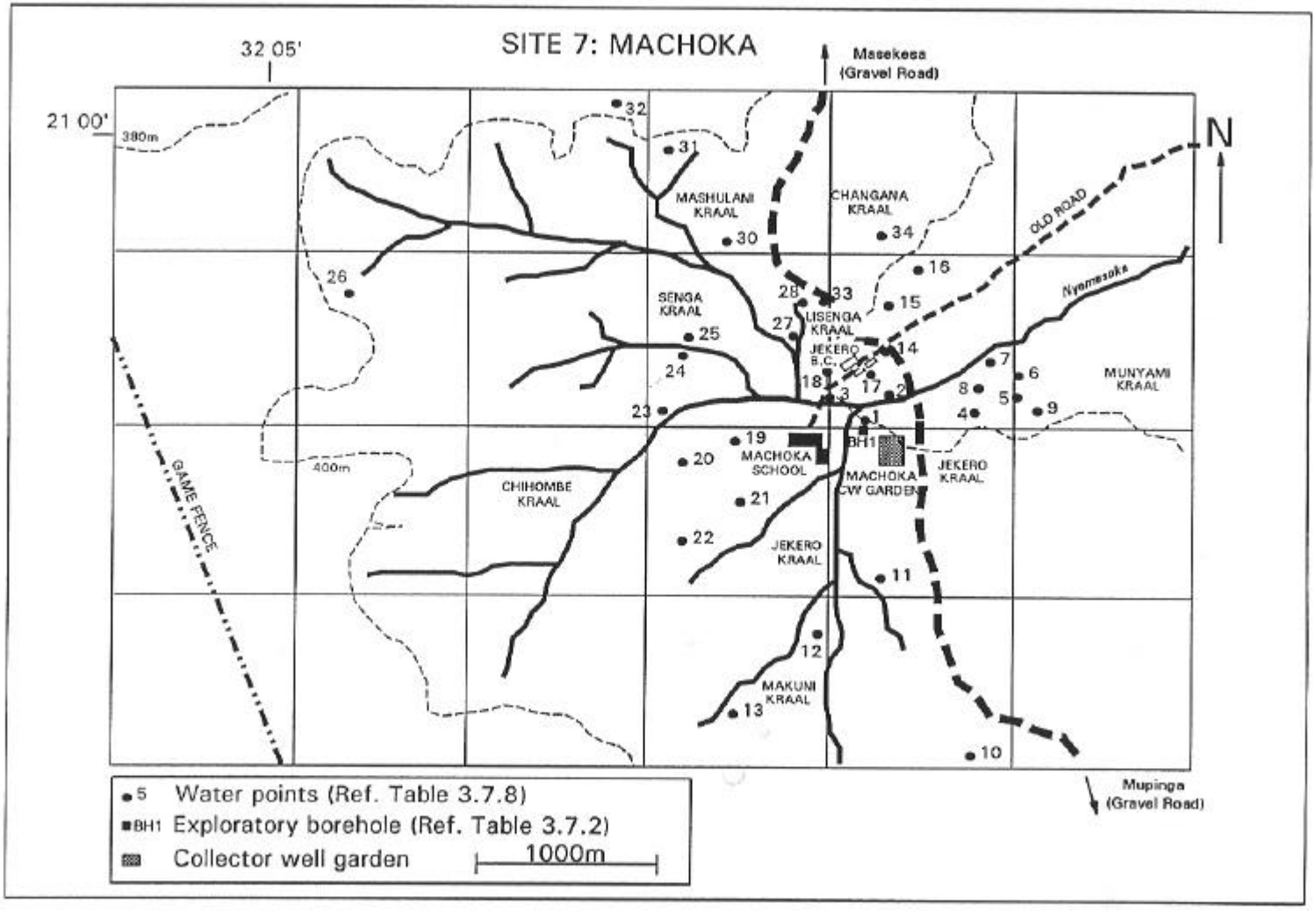


Figure 3.7.1 Map of location of collector well garden and local water points

not necessary

Figure 3.7.2 Detail showing location of exploratory boreholes

not applicable

Figure 3.7.3 Map of vicinity of collector well showing direction of laterals

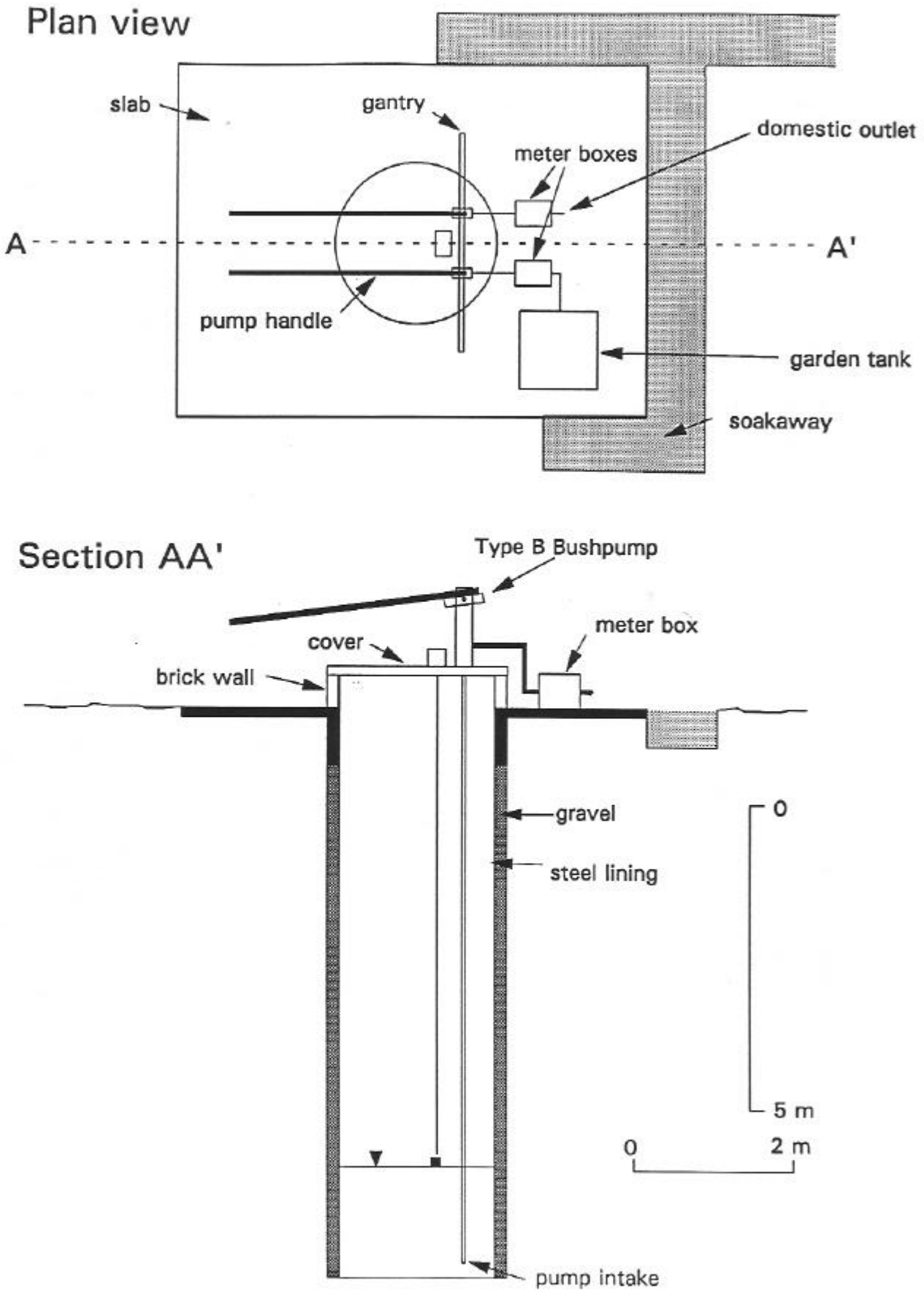


Figure 3.7.4 Collector well and headworks construction, site 7, Machoka

Table 3.7.1 Diary of activities at site 7, Machoka

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
identify site	20/04/94 (? days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel ?? drill bits ??
drill one exploratory hole	20/04/94 (1 day)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 25l drill bits ??
pumptest BH1	06/05/94 (1 day)	ptest engineer site assistant	Pump and associated equipment	petrol 5l
dig well shaft to 9.5m, backfill with gravel, concrete in sanitary seal, build and plaster head wall	14/12/94 (156 days)	construction manager site foreman 5 labourers Note. For much of the time there were only three labourers.	compressor pump + hoses winch + hoses wire rope gantry kibble personnel frame 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helmets 2 ear protectors jackhammer cement mixer shifting spanner 27mm spanner torch foreman's tent foreman's bed foreman's stove	cement 26bags bricks 200 river sand 4cum 19mm gravel 10cum diesel(comp) 3200l steel casing 9m jh points 9 jh side rod 1 chisels 2 pump rubbers 2 hydraulic oil 20l engine oil 15l gumboots 6prs overalls 3sets soap 6bars gloves 4prs paraffin 25l gas 20kg batteries 6 mask refills 3 pump bearings 2
complete headworks, well covers, water tank, soakaway, gantry	10/11/94 (7 days)	construction manager site foreman 5 labourers	formwork level trowel	bricks 100 cement 5bags sand/gravel 1cum pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15m 50mm elbows 2 50mm nipples 2
pump test collector well before laterals x 2	11/11/94 (4 days)	ptest engineer site assistant	pump and associated equipment	petrol 15l

Table 3.7.1 Diary of activities at site 7, Machoka (continued)

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
install bushpumps with community as part of pump maintenance workshop	(1 day)	instructor translator 6 local people	thread cutter for 60mm pipe and 19mm rods	50mm galv pipe 18m 50mm nipples 6 pump cylinder 2 17mm rods 18m type B bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for large dia. well, DDF borehole, DDF well piezometer 'bh1'	(2 days)	ptest engineer foreman	munro wl recorder 2 water meters	bricks 100 cement 3bags munro box 1 padlock 1 50mm galv pipe 6m 50mm elbows 8 50mm unionjoint 2 w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	(3 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20bags steel posts 13 steel stays 10 steel standards36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer, vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a separate report Thompson (1994).
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenance and attending to minor breakdowns.

Table 3.7.2 Drilling logs of exploratory boreholes at site 7, Machoka

EXPLORATORY DRILLING AT MACHOKA (COLLECTOR WELL SITE 7)

Exploratory borehole BH1
Drilled 20/04/94 by DWD air rig
diameter = 150mm, depth = 18m
first strike = 8m, RWL(21/4/94) = 7.92m
blowing yield(20/4/94) = 0.65l/s

Depth (m)	Penetration rate(min/m)	Comment
1.00	1.00	clay
2.00	1.00	clay
3.00	1.00	clay
4.00	1.00	weathered basalt
5.00	1.50	weathered basalt
6.00	1.50	weathered basalt
7.00	2.00	weathered basalt
8.00	5.00	harder basalt
9.00	5.00	break
10.00	5.00	harder basalt
11.00	5.00	weathered hardish
12.00	5.00	weathered hardish
13.00	5.00	weathered hardish
14.00	5.00	weathered hardish
15.00	5.00	weathered hardish
16.00	5.00	weathered hardish
17.00	5.00	weathered hardish
18.00	5.00	weathered hardish

Table 3.7.3 Geological descriptions of collector well digging samples, site 7, Machoka

MACHOKA (SITE SEVEN) GEOLOGICAL DESCRIPTION OF DRILLING SAMPLES FROM THE COLLECTOR WELL	
DEPTH (m)	Description
0 to 3	samples missing
3 to 4	Angular and sub-rounded fragments of weathered basalt and some friable pieces of soft, weathered basalt, with coating of grey drilling dust.
4 to 5	Angular pieces of weathered basalt with coatings as above. Some (few) small pieces of ?calcrete.
5 to 6	Angular pieces of less weathered basalt, fresh faces grey, fine grained, unstained.
6 to 7	Angular pieces of reddish basaltic rock containing black mineral patches (as at site 8).
7 to 8	Angular fragments of pale grey, slightly weathered to fresh rock, containing rounded black phenocrysts of ?hornblende or olivine.
8 to 9	Angular fragments of grey basaltic rock, some clean, some coated with greenish-grey clay.
9 to 10	Angular fragments of grey basalt, some clay coating, but much less than above.
10 to 11	Clean, angular fragments of fresh basalt, some dark grey, some reddish purple, some with quartz-filled vesicles, or quartz vein material.
11 to 12	Clean, angular fragments and dust of fresh basalt. Little to no iron staining.
12 to 13	As above. Fragments, mostly paler grey, showing round or oval patches of dark greenish mineral up to 5 mm across. Some also with white vesicles of quartz up to 2-3 mm across.
13 to 14	Clean, angular fragments of reddish basalt with dark green phenocrysts and of pale greenish-grey basalt, also with darker greenish patches or phenocrysts of ?olivine.
14 to 16	Angular fragments of greenish-grey basalt as above, and some of the more reddish type described earlier, both with dark mineral patches.
16 to 17	Clean, angular fragments of pale grey basalt.
17 to 18	Clean, angular fragments of grey basalt, with some smaller, rounded buff pieces of ?more weathered basalt and some basalt pieces with white calcite veining.

Table 3.7.4 Lateral drilling logs from site 7, Machoka

Large-diameter well not converted to collector well.

Table 3.7.5 Pumping-tests performed at site 7, Machoka

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	10/26/94	T1CWBL(TD = 8.76mbgl)	DT/TC	1.00	5.00	7.72	8.42	<7.86	2220	RATE+-3%, end of test wl close to well bottom. well deepened to 9.50mbgl by 14/12/94, Retest?

WELL DESCRIPTION_____ EXPLORATORY BH

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	05/06/94	T1	DT	0.64	10	7.12	7.28	<7.12	8	RATE+-3%, RATE TOO LOW
2	05/06/94	T2	DT	1.06	120	7.12	7.66	<7.12	80	RATE+-3%

Table 3.7.6 Pumping-test data from tests completed at site 7, Machoka

SITE SEVEN LARGE DIA WELL HIGH DISCH BEFORE LATERALS (25/10/94)

PUMPING DATA

SITE	seven
DATE	10/25/94
TEST	hdbl
TESTER	dt/tc
PUMPING TIME (hrs)	5.00
START VOL (m3)	39.582
END VOL. (m3)	57.582
START WL. (mbd)	7.86
END WL. (mbd)	8.51
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.25
CW DATUM	mark on casing
DATUM ELEV. (magl)	0.14
BH DATUM	toc
DATUM ELEV.(magl)	0.15

CALCULATED DATA

AV PUMP RATE (l/s)	1.00
DRAWDOWN (m)	0.65
DEWATERED VOL (m3)	2.251
PUMPED VOL (m3)	18.000
'LAMDA'	0.13

COLLECTOR WELL DATA

PIEZO DATA

T pstart (hrs)	T pstop (hrs)	WL (mbd)	WL (mbgl)	WL (mbd)	WL (mbgl)
0.00		7.86	7.72	7.87	7.72
1.00		8.17	8.03	8.13	7.98
2.00		8.28	8.14	8.23	8.08
3.00		8.37	8.23	8.32	8.17
4.00		8.45	8.31	8.40	8.25
5.00	0	8.56	8.42	8.51	8.36
6.00	1	8.22	8.08	8.21	8.06
7.00	2	8.12	7.98	8.11	7.96
8.00	3	8.07	7.93	8.08	7.93
9.00	4	8.04	7.90	8.04	7.89
10.00	5	8.02	7.88	8.02	7.87
12.00	7	NA	NA	NA	NA
14.00	9	NA	NA	NA	NA
16.00	11	NA	NA	NA	NA
18.00	13	7.95	7.81	7.96	7.81
20.00	15	7.95	7.81	7.95	7.80
24.00	19	7.93	7.79	7.94	7.79
30.00	25	7.92	7.78	7.93	7.78
36.00	31	7.92	7.78	7.93	7.78
42.00	37	7.91	7.77	7.92	7.77
48.00	43	NA	NA	NA	NA
60.00	55	NA	NA	NA	NA
72.00	67	NA	NA	NA	NA
84.00	79	NA	NA	NA	NA

NOTES
-The piezo (dia 0.06m) was 1.00M from the well (dia 2.10m)
-Well was at rwl at start of test
-dipped to temporary datum, wall incomplete.
-maximum depth = 8.67mbgl well bottom not flat.

Table 3.7.6 Pumping-test data from tests completed at site 7, Machoka (continued)

SITE	seven	Machoka School			
TEST	Expl. BH T1	MEASURED DATA	DEPTH (mbgl)		16.40
DATE	05/06/94	TESTER DT	PUMP SET AT		13.40

BH DATA FROM MINISTRY OF WATER RECORDS ref:- NA

NAME	Machoka School	WATER FIRST STRIKE (m)	8
NUMBER	NA	MAIN STRIKE (m)	NA
GRID REF	NA	REST WATER LEVEL (m)	7.92
DATE DRILLED	04/20/94	BLOWING YIELD (m3/h)	2.35
DRILLED BY	DWD Mr Chikuni	CASED	---
DEPTH (m)	18.00	SCREENED	---
DIAMETER (m)	0.15	OPEN	0 to 18

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs)	0.17	AV PUMP RATE (l/s)	0.54
START VOL (m3)	244.772	DRAWDOWN (m)	0.16
END VOL. (m3)	245.096	DEWATERED VOL (m3)	0.003
START WL. (mbd)	7.12	PUMPED VOL (m3)	0.324
END WL. (mbd)	7.28	'LAMDA'	0.009
BH DATUM	toc		
DATUM ELEV.(magl)	0.00		

TEST DATA BH

T pstart (min)	T pstop (min)	WL (mbd)	WL (mbgl)
0.00		7.12	7.12
0.50		7.26	7.26
1.00		7.27	7.27
2.00		7.27	7.27
3.00		7.27	7.27
4.00		7.27	7.27
5.00		7.28	7.27
6.00		7.28	7.28
7.00		7.28	7.28
8.00		7.28	7.28
9.00		7.28	7.28
10.00	0	7.28	7.28
10.50	0.5	7.14	7.14
11.00	1	7.13	7.13
11.50	1.5	7.13	7.13
12.00	2	7.13	7.13
12.50	2.5	7.13	7.13
13.00	3	7.12	7.12
13.50	3.5	7.12	7.12
14.00	4	7.12	7.12
14.50	4.5	7.12	7.12
15.00	5	7.12	7.12
16.00	6	7.12	7.12
17.00	7	7.12	7.12
18.00	8	7.12	7.12

Table 3.7.6 Pumping-test data from tests completed at site 7, Machoka (continued)

SITE	seven	Machoka School		
TEST	Expl. BH T2	MEASURED DATA	DEPTH (mbgl)	16.40
DATE	05/06/94	TESTER DT	PUMP SET AT	13.40

BH DATA FROM MINISTRY OF WATER RECORDS ref:- NA

NAME	Machoka School	WATER FIRST STRIKE (m)	8
NUMBER	NA	MAIN STRIKE (m)	NA
GRID REF	NA	REST WATER LEVEL (m)	7.92
DATE DRILLED	04/20/94	BLOWING YIELD (m3/h)	2.35
DRILLED BY	DWD Mr Chikuni	CASED	---
DEPTH (m)	18.00	SCREENED	---
DIAMETER (m)	0.15	OPEN	0 to 18

PUMPING DATA

PUMPING TIME (hrs	2.00
START VOL (m3)	245.096
END VOL. (m3)	252.732
START WL. (mbd)	7.12
END WL. (mbd)	7.67
BH DATUM	toc
DATUM ELEV.(magl	0.00

CALCULATED DATA

AV PUMP RATE (l/s)	1.06
DRAWDOWN (m)	0.55
DEWATERED VOL (m3)	0.010
PUMPED VOL (m3)	7.636
'LAMDA'	0.001

TEST DATA BH

T pstart (min)	T pstop (min)	WL (mbd)	WL (mbgl)
0.00		7.12	7.12
0.50		7.47	7.47
1.00		7.50	7.50
1.50		7.51	7.50
2.00		7.52	7.51
2.50		7.52	7.52
3.00		7.53	7.52
3.50		7.53	7.53
4.00		7.53	7.53
4.50		7.53	7.53
5.00		7.53	7.53
6.00		7.53	7.53
7.00		7.55	7.55
8.00		7.55	7.55
9.00		7.55	7.55
10.00		7.55	7.55
12.00		7.56	7.56
14.00		7.57	7.57
16.00		7.57	7.57
18.00		7.57	7.57
20.00		7.58	7.58
22.00		7.57	7.57
24.00		7.58	7.58
26.00		7.58	7.58
28.00		7.59	7.59
30.00		7.59	7.59
32.00		7.60	7.60

Table 3.7.6 Pumping-test data from tests completed at site 7, Machoka (continued)

35.00		7.60	7.60
40.00		7.61	7.61
45.00		7.61	7.61
50.00		7.62	7.62
60.00		7.62	7.62
70.00		7.63	7.63
80.00		7.64	7.64
90.00		7.65	7.65
100.00		7.65	7.65
120.00	0.00	7.67	7.67
120.50	0.50	7.29	7.29
121.00	1.00	7.28	7.28
121.50	1.50	7.27	7.27
122.00	2.00	7.27	7.27
122.50	2.50	7.26	7.26
123.00	3.00	7.26	7.26
123.50	3.50	7.25	7.25
124.00	4.00	7.25	7.25
124.50	4.50	7.25	7.25
125.00	5.00	7.24	7.24
126.00	6.00	7.24	7.24
127.00	7.00	7.23	7.23
128.00	8.00	7.23	7.23
129.00	9.00	7.23	7.23
130.00	10.00	7.23	7.23
132.00	12.00	7.22	7.22
134.00	14.00	7.22	7.22
136.00	16.00	7.21	7.21
138.00	18.00	7.21	7.21
140.00	20.00	7.21	7.21
142.00	22.00	NA	NA
144.00	24.00	NA	NA
146.00	26.00	7.21	7.21
148.00	28.00	NA	NA
150.00	30.00	NA	NA
152.00	32.00	7.20	7.20
155.00	35.00	NA	NA
160.00	40.00	NA	NA
165.00	45.00	7.19	7.19
170.00	50.00	NA	NA
180.00	60.00	7.18	7.18
190.00	70.00	NA	NA
200.00	80.00	7.16	7.16

Table 3.7.6 Pumping-test data from tests completed at site 7, Machoka (continued)

SITE # 7 DIGGING DATA

DIGGING STARTED	03-May-94
DIGGING FINISHED	28-Jul-94
TOTAL DIGGING TIME	12.3 WEEKS

DATUM DESCRIPTION	HEIGHT ABOVE GROUND LEVEL (m)
Top of wall	0.58
Munro datum (Top of slab)	0.68

DEPTH OF WELL 9.42 mbgl

RECOVERY AFTER DIGGING

DATE	TIME (of day)	REC. TIME (hrs)	WL (mbtoc)	activity during preceding 24hrs
06/15/94	06:00	0.00	10.10	dewatering to 10.10m
06/16/94	06:00	24.00	9.04	
06/17/94	06:00	48.00	8.22	
06/18/94	06:00	72.00	7.65	
06/20/94	06:00	120.00	6.95	
06/21/94	06:00	144.00	6.70	
06/22/94	06:00	168.00	6.50	
06/23/94	06:00	192.00	6.30	
06/24/94	06:00	216.00	6.11	
06/26/94	06:00	264.00	6.00	
06/28/94	06:00	312.00	5.96	
06/29/94	06:00	336.00	5.95	
06/30/94	06:00	360.00	5.94	

Table 3.7.7 Attendees at pump maintenance workshop site 7, Machoka

not available

Table 3.7.8 Water points in the region of collector well site 7, Machoka

not available

Table 3.7.9 Wells and boreholes monitored for water-levels at site 7, Machoka

not available

Site 8 - Masekesa

Site description

Geology:	basalt
Location:	approx. 60 km east of Chiredzi Research Station, 10 km west of the Save River, just north of the main Mutare to Ngundu road.
Access:	-
Annual rainfall:	580 mm

Exploratory drilling

Drilling:	DWD drilling rig and crew
No. of exploratory holes:	2
Comments:	-

Specific construction details

Foreman:	Peter Msanu
Depth of well shaft:	18 m
Time to dig shaft:	23 weeks
No. of laterals:	4
Length of laterals:	9, 19, 27, 27 m
Comments:	digging was hard and progress was slow, hampered by poor community organisation.

A soakaway trench (0.5m wide, 0.5m deep was dug on three sides of the slab to collect waste water and a further trench dug to drain the waste water away down slope. These trenches were filled with pieces of hard rock the size of a small fist to create a French drain.

Monitoring of well performance

The water-level in the collector well, Mr Gwenzi's well and the DDF borehole will be dipped by Mr Gwenzi at 0600 each Sunday. The pumping times of the borehole will also be recorded.

20° 56' 50.886" S 32° 06' 25.46" E
36K 407166.43m E 7679724.24m S

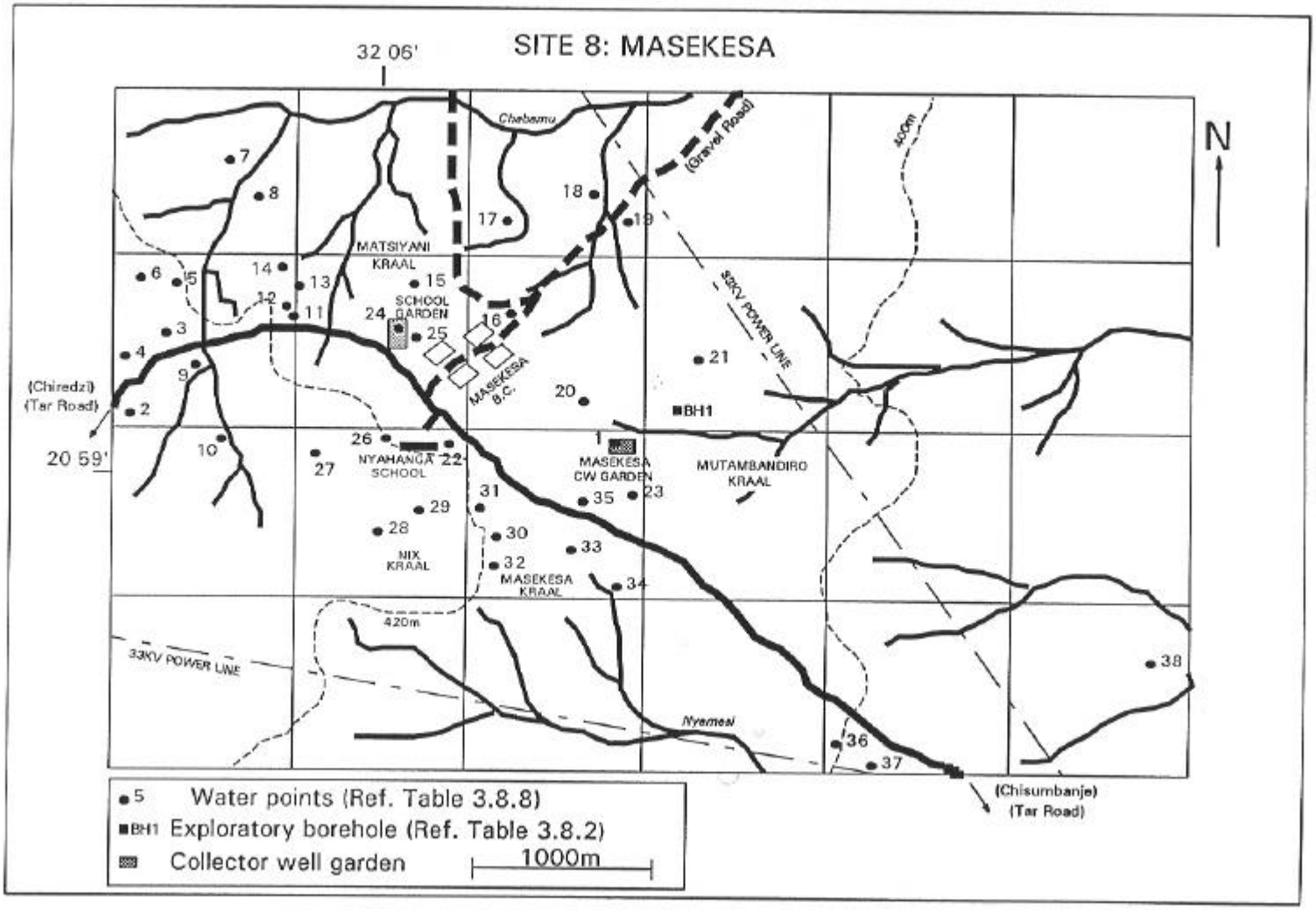


Figure 3.8.1 Map of location of collector well garden and local water points

not necessary

Figure 3.8.2 Detail showing location of exploratory boreholes

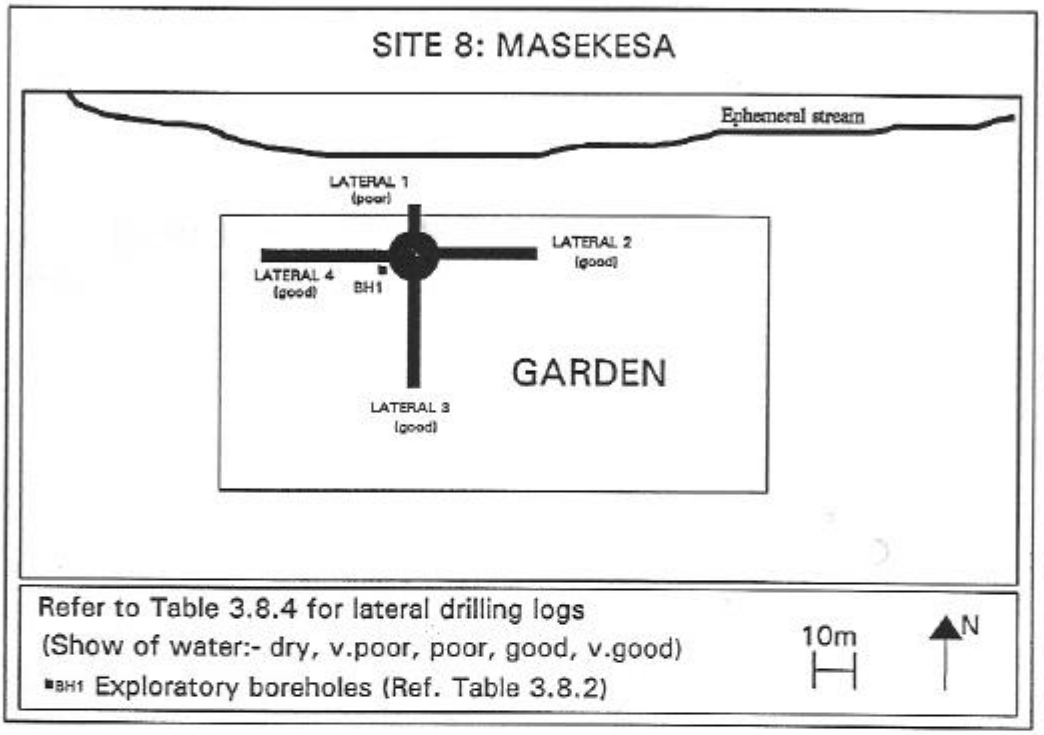
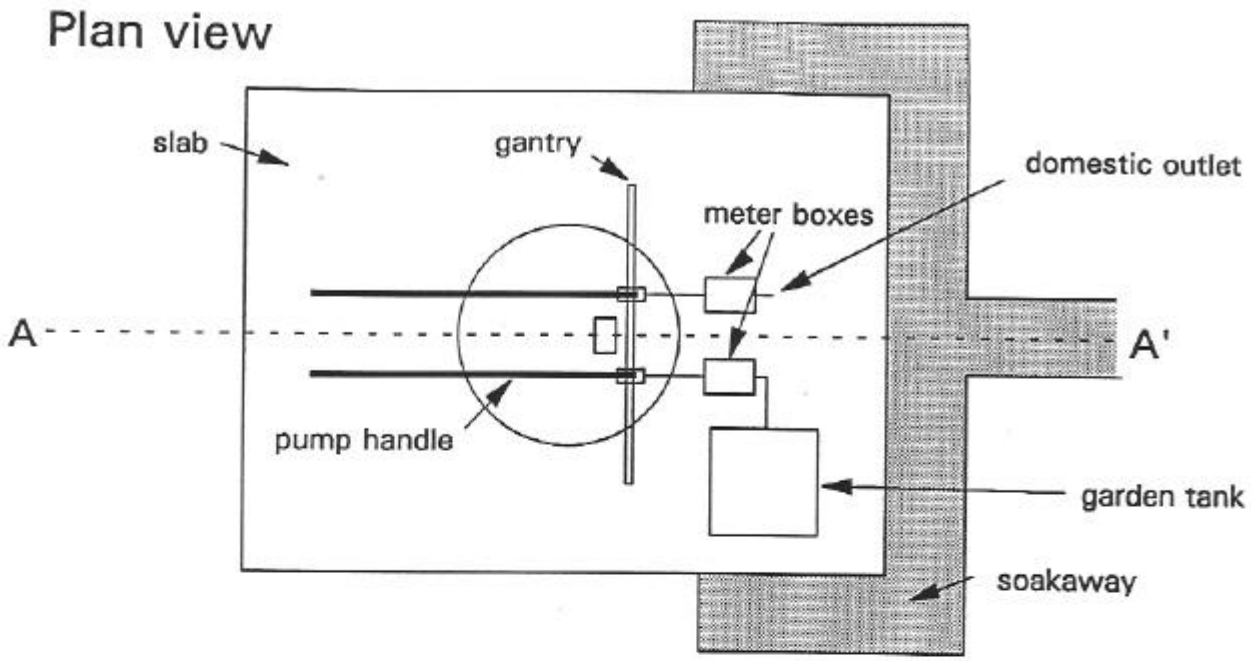


Figure 3.8.3 Map of vicinity of collector well showing direction of laterals



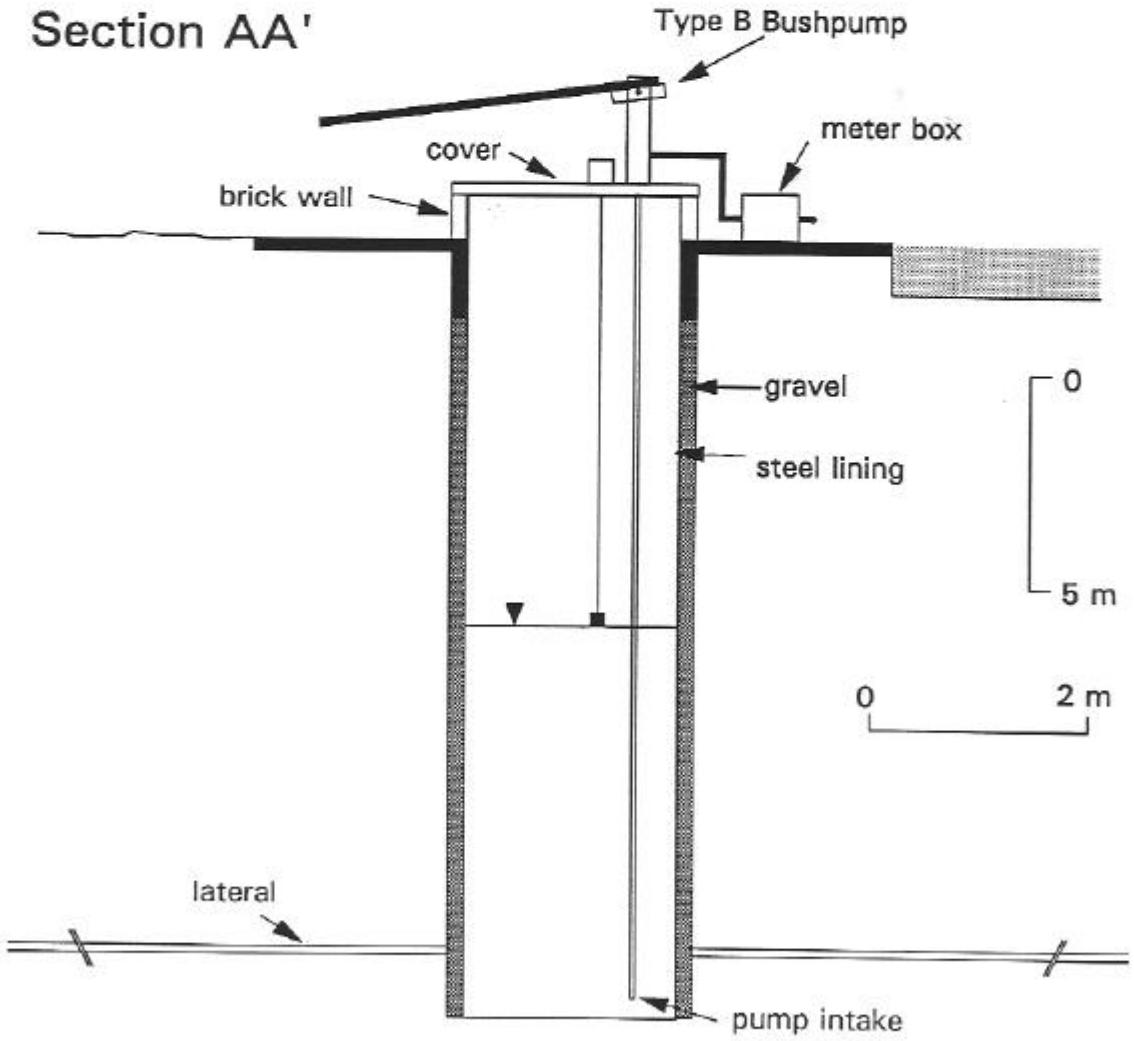


Figure 3.8.4 Collector well and headworks construction, site 8, Masekesa

Table 3.8.1 Diary of activities at site 8, Masekesa

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
identify site	23/04/94 (? days)	hydrogeologist driller 1 labourer	air rig and associated eqipment	diesel ?? drill bits ??
drill two exploratory holes	23/04/94 (2 days)	hydrogeologist driller 1 labourer	air rig and associated equipment	diesel 50l drill bits ??
pumptest BH2	05/05/94 (1 day)	ptest engineer site assistant	Pump and associated equipment	petrol 5l
dig well shaft to 18m, backfill with gravel, concrete sanitary seal, build and plaster head wall	23/10/94 (164 days)	construction manager site foreman 5 labourers	compressor pump + hoses winch + hoses wire rope gantry kibble personnel frame 4 200l drums 2 picks 2 wheelbarrows 4 shovels 6 helments 2 ear protectors jackhammer cement mixer shifting spanner 27mm spanner tourch forman's tent foreman's bed foreman's stove	cement 26bags bricks 200 river sand 4cum 19mm gravel 10cum diesel(comp) 5200l steel casing 18m jh points 9 jh anvil block 1 jh fronthead 1 jh side rod 2 jh pins 2 pump rubbers 2 hydraulic oil 20l engine oil 15l gumboots 6prs overalls 3sets soap 6bars gloves 4prs parrafin 25l gas 20kg batteries 6
lateral drilling (four laterals)	28/10/94 (5 days)	driller crane operator 1 labourer	air rig and associated equipment	16mm wire rope 15m diesel 1200l
complete headworks, well covers, water tank, soakaway, gantry	10/11/94 (7 days)	construction manager site foreman 5 labourers	formwork level trovel	bricks 100 cement 5bags sand/gravel 1cum pump mountings 2 handles 4 reinforcing 8sqm 50mm galv pipe 15m 50mm elbows 2 50mm nipples 2
pump test collector well before laterals x 1 after laterals x 2	11/11/94 (6 days)	ptest engineer site assistant	pump and associated equipment	petrol 15l

Table 3.8.1 Diary of activities at site 8, Masekesa (continued)

ACTIVITY	COMPLETION DATE (DURATION)	PERSONNEL REQUIRED	EQUIPMENT REQUIRED	MATERIALS USED
install bushpumps with community as part of pump maintenance workshop	(1 day)	instructor translator 6 local people	thread cutter for 50mm pipe and 19mm rods	50mm galv pipe 34m 50mm nipples 11 pump cylinder 2 17mm rods 34m type B bushpump 2 handles 2 18" pipe wrench 2 10" shifter 1 15mm rope 20m 2" pipe clamp 1 2" lifting plug 1 pump manual 1
install monitoring for collector well DDF borehole piezometer 'bh2' Mr Gwenezi's well.	(1 day)	ptest engineer		w.level dipper 1 notebook 1 pen 2 raingauge 1
erect garden fence and hang gate	(3 days)	construction manager site foreman 20 local people	cement mixer 2 wheel barrows 4 shovels 2 picks wire strainer electric drill 18mm drill bit generator	cement 20bags steel posts 13 steel stays 10 steel standards36 gate 1 diamond mesh 10rls barbed wire 50kg 13Gge wire 50kg 14Gge wire 50kg

NOTES

1 All tasks required a driver with ready access to a landrover and twin axle (2m3) trailer. vehicle running costs are not included in this table.
2 Construction manager, pumptest engineer and instructor can be done by one person.
3 Equipment required for pump testing is detailed in a seperate report Thompson (1994).
4 The construction manager required a comprehensive set of general tools for all tasks.
5 The site foreman required a small set of tools for maintenence and attending to minor breakdowns.

Table 3.8.2 Drilling logs of exploratory boreholes at site 8, Masekesa

EXPLORATORY DRILLING AT MASEKESA (COLLECTOR WELL SITE 8)

Exploratory borehole BH1
Drilled 22/04/94 by DWD air rig
diameter = 150mm, depth = 19.5m
dry when drilled
RWL(23/4/94) = ??

Exploratory borehole BH2
Drilled 23/04/94 by DWD air rig
diameter = 150mm, depth = 30m
first strike = 18m, main strike = 18m RWL(24/4/94) = 9.24m
blowing yeild(24/4/94) = 0.36l/s

Depth (m)	Penetration rate(min/m)	Comment	Depth (m)	Penetration rate(min/m)	Comment
1.00	na	clay	1.00	na	soft
2.00	na	clay	2.00	na	soft
3.00	na	clay	3.00	na	soft
4.00	2.00	fine dry dust	4.00	na	soft
5.00	2.00	fine dry dust	5.00	na	soft
6.00	2.00	fine dry dust	6.00	na	soft
7.00	4.24	weathered	7.00	na	hard pieces
8.00	4.24	basalt	8.00	na	weathered
9.00	4.24	partly hard	9.00	na	basalt
10.00	3.00	hard	10.00	1.07	decomposed
11.00	3.00	hard	11.00	na	decomposed
12.00	2.70	decomposed	12.00	1.30	decomposed
13.00	2.70	decomposed	13.00	1.60	hard pieces
14.00	2.70	desomposed	14.00	0.20	decomposed
15.00	2.70	decomposed	15.00	0.30	moisture
16.00	2.70	hard	16.00	0.70	moisture
17.00	3.00	hard	17.00	0.70	moisture
18.00	3.00	hard	18.00	1.00	first strike
19.00	3.00	hard	19.00	2.70	decomposed
20.00			20.00	3.23	hard pieces
21.00			21.00	3.72	hard pieces
22.00			22.00	3.70	hard pieces
23.00			23.00	3.90	hard pieces
24.00			24.00	3.90	quite hard
25.00			25.00	2.90	quite hard
26.00			26.00	3.70	quite hard
27.00			27.00	3.90	hard
28.00			28.00	4.00	hard
29.00			29.00	4.00	hard
30.00			30.00	4.00	hard

Table 3.8.3 Geological descriptions of collector well digging samples, site 8, Masekesa

MASEKESA (SITE EIGHT) GEOLOGICAL DESCRIPTION OF DIGGING SAMPLES FROM THE LARGE DIAMETER WELL	
DEPTH (m)	Description
0 to 1	Black sandy, silty soil.
1 to 2	Grey clay soil. Some small (1-2mm) pieces of white mineral.
2 to 4	Angular pieces of grey basaltic rock with some reddish brown iron staining on joint faces and some quartz patches. Thin white coatings of ?calcite on some faces.
4 to 4.5	Angular fragments of grey basalt, clean pieces fresh with some weathering on joint faces, and pieces as 3-4 m above. Also white angular pieces of ?calcrete or ?weathered calcite veining of baked soil horizon.
4.5 to 5	Mixture 50:50 of a) angular fragments of grey basalt as above, with brownish-buff weathering spots. Some pieces with ?calcite or ?calcrete on faces, and b) angular white pieces of calcrete or possibly material from a baked soil horizon.
5 to 6	As above, 50:50 mixture of grey basalt fragments and angular pieces of white calcrete.
6 to 7	Much smaller angular fragments of slightly weathered basalt and angular pieces of ?calcrete.
7 to 8	Angular fragments of grey, slightly weathered, basalt with some brownish spotting as above. Some fragments showing slightly brownish stained calcite veining on surfaces, coated with fine buff-grey dust. One large angular piece of ?calcrete as above.
8 to 9	As above, but smaller fragments and mostly basalt not calcrete.
9 to 10	Angular fragments of slightly weathered basalt, and few small pieces of ?calcrete.
10 to 11	Small angular pieces of more heavily weathered basalt coated with buff fine dust of silt and maybe some clay. Some very soft pieces of heavily rotted basalt, no calcrete.
11 to 12	Angular pieces of weathered reddish basaltic rock, in which black minerals stand out as spots 1-2mm across. Also, as above, some soft friable lumps of heavily weathered rock.
12 to 13	As above. Angular fragments of reddish weathered basaltic rock, together with few smaller fragments of ?calcrete.
13 to 14	Angular pieces of weathered basalt, slightly reddish, with some white patches up to 2-3mm across.
14 to 18	Angular pieces of coarser-grained basaltic rock, showing buff-reddish iron staining, some black patches or grains of unweathered minerals up to 2-3mm across. Some soft enough to break.

Table 3.8.4 Lateral drilling logs from site 8, Masekesa

MASEKESA SITE EIGHT. COLLECTOR WELL LATERAL DRILLING LOGS				
	LATERAL 1	LATERAL 2	LATERAL 3	LATERAL 4
DRILLER	P.Rastall	P.Rastall	P.Rastall	P.Rastall
DIRECTION	north	east	south	west
ELEVATION	-5 degrees	-5 degrees	-5 degrees	-5 degrees
LENGTH	12rods,9m	26rods,19.5m	36rods,27m	36rods,27m
COMPLETED	24/9/94	25/9/94	26/9/94	28/9/94
WATER FLOW	fair	lots	lots	lots
ROD NUMBER (0.75m rods)	**COMMENT**	**COMMENT**	**COMMENT**	**COMMENT**
1	weathered	weathered	weathered	hard
2	weathered	weathered	weathered	weathered
3	weathered	weathered	weathered	weathered
4	weathered	weathered	weathered	weathered
5	weathered	weathered	weathered	weathered
6	weathered	weathered	weathered	weathered
7	weathered	weathered	weathered	weathered
8	weathered	weathered	weathered	weathered
9	weathered	weathered	weathered	weathered
10	hard	weathered	weathered	weathered
11	hard	|	weathered	weathered
12	hard	|	|	|
13		|	|	|
14		hard bands with very	|	|
15		soft, black basalt	|	|
16		gravel	|	|
17		|	|	|
18		|	|	hard bands
19		|	hard bands with soft	|
20		|	black gravel and clay	|
21		|	|	|
22		|	|	|
23		|	|	hard
24		|	|	hard
25		|	|	hard
26		|	|	hard
27		|	|	
28		|	|	
29		|	|	
30		|	|	
31		|	|	
32		|	|	
33			|	
34			|	
35			|	
36				
37				
38				
39				
40				

Table 3.8.5 Pumping-tests performed at site 8, Masekesa

WELL DESCRIPTION_____ COLLECTOR WELL

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	10/10/94	LDW	DT/TC	1.00	300	9.23	12.21	<9.23	4320	RATE+-3%
3a	11/03/94	CW	DT/TC	1.00	300	9.48	12.34	<9.48	3120	poor test DDF pumped bh 30m away
3b	11/11/94	CW	DT/TC	1.00	300	9.36	12.09	<9.36	3960	RATE+-3%, repeated above test

WELL DESCRIPTION_____ EXPLORATORY BOREHOLE

TEST No	DATE	DESCRIPTION	TEST BY	PUMP RATE (l/s)	PUMP TIME (min)	PSTART WL (mbgl)	PSTOP WL (mbgl)	RWL ESTM. (mbgl)	REC. TIME (min)	COMMENTS
1	05/05/94	OPEN BH	DT	0.49	100	9.01	17.26	9.01	1540	RATE+-3%

Table 3.8.6 Pumping-test data from tests completed at site 8, Masekesa

SITE EIGHT LARGE DIA WELL HIGH DISCH BEFORE LATERALS (19/10/94)

PUMPING DATA

SITE	eight
DATE	19/10/94
TEST	hdbl
TESTER	dt/pm
PUMPING TIME (hrs)	5.00
START VOL (m3)	21.559
END VOL. (m3)	39.582
START WL. (mbd)	9.36
END WL. (mbd)	12.34
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.25
CW DATUM	toc
DATUM ELEV. (magl	0.13
BH DATUM	toc
DATUM ELEV.(magl)	0.15

CALCULATED DATA

AV PUMP RATE (l/s)	1.00
DRAWDOWN (m)	2.98
DEWATERED VOL (m3)	10.322
PUMPED VOL (m3)	18.023
'LAMDA'	0.57

COLLECTOR WELL DATA

T pstart (hrs)	T pstop (hrs)	WL (mbd)	WL (mbgl)
0.00		9.36	9.23
1.00		10.20	10.07
2.00		10.87	10.74
3.00		11.45	11.32
4.00		11.93	11.80
5.00	0	12.34	12.21
6.00	1	11.84	11.71
7.00	2	11.40	11.27
8.00	3	11.06	10.93
9.00	4	10.78	10.65
10.00	5	10.54	10.41
12.00	7	10.28	10.15
14.00	9	NA	NA
16.00	11	NA	NA
18.00	13	NA	NA
20.00	15	9.52	9.39
24.00	19	9.40	9.27
30.00	25	9.34	9.21
36.00	31	9.30	9.17
42.00	37	9.27	9.14
48.00	43	9.26	9.13
60.00	55	NA	NA
72.00	67	NA	NA
84.00	79	NA	NA

PIEZO DATA

WL (mbd)	WL (mbgl)
9.38	9.23
9.73	9.58
10.02	9.87
10.28	10.13
10.49	10.34
10.66	10.51
10.51	10.36
10.33	10.18
10.20	10.05
10.10	9.95
9.95	9.80
9.82	9.67
NA	NA
NA	NA
NA	NA
9.48	9.33
9.41	9.26
9.34	9.19
9.32	9.17
9.29	9.14
9.29	9.14
NA	NA
NA	NA
NA	NA

NOTES
-The piezo (dia 0.06m) was 3.52M from the well (dia 2.10m)
-Well was at rwl at start of test
-well dipped to top of casing, wall not complete. TD = 18m toc

Table 3.8.6 Pumping-test data from tests completed at site 8, Masekesa (continued)

SITE EIGHT LARGE DIA WELL HIGH DISCH AFTER LATERALS (11/11/94)

PUMPING DATA

SITE	eight
DATE	11/11/94
TEST	HDAL#2
TESTER	DT/TC
PUMPING TIME (hrs)	5.00
START VOL (m3)	323.147
END VOL. (m3)	341.073
START WL. (mbd)	9.49
END WL. (mbd)	12.22
ORIFICE DIA (mm)	19.00
PRESS. DIFF (m)	1.25
CW DATUM	toc
DATUM ELEV. (magl	0.13
BH DATUM	toc
DATUM ELEV.(magl)	0.15

CALCULATED DATA

AV PUMP RATE (l/s)	1.00
DRAWDOWN (m)	2.73
DEWATERED VOL (m3)	9.456
PUMPED VOL (m3)	17.926
'LAMDA'	0.53

COLLECTOR WELL DATA

T pstart (hrs)	T pstop (hrs)	WL (mbd)	WL (mbgl)
0.00		9.49	9.36
1.00		10.32	10.19
2.00		10.96	10.83
3.00		11.48	11.35
4.00		11.90	11.77
5.00	0	12.22	12.09
6.00	1	11.73	11.60
7.00	2	11.32	11.19
8.00	3	10.99	10.86
9.00	4	NA	NA
10.00	5	NA	NA
12.00	7	NA	NA
14.00	9	NA	NA
16.00	11	NA	NA
18.00	13	9.78	9.65
20.00	15	9.72	9.59
24.00	19	9.65	9.52
30.00	25	9.59	9.46
36.00	31	NA	NA
42.00	37	9.56	9.43
48.00	43	9.54	9.41
60.00	55	NA	NA
72.00	67	NA	NA
84.00	79	NA	NA

PIEZO DATA

WL (mbd)	WL (mbgl)
9.47	9.32
9.83	9.68
10.11	9.96
10.35	10.20
10.56	10.41
10.75	10.60
10.56	10.41
10.38	10.23
10.25	10.10
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
9.66	9.51
9.63	9.48
9.58	9.43
9.55	9.40
NA	NA
9.52	9.37
9.50	9.35
NA	NA
NA	NA
NA	NA

NOTES
-The piezo (dia 0.06m) was 3.52M from the well (dia 2.10m)
-Well was at rwl at start of test
-well dipped to top of casing, wall not complete. TD = 18m toc
-Test repeated, #1 was spoilt by pumping of nearby bh
-Effect on well test of bh pumping shown in 't3cwal#1.wk3'

Table 3.8.6 Pumping-test data from tests completed at site 8, Masekesa (continued)

SITE EIGHT LARGE DIA WELL HIGH DISCH AFTER LATERALS (3/11/94)

PUMPING DATA		CALCULATED DATA	
SITE	eight	AV PUMP RATE (l/s)	1.00
DATE	3/11/94	DRAWDOWN (m)	2.86
TEST	HDAL#1	DEWATERED VOL (m3)	9.906
TESTER	DT/TC	PUMPED VOL (m3)	17.933
PUMPING TIME (hr	5.00	'LAMDA'	0.55
START VOL (m3)	305.209		
END VOL. (m3)	323.142		
START WL. (mbd)	9.61		
END WL. (mbd)	12.47		
ORIFICE DIA (mm)	19.00		
PRESS. DIFF (m)	1.25		
CW DATUM	toc		
DATUM ELEV. (ma	0.13		
BH DATUM	toc		
DATUM ELEV.(magl	0.15		

COLLECTOR WELL DATA				PIEZO DATA	
T pstart (hrs)	T pstop (hrs)	WL (mbd)	WL (mbgl)	WL (mbd)	WL (mbgl)
0.00		9.61	9.48	NA	NA
1.00		10.46	10.33	NA	NA
2.00		11.10	10.97	10.17	10.02
3.00		11.63	11.50	10.43	10.28
4.00		12.08	11.95	10.69	10.54
5.00	0	12.47	12.34	10.78	10.63
6.00	1	11.95	11.82	10.62	10.47
7.00	2	11.53	11.40	10.48	10.33
8.00	3	11.20	11.07	10.33	10.18
9.00	4	10.96	10.83	10.22	10.07
10.00	5	NA	NA	NA	NA
12.00	7	NA	NA	NA	NA
14.00	9	NA	NA	NA	NA
16.00	11	NA	NA	NA	NA
18.00	13	9.95	9.82	9.77	9.62
20.00	15	9.87	9.74	9.73	9.58
24.00	19	9.78	9.65	9.67	9.52
30.00	25	9.71	9.58	9.62	9.47
36.00	31	NA	NA	NA	NA
42.00	37	9.65	9.52	9.61	9.46
48.00	43	9.63	9.50	9.58	9.43
60.00	55	NA	NA	NA	NA
72.00	67	NA	NA	NA	NA
84.00	79	NA	NA	NA	NA

NOTES
-The piezo (dia 0.06m) was 3.52M from the well (dia 2.10m)
-Well was at rwl at start of test
-well dipped to top of casing, wall not complete. TD = 18m toc
-BH 30m away pumped with mono for two hrs from Tpstart = 3hrs
-TEST SPOILT BY PUMPING INTERFERENCE FROM BH NEARBY

Table 3.8.6 Pumping-test data from tests completed at site 8, Masekesa (continued)

SITE	eight	Masekesa			
TEST	Expl. BH T1	MEASURED DATA	DEPTH (mbgl)		27.00
DATE	05/05/94	TESTER DT	PUMP SET AT		22.00

BH DATA FROM MINISTRY OF WATER RECORDS ref:- NA

NAME	Masekesa	WATER FIRST STRIKE (m)	18
NUMBER	NA	MAIN STRIKE (m)	NA
GRID REF	NA	REST WATER LEVEL (m)	9.24
DATE DRILLED	04/23/94	BLOWING YIELD (m3/h)	1.29
DRILLED BY	DWD Mr Chikuni	CASED	---
DEPTH (m)	30.00	SCREENED	---
DIAMETER (m)	0.15	OPEN	0 to 30

PUMPING DATA		CALCULATED DATA	
PUMPING TIME (hrs)	1.67	AV PUMP RATE (l/s)	0.49
START VOL (m3)	241.745	DRAWDOWN (m)	8.24
END VOL. (m3)	244.697	DEWATERED VOL (m3)	0.146
START WL. (mbd)	9.01	PUMPED VOL (m3)	2.952
END WL. (mbd)	17.25	'LAMDA'	0.049
BH DATUM	toc		
DATUM ELEV.(magl)	0.00		

TEST DATA BH

T pstart (min)	T pstop (min)	WL (mbd)	WL (mbgl)
0.00		9.01	9.01
0.50		NA	NA
1.00		10.20	10.20
1.50		NA	NA
2.00		11.05	11.05
2.50		NA	NA
3.00		11.70	11.70
3.50		NA	NA
4.00		NA	NA
4.50		NA	NA
5.00		12.61	12.61
6.00		12.92	12.92
7.00		13.16	13.16
8.00		13.35	13.35
9.00		NA	NA
10.00		13.70	13.70
12.00		NA	NA
14.00		14.14	14.14
16.00		14.40	14.40
18.00		14.61	14.61
20.00		14.81	14.81
22.00		14.95	14.95
24.00		15.10	15.10
26.00		15.21	15.21
28.00		15.29	15.29
30.00		15.37	15.37
32.00		15.48	15.48

Table 3.8.6 Pumping-test data from tests completed at site 8, Masekesa (continued)

35.00		15.57	15.57
40.00		15.96	15.96
45.00		16.14	16.14
50.00		16.42	16.42
60.00		16.70	16.70
70.00		16.78	16.78
80.00		17.05	17.05
90.00		17.12	17.12
100.00	0.00	17.25	17.25
100.50	0.50	NA	NA
101.00	1.00	15.20	15.20
101.50	1.50	NA	NA
102.00	2.00	13.80	13.80
102.50	2.50	NA	NA
103.00	3.00	12.67	12.67
103.50	3.50	NA	NA
104.00	4.00	11.85	11.85
104.50	4.50	NA	NA
105.00	5.00	11.20	11.20
106.00	6.00	10.70	10.70
107.00	7.00	10.35	10.35
108.00	8.00	10.05	10.05
109.00	9.00	9.87	9.87
110.00	10.00	9.71	9.71
112.00	12.00	NA	NA
114.00	14.00	9.38	9.38
116.00	16.00	9.30	9.30
118.00	18.00	9.25	9.25
120.00	20.00	9.20	9.20
122.00	22.00	9.17	9.17
124.00	24.00	9.15	9.15
126.00	26.00	9.13	9.13
128.00	28.00	9.11	9.11
130.00	30.00	9.10	9.10
132.00	32.00	9.09	9.09
135.00	35.00	9.08	9.08
140.00	40.00	9.07	9.07
145.00	45.00	9.06	9.06
150.00	50.00	9.06	9.06
160.00	60.00	NA	NA
170.00	70.00	NA	NA
180.00	80.00	NA	NA

Table 3.8.7 Attendees at pump maintenance workshop site 8, Masekesa

not available

Table 3.8.8 Water points in the region of collector well site 8, Masekesa

not available

Table 3.8.9 Details of monitored wells and boreholes at site 8, Masekesa

not available

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