GROUNDWATER RESOURCE INFORMATION PROJECT
EASTERN CAPE PROVINCE

GROUNDWATER INFORMATION SOURCE REFERENCE SHEET

SOURCE REF NR:	AG101	Own Archive	X	Copy attached	X
		Sourced		Copy at source	

A: SOURCE DESCRIPTION

District Municipality:	Amatole		Chris Hani	X	O.R Tambo	
	Ukhahlamba		Cacadu		Alfred Nzo	
Local Municipality:	Engcobo					
Institution where Information is held:	AGES EC CC					
Branch of Institution:	EAST LONDON					
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B: TYPE OF INFORMATION

Information format:	Hard copy	X	Data Summary		Electronic Report	
	Specify Other:					
Report / Info Title:	Groundwater source definition and feasibility study for the Engcobo local municipality – Chris Hani district municipality – Eastern Cape Province					
Report Nr:	EC/03/26/HG		Date:	May 2003		
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	Specify Other:					
Captured by:	A VILJOEN	Date:	23/2/2004	Signed:	Alliljoen	

C: GEOHYDROLOGICAL CATEGORIZATION

Project Type	Source development	X	Feasibility Study	X	Sanitation Study	
	Specify Other:					

Reference Co-ordinate:	Latitude		Longitude	
	S	31° 40' 00"	E	28° 5' 00"

	Yes	No	Complete	Incomplete
Lithological & Construction Logs	X		X	
Hydrocensus Data	X			X
Pump Testing Data	X		X	
Chemical Water Analysis Data	X		X	
Geohydrological Data	X		X	
Spring Data	X			X
Remote Sensing Data	X			X
Map Data	X			X

Comments:

Reviewed by: F. de Jager Date: 12/3/04 Signed:

Final Project Report: EC/03/26/HG

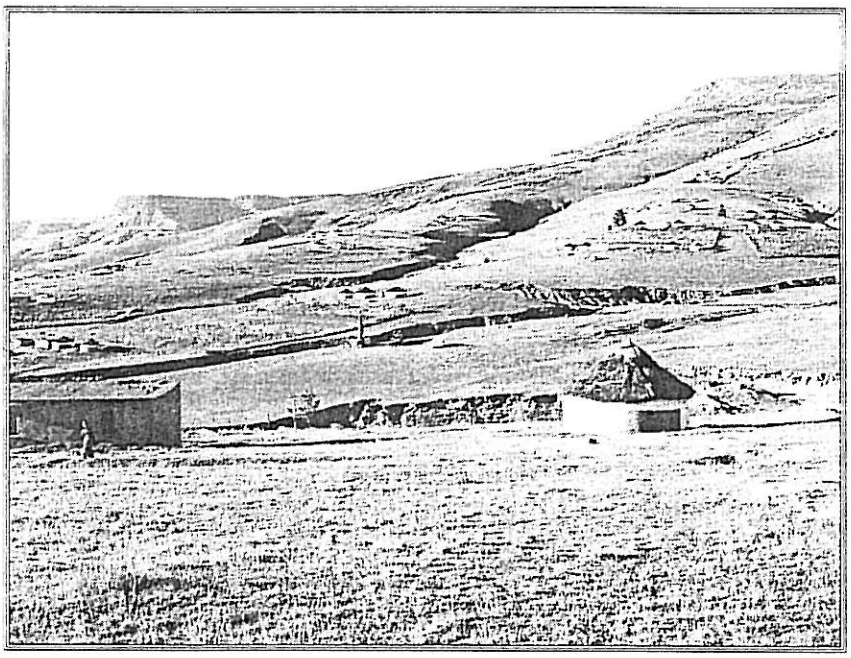
GeoCon

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD

Hydrogeological investigation

GROUNDWATER SOURCE DEFINITION AND FEASIBILITY STUDY FOR THE ENGCOBO LOCAL MUNICIPALITY - CHRIS HANI DISTRICT MUNICIPALITY– EASTERN CAPE PROVINCE

July 2003



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Final Project Report: EC/03/26/HG

Hydrogeological investigation

GROUNDWATER SOURCE DEFINITION AND FEASIBILITY STUDY FOR THE ENGCOBO LOCAL MUNICIPALITY - CHRIS HANI DISTRICT MUNICIPALITY– EASTERN CAPE PROVINCE

25 July 2003

Conducted for the Chris Hani District Municipality – on behalf of:

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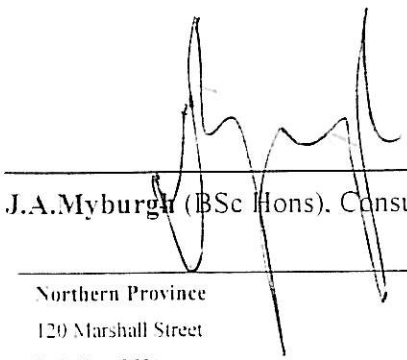

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1 INTRODUCTION

1.1 Preface

Southern Africa GeoConsultants (PTY) Ltd – hereafter referred to as GeoCon- was appointed by the Chris Hani District Municipality to carry out a groundwater feasibility study in association with FST Consulting Engineers as part of a water supply feasibility study for the Engcobo Local Municipality of the Chris Hani District Municipality of the Eastern Cape Province.

This report provides detailed results of the work conducted, is an extension of, and is based on methodologies and approaches followed during the groundwater feasibility studies carried out in the Emalahleni and Lukanji Local Municipalities. Geohydrological work was further carried out in association with SRK Consulting Engineers and Scientists who have been appointed for the Intsika Yethu Local Municipality's geohydrological feasibility study.

1.2 Project aims and objectives

The project aims, objectives and methodologies were defined in a proposal that was initially submitted to the District Municipality and were later defined in coordination with FST.

The objectives of the study were outlined based on two phases namely:

Feasibility Study:

- Desk Study & Data collection
- Lineament Mapping & Recharge evaluations
- Groundwater Potential Assessment
- GIS Map Compilation & reporting
- Collation of all available historical information in the form of reports, databases, etc.
- Consultation with role players that have been involved in the area:
- Study of relevant geological maps, aerial photographs, Satellite Images.
- Compilation of preliminary GIS-based maps indicating areas of high structural intensity (e.g. lineaments), recharge potential, rainfall and terrain accessibility

Verification Phase:

- Feasibility study results evaluation and verification
- Exploration borehole site selection through geophysical surveys
- Investigate and verify defined groundwater potential zones, topography, access to drilling targets, recharge potential and water quality:
- Pump testing of selected existing boreholes
- Identification of drilling targets in the identified groundwater potential zones:
- Exploration drilling under hydrogeological co-ordination and supervision
- Scientific Pump testing and chemical water analyses under hydrogeological co-ordination and supervision
- Classification of villages based on groundwater potential
- Data evaluation and processing - final report compilation

2 SITE DESCRIPTION

2.1 Location

The Engcobo Local Municipality is located on the eastern edge of the Chris Hani District Municipality in the central part of the Eastern Cape Province. The R61 provincial road runs through the study area, linking the Chris Hani District Municipality with the O.R. Tambo District Municipality to the east.

The regional locality of the study area is indicated in the attached MAP 1.

2.2 Topography and drainage

The site is situated at an elevation between 800 – 1400 mamsl. The terrain is characterised by prominent mountain ridges with steep narrow valleys in the north, with more open valley floors and moderately sloping topography towards the south.

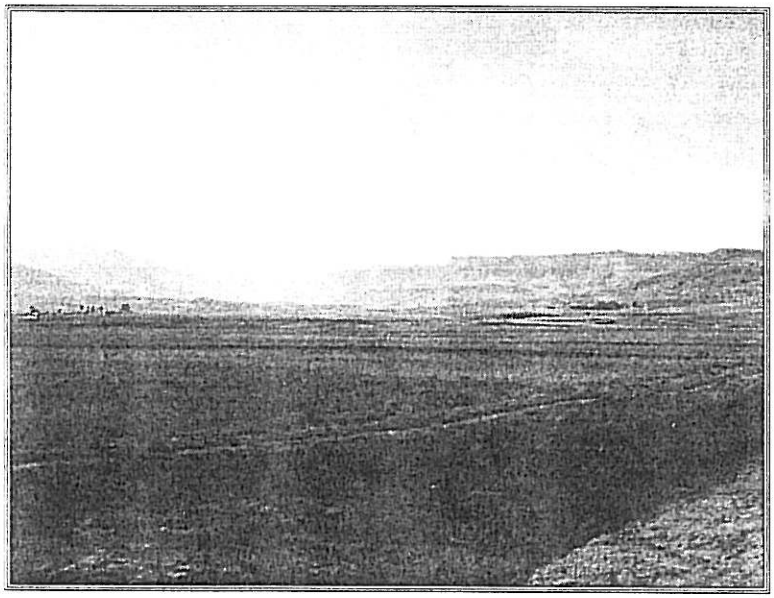

Photo 1: Even slopes of open valley floors in foreground with mountainous northern region in the background

The groundwater flow is presumed to mimic topography, with shallow groundwater levels occurring at low-lying areas. Three perennial rivers drain the entire project area namely:

- Mbashe River
- Xuka River
- Mgwali River

These rivers drain water in a southeasterly direction towards the Indian Ocean.

2.3 Physical environment and climate

The Engcobo area is generally defined as a semi arid region and is characterized by cold dry winters and hot humid summers. The rainfall pattern varies seasonally with an average monthly precipitation of approximately 100mm occurring during the summer season. The precipitation decreases quite significantly in winter to an average of approximately 16 mm per month. Average monthly precipitation levels recorded at Engcobo are indicated in Figure 1 below.

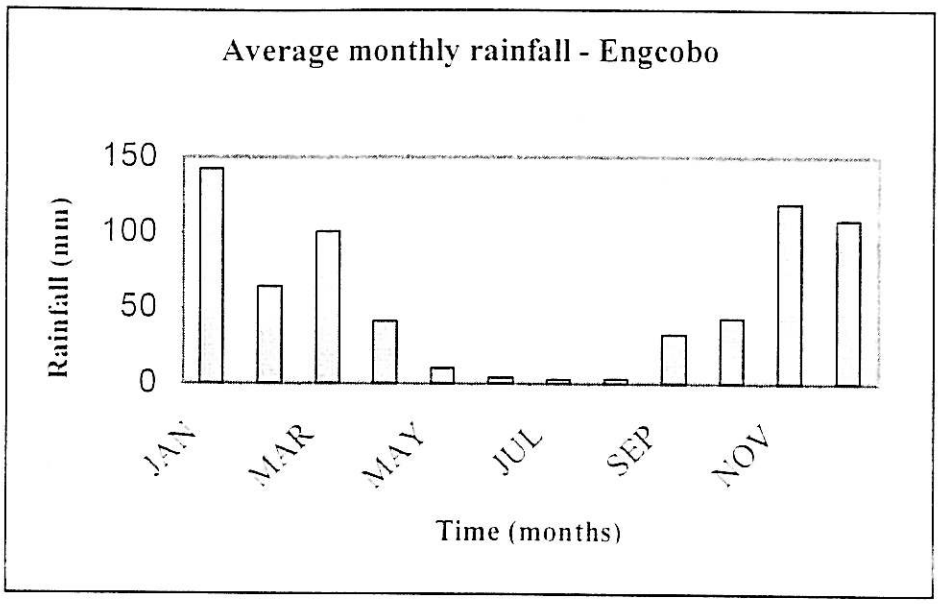

Figure 1: Average monthly rainfall for Engcobo - Weather Bureau station 0125880 X Engcobo Prison

The mean annual evaporation for the region ranges between 1300 and 1400 mm per year (Midgley et al. 1994). High temperatures of the region affect the high mean annual evaporation values observed. During summer, temperatures of up to and exceeding 30^0 C are recorded while in winter a drop in temperatures occurs to approximately 11.5^0 C and colder. Snowfalls during winter are seldom, occurring on higher grounds, while frost commonly occurs throughout the area. The higher grounds are also characterised by mist and fog in the early morning and late evenings, which are mostly accompanied by drizzle throughout the year with increased humidity as a result. Uneven distribution of precipitation is noted across the area, due to the windward sides of the mountain ridges generally experiencing higher amounts of precipitation than the leeward sides.

2.4 Surface Hydrology

The study area is known for springs occurring in certain parts. These are mainly controlled by the underlying geology where the capping of mountain ridges by dolerite sills and sheets serve as the important structures for spring formation. The springs have been traditionally used as source of water for domestic and livestock purposes in most communities. This has also impacted on the site selection by communities who tend to target foothills for new settlements, where most springs are most likely to occur. Several major rivers flow through the study area. These rivers are partly used for domestic water supply. A number of small stock dams are found in the study area. These surface water sources are presumably linked to local aquifers, and the final water source potential definition in the area will have to address both sources to make feasible and accurate recommendations for regional water supply. Surface water source definition and potential was addressed in the surface water component of the study, under the appointment of FST.

3 DESKTOP STUDY

3.1 Information sources

Several information sources that may lead to better understanding of the region were used. These included the previous studies done by GeoCon and other external reports. The sources of information considered and referred are the following:

- Climatic and surface water information was obtained from:
  - South African Weather Services
  - The report *Surface Water Resources of South Africa 1990. Midgley D. C. et al. WRC Report 298/5.1/94* and *298/5.2/94, 1994.*
  - 1:250 000 scale geological map: 3126 Queenstown and 3128 Umtata
- Geological and geohydrological information was obtained from
  - The 1:250 000 scale geological map: 3126 Queenstown and 3128 Umtata
  - The report *Karoo Aquifers, Their geology, Geometry and physical properties. Botha et al. WRC Report 487/1/98, 1998*
  - The report *Karoo Aquifers. The influence of dolerite sill and ring complexes on the occurrence of groundwater in Karoo Fractured Aquifers: a morpho- tectonic approach. Chevillier et al. WRC Report 937/1/01, 2001.*
- Hydrogeological information was obtained from the 1:500 000 scale hydrogeological map: 3126 Queenstown.
- Regional remote sensing was done using satellite imagery – Landsat Images WRS 170-82, WRD 169-82
- Detailed remote sensing was done using 1:150 000 scale stereoscopic air photography - Job 916 Strip 3, photos 487, 484 and 494 and 1:50 000 scale stereoscopic air photography - Job 983 Strip 12, photos 903, 904; 905, 906 and strip 13, photo 792
- Topographical information was obtained from the following 1:50 000 scale topographical maps
  - 3127DA Cala, second edition, 1982
  - 3127DB Engcobo, second edition, 1981
  - 3127DD Ncora Dam, second edition, 1995
  - 3128AC Xuka Drift, second edition, 1980
  - 3128AD Umnga Flats, second edition, 1982
  - 3128CA All Saints, second edition, 1982
  - 3128CB Baziya, first edition, 1982
  - 3128CC Mjanyana, second edition, 1995
  - 3128CD Clarkbury, second edition, 1995
- Community liaison was used to assess terrain conditions and obtain historical data regarding existing water sources and general terrain conditions
- Pump test evaluation and analyses was done using:

- Kruseman, G.P. and De Ridder, N.A. (1991). *Analysis and Evaluation of Pumping Test Data* International Institute for Land Reclamation and Improvement, PO Box 45, 6700 AA Wageningen, The Netherlands
- Van Tonder G.J. *et al* (2000) *FC-Program (Flow Characteristic Program)*. Institute for Groundwater studies, University of the Orange Free State, Bloemfontein, South Africa

- Water quality assessment was done using the document ***Quality of Domestic Water Supplies; Volume 1;Assessment Guide; Second Edition 1998; Water Research Commission No. TT101/98*** as well as the recommended limits set in SABS 241 of 1984.

3.2 Hydrogeology

The geology of the Engcobo area comprises the middle part of the stratigraphic sequence of the Karoo Supergroup as indicated in Figure 2. The area is dominated by the sedimentary rocks of the Beaufort and the Stormberg Groups, occurring as indicated in MAP 2.

Drakensberg Volcanics			Basalt	Jurassic
Stormberg Group	Clarens		Cross-bedded sandstone	Triassic
	Elliott		Red mudstone and sandstone	
	Molteno		Sandstone, conglomerate and mudstone	
Beaufort Group	Tarkastad Subgroup		Burgersdorp Formation	
			Katberg Sandstone	
	Adelaide Subgroup		Green, grey and purple mudstones	Permian
			Sandstone	
Ecca Group			Shale and sandstone	
Dwyka Group			Tillite and diamictite	Carboniferous

The Karoo Supergroup. [Adapted from Tankard *et al.* (1982).]

Figure 2: Stratigraphic succession of formations occurring in the study area

3.2.1 Katberg Formation

The Katberg Formation occurs in the extreme south of the Engcobo district and is characterized by the brownish red and grey mudstones and fine-grained sandstone. The formation is mainly sandstone rich with quartz dominant. The rapid increase in the quartz content at the expense of feldspar in the Katberg Formation would appear to reflect strong uplift and denudation of the Cape Fold Belt, located between the magmatic arc and the Basin. The sediments of the Katberg Formation were probably deposited under fluvial environments. The mode of transportation of the sediments was mainly the meandering and the

braided streams of the Triassic periods. The nature of deposition explains the layered sequence of alternating sandstones and mudstones in the Engcobo area. Groundwater mainly occurs in intergranular and fractured zones.

3.2.2 Burgersdorp Formation

The sediments of the Burgersdorp Formation overlies the Katberg formation and consist of brownish red and grey mudstone and sandstones, with mudstones dominating (70-80% mudstones). During the deposition of these sediments the fluvial conditions of the Triassic Period were still prevalent, marking the deposition of the Burgersdorp Formation. Due to the nature of deposition, the sediments of the Burgersdorp Formation have a layered sequence. In nature, the sediments of the Burgersdorp Formation differ widely. The variation is marked by the presence of coarse to fine-grained sediments, which indicate reworking of the sediments during the time of deposition. Groundwater occurrence is mainly expected in fractured zones and intergranular spaces of the rocks. Where layers of coarse sediments exist, high yielding boreholes can be expected.

3.2.3 Molteno Formation

The sediments of the Molteno Formation consists of the coarse to fine grained buff sandstones with thin pebbly beds with blue and grey mudstone and shale layers with occasional coal seams. The climatic conditions that existed during the deposition of the Burgersdorp Formation were still prevalent during the onset of Molteno Formation. As such, the sediments of the Molteno Formation were deposited under fluvial environments by braided streams, which imply the graded nature of deposition. With regard to groundwater occurrence, the pebbly beds and the coarse grained sandstone of this formation have a relatively high storage capacity.

3.2.4 Karoo Volcanism

The last stages of the Karoo sedimentation were marked by the deposition of the volcanic lavas during the Early Jurassic period. The lavas were deposited in several phases, which marked the occurrence of the geological structures (ring, linear and sheet structures) of the Karoo Sequence. As such, the Burgersdorp Formation is mainly characterised by dykes, ring sheets and sheets while the Molteno Formation is mainly characterised by dykes. This explains the common dolerite ring structures, which form mountains in the Engcobo area. The nature of deposition of these lavas differed tremendously, where linear dykes, ring dykes and dolerite sills occur. When deposition occurred the Basaltic lavas must have followed the zones of weakness, hence the structures seen today. The linear structures can stretch up to the tens of kilometres and their width varies between 1 and 10m. For the dolerite sheet structures the lavas must have followed the bedding planes of the country rock.

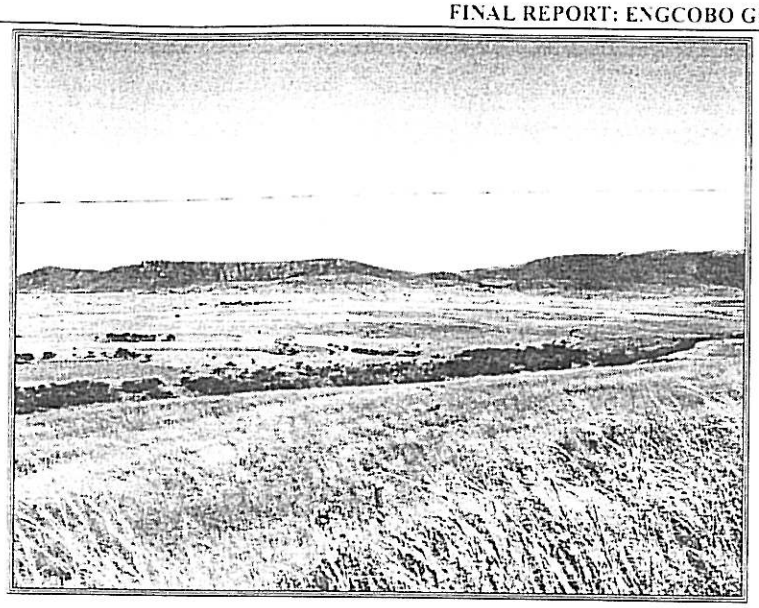

Photo 2: Ring type dolerite intrusion north east of Engcobo town

3.2.5 Alluvium

One of the recent Karoo deposits are alluvial and colluvial deposits. These sediments overlie the original Karoo sediments. Although they are not widely spread they serve as important sites for groundwater occurrence. These sediments occur within the study area and are mostly located along riverbeds with distribution as indicated in MAP 2.

3.3 Remote sensing

Satellite imagery and air photography was used to define and delineate structures occurring in the study area. Lineaments are in most cases related to dolerite dyke intrusion and several of the major lineaments could be verified as such with the NW and NE direction as the dominant direction of dolerite dyke intrusion in the study area. Most lineaments in the study area are related to dyke intrusion and no major faults with huge displacements along them were observed. Small scale faulting and fracturing related to dolerite intrusion will however be present throughout the area.

MAP 3 shows the orientation, distribution and density of lineaments in the study area, as observed from the satellite imagery. This was used as an important part of the groundwater potential delineation as well as for target selection for exploration drilling during the verification phase.

3.4 Structural geology

Geological structures (dykes) that were induced during Karoo Volcanism differed in orientation as well as distributions amongst lithological units of the Karoo Supergroup. This implies lithological control as well as stress variations during the time of emplacement. As such several orientation of dykes/ lineaments can be observed in the study area and these include:

- NW trending dykes
- EW trending dykes
- NE trending dykes

- NNE trending dykes

In some places the occurrence of these dykes is accompanied by the dolerite ring structures. The ring structures have recently been given attention as major structures for groundwater occurrence. A study by Chavallier et al. (2001) revealed that yields in excess of 60l/s can be obtained if suitable structures are penetrated up to depths of 300m.

The emplacement of the basaltic lavas during Jurassic Period had several effects on the country rocks of the Karoo Supergroup. The effects mainly include:

- Mechanical deformation of the rocks which mainly involved:
  - Dilation of the rock, which was induced laterally by the pressure of intruding magma on the walls of the host rock. In this case shearing and displacement of the host rock is common. Field investigations have also revealed presence of slickensides, which give evidence of shearing.
  - Bending, shearing (depending on the elasticity of the rock) and fracturing of the overburden material due to intruding magma
- Baking and metamorphism of the host rock which improved the matrix potential of the Burgersdorp Formation mudstones

The mechanical deformation obviously has a marked advantage on groundwater occurrence where the fracturing at depth and along prominent and major dykes serves as sites for groundwater occurrence. This is also the case with ring structures where the outer side has been noted to be highly fractured due to intruding magma (Chevallier et al. 2001).

Where the aforementioned structures occur, fracturing and shearing is mostly observed. Such zones generally have a high potential for groundwater occurrence and were targeted during groundwater exploration.

MAP 4 indicates the distribution of all structures observed and derived from remote sensing, as well as dolerite ring structures. This was further used as part of the groundwater potential delineation as well as for target selection for exploration drilling during the verification phase

3.5 Preliminary Groundwater Potential Zonation

Based on desktop study results, preliminary groundwater potential zonation was conducted for the entire Engcobo Local Municipal area. The data used was obtained from various sources, and included information such as borehole yields, lithological drilling logs, pump testing data and water chemistry results. The information was evaluated and a groundwater potential zonation map was compiled to act as a planning tool for groundwater source development and planning purposes. Potential zonation takes into account expected borehole yields and water quality but is mainly determined by long-term sustainability of the underground sources. It has been found that the zone of highest potential can be delineated according to the geometry and occurrence of the outer limbs of the main dolerite ring structure occurring in the study area as well as secondary structures associated with it. Several smaller ring type intrusions also influenced regional potential distribution.

The study area was divided into *HIGH*, *MODERATE* and *LOW* potential zones. Exploration drilling and pump testing of existing boreholes as well as the newly drilled boreholes aims to confirm and better-define the preliminary groundwater potential zonation. This was reported in Geocon report EC 03/13/HG: *Preliminary report on the hydrogeological investigation – Engcobo Local Municipality: February 2003.*

4 POTENTIAL VERIFICATION

4.1 Remote Sensing

Remote sensing of the study area was done using satellite images as well as stereoscopic aerial photography as mentioned in paragraph 3.3. Satellite imagery is processed electronically using computer software to define and delineate prominent regional structures and their orientation. Stereoscopic aerial photography is used to delineate geological contacts and identify possible structures that may have an influence on the local underground water potential. These aerial photographs allow the viewer to see the photographed region three dimensionally. The viewer looks down on the photographed area, and can clearly identify landforms, dolerite dykes, sills and linear features that may predict the existence of possible water-bearing features. Features identified on the aerial photographs are then targeted for geophysical surveying and profiling.

4.2 Borehole siting

The methodology followed during the borehole-siting phase consisted of the following:

- Evaluation of available data - desktop study
- Stereoscopic aerial photo and satellite image investigation and interpretation – identification of structures and target areas
- Field surveys and Hydrogeological mapping – identification of geophysical profile positions
- Geophysical profiling comprising magnetic profiling, Very Low Frequency electromagnetic surveys and electrical resistivity profiling
- Evaluation of geophysical data in relation to surface geological observations
- Site finalisation and marking – liaison with community regarding access of drilling rig and ownership

4.3 Geophysical Profiling

4.3.1 Magnetic method

For the magnetic surveys, a proton magnetometer is the most commonly used instrument in groundwater exploration. Measurements of the magnetic field, taken in the vicinity of geological formations and contacts, show departures from the undisturbed magnetic field of the earth. These changes (called anomalies) could be large or small and could be either an increase or decrease of the earth's field and will depend on the depth of burial, degree and direction of magnetisation and the relationship to the direction of the earth's field at the locality.

The sensor of the proton magnetometer consists of a container of proton-rich fluid usually kerosene around which is wound a coil of wire. The protons act as small spinning magnets. The spin axes precess about the direction of the earth's magnetic field. Under normal circumstances the direction of the spin axes of the numerous protons are randomly oriented and will have no effect on the coil. A current is applied to the coil, creating a strong magnetic field that then aligns all the spin axes in the direction of this field. The current is switched off and the spin axes will then all precess about the direction of the earth's field and together will induce an oscillating voltage in the coil. The frequency of this oscillation will be equal to the precession

rate and is directly proportional to the earth's magnetic field.

The electronic console of the magnetometer provides the current for the coil in the form of a pulse and contains the electronics for measuring and recording the earth's magnetic field directly on a digital display.

These readings are taken at an interval of every 5 m for example, on a straight line and the results of the survey are plotted as profiles as the survey progresses. This gives the operator the opportunity of viewing his data to see where obvious errors have occurred and exactly where a geological feature is located. The slope and shape of the anomaly is used to determine the possible shape and orientation of the structure.

4.3.2 Very Low Frequency (VLF) Electromagnetic Profiling

Like most other so-called electromagnetic methods, the Very Low Frequency method can be used to find steeply dipping structures that differ form their surroundings with regard to the inherent electrical resistance of the rock. This method is thus very well suited for water prospecting in fractured zones.

The low-frequency field that is used is sent out from a radio transmitter. Normally the frequency is between 15 and 30 kHz. When the field emitted by a transmitter strikes a geological body having low electrical resistivity, secondary circuits are created in the body. This is called induction. These secondary currents, in turn, create a secondary magnetic field that is opposed to the original field emitted from the transmitter. Nature is quite conservative because it tries to counteract build-up of the external field by creating its own secondary field in the opposite direction. Only a body having low electrical resistance can create a secondary field.

The VLF instrument records the ratio of the strengths of the vertical and horizontal fields at the ground surface. Since the primary field emitted from the transmitter is horizontal, it is evident that a normal reading (taken where there is no anomaly) will be zero. A deviation from a normal reading is called an anomaly indication. The VLF instrument records these values and automatically constructs a profile similar to that of the magnetometer, indicating the exact position and size of the anomaly.

4.3.3 Electrical Resistivity Profiling

The direct current resistivity method is based on the behaviour of the flow of electrical current in the subsurface. The energy source is artificial which makes it possible to control the depth of investigation.

Horizontal profiling was done in targeted areas and the technique implies that the lateral distribution of electrical resistivity is studied by an electrode array for which the depth of investigation remains relatively constant. Profiling is most effective when lateral changes in resistivity are large. The electrical resistivity method is applied extensively in ground water investigations where it is often used to maximum advantage.

4.4 Borehole Drilling

All boreholes drilled during this project were drilled using the rotary air percussion technique. Drilling was done according to Minimum Standards and Guidelines set out by DWAF, 1997. This resulted in boreholes being drilled using the specified equipment under supervision of the hydrogeological consultant. Casing was installed to stabilise loose shallow formations and was inserted at least 3m into solid formations. Boreholes which can act as future production boreholes were each delivered with a sanitary seal such as to prevent the ingress of surface water and possible contamination of the groundwater source.

The straightness of boreholes was evaluated by means of a dummy test under supervision of the consultant where it was seen as necessary. Boreholes were numbered and marked by means of a metal stake planted 5m north of each borehole.

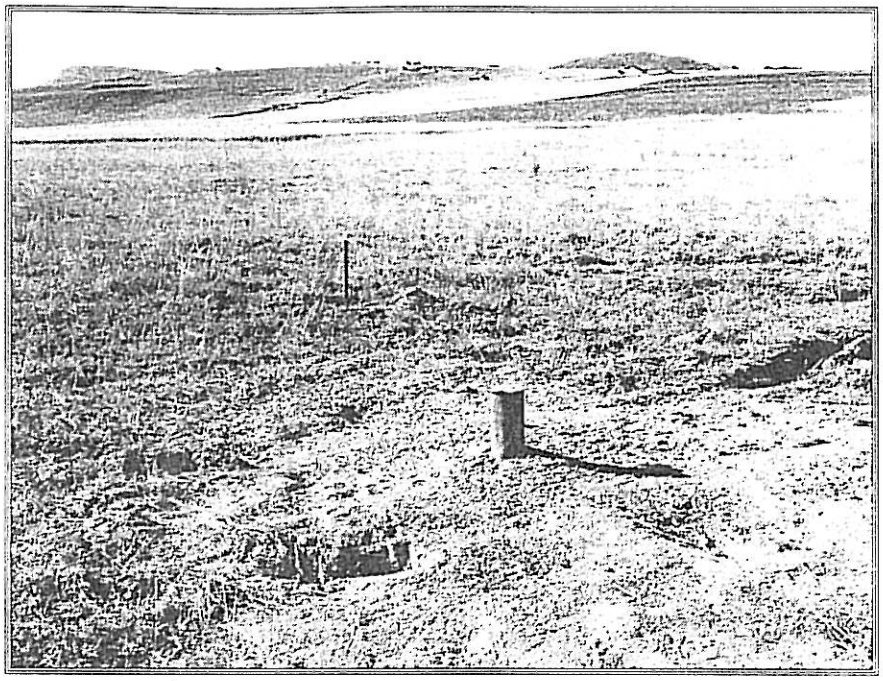

Photo 3: Boreholes are sealed and marked with a metal stake after completion

4.5 Pump testing and data analyses

Pump testing was carried out under the co-ordination and guidance of the hydrogeological consultant. It was the aim of the pump testing exercise to determine the potential at each borehole and tests were adapted according to the yields observed. This resulted in some boreholes being pumped for longer periods than others. The aim at all times was to obtain maximum information regarding the local aquifer within the allowed budget and scope of the appointment.

Initial testing procedures involved calibration testing where no information or inaccurate information regarding the yield of a borehole exists. This was typically followed by a step drawdown test during which the water level response to different abstraction rates was measured. Results from this test were used to determine a safe and adequate rate at which to perform the constant rate drawdown test. The constant rate drawdown test was commenced once the water level has recovered sufficiently.

The water level response to the constant rate drawdown test, as well as the recovery after the test, was used to assess the hydraulic parameters of the aquifer. These results help to determine the safe long-term abstraction rates at each of the tested boreholes.

Two parameters are used to describe the physical properties of the aquifer, namely transmissivity (T) and storativity (S). The first of these two quantifies the rate at which water moves through the aquifer and the latter quantifies the aquifer's ability to release water.

Different methods are available to determine the T values and other aquifer parameters. For this investigation the *FC-analysis method* was applied. The values obtained were then used to fit the step-drawdown data as a means of calibration.

4.6 Chemical Water Analyses

Water samples were taken at the end of constant rate drawdown tests at boreholes that were pump tested. Samples were analysed as far as physical, chemical and microbiological quality is concerned.

Results were evaluated by using the document: ***Quality of Domestic Water Supplies; Volume 1;Assessment Guide; Second Edition 1998; Water Research Commission No. TT101/98*** as well as the recommended limits set in SABS 241 of 1984.

This Guide allows the quality of water supplied for domestic use to be assessed by using a simple classification system. The system shows the nature of the effects of water quality on the domestic user for a range of concentration values for those substances commonly encountered in water. The information is presented in a simplified format so that a wide spectrum of users of the Guide will be able to understand the concepts of water quality as it affects the domestic user.

The Water Quality Assessment Guide defines the following classes:

Table 1: Water Quality Assessment Guide

Class 0	**Ideal water quality**	*Suitable for lifetime use*
Class 1	Good water quality	*Suitable for use, rare instances of negative effects.*
Class 2	Marginal water quality	*Conditionally acceptable. Negative effects may occur in some sensitive groups.*
Class 3	**Poor water quality**	*Unsuitable for use without treatment. Chronic effects may occur*
Class 4	**Dangerous water quality**	*Totally unsuitable for use. Acute effects may occur.*

4.7 Groundwater Balance Calculation

A water balance model is a quantitative evaluation of water gained or lost from a groundwater system under investigation during a specific period. It is assumed that the change in groundwater stored in the system relates directly to the change in groundwater level within the system, and it can be expressed as:

Equation 1 may be written as: $\frac{S\Delta V}{\Delta t} = R_e + I - O - Q$ Equation 1

where:

ΔV [L^3]	=	change in groundwater storage within the time increment Δt
Re [L^3/T]	=	natural effective groundwater recharge to aquifer
I [L^3/T]	=	natural groundwater Inflow into the system
O [L^3/T]	=	natural groundwater Outflow from the system
Q [L^3/T]	=	abstraction (including springflow) from the system
S [ ]	=	specific yield (S-value)
Δt [T]	=	time increment

The two entities I and O in Equation 1 can be sub-divided further into the following components:

$I = I_b + I_r + I_{df}$ and $O = O_b + O_r + O_{df}$

where

I_b and O_b = lateral groundwater inflow and outflow over catchment boundaries

I_r and O_r = groundwater inflow and outflow to/from rivers

I_{df} and O_{df} = deep groundwater inflow and outflow over catchment boundaries (= 0 for first approximation because it is difficult to estimate it).

Under the steady-state groundwater flow condition, the change in storage is zero, and Equation 1 can be rewritten as:

$R_e + I - O - Q = 0$ Equation 2

Under steady state conditions (Equation 2), the Potential Allocatable Groundwater for an area is defined as:

Allocatable groundwater = $R_e - I - O$ Equation 3

5 RESULTS

Borehole information was obtained from three different groups of boreholes, namely:

- Existing boreholes reflected on the National Groundwater Database (NGDB) and / or located in zones where insufficient data exists – verified through focussed hydrocensus process.
- Existing boreholes drilled and tested at several recently completed water supply projects carried out by GeoCon in the Engcobo municipal area.
- Newly drilled exploration boreholes – drilled and tested as part of this study.

5.1 EXISTING BOREHOLES

A desktop study evaluation of all boreholes occurring in the study area according to the National Groundwater Database resulted in thirteen boreholes being selected for evaluation. Some of these boreholes were however not reflected in the NGDB but were located through a hydrocensus in specific zones where insufficient data was available. The distribution of these existing boreholes is indicated in MAP 5. The boreholes considered were chosen as to best represent the entire project area. The conditions of existing boreholes were found to be moderate to poor, with some boreholes clogged and others in disrepair. Boreholes with poor construction or where unstable conditions occur were eliminated for the pump-testing phase. The list of all these boreholes is included in the BOREHOLE DATA SUMMARY TABLE, which is attached at the end of this report.

5.1.1 Borehole information and pump testing data

From the thirteen boreholes that were selected for pump testing, only seven could be tested effectively. The constant rate discharge tests varied between 24 and 48 hours depending on yields and aquifer conditions. Five boreholes were tested for a 48-hour period each and the rest were pump tested for 24 hours. The data obtained was then analysed using the FC Method as mentioned, in section 4.5 to evaluate aquifer characteristics and sustainable yields. The results obtained from the FC Method are summarised in the BOREHOLE DATA SUMMARY TABLE. Pump test data is attached in Appendix A for reference.

Boreholes were found to be 55 m deep on average. Transmissivities calculated from pump testing data vary from 8 m^2/d to 116 m^2/d, probably from fracture zones intersected by these boreholes while transmissivities of between 0.5 m^2/d and 18 m^2/d were observed during later stages of the constant rate tests – giving an indication of matrix flow capacity. An average sustainable yield of 0.9 l/s over 12/24 hr duty cycles could be calculated for these existing boreholes.

5.1.2 Water quality

Water samples were collected at the end of the constant discharge pump test as part of the pump testing process and sent to the Amatola Water Laboratory to be analysed as far as physical, chemical and microbial qualities are concerned. The results obtained from the analyses are summarised in the BOREHOLE DATA SUMMARY TABLE.

The results obtained from water quality analyses revealed that generally, the groundwater of the Engcobo area varies between class 1 and class 2, i.e. Good to Marginal water quality for domestic purposes. Classes higher than class 2 can also be encountered depending on the problem constituent. The analyses revealed that slight faecal contamination occurs in some boreholes. Hardness and fluoride persist in some boreholes and this can be related to the underlying sediments i.e. sandstone and mudstone. .

Treatment measures: Chlorination of water is recommended for those boreholes that are affected by slight faecal contamination to improve the quality of water for domestic purposes.

The water quality data for each borehole evaluated is attached in Appendix B.

5.2 RECENTLY DEVELOPED BOREHOLES

5.2.1 Borehole information and testing data

Data from previous water supply projects that were undertaken by Geocon were incorporated into the study to fill in the gaps where borehole data was insufficient. This resulted in twenty-four boreholes being incorporated into this study to better define the groundwater potential for the entire Engcobo area. Most boreholes drilled were along the ring structures, on the steeply dipping side of the dolerite ring structure, where Nyanga, Eluheweni and Cobosi villages lie. High yielding boreholes have been obtained from this terrain, with yields varying between 2 and 15 l/s. Due to the successful results that were obtained in this region from previous water supply projects, the region was not considered for further evaluation. The list of all these boreholes is included in the BOREHOLE DATA SUMMARY TABLE.

5.2.2 Water quality

The water quality results from the recently drilled boreholes indicate Marginal water quality for Engcobo area, with total hardness being prominent but at marginal values. Regarding bacteriological water quality, only few boreholes showed a problem with faecal coliforms at the marginal range, which may only be problematic to sensitive groups. Chlorination of water prior to use is recommended.

5.3 NEWLY DEVELOPED BOREHOLES

A number of drilling sites were identified within the project area. These were sited in target zones identified for exploration drilling and groundwater source evaluation, based on the following:

- To define potential in zones where no information is available
- To verify potential in similar structures as the structures already successfully explored during recent groundwater development programs where high yielding boreholes were intersected
- To verify potential in smaller, secondary ring-type dolerite intrusions noted east of the main ring structure occurring in the direct vicinity of Engcobo Town
- To verify potential in preliminarily identified low potential zones.

The result was a test in the western portion of the study area where Nkwenkwezi was targeted, while on the eastern and northern portions of the study area Sentube and KwaSandile were targeted. Tyeni, Cefane, Gobhoti and Deberha mainly represented the central and the southern portions of the study area that were investigated.

5.3.1 Geophysical survey for groundwater exploration

Geophysical profiles were executed across targeted structures and lineaments identified during the geological mapping phase using the geophysical techniques described. The profiles varied in length and direction depending on the orientation of the targeted geological structure. A total of nineteen profiles were executed resulting in a total profiling length of 4780m. All anomalies noted from the geophysical profiles

were verified on terrain and drilling sites were finalised using on-site hydrogeological information in conjunction with geophysical data.

A total of ten drilling sites were finalised in different villages, as mentioned in section 5.2, and on various geological structures and geophysical anomalies. Results of the siting phase were reported and discussed with the project engineer before drilling commenced.

Geophysical data is attached in Appendix C for reference.

5.3.2 Geological targets and exploration drilling

Several structures were targeted during the exploration phase for groundwater source evaluation. These included the NW- SE trending lineaments, NE- SW trending lineaments, dolerite ring structures and contacts between dolerite sills structures with sedimentary bedrock. The targets in the sedimentary bedrock were mainly mudstone and sandstone of the Burgersdorp Formation and shale, mudstone and sandstone of the Molteno Formation. Identified and targeted geological structures are indicated in MAP 4 and can be compared to exploration borehole localities indicated in MAP 3.

Ten boreholes were drilled in the project area under the supervision of the hydrogeological consultant. Exploration borehole localities are indicated in Map 3 for which drilling results are summarised in the BOREHOLE DATA SUMMARY TABLE.

Measured airlift yields ranged between 0.1 l/s to 15 l/s. The drilling depth varied widely, depending on the structure targeted and the average depth of 95m was obtained. The water strikes intersected also depended on the structures targeted. As a result the water strikes intersected ranged between 38.5 and 127 m below ground level. Two of the drilled boreholes, EC-T11-003 and EC-T11-005, had very low yields, and were backfilled. From the ten boreholes drilled, six boreholes were developed. Solid and perforated steel casing was installed to the required depths where unstable formations necessitated it. Sanitary seals were installed to prevent the ingress of surface water into boreholes suitable for future utilisation. Drilling was stopped by the hydrogeological consultant, taking into account the drilling budget, results obtained and the borehole yields.

Lithological and construction logs are attached in Appendix D for reference.

Drilling results at each of the targeted geological structures are described in the paragraphs below:

5.3.2.1 North West-South East trending lineaments

Three boreholes were sited on NW-SE trending lineaments. The lineaments targeted included a dolerite dyke, which connects to a dolerite sill at Tyeni village and a fault at Deberha. These structures were targeted within the Burgersdorp Formation. The degree of weathering of the dolerite dyke at Tyeni was noted to be very low, with the structure poorly weathered. The yields obtained from the exploitation of this structure were very low.

Where a fault zone was targeted at Deberha, drilling of the borehole was unsuccessful. Several exploration boreholes were drilled on this structure, none yielding water.

All these boreholes were drilled in an area identified as high groundwater potential zone during desktop studies.

5.3.2.2 North East-South West trending lineaments

A northeast trending structure was evaluated in KwaSandile, where two boreholes were drilled. The first

borehole was sited on a fault zone; the target was a fault running along a northeast trending dyke. The second borehole was sited on the shear zone along a major dolerite dyke. The host bedrock was sediments of the Burgersdorp Formation. Exploration was successful with both boreholes yielding moderate to high flow rates and volumes. These boreholes were drilled in an area identified as having moderate groundwater potential during desktop studies.

5.3.2.3 Dolerite ring structures

In the past, dolerite ring structures have been given little attention for groundwater exploration in the province. During the exploration phase, these structures were considered for groundwater development. The two most prominent dolerite ring structures located within the Engcobo local municipal area were targeted. The first was the big dolerite ring structure in the direct vicinity of the town of Engcobo, and was targeted on its dipping side at Gobhoti village. On this structure, one existing borehole was drilled deeper to a depth of approximately 190m after which drilling was stopped due to the hammer being lost in the borehole. The dolerite seemed to be solid throughout the entire depth encountering only low yielding structures.

The second dolerite ring structure was targeted at Sentube village where a borehole was drilled to a final depth of 300m on the dipping side of the dolerite structure. The results obtained from this structure were similar to those obtained at Gobhoti village.

The results obtained from this exploration of dolerite ring structures was then compared to the existing data obtained from the same ring structure but on the steeply dipping side at Nyanga, Eluheweni and Cobosi. The comparison revealed that high yielding boreholes could be obtained on the steeply dipping side of the dolerite ring structure.

5.3.2.4 Contact between dolerite sill and host rock sediments

Two boreholes were drilled at Cefane to evaluate the groundwater potential on the contact zone between a dolerite sill and the sedimentary bedrock. The target zone on the dolerite sill was mainly on the periphery where the sill is generally dipping at a steep angle. The boreholes were mainly sited on the sediments of the Burgersdorp Formation. Both boreholes drilled on this target zone had very low yields.

Lithological logs are included in Appendix D for reference.

From the exploration drilling conducted the following can be said:

- Northeast trending lineaments including dolerite dyke yield better results
- East west trending lineaments also yield promising results.
- The outer side/ steeply dipping side of the dolerite ring structure yielded good results
- The inner side/ gently dipping side of the dolerite ring structure yielded very low results.
- Faults not occurring in association with dolerite yielded very low results.
- Where less weathering/ unweathered dolerite dykes were targeted low yield results were obtained.

5.3.3 Pump testing data

The boreholes that were successfully drilled and delivered adequate airlift yields pump tested by the appointed pump-testing contractor under supervision and guidance of the geohydrological consultant. From

the ten boreholes drilled - five boreholes were pump tested. Pump testing results are summarised in the BOREHOLE DATA SUMMARY TABLE

The transmissivity values from newly drilled boreholes suggest high fracture network with less matrix storage, indicated by a drop in Late Time Transmissivity as compared to Early Time Transmissivity. This means low abstraction values as compared to airlift yields obtained to ensure no over abstraction of the boreholes.

The duration of the pump tests varied widely depending on the yields of the boreholes. Constant drawdown tests generally varied between 24 and 48 hour durations at rates varying between 1 and 14 l/s. Long-term sustainability of each borehole was determined by interpreting and evaluating the pump testing data with the Flow Characteristic (FC) Method.

Detailed pump testing data is attached in Appendix A for reference

5.3.4 Water chemistry- newly drilled boreholes

To evaluate the water quality of the newly drilled boreholes, water samples were collected from each pump-tested borehole at the end of the constant drawdown test by the pump testing contractor. Samples were submitted to the Amatola Water Laboratory to be analysed as far as physical, chemical and microbial qualities are concerned. The results obtained from the analyses are summarised in the BOREHOLE DATA SUMMARY TABLE.

The water quality results obtained from newly drilled boreholes correlated well with the results obtained from the existing boreholes. The overall water quality is marginal, with slight changes in some boreholes due to certain increased constituents. Only one borehole EC-T12-004 had a problem with faecal contamination. Water quality results from the nearby river revealed that there is faecal contamination and this is affecting water quality in this borehole. Besides this faecal problem from EC-T12-004 and pH problem from EC-T12-005 the water quality from newly drilled boreholes is good.

Detailed chemical water analysis data is attached in Appendix B for reference.

5.4 Groundwater Potential Zonation

Groundwater potential can be defined as the amount of groundwater of a suitable quality that can be abstracted on a sustainable basis. There are numerous factors that influence the sustainability of an aquifer. This section will discuss some of these factors, however due to data constraints the confidence in the results is not always high.

5.4.1 Groundwater recharge

Groundwater recharge can be defined as water added to an aquifer e.g. from rainfall. Recharge (due to precipitation) or natural discharge (due to evaporation and transpiration) is generally the most prominent component of the water balance equation. Recharge is influenced by many factors, such as precipitation intensity, depth to groundwater, soil type, climatic conditions, vegetation and slope of ground surface. These factors make an accurate estimation of natural groundwater recharge and discharge complex.

An EXCEL-spreadsheet programme, RECHARGE (Van Tonder and Xu, 2000) can be used to determine the net groundwater recharge. RECHARGE is capable of using different methods including the chloride method, saturated volume fluctuation method, cumulative rainfall departure method, isotopes method, and series of qualified guesses. Bredenkamp et al. (1995) gives a detailed discussion of these methods.

The groundwater recharge for the area is calculated using the chloride method. The method is based on the following equation:

$$R_e = \frac{\text{Chloride concentration in rainfall}}{\text{Harmonic mean of Cl concentration in ground water}} \times 100$$

The results of the recharge calculations are shown in Figure 3 below.

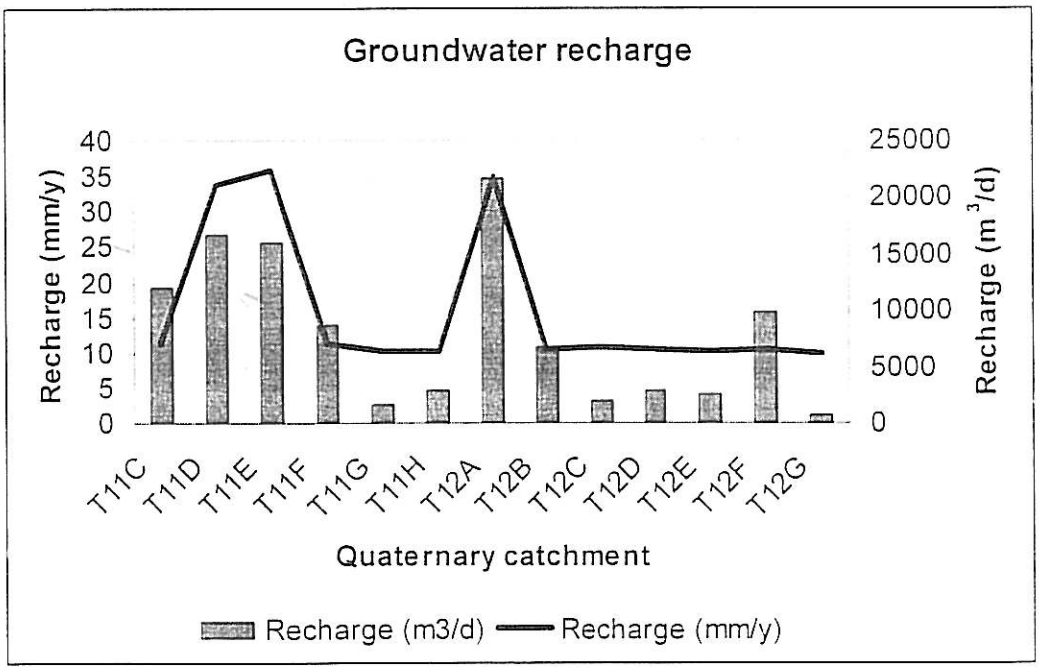

Figure 3: Recharge distribution for the study area.

Assumptions made in these calculations are:

- Chloride values in groundwater were obtained from field data and from Woodford and Chevallier (2001).
- Chloride values in rainfall were obtained from Van Tonder and Xu (2000).
- Rainfall data for the quaternary catchments were obtained from FST engineers.

5.4.2 Surface water-groundwater interaction

Surface water bodies can recharge or discharge groundwater. The exchange rate of water is usually controlled by the difference in hydraulic heads (water levels) and resistance of the media between the groundwater and surface water bodies. According to water levels, surface water bodies can be classified:

- *Influent*: The groundwater level is lower than the surface water level, and therefore surface water is recharging groundwater.
- *Effluent*: The groundwater level is higher than surface water level, and therefore groundwater is recharging surface water.
- *Intermittent*: The groundwater level is higher than the bed of the surface water body, but depending on the elevation of the water level, groundwater may recharge the surface water body or the surface water may recharge groundwater.
- *No connection*: The groundwater level is below the surface water level and the two do not influence each other.

In more than 95% of the cases in South Africa, groundwater will flow towards rivers, implying that groundwater is recharging the rivers.

Very little information is available concerning groundwater-surface water interaction within the study area. Therefore it is assumed that the low-flows in the rivers are equivalent to the amount of groundwater entering the river in the form of base flow. A map of the low flows for the study area is shown in the following figure.

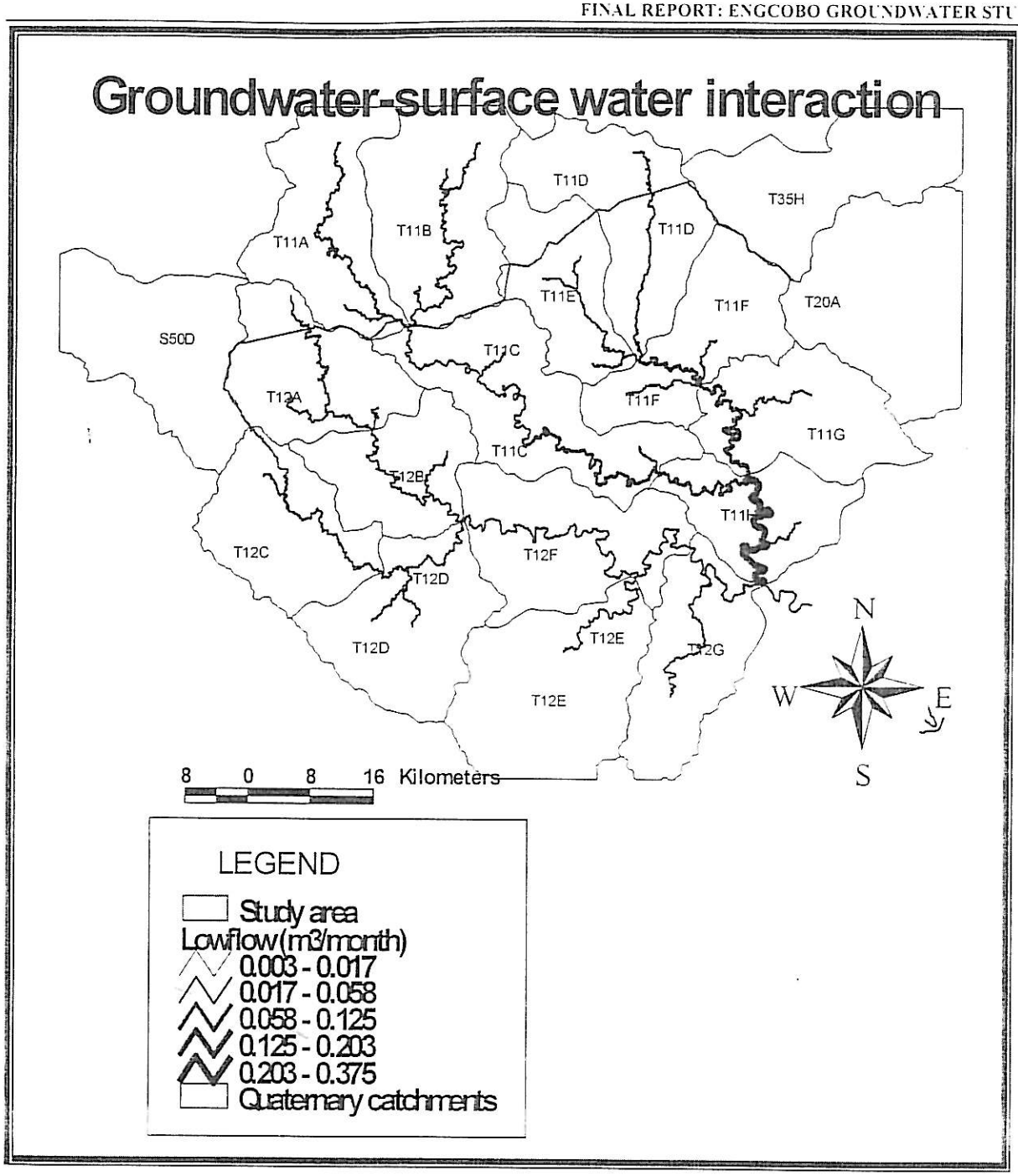

Figure 4: Lowflow values in million m3/month for the study area (FST Consulting Engineers)

Where lowflow values were not available baseflow values were obtained from the Institute for Groundwater Studies (Van Tonder, 2003). The amount of groundwater entering the rivers is assumed to be 30% of the baseflow value.

5.4.3 Lateral groundwater flow across catchment boundaries

Groundwater levels in an aquifer usually (in more than 95% of aquifers studied in South Africa) follow surface topography. Using *Bayesian* interpolation, a reliable groundwater contour map can be plotted, using surface topography. From the groundwater contour map areas where groundwater enters or leaves the catchment can be identified. Groundwater fluxes can then be calculated. Due to limited groundwater levels being available for the study area, a water level map from topography and average depth to water level was generated. Figure 5 estimates groundwater levels for the study area.

Table 2: Depth to groundwater

Borehole nr	Depth to groundwater (mbgl)
EC 031 CH	18.12
EC 032 CH	5.03
EC 033 CH	dry
EC 034 CH	dry
EC 035 CH	4.8
EC T11 002	1.76
EC T11 003	9.99
EC T11 007	13.16
EC T11 008	17.5
EC T12 005	36
EC T12 008	7.53
T32314 3128CB00046	3.74
T32333 3127DB00031	1.85
T32396 3128CA00041	0.54
T32342B 3128CA00013	1.15
T32343 3128CA00015	14.34

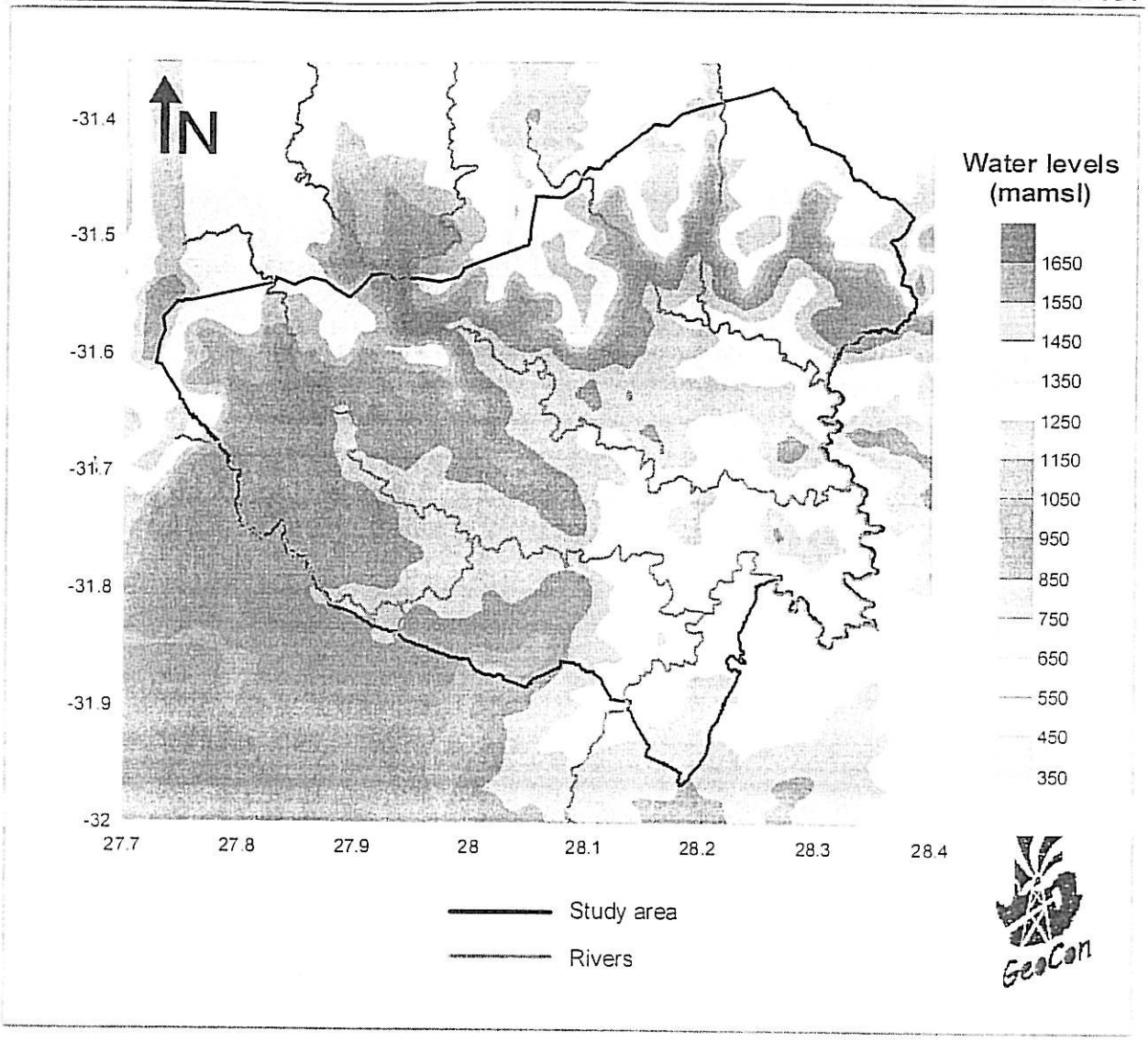

Figure 5 Groundwater levels for the study area

More than 90% of the horizontal flow within the study area is towards the rivers. therefore for the sake of the water balance only flow towards rivers was taken into account.

5.4.4 Groundwater balance and availability

Using all available data - groundwater balance calculations were considered for the entire study area. The calculations were made based on equation 3 in section 4.7. When the calculation were made the following assumptions were taken into consideration:

- *The amount of water that can be allocated is assuming steady state conditions, therefore the integrity of the resource is taken into account.*
- *The flow across a catchment boundary is not altered, thereby taking adjacent catchments into account.*

- *The flow from/to deeper aquifer systems is assumed zero in the first approximation.*
- *Current groundwater abstraction within the study area is not taken into account.*

The results obtained from the calculations were then presented according to quaternary catchments covering the study area. Such results area summarised in Table 3. A typical Storativity value for Karoo aquifers within the study area is 0.005 (Van Tonder and Dennis, 2000). Assuming the aquifer is 20 m thick, the amount of groundwater that can be released from storage can be calculated (see Table 3)

Catchment[1]	Groundwater recharge (m^3/d)	Flow to surface water bodies (m^3/d)	Groundwater available for abstraction (m^3/d)	Groundwater in storage (Mm^3)
T11C	12040.27397	6766.667	5273.607306	3858
T11D	16810.68493	1021.405	15789.27999	1811
T11E	16107.94521	1361.97	14745.97499	1641
T11F	8670.684932	4166.667	4504.018265	2754
T11G	1607.794521	2437.242	No groundwater available[2]	567
T11H	2848.438356	5932.007	No groundwater available[2]	1027
T12A	21714.49315	461.5854	21252.90778	2273
T12B	6663.150685	3287.671	3375.479452	2300
T12C	1931.863014	763.9546	1167.90838	660
T12D	2896.689498	1302.289	1594.40012	1016
T12E	2603.232877	1105.73	1497.50312	925
T12F	9924.694064	4931.507	4993.187215	3464
T12G	681.8849315	302.7085	379.1764401	255

Table 3: Results of water balance calculations

[2]*The flow towards the surface water bodies exceeds the recharge. Please note that only the section of the catchment within the study area was taken into account in the recharge calculations, and in this section, the flow to the surface water body exceeds the groundwater recharge. However, if the whole catchment were taken into account the groundwater will exceed the flow to the river.*

The availability of groundwater - as defined in the previous section - is defined per quaternary catchment in Figure 6.

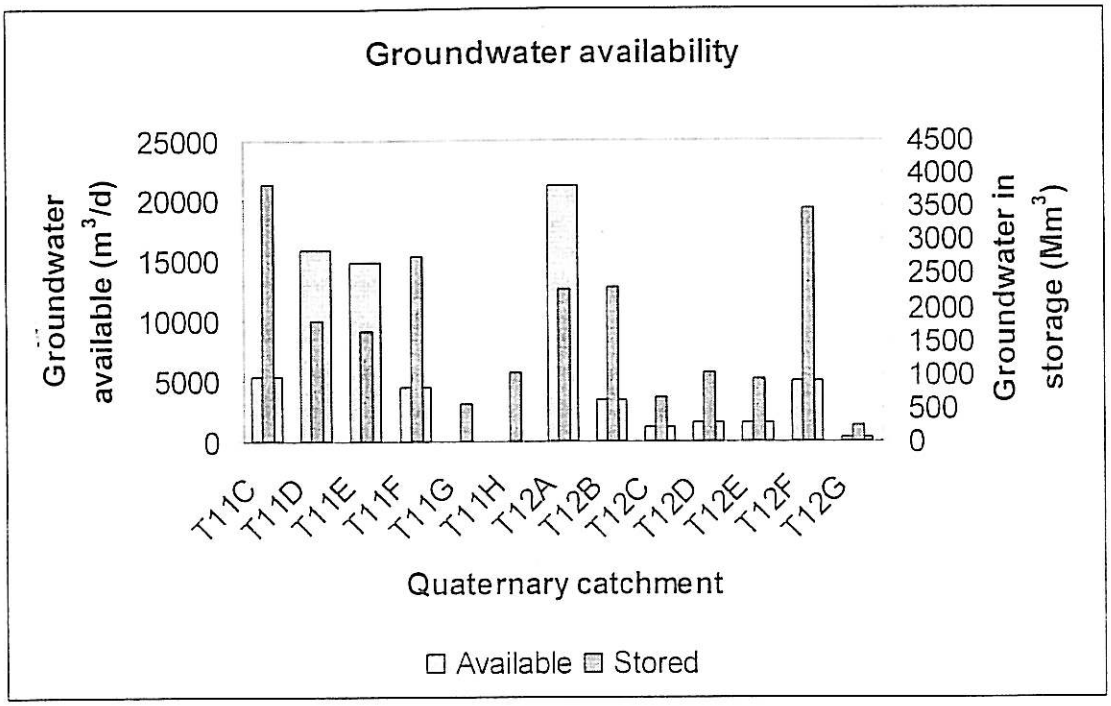

Figure 6 Groundwater availability (only sections of quaternary catchments within study area are taken into account)

5.4.5 Delineation of groundwater potential

Final groundwater potential zonation resulted in the study area being divided into four zones, namely very high potential, high potential, moderate potential and low potential. This zonation is the result of refinement of the preliminary potential zonation, which was done during the desk top study phase.

The first aspect considered when refining the preliminary zones is groundwater availability. On this basis the sections of T11G and T11H are assigned low potential areas, as their recharge area does not fall within the study area. Although the catchments to the north of the study area (T11D, T11E and T12A) receive the highest rainfall – groundwater abstraction is difficult in the northern parts of the catchments because of the steep terrain and inaccessibility as can be seen in MAP 3.

Once the zones were defined according to groundwater availability, highest potential areas were identified according to geology, dolerite intrusion, faulting as well as slopes. The recharge in flat open valleys is normally higher.

The final potential zonation of the area is delineated in MAP 6.

Potential per delineated zone was applied to the specific villages occurring in these zones and all villages are listed according to the groundwater potential defined in the attached VILLAGE GROUNDWATER POTENTIAL TABLE.

In this table potential and cost estimates for source development have been based on the following:

Potential	Drilling attempts to deliver one production borehole	Expected Production Borehole Yield (l/s – over 12/24 hr duty cycle)
Very High	3	2.3
High	3	1.7
Moderate	4	0.8
Low	4	0.4

Table 4: Village based groundwater potential – as per MAP 6

6 REGIONAL SANITATION PERSPECTIVE

According to the Aquifer Classification Map of South Africa, the Engcobo District is located in an area that is classified as a *MINOR* aquifer. Although the national classification defines it as such - the aquifer is not currently fully utilised and its potential defined. The local value of the aquifer as determined by this study, is seen as *HIGH*. High yielding boreholes drilled in recent water supply programs in the study area, as well as during this study confirm this general high potential. A large percentage of community water demand can be met from utilising local groundwater sources. General chemical water quality is good but influences from poor borehole construction; animal waste and poor sanitation practises have caused contamination of groundwater sources in places. Protection of the aquifer at abstraction points is therefore seen as important.

In the light of the available physiographic information, the study area can be divided into the following landforms (i.e.: areas with similar topography, drainage regime and geological character) according to the systems devised by the National Data Bank for Roads of the Council for Scientific and Industrial Research (CSIR):

- Ridge crests
- Concave side slopes
- Convex side slopes
- Pediment slopes

Areas underlain by dolerite is expected to be covered by hillwash composed of silty sand to sandy clay exhibiting a stiff and moderately dense consistency and an intact structure that is micro-shattered. Hillwash generally extends from the surface to a depth of approximately 0.5m. The hillwash is usually ferruginised. A weakly developed pebble marker horizon is usually present. This layer is generally composed of abundant ferricrete nodules in a matrix of silty sand with scattered angular and sub-rounded sandstone and dolerite gravel and cobbles. The transported material is generally underlain by residual dolerite.

Areas underlain by sedimentary formations are generally found to be covered by hillwash composed of silty sand and clayey sand with a dense to moderately dense consistency and intact structure that extends from the surface to a depth of approximately 1m. The hillwash becomes increasingly ferruginised from this depth. The transported material is generally underlain by residual sandstone, siltstone or mudstone.

Excavatability plays an important role in the determination of the type of sanitation system that will be implemented. Pit latrines are generally required to be excavated to a depth ranging between 1.50 and 2.00 metres (ideally 1.80 m), into a suitable permeable soil at the base while a septic tank system requires at least 2.00 metres of suitable permeable soil from the surface to the base, implying depths in excess of 2.00 metres. It is expected in general for pits to be excavated to a depth ranging between 0.5 and 2.5 m, after which bedrock with a very soft rock to soft rock consistency will be encountered. The sidewalls of pits are expected to remain stable in general with collapse possibly occurring in specific problematic zones.

Static water levels noted in the Engcobo area vary from 1 to 36 m below surface with artesian boreholes known to occur in places. Springs are most prominent in the northern mountainous part of the area and surface water-groundwater interaction is prominent. Influence from on-site-sanitation practises is therefore likely.

The following flag-situations can occur in the Engcobo area and must be taken note of:

- The base of some pit latrines can be in fractured and weathered bedrock at some villages – especially towards the north
- Shallow depths to the groundwater table can be expected closer to valley floors and near dolerite contact zones
- Contaminated surface and spring water can influence groundwater quality
- The formation of contaminated perched groundwater within slightly permeable soil material is likely
- The ponding of contaminated water at the surface in the vicinity of water abstraction points and sanitation systems is likely due to local soil characteristics.
- Water abstraction points – if not protected – will promote contamination from animal waste and activity around these points.
- Ferruginised soil material is expected over the majority of the study area, which is indicative of perched groundwater conditions.

Evaluating the project area according to the Groundwater Protocol's Risk Assessment Table, it is seen that in general, a *POSSIBLE RISK* exists as far as ground water pollution is concerned throughout most of the study area.

Due to the classification of the terrain as a zone of *POSSIBLE RISK*, the following approach will have to be taken to reduce this *possible risk:*

- Detailed hydrogeological surveys per village will be required to delineate sensitive zones and make site-specific recommendations
- Alterations to existing and to-be-installed on-site systems might be required
- Alterations to existing borehole supplies might be required
- Zones where future groundwater sources can be developed must be protected
- Zones where pollution of the shallow aquifer is possible due to perched groundwater and seepage into pits must be defined
- Zones where pollution of the deep fractured aquifer is possible due to pit latrines being excavated in shallow bedrock must be delineated
- Localised rock outcrops have to be avoided by moving pit latrine sites.
- Excavation is recommended to take place beyond the bottom of impermeable hardpan ferricrete (when encountered) so that the pit base is in more permeable ground. It is recommended that the ferricrete be removed within at least a 1-metre radius of the pit and replaced with a suitably impermeable material. Alternatively the pit could be lined.
- Pit opening must be protected such that no surface water is allowed to enter the hole.
- No pit latrine should be excavated into fractured bedrock. If this is unavoidable, the specific pit should be lined to prevent the possible pollution of the local aquifer.

7 CONCLUSIONS AND RECOMMENDATIONS

Based on results of the groundwater feasibility and groundwater potential verification studies carried out as part of the Engcobo Water Services Feasibility Study, the following can be concluded:

- The groundwater potential of the Engcobo Local Municipality is presently under-utilised due to local aquifers not having been developed optimally, poor condition of existing borehole equipment and misperceptions regarding groundwater – its origins, recharge and potential.
- Literature reviewed and results from previous studies have indicated that groundwater data for the Engcobo Local Municipality is insufficient to define exact groundwater potential variations and occurrences
- The objectives of the study were outlined based on two phases namely a feasibility desk-top phase, followed by a verification phase involving borehole drilling and testing
- The geology of the Engcobo area comprises the middle part of the stratigraphic sequence of the Karoo Supergroup, comprising sedimentary rocks intruded by dolerite during late Karoo volcanism.
- The dominant geological formation in the Engcobo study area is the Burgersdorp formation that is relatively mudstone rich, with the second most important formation being the Molteno formation that has a higher sandstone component and therefore theoretically of higher groundwater potential. It is however the effect, abundance as well as type of dolerite intrusion that is the determining factor when assessing the groundwater potential in the study area.
- Ring-shaped dolerite intrusions are common. Ring-shaped structures can be delineated from satellite imagery and is of high importance when defining groundwater potential
- Groundwater quality data is insufficient to delineate potential based on expected water classes. The groundwater can however be described as a Calcium Magnesium Bicarbonate water with sodium enrichment, indicative of active groundwater circulation. In general - Good Water Quality (Class 1) to Marginal water quality (Class 2) is expected throughout the study area at groundwater sources.
- Groundwater potential can be defined as the amount of groundwater of a suitable quality that can be abstracted on a sustainable basis. Numerous factors influence the sustainability and potential of an aquifer. In this study – recharge, water balance, surface-groundwater interaction, groundwater storage and flow directions as well as calculations of aquifer hydraulic parameters were taken into account in conjunction with hydrogeology and exploration results to define groundwater potential.
- A groundwater potential zonation map was compiled which is intended to act as a planning tool for source development and planning purposes in the Engcobo Local Municipality. Regional potential was applied to individual villages and site-specific observations were added to characterise villages into four classes, namely Low, Moderate, High and Very High Potential villages. Data is presented in table format where potential is coupled to each village and related to source development factors and costs
- Sustainable borehole yields ranging from 0.5 l/s to over 2.0 l/s (over 12-hr pumping cycles) can be used for water supply estimations in the Engcobo area.

- Based on a water demand of 25 l/c/d. the largest percentage of villages in the Engcobo area can be supplied from a single borehole source. Groundwater development costs for villages vary from an estimated R140 000 where one production borehole needs to be delivered at a very high potential village to up to approximately R300 000 and more to develop a groundwater source at a low potential village with a large population.
- The regional sanitation perspective for the Engcobo area revolves around the high local value of the aquifers present.
- Static water levels noted in the Engcobo area vary from 1m to 36m below surface with artesian boreholes known to occur in places. Springs are most prominent in the northern mountainous part of the area and surface water-groundwater interaction is prominent. Influence from on-site-sanitation practises is therefore likely
- General chemical water quality is good but influences from poor borehole construction; animal waste and poor sanitation practises have caused contamination of groundwater sources in places. Protection of the local aquifers is therefore seen as important

The following is recommended to further verify the results of this study as well as to utilise surplus funds available under the hydrogeological component of the study:

- Spring evaluation in northern mountainous zone
- Further definition and verification of high yielding boreholes drilled in the northern zone during exploration drilling – an area initially thought to be of low potential
- Extension of the proposed regional sanitation survey
- Regional water quality assessment

8 REFERENCES

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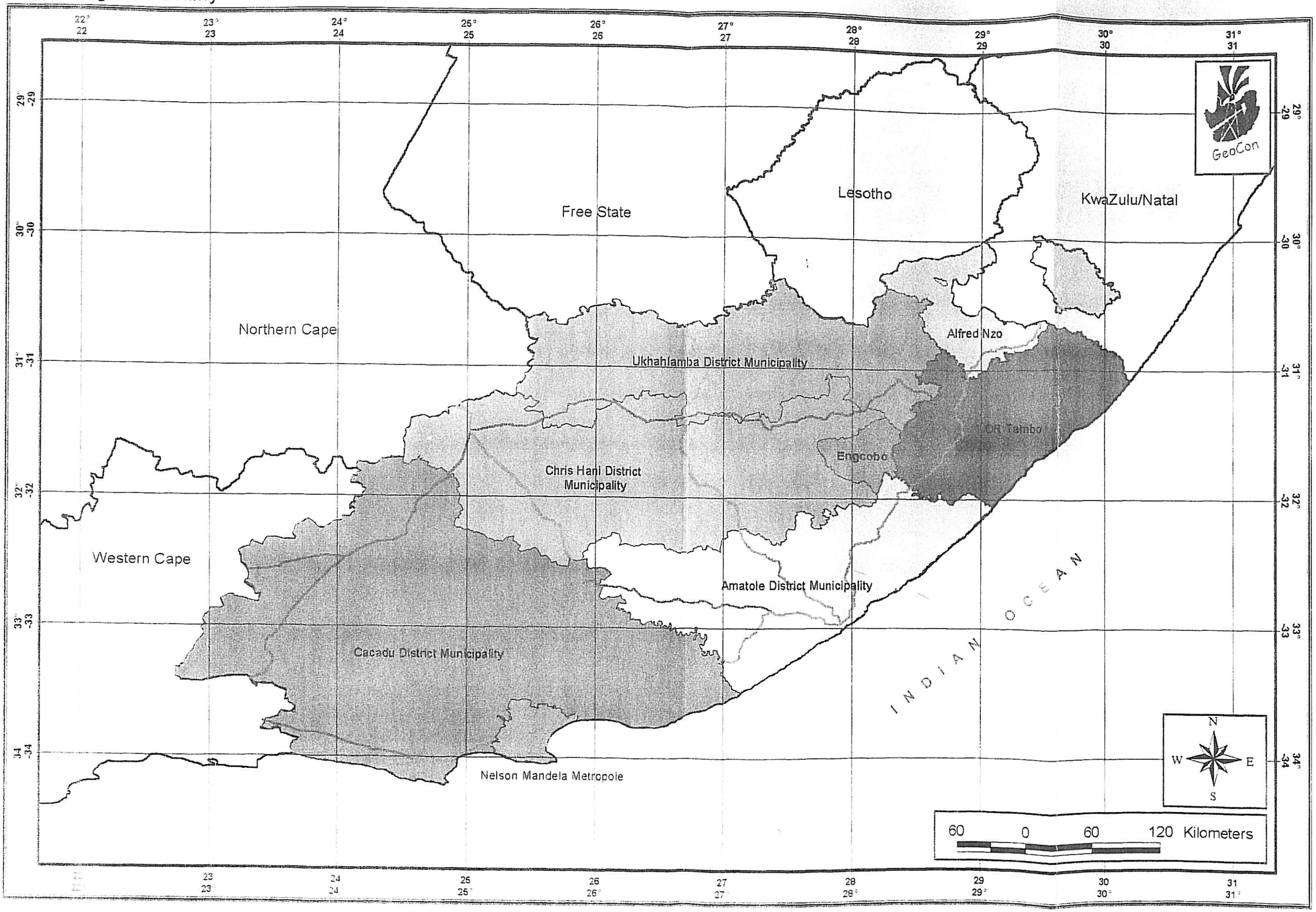
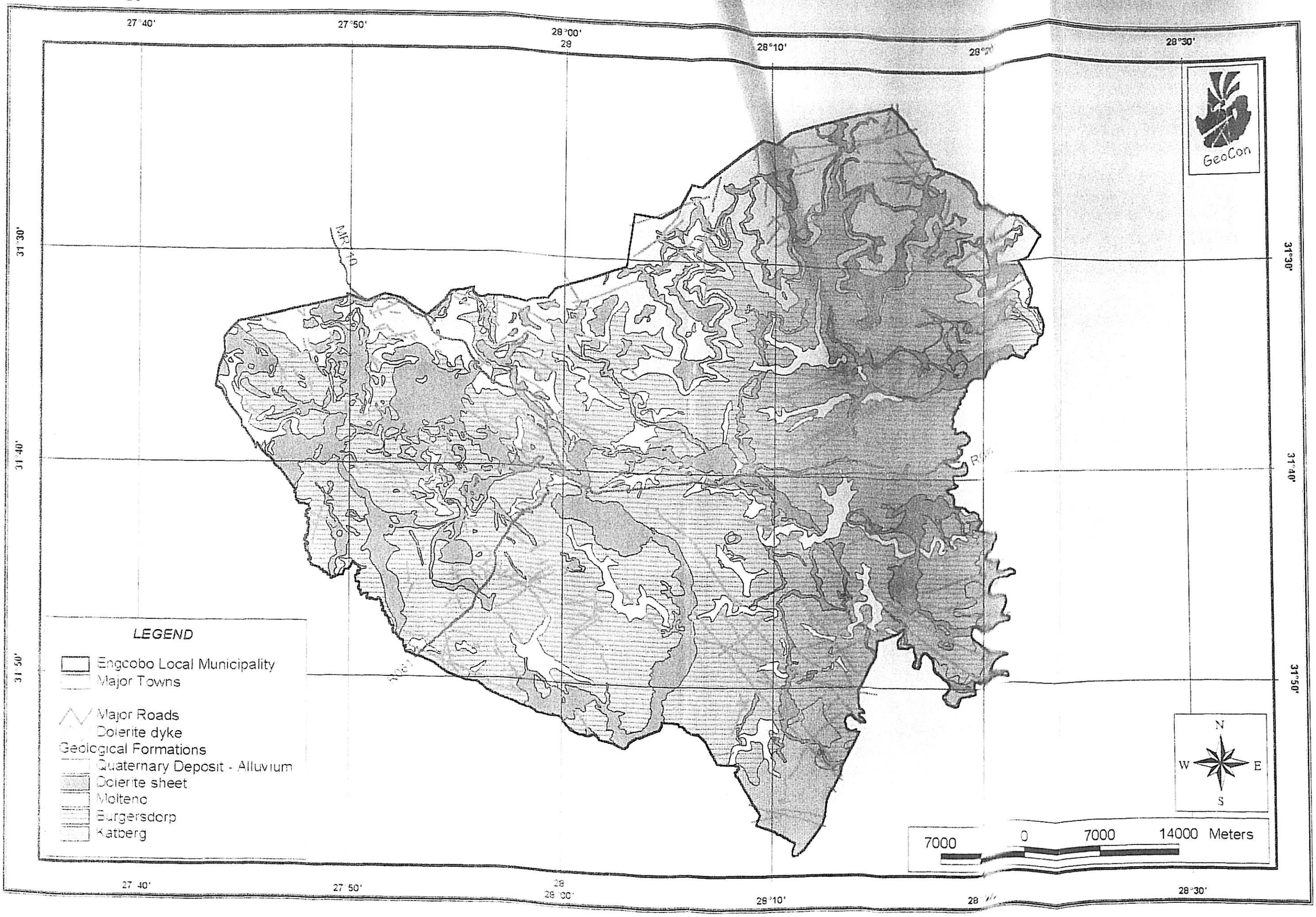
PROJECT: CHRIS HANI GROUNDWATER STUDY - ENGCOBO LOCAL MUNICIPALITY

Map 1: Regional locality



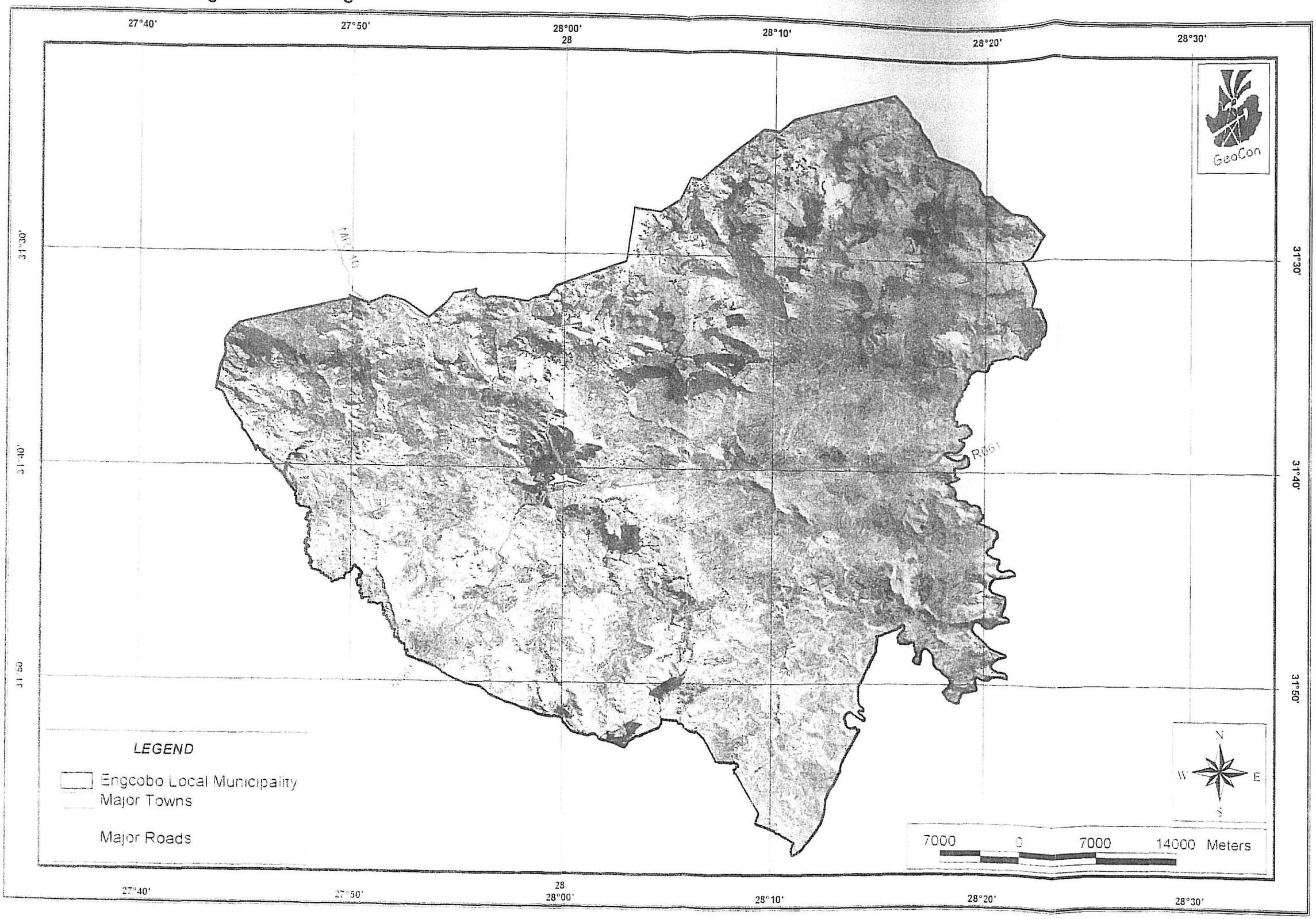
PROJECT: CHRIS HANI GROUNDWATER STUDY - ENGCOBO LOCAL MUNICIPALITY

Map 2: Geology



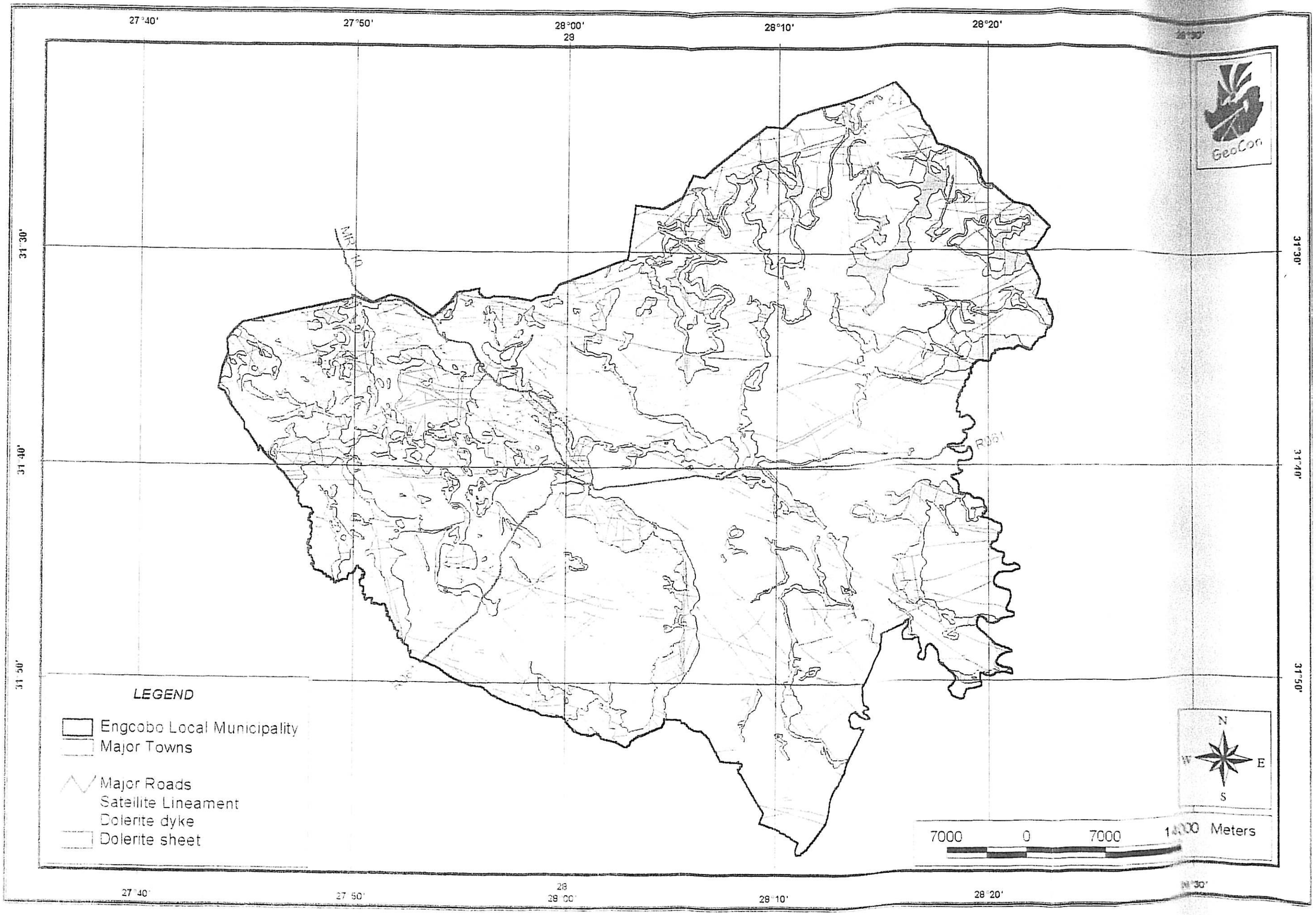
PROJECT: CHRIS HANI GROUNDWATER STUDY - ENGCOBO LOCAL MUNICIPALITY

Map 3: Remote Sensing - Satellite Image

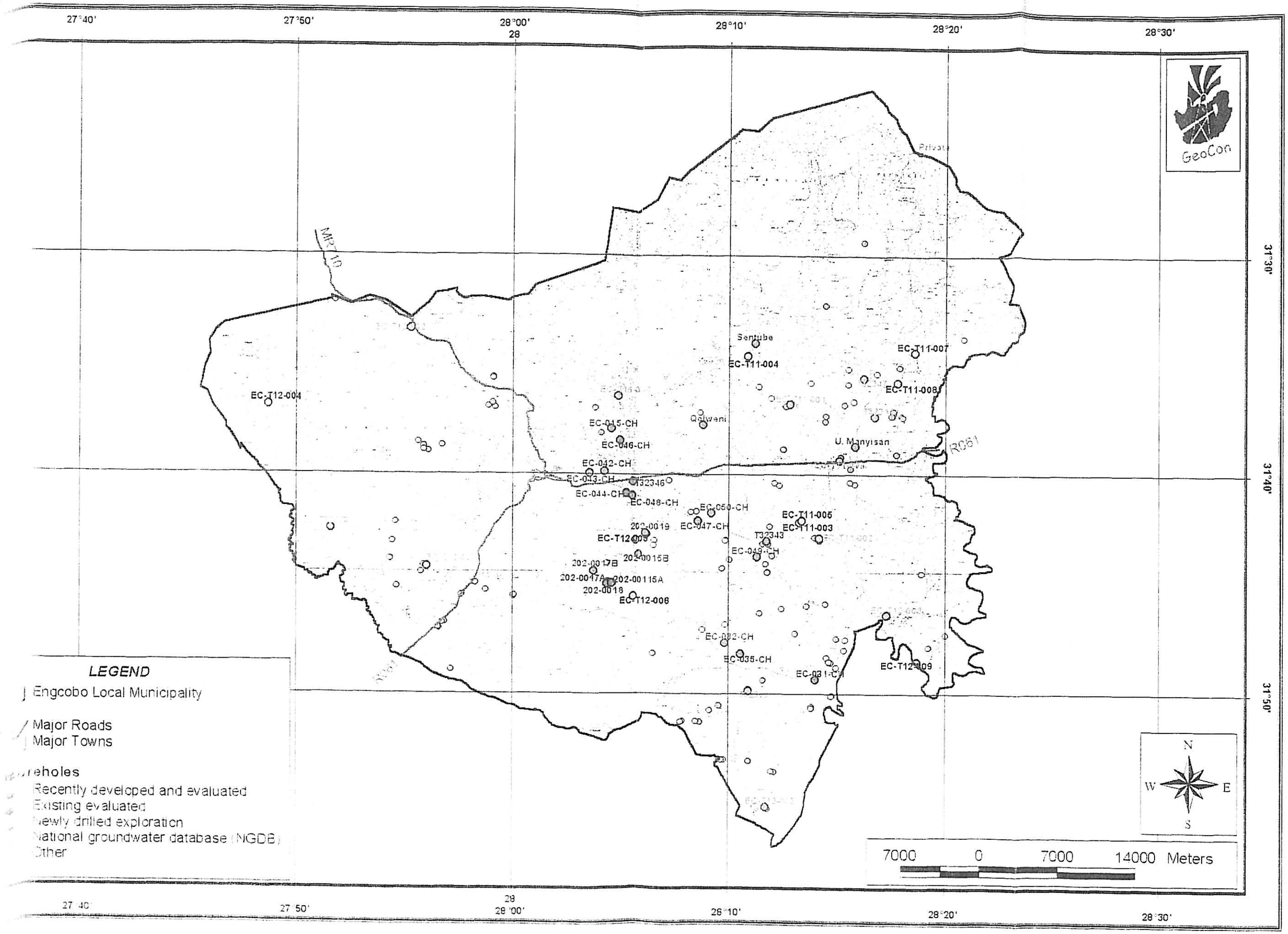


PROJECT: CHRIS HANI GROUNDWATER STUDY - ENGCOBO LOCAL MUNICIPALITY

Map 4: Structural Geological Map

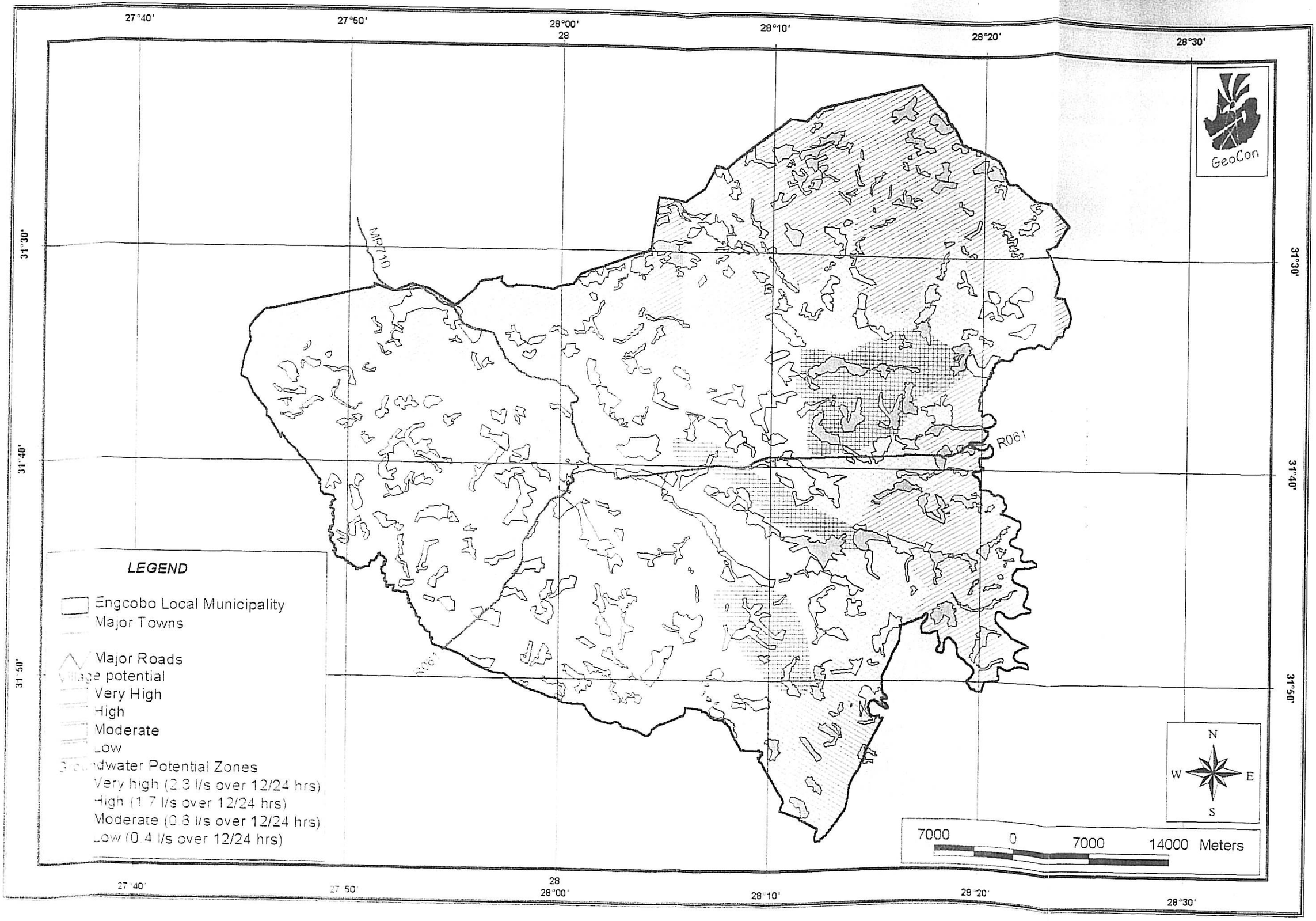


T: CHRIS HANI GROUNDWATER STUDY - ENGCOBO LOCAL MUNICIPALITY
Borehole Distribution



PROJECT: CHRIS HANI GROUNDWATER STUDY - ENGCOBO LOCAL MUNICIPALITY

Map 6: Groundwater Potential Zonation



APPENDIX A

PUMP TESTING DATA

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/001	PROJECT:	ENCGOBO FEASILBILITY STUDY
ALTERNATIVE NO. :		SITE NAME:	XIBENI VILLAGE
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUN

BOREHOLE DEPTH (mbdl):	97.50	CASING DEPTH (mbdl):	5.95	PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	86.70	CASING HEIGHT (magl):	0.21	OPERATOR:	JOHANNES
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):		CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	1.40	DATUM LEVEL (magl):	0.43	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 02/04/2003 TIME: 18H40

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.73		1	
2	0.94	0.72	2	
3	1.08	0.71	3	
5	1.16		5	
7	1.23	0.72	7	
10	1.27		10	
15	1.34		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 02/04/2003 TIME: 18H55

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	2.10		1	
2	2.81	1.59	2	
3	2.86	1.6	3	
5	2.98		5	
7	3.10	1.59	7	
10	3.19		10	
15	3.28		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 02/04/2003 TIME: 19H10

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	4.27	2.40	1	
2	5.43		2	
3	6.15		3	
5	8.50	3.01	5	
7	9.74	3	7	
10	10.95	3.01	10	
15	12.40		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 02/04/2003 TIME: 19H25

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	13.39		1	
2	14.85	3.74	2	
3	16.82		3	
5	20.34	4.15	5	
7	27.30	4.16	7	
10	33.92		10	
15	43.08		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 02/04/2003 TIME: 19H40

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	44.60		1	
2	47.37	5.02	2	
3	51.56		3	
5	64.31	5.01	5	
7	71.02	5.01	7	
10	85.98		10	
15	85.98	PI 3.21	15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	72.13
2			2	60.04
3			3	51.11
5			5	30.72
7			7	20.33
10			10	10.15
15			15	5.40
			20	1.76
			30	1.48
			40	1.24
			50	1.19
			60	1.14
			70	1.08
			80	0.96
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ? NO

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/001	PROJECT:	ENCGOBO FEASILBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	XIBENI VILLAGE
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUN

BOREHOLE DEPTH (mbdl):	97.50	CASING DEPTH (mbdl):	5.95	PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	86.70	CASING HEIGHT (magl):	0.21	OPERATOR:	JOHANNES
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	0.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	1.40	DATUM LEVEL (magl):	0.43		

DISCHARGE RATE 1			Time	Recovery 1
DATE:	03/04/2003		(min)	(m)
TIME:	06H20		1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
1	1.33		5	
	1.67	0.730	7	
	1.79		10	
5	2.05	0.800	15	
	2.21	0.810	20	
0	2.36		30	
15	2.44		40	
20	2.52		50	
0	2.61	0.800	60	
40	2.78		70	
50	2.78	0.800	80	
0	2.81		90	
0	2.86	0.810	100	
80	2.91	0.800	110	
0	2.95		120	
00	2.95		150	
110			180	
120			210	
Average yield: 0.79285714 l/s				

DISCHARGE RATE 2			Time	Recovery 2
DATE:	03/04/2003		(min)	(m)
TIME:	08H00		1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
1	3.32		5	
2	3.48	1.260	7	
3	3.69		10	
5	3.90		15	
7	6.14	1.520	20	
10	6.43	1.510	30	
15	6.66		40	
20	6.85		50	
30	6.97	1.520	60	
40	7.12		70	
50	7.21	1.510	80	
60	7.34	1.520	90	
70	7.41		100	
80	7.48	1.510	110	
90	7.57		120	
100	7.64		150	
110			180	
120			210	
Average yield: 1.47857143				

DISCHARGE RATE 3			Time	Recovery 3
DATE:	03/04/2003		(min)	(m)
TIME:	09H40		1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
1	8.32		5	
2	10.18	2.450	7	
3	11.61		10	
4	14.55	3.010	15	
7	15.74		20	
10	20.19	3.030	30	
15	23.54		40	
20	25.67		50	
30	28.63	3.010	60	
40	30.39	3.030	70	
50	31.20		80	
60	32.14		90	
70	32.78	3.030	100	
80	33.13		110	
90	33.71		120	
100	34.18		150	
110			180	
120			210	
Average yield: 2.92666667				

DISCHARGE RATE 4			Time	Recovery 4
DATE:	03/04/2003		(min)	(m)
TIME:			1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
			5	
			7	
3			10	
			15	
			20	
10			30	
15			40	
20			50	
30			60	
40			70	
50			80	
50			90	
70			100	
80			110	
90			120	
100			150	
110			180	
120			210	
Average yield: #DIV/0!				

DISCHARGE RATE 5			Time	Recovery 5
DATE:	03/04/2003		(min)	(m)
TIME:			1	
Time	Drawdown		2	
(min)	(m)	(l/s)	3	
1			5	
2			7	
3			10	
5			15	
7			20	
10			30	
15			40	
20			50	
30			60	
40			70	
50			80	
60			90	
70			100	
80			110	
90			120	
100			150	
110			180	
120			210	
			240	
			300	
			360	
			420	
			480	
			540	
			600	
			660	
			780	

DISCHARGE RATE 6			Time	Recovery
DATE:	03/04/2003		(min)	(m)
TIME:			1	23.07
Time	Drawdown	Yield	2	12.90
(min)	(m)	(l/s)	3	8.89
1			5	5.12
2			7	3.95
3			10	3.51
5			15	3.34
7			20	3.17
10			30	2.92
15			40	2.78
20			50	2.53
30			60	2.42
40			70	2.31
50			80	2.22
60			90	2.15
70			100	2.07
80			110	1.99
90			120	1.92
100			150	1.77
110			180	1.65
120			210	1.57
150			240	1.42
180			300	
210			360	
240			420	
300			480	
360			540	
420			600	
480			660	
Average yield:			720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/001	PROJECT:	ENCGOBO FEASILBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUN
ALTERNATIVE NO. :	0	SITE NAME:	XIBENI VILLAGE		
DEPTH OF PUMP (mbdl):	86.70	PUMP TYPE USED:	P 100	OPERATOR:	JOHANNES
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	0	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	03/04/2003	TEST COMPLETED	DATE:		TOTAL TIME - PUMPED (min):	2880
	TIME:	16h20		TIME:		TOTAL TIME-RECOVERY(min):	2880

TOTAL TEST TIME (min):	2880						
AVERAGE YIELD (l/s):	1.63						

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
CASING HEIGHT (magl):			0.21	No. :			No. :			No.		
CASING DEPTH (mbdl):			5.95	DATUM LEVEL (magl):			DATUM LEVEL (magl):			DATUM LEVEL (magl):		
CASING ID (mm):			0.00	CASING DEPTH (mbdl):			CASING DEPTH (mbdl):			CASING DEPTH (mbdl):		
BOREHOLE DEPTH (mbdl):			97.50	BOREHOLE DEPTH :			BOREHOLE DEPTH :			BOREHOLE DEPTH :		
WATER LEVEL (mbdl):			1.40	WATER LEVEL:			WATER LEVEL:			WATER LEVEL:		
DATUM LEVEL (magl):			0.43	DISTANCE (m):			DISTANCE (m):			DISTANCE (m):		
Time	Drawdown	Yield	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery
(min)	(m)	(l/s)	(m)	(min)	(m)	(m)	(min)	(m)	(m)	(min)	(m)	(m)
1	3.41		8.39	1			1			1		
2	4.62	1.56	6.93	2			2			2		
3	5.48		6.20	3			3			3		
5	6.80	1.64	5.86	5			5			5		
7	7.21		5.69	7			7			7		
10	7.54		5.55	10			10			10		
15	7.90	1.63	5.38	15			15			15		
20	8.04	1.64	5.30	20			20			20		
30	8.27		5.10	30			30			30		
40	8.42		4.94	40			40			40		
60	8.78	1.64	4.71	60			60			60		
90	8.94	1.63	4.41	90			90			90		
120	9.18		4.19	120			120			120		
150	9.34		4.02	150			150			150		
180	9.53	1.65	3.87	180			180			180		
210	9.69	1.64	3.79	210			210			210		
240	9.82		3.61	240			240			240		
300	9.94		3.40	300			300			300		
360	10.20		3.25	360			360			360		
420	10.41		3.13	420			420			420		
480	10.58	1.64	3.02	480			480			480		
540	10.73		2.90	540			540			540		
600	10.87		2.72	600			600			600		
660	10.98		2.64	720			720			720		
720	11.05		2.59	840			840			840		
780	11.13	1.63	2.53	960			960			960		
840	11.20	1.64	2.47	1080			1080			1080		
900	11.23		2.38	1200			1200			1200		
960	11.27		2.32	1320			1320			1320		
1020	11.36		2.26	1440			1440			1440		
1080	11.44	1.64	2.21	1800			1800			1800		
1140	11.50	1.65	2.15	2280			2280			2280		
1200	11.59		2.09	2880			2880			2880		
1260	11.63	1.64	2.02									
1320	11.67		1.99									
1380	11.68	1.64	1.96									
1440	11.70		1.90									

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time	Drawdown	Yield	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery
(min)	(m)	(l/s)	(m)	(min)	(m)	(m)	(min)	(m)	(m)	(min)	(m)	(m)
1500	11.78		1.85	1500			1500			1500		
1560	11.87	1.63	1.83	1560			1560			1560		
1620	11.92		1.80	1620			1620			1620		
1680	11.86		1.72	1680			1680			1680		
1740	11.99		1.69	1740			1740			1740		
1800	12.02	1.64	1.65	1800			1800			1800		
1860	12.07	1.65	1.60	1860			1860			1860		
1920	12.14		1.57	1920			1920			1920		
1980	12.17		1.53	1980			1980			1980		
2040	12.20		1.50	2040			2040			2040		
2100	12.22		1.48	2100			2100			2100		
2160	12.25		1.46	2160			2160			2160		
2220	12.27	1.64	1.44	2220			2220			2220		
2280	12.30		1.42	2280			2280			2280		
2340	12.33		1.39	2340			2340			2340		
2400	12.36	1.64	1.36	2400			2400			2400		
2460	12.38		1.33	2460			2460			2460		
2520	12.38	1.63	1.30	2520			2520			2520		
2580	12.41		1.27	2580			2580			2580		
2640	12.43		1.25	2640			2640			2640		
2700	12.45	1.64	1.23	2700			2700			2700		
2760	12.49		1.19	2760			2760			2760		
2820	12.52	1.64	1.17	2820			2820			2820		
2880	12.54		1.16	2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT		Sum
INTER HOLE MOVE > 10 km	43	Km.
FROM: SITE NAME:	HIGHVIEW STORE	
BOREHOLE No:		
INTER HOLE MOVE < 10 km:		No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:	0	No.
REMOVAL OF EXISTING EQUIPMENT:	0	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	0	No.
WORK TIME RATE (REPAIRS):	0	Hour
STANDING TIME:	0	Hour
LATITUDE:	LONGITUDE:	

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	1	No
VERTICALITY TEST:	0	No
CASING DETECTION:	1	No
STEEL BOREHOLE COVER:	1	No
BOREHOLE MARKING:	1	No
SITE CLEANING / FINISHING:	1	No
REPORTING & DATA RECORDING:	1	No
SLUG TEST:	0	No
LAYFLAT (m):	50	m
BOREHOLE DEPTH AFTER TEST:	97.5	m
BOREHOLE WATERLEVEL AFTER TEST:	1.96	m

TEST DESCRIPTION	STEP	1	2	3	4	5	6	TOTAL: (min)	TOTAL: (hrs)	RECOVERY: (m)	RECOVERY: (min)
CALIBRATION TEST:											
TEST DURATION (Minutes)		15	15	15	15	15		75	1.25	0.96	60
TEST YIELD (l/s)		0.72	1.59	2.86	4.02	5.01		MAXIMUM (l/s)	5.0		
DRAWDOWN (m)		1.34	3.28	12.40	43.08	85.98		MAXIMUM (m)	86.0		
MULTI-RATE / STEP DRAWDOWN:											
TEST DURATION (Minutes)		100	100	100				300	5.00	1.42	240
TEST YIELD (l/s)		0.79	1.48	2.93				MAXIMUM (l/s)	2.9		
DRAWDOWN (m)		3.0	7.64	34.18				MAXIMUM (m)	34.2		

RECOVERY TEST			
TIME TOTAL (hrs):			53.33
Cal	Steps	CD	Total
60	240	2880	3200
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED	%	
85.3	12.54	14.70	

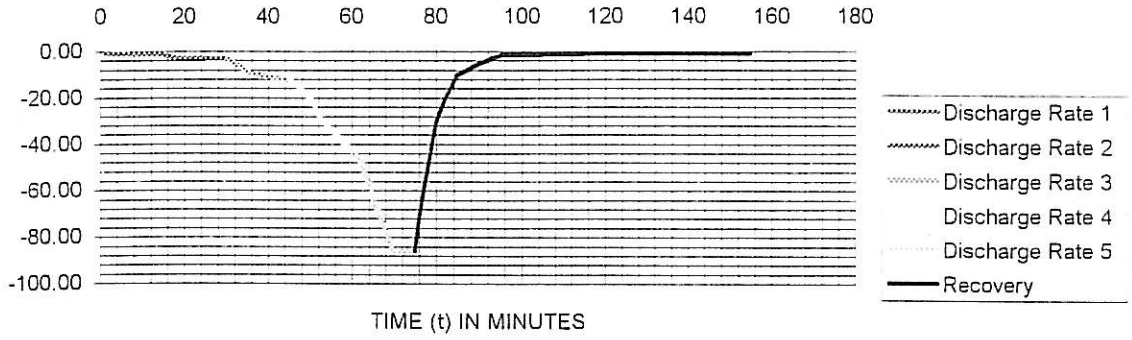
CONSTANT DISCHARGE TEST	TEST DURATION (min)	TEST DURATION (hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	RECOVERY: %	RECOVERY: (min)	RECOVERY: (hrs)
	2880	48.00	1.63	12.54	1.16	90.75	2880	48.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	>2880 (min) Time	TOTAL: (min)	TOTAL: (hrs)
							0	0.00

BOREHOLE NUMBER: EC/T11/001

CALIBRATION TEST AND RECOVERY

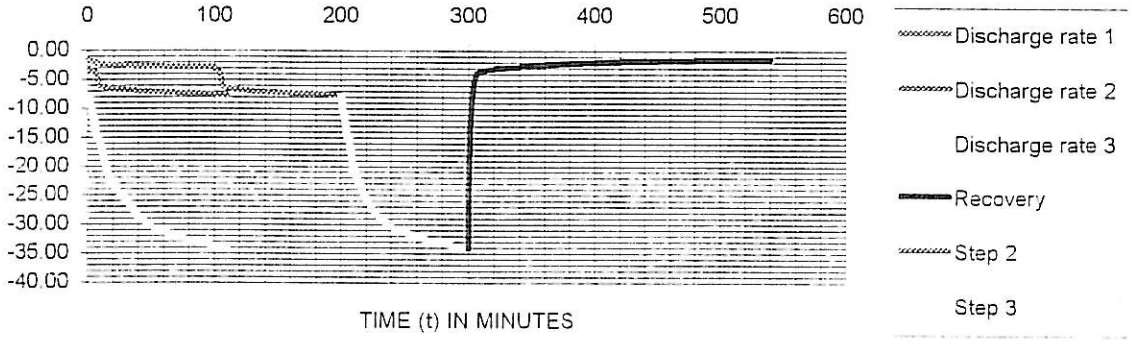
Discharge 1:	0.72	Discharge 2:	1.59	Discharge 3:	2.86	Discharge 4:	4.02	Discharge 5:	5.01	Discharge 6:	



Drawdown 1:	1.34
Drawdown 2:	3.28
Drawdown 3:	12.40
Drawdown 4:	43.08
Drawdown 5:	85.98
Drawdown 6:	0.00
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	15
Duration 6:	
Recovery (m):	0.96
Recovery (min):	80

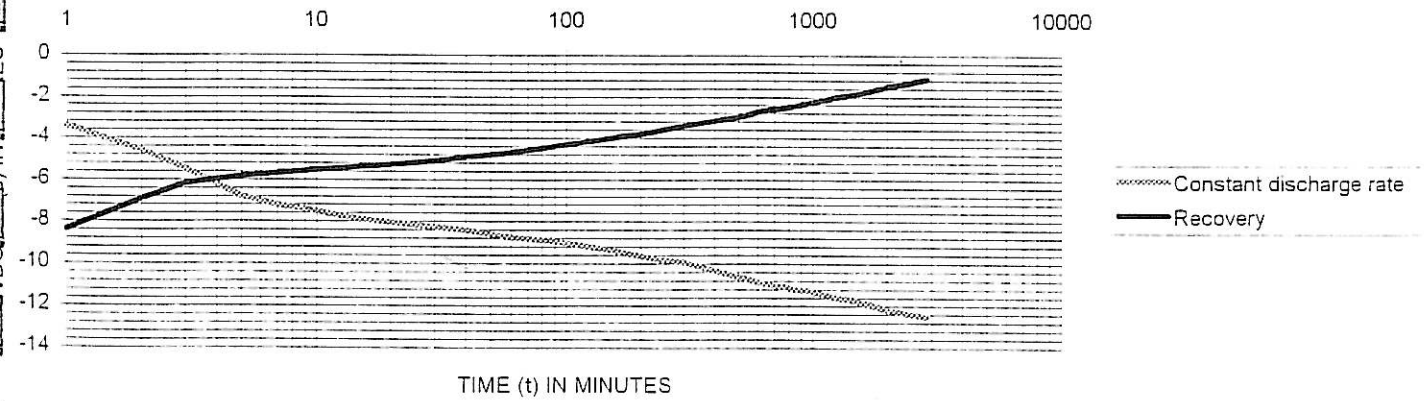
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	0.79286	Discharge 2:	1.47857	Discharge 3:	2.92667	Discharge 4:		Discharge 5:		Discharge 6:	



Drawdown 1:	2.95
Drawdown 2:	7.64
Drawdown 3:	34.18
Drawdown 4:	0.00
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	100
Duration 3:	100
Duration 4:	
Duration 5:	
Duration 6:	
Recovery (m):	1.42
Recovery (min):	240

CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	03/04/2003	Water level (mbgl)	1.40	Depth of pump (mbgl)		86.7
Duration	2880	CD discharge rate	1.63	CD drawdown		12.54
Usable drawdown (m)	85.3	% Recovery after CD	91	% after	2880	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO.:	EC/T11/002		PROJECT:	ENCGOBO FEASIBILITY STUDY	
ALTERNATIVE NO.:	T 32342 T32312 B		SITE NAME:	QOTHA	
ALTERNATIVE NO.:	3128CA 00013		CLIENT:	CHRIS HANI DISTRICT MUN	
BOREHOLE DEPTH (mbdl):	48.12	CASING DEPTH (mbdl):	6.78	PUMP TYPE USED:	BP 22 M
DEPTH OF PUMP (mbdl):	44.70	CASING HEIGHT (magl):	0.50	OPERATOR:	ABRAHAM
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	165.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	1.02	DATUM LEVEL (magl):	0.13	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 01/04/2003 TIME: 14H20

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.60		1	
2	0.85		2	
3	1.01	0.3	3	
5	1.15		5	
7	1.22		7	
10	1.32	0.3	10	
15	1.36		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 01/04/2003 TIME: 14H35

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.70		1	
2	2.02		2	
3	2.15		3	
5	2.31	0.71	5	
7	3.04		7	
10	3.27	0.7	10	
15	3.41		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 01/04/2003 TIME: 14H50

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	4.27		1	
2	4.64		2	
3	5.37		3	
5	6.18	1.51	5	
7	6.62	1.51	7	
10	6.97		10	
15	7.21	1.51	15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 01/04/2003 TIME: 15H05

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	8.09		1	
2	9.38		2	
3	10.09	2.4	3	
5	11.46		5	
7	12.16	2.4	7	
10	13.56		10	
15	14.04		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:
WINDMILL

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):

PUMP RPM:

PUMP CONDITION:
POOR

DISCHARGE RATE 5

DATE: 01/04/2003 TIME: 15H20

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	15.12		1	
2	18.71	4.01	2	
3	21.71	5.07	3	
5	26.26		5	
7	34.82		7	
10	41.04	5.07	10	
15	44.29		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	34.50
2			2	23.33
3			3	13.51
5			5	5.09
7			7	3.72
10			10	3.15
15			15	2.77
			20	2.42
			30	2.21
			40	2.12
			50	2.01
			60	1.91
			70	1.78
			80	
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/002	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	T 32342	SITE NAME:	QOTHA
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUN

BOREHOLE DEPTH (mbdl):	48.12	CASING DEPTH (mbdl):	6.78	PUMP TYPE USED:	BP 22 M
DEPTH OF PUMP (mbdl):	44.70	CASING HEIGHT (magl):	0.50	OPERATOR:	ABRAHAM
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	165.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	1.76	DATUM LEVEL (magl):	0.13		

DISCHARGE RATE 1

DATE: 01/04/2003
TIME: 17H20

Time (min)	Drawdown (m)	Yield (l/s)
1	3.44	
	3.96	0.880
	4.40	
5	5.97	1.510
	6.78	
0	7.47	
15	7.57	1.510
90	7.69	
0	8.28	
40	8.93	1.500
50	9.31	
0	9.49	1.510
0	9.56	
80	9.63	1.510
0	9.79	
00	9.92	
110		
120		

Average yield: 1.40333333 (l/s)

Recovery 1

Time (min)	Recovery 1 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 2

DATE: 01/04/2003
TIME: 19H00

Time (min)	Drawdown (m)	Yield (l/s)
1	11.14	
2	12.59	
3	13.47	
5	16.44	3.110
7	18.29	
10	20.41	3.110
15	22.17	
20	22.92	3.110
30	23.60	
40	24.03	3.110
50	24.12	
60	24.53	
70	25.31	3.100
80	26.16	
90	26.52	3.110
100	26.70	
110		
120		

Average yield: 3.10833333

Recovery 2

Time (min)	Recovery 2 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 01/04/2003
TIME: 20H40

Time (min)	Drawdown (m)	Yield (l/s)
1	27.72	
2	29.65	3.870
3	31.94	4.010
4	34.16	
7	36.34	4.010
10	41.15	
15	44.29	
16	44.29	Pl 2.57
18	44.29	Pl 2.22
20	44.29	Pl 2.10
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: 3.96333333

Recovery 3

Time (min)	Recovery 3 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 01/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

Recovery 4

Time (min)	Recovery 4 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 01/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Recovery 5

Time (min)	Recovery 5 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
780	

DISCHARGE RATE 6

DATE: 01/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Recovery

Time (min)	Recovery (m)
1	37.50
2	27.45
3	18.30
5	10.57
7	8.93
10	7.59
15	7.11
20	6.89
30	6.49
40	6.17
50	5.91
60	5.68
70	5.59
80	5.38
90	5.17
100	4.99
110	4.78
120	4.53
150	4.44
180	4.31
210	4.23
240	
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/002	PROJECT:	ENCGOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUN
ALTERNATIVE NO. :	T 32342	SITE NAME:	QOTHA		
DEPTH OF PUMP (mbdl):	44.70	PUMP TYPE USED:	BP 22 M	OPERATOR:	ABRAHAM
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	WINDMILL	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	02/04/2003	TEST COMPLETED	DATE:	4/4/03	TOTAL TIME - PUMPED (min):	1440	TOTAL TEST TIME (min):	1440
	TIME:	07H30		TIME:	07H30	TOTAL TIME-RECOVERY (min):	1440	AVERAGE YIELD (l/s):	1.03

DISCHARGE BOREHOLE		OBSERVATION BOREHOLE 1		OBSERVATION BOREHOLE 2		OBSERVATION BOREHOLE 3	
CASING HEIGHT (magl):	0.50	No. :		No. :		No.	
CASING DEPTH (mbdl):	6.78	DATUM LEVEL (magl):		DATUM LEVEL (magl):		DATUM LEVEL (magl):	
CASING ID (mm):	165.00	CASING DEPTH (mbdl):		CASING DEPTH (mbdl):		CASING DEPTH (mbdl):	
BOREHOLE DEPTH (mbdl):	48.12	BOREHOLE DEPTH :		BOREHOLE DEPTH :		BOREHOLE DEPTH :	
WATER LEVEL (mbdl):	1.02	WATER LEVEL:		WATER LEVEL:		WATER LEVEL:	
DATUM LEVEL (magl):	0.13	DISTANCE (m):		DISTANCE (m):		DISTANCE (m):	

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1	3.10		7.71	1			1			1		
2	3.98		6.35	2			2			2		
3	4.57	0.98	5.96	3			3			3		
5	4.83		5.70	5			5			5		
7	5.03	1.03	5.30	7			7			7		
10	5.19		5.18	10			10			10		
15	5.36	1.03	5.04	15			15			15		
20	5.45		4.92	20			20			20		
30	5.63	1.03	4.81	30			30			30		
40	5.76		4.62	40			40			40		
60	5.95	1.03	4.46	60			60			60		
90	6.27		4.26	90			90			90		
120	6.47	1.03	4.12	120			120			120		
150	6.70		3.58	150			150			150		
180	6.90	1.03	3.37	180			180			180		
210	7.03		3.25	210			210			210		
240	7.14	1.03	2.91	240			240			240		
300	7.28		2.61	300			300			300		
360	7.43		2.34	360			360			360		
420	7.53	1.03	2.11	420			420			420		
480	7.61		1.93	480			480			480		
540	7.77	1.03	1.82	540			540			540		
600	7.91		1.61	600			600			600		
660	8.11		1.58	720			720			720		
720	8.23	1.03	1.53	840			840			840		
780	8.49		1.47	960			960			960		
840	8.60		1.44	1080			1080			1080		
900	8.73	1.03	1.40	1200			1200			1200		
960	8.89		1.37	1320			1320			1320		
1020	9.01		1.33	1440			1440			1440		
1080	9.21	1.03	1.30	1800			1800			1800		
1140	9.33		1.26	2280			2280			2280		
1200	9.42		1.21	2880			2880			2880		
1260	9.50	1.03	1.16									
1320	9.55		1.13									
1380	9.60	1.03	1.09									
1440	9.64		1.07									

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500				1500			1500			1500		
1560				1560			1560			1560		
1620				1620			1620			1620		
1680				1680			1680			1680		
1740				1740			1740			1740		
1800				1800			1800			1800		
1860				1860			1860			1860		
1920				1920			1920			1920		
1980				1980			1980			1980		
2040				2040			2040			2040		
2100				2100			2100			2100		
2160				2160			2160			2160		
2220				2220			2220			2220		
2280				2280			2280			2280		
2340				2340			2340			2340		
2400				2400			2400			2400		
2460				2460			2460			2460		
2520				2520			2520			2520		
2580				2580			2580			2580		
2640				2640			2640			2640		
2700				2700			2700			2700		
2760				2760			2760			2760		
2820				2820			2820			2820		
2880				2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT	1	Sum
INTER HOLE MOVE > 10 km		Km.
FROM: SITE NAME:	BASE	
BOREHOLE No:		
INTER HOLE MOVE < 10 km:		No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:		No.
REMOVAL OF EXISTING EQUIPMENT:	1	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	1	No.
WORK TIME RATE (REPAIRS):		Hour
STANDING TIME:		Hour
LATITUDE:	LONGITUDE:	

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:		No
VERTICALITY TEST:	0	No
CASING DETECTION:	1	No
STEEL BOREHOLE COVER:	1	No
BOREHOLE MARKING:	1	No
SITE CLEANING / FINISHING:	1	No
REPORTING & DATA RECORDING:	1	No
SLUG TEST:	0	No
LAYFLAT (m):	50	m
BOREHOLE DEPTH AFTER TEST:	48.11	m
BOREHOLE WATERLEVEL AFTER TEST:	1.87	m

TEST DESCRIPTION	STEP 1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:										
TEST DURATION (Minutes)	15	15	15	15	15		75	1.25	1.78	70
TEST YIELD (l/s)	0.30	0.71	1.51	2.40	4.72		MAXIMUM (l/s)	4.7		
DRAWDOWN (m)	1.36	3.41	7.21	14.04	44.29		MAXIMUM (m)	44.3		
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	15				215	3.58	4.23	210
TEST YIELD (l/s)	1.40	3.11	3.96				MAXIMUM (l/s)	4.0		
DRAWDOWN (m)	9.9	26.70	44.29				MAXIMUM (m)	44.3		

RECOVERY TEST			
TIME TOTAL (hrs):			28.67
Cal	Steps	CD	Total
70	210	1440	1720
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTILISED	%	
43.7	9.64	22.07	

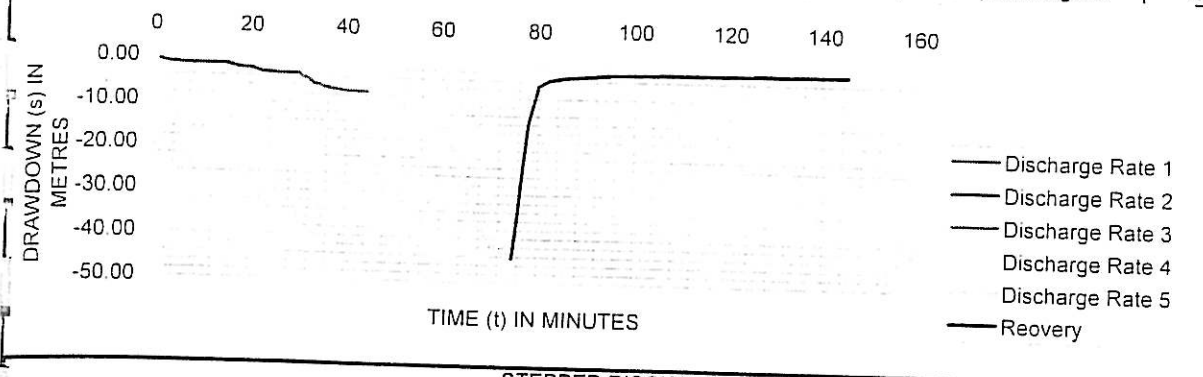
CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	1440	24.00	1.33	9.64	1.07	88.90	1440	24.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: EC/T11/002

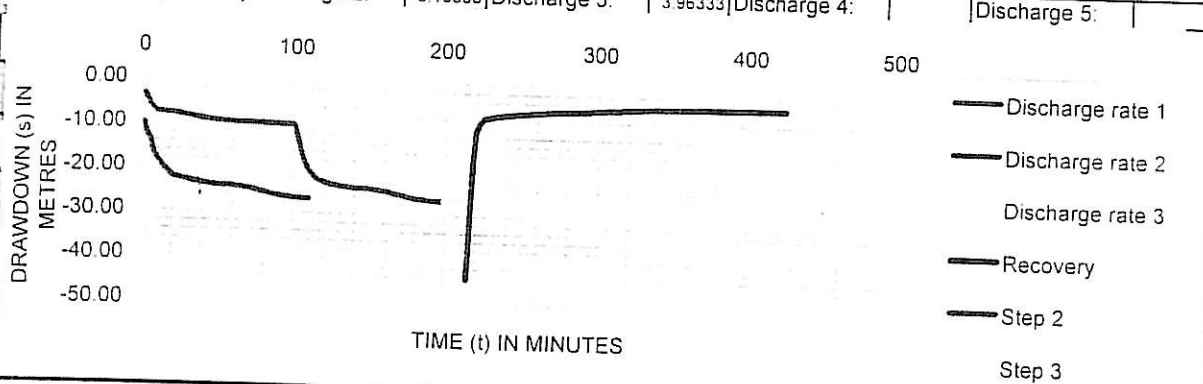
CALIBRATION TEST AND RECOVERY

Discharge 1:	0.30	Discharge 2:	0.71	Discharge 3:	1.51	Discharge 4:	2.40	Discharge 5:	4.72	Discharge 6:	
										Drawdown 1:	1.36
										Drawdown 2:	3.41
										Drawdown 3:	7.21
										Drawdown 4:	14.04
										Drawdown 5:	44.29
										Drawdown 6:	0.00
										Duration 1:	15
										Duration 2:	15
										Duration 3:	15
										Duration 4:	15
										Duration 5:	15
										Duration 6:	
										Recovery (m):	1.78
										Recovery (min):	70

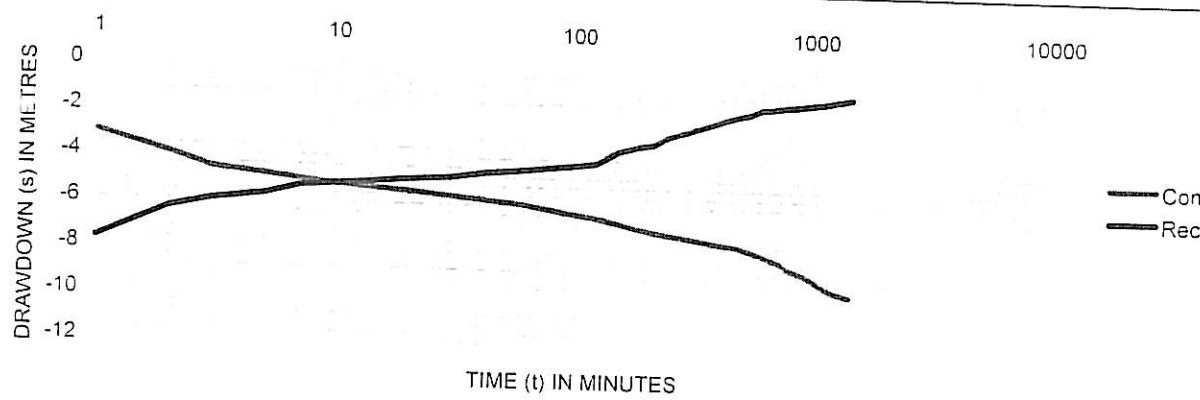


STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	1.40333	Discharge 2:	3.10833	Discharge 3:	3.96333	Discharge 4:		Discharge 5:		Discharge 6:	
										Drawdown 1:	9.92
										Drawdown 2:	26.70
										Drawdown 3:	44.29
										Drawdown 4:	0.00
										Drawdown 5:	0.00
										Drawdown 6:	
										Duration 1:	100
										Duration 2:	100
										Duration 3:	15
										Duration 4:	
										Duration 5:	
										Duration 6:	
										Recovery (m):	4.23
										Recovery (min):	210



CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	02/04/2003	Water level (mbgl)	1.02	Depth of pump (mbgl)		44.7
CD duration	1440	CD discharge rate	1.03	CD drawdown		9.64
Available drawdown (m)	43.68	% Recovery after CD	89	% after	1440	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/003	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :		SITE NAME:	QUNENE
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUN

BOREHOLE DEPTH (mbdl):	54.52	CASING DEPTH (mbdl):	7.45	PUMP TYPE USED:	BP 22
DEPTH OF PUMP (mbdl):	50.70	CASING HEIGHT (magl):	0.22	OPERATOR:	SIMON
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):		CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	9.99	DATUM LEVEL (magl):	0.16	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 05/04/2003 TIME: 16H30

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.41		1	
2	0.50	0.5	2	
3	0.56		3	
5	0.61	0.5	5	
7	0.64		7	
10	0.65	0.5	10	
15	0.66		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 05/04/2003 TIME: 16H45

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.78		1	
2	0.93	1.2	2	
3	1.03		3	
5	1.07	1.2	5	
7	1.23		7	
10	1.55	1.2	10	
15	1.69		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 05/04/2003 TIME: 17H00

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	2.44		1	
2	2.63	2.1	2	
3	2.88		3	
5	3.19	21.1	5	
7	3.25		7	
10	3.29	2.1	10	
15	3.38		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 05/04/2003 TIME: 17H15

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	3.94		1	
2	4.84	4.88	2	
3	5.92		3	
5	7.16	5.01	5	
7	8.06		7	
10	8.81	5.01	10	
15	8.97		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:
WINDMILL

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):
36.7

PUMP RPM:
GOOD

PUMP CONDITION:
GOOD

DISCHARGE RATE 5

DATE: 05/04/2003 TIME: 17H30

Time (min)		Yield (l/s)	Time (min)	Recovery (m)
1	9.06		1	
2	9.31	6.52	2	
3	11.64	7.02	3	
5	13.09		5	
7	14.51		7	
10	17.27	7.02	10	
15	19.41		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	7.49
2			2	5.92
3			3	3.09
5			5	0.53
7			7	0.31
10			10	0.22
15			15	0.18
			20	0.13
			30	0.08
			40	0.06
			50	0.04
			60	0.00
			70	
			80	
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ? NO

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/003	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	QUNENE
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUN

BOREHOLE DEPTH (mbdl):	54.52	CASING DEPTH (mbdl):	7.45	PUMP TYPE USED:	BP 22
DEPTH OF PUMP (mbdl):	50.70	CASING HEIGHT (magl):	0.22	OPERATOR:	SIMON
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	0.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	9.99	DATUM LEVEL (magl):	0.16		

DISCHARGE RATE 1

DATE: 06/04/2003
TIME: 06H20

Time (min)	Drawdown (m)	Yield (l/s)
1	0.64	
	0.91	1.280
	1.54	
5	2.02	2.040
	2.75	
0	3.11	
15	3.24	2.030
20	3.29	
0	3.39	
40	3.44	
50	3.51	2.040
0	3.59	
0	3.60	
80	3.64	2.040
0	3.68	
00	3.74	
110		
120		

Average yield: 1.886

Time (min)	Recovery 1 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

(l/s)

DISCHARGE RATE 2

DATE: 06/04/2003
TIME: 08H00

Time (min)	Drawdown (m)	Yield (l/s)
1	4.73	
2	5.23	
3	5.98	3.960
5	7.85	
7	8.10	4.010
10	8.35	
15	8.52	
20	8.60	4.010
30	8.62	
40	8.75	
50	8.81	4.010
60	8.82	
70	8.83	
80	8.84	4.010
90	8.84	
100	8.85	
110		
120		

Average yield: 4

Time (min)	Recovery 2 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 06/04/2003
TIME: 09H40

Time (min)	Drawdown (m)	Yield (l/s)
1	8.85	
2	9.20	
3	10.42	5.200
4	12.15	
7	13.72	6.130
10	14.54	
15	15.08	
20	15.34	6.130
30	15.44	
40	15.67	
50	15.89	
60	15.94	6.130
70	16.06	
80	16.28	
90	16.43	6.130
100	16.47	
110		
120		

Average yield: 5.944

Time (min)	Recovery 3 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 06/04/2003
TIME: 11H20

Time (min)	Drawdown (m)	Yield (l/s)
	17.25	
	18.27	6.54
3	19.06	
5	19.35	7.02
	20.09	
10	21.58	
15	22.54	
20	22.61	7.02
30	23.77	
40	24.24	
50	24.68	
60	25.41	7.02
70	25.58	
80	25.61	
90	25.70	7.02
100	25.87	
110		
120		

Average yield: 6.924

Time (min)	Recovery 4 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 06/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Time (min)	Recovery 5 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	
780	

DISCHARGE RATE 6

DATE: 06/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Time (min)	Recovery (m)
1	15.47
2	8.23
3	5.08
5	1.79
7	0.93
10	0.76
15	0.66
20	0.58
30	0.54
40	0.44
50	0.40
60	0.38
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/003	PROJECT:	ENCGOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUN
ALTERNATIVE NO. :	0	SITE NAME:	QUNENE		
DEPTH OF PUMP (mbdl):	50.70	PUMP TYPE USED:	BP 22	OPERATOR:	SIMON
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	WINDMILL	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	08/04/2003	TEST COMPLETED	DATE:	10/04/2003	TOTAL TIME - PUMPED (min):	2880	TOTAL TEST TIME (min):	2880
	TIME:	12H10		TIME:	13H40	TOTAL TIME-RECOVERY(min):	90	AVERAGE YIELD (l/s):	4.01

DISCHARGE BOREHOLE		OBSERVATION BOREHOLE 1		OBSERVATION BOREHOLE 2		OBSERVATION BOREHOLE 3	
CASING HEIGHT (magl):	0.22	No. :		No. :		No.	
CASING DEPTH (mbdl):	7.45	DATUM LEVEL (magl):		DATUM LEVEL (magl):		DATUM LEVEL (magl):	
CASING ID (mm):	0.00	CASING DEPTH (mbdl):		CASING DEPTH (mbdl):		CASING DEPTH (mbdl):	
BOREHOLE DEPTH (mbdl):	54.52	BOREHOLE DEPTH :		BOREHOLE DEPTH :		BOREHOLE DEPTH :	
WATER LEVEL (mbdl):	9.99	WATER LEVEL:		WATER LEVEL:		WATER LEVEL:	
DATUM LEVEL (magl):	0.16	DISTANCE (m):		DISTANCE (m):		DISTANCE (m):	

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1	1.44		7.52	1			1			1		
2	2.72		5.67	2			2			2		
3	3.24	3.94	3.98	3			3			3		
5	4.10		1.51	5			5			5		
7	5.44		1.27	7			7			7		
10	6.94	4.01	1.15	10			10			10		
15	7.22		1.10	15			15			15		
20	7.64		1.05	20			20			20		
30	7.92	4.02	0.91	30			30			30		
40	8.13		0.79	40			40			40		
60	8.22		0.34	60			60			60		
90	8.36	4.01	0.21	90			90			90		
120	8.43			120			120			120		
150	8.53			150			150			150		
180	8.62	4.02		180			180			180		
210	8.71			210			210			210		
240	8.76			240			240			240		
300	8.83	4.00		300			300			300		
360	8.91			360			360			360		
420	9.09			420			420			420		
480	9.15	4.01		480			480			480		
540	9.21			540			540			540		
600	9.30			600			600			600		
660	9.39	4.02		720			720			720		
720	9.47			840			840			840		
780	9.55			960			960			960		
840	9.64	4.01		1080			1080			1080		
900	9.72			1200			1200			1200		
960	9.81			1320			1320			1320		
1020	9.97	4.02		1440			1440			1440		
1080	10.04			1800			1800			1800		
1140	10.17			2280			2280			2280		
1200	10.26	4.01		2880			2880			2880		
1260	10.34											
1320	10.41											
1380	10.51	4.02										
1440	10.60											

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500	10.66	4.03		1500			1500			1500		
560	10.69			1560			1560			1560		
1620	10.74	4.01		1620			1620			1620		
1680	10.77			1680			1680			1680		
740	10.82	4.02		1740			1740			1740		
800	10.83	4.03		1800			1800			1800		
1860	10.91			1860			1860			1860		
920	11.06			1920			1920			1920		
1980	11.11	4.02		1980			1980			1980		
2040	11.15			2040			2040			2040		
2100	11.20			2100			2100			2100		
2160	11.24	4.01		2160			2160			2160		
2220	11.28			2220			2220			2220		
2280	11.31			2280			2280			2280		
2340	11.35	4.02		2340			2340			2340		
2400	11.39			2400			2400			2400		
2460	11.43			2460			2460			2460		
2520	11.51	4.01		2520			2520			2520		
2580	11.67			2580			2580			2580		
2640	11.87			2640			2640			2640		
2700	12.04	4.02		2700			2700			2700		
2760	12.12			2760			2760			2760		
2820	12.21	4.02		2820			2820			2820		
2880	12.34			2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT		Sum
INTER HOLE MOVE > 10 km	16	Km
FROM: SITE NAME:	QULUQU	
BOREHOLE No:	T 32349	
INTER HOLE MOVE < 10 km:	0	No
REMOVAL AND RE-ERECTION OF PUMP HOUSE:	0	No
REMOVAL OF EXISTING EQUIPMENT:	1	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	1	No.
WORK TIME RATE (REPAIRS):	0	Hour
STANDING TIME:	0	Hour
LATITUDE:	LONGITUDE:	

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	1	No
VERTICALITY TEST:	0	No
CASING DETECTION:	1	No
STEEL BOREHOLE COVER:	1	No
BOREHOLE MARKING:	1	No
SITE CLEANING / FINISHING:	1	No
REPORTING & DATA RECORDING:	1	No
SLUG TEST:	0	No
LAYFLAT (m):	50	m
BOREHOLE DEPTH AFTER TEST:	54.51	m
BOREHOLE WATERLEVEL AFTER TEST:	20.01	m

TEST DESCRIPTION	STEP 1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:										
TEST DURATION (Minutes)	15	15	15	15	15		75	1.25	0.00	60
TEST YIELD (l/s)	0.50	1.20	8.43	4.97	6.85		MAXIMUM (l/s)	8.4		
DRAWDOWN (m)	0.66	1.89	3.38	8.97	19.41		MAXIMUM (m)	19.4		
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	100	100			400	6.67	0.38	60
TEST YIELD (l/s)	1.99	4.00	5.94	6.92			MAXIMUM (l/s)	6.9		
DRAWDOWN (m)	3.7	9.85	16.47	25.87			MAXIMUM (m)	25.9		

RECOVERY TEST			
TIME TOTAL (hrs):			3.50
Cal	Steps	CD	Total
60	60	90	210
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
40.7	12.34		30.31

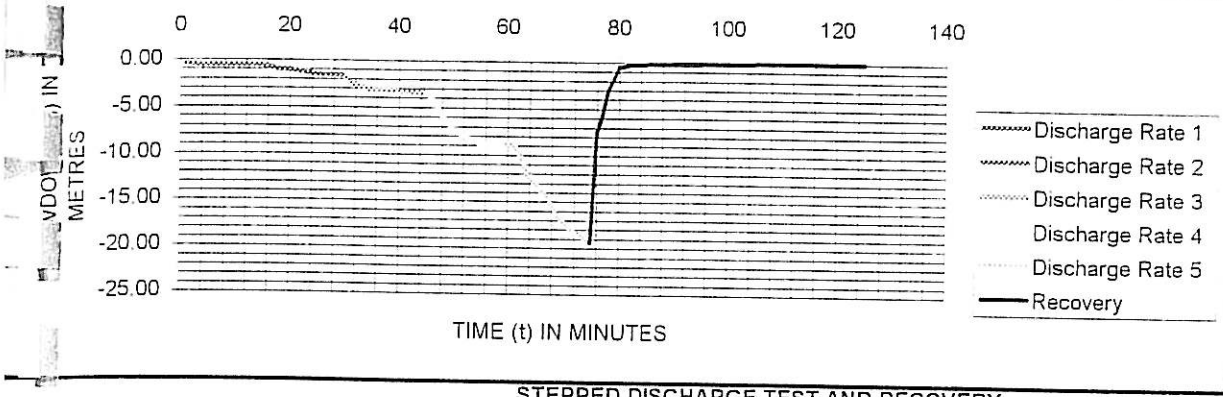
CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	2880	48.00	4.01	12.34	3.81	69.30	90	1.50

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: EC/T12/003

CALIBRATION TEST AND RECOVERY

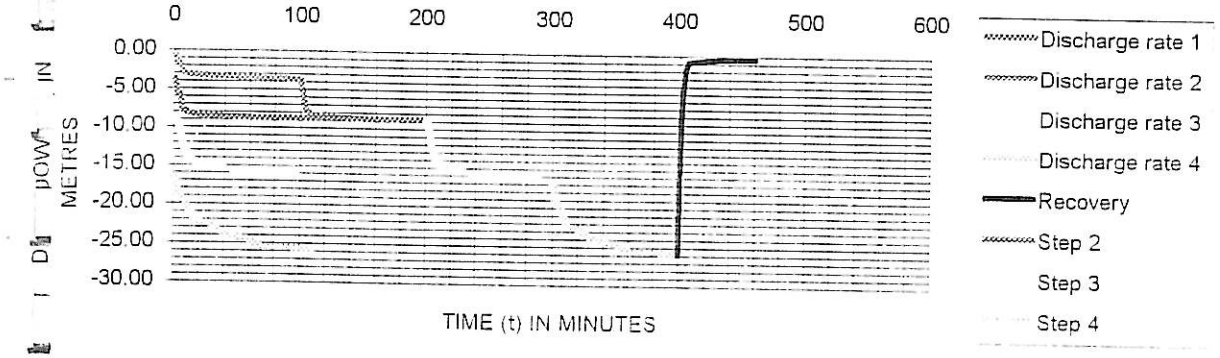
Discharge 1:	0.60	Discharge 2:	1.20	Discharge 3:	3.43	Discharge 4:	4.97	Discharge 5:	6.85	Discharge 6:	



Drawdown 1:	0.66
Drawdown 2:	1.69
Drawdown 3:	3.38
Drawdown 4:	8.97
Drawdown 5:	19.41
Drawdown 6:	0.00
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	15
Duration 6:	
Recovery (m):	0.00
Recovery (min):	60

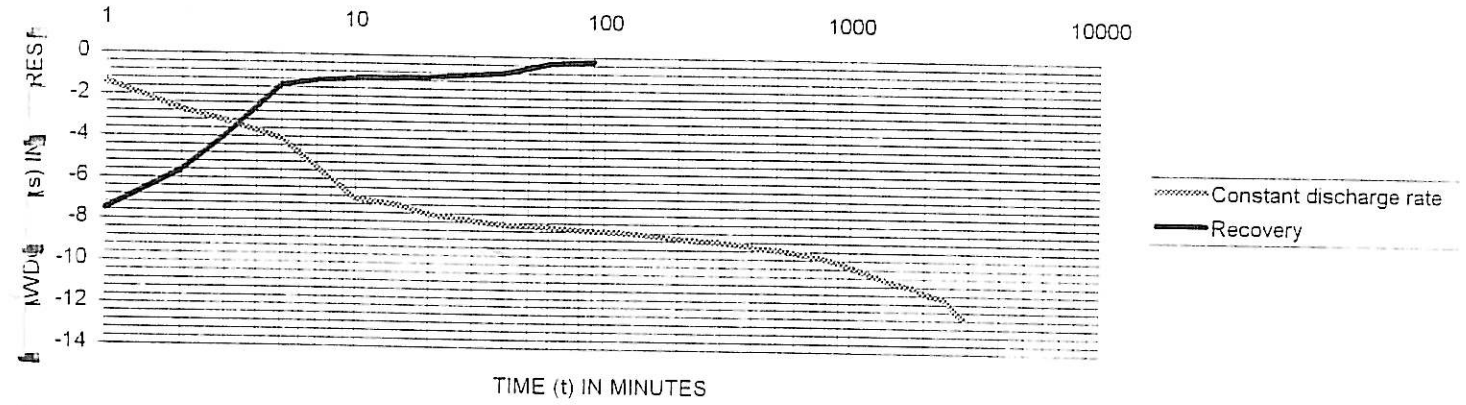
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	1.866	Discharge 2:	4	Discharge 3:	5.944	Discharge 4:	6.924	Discharge 5:		Discharge 6:	



Drawdown 1:	3.74
Drawdown 2:	8.85
Drawdown 3:	16.47
Drawdown 4:	25.67
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	100
Duration 3:	100
Duration 4:	100
Duration 5:	
Duration 6:	
Recovery (m):	0.38
Recovery (min):	60

CONSTANT DISCHARGE TEST AND RECOVERY



INFORMATION

ate tested	08/04/2003	Water level (mbgl)	9.99	Depth of pump (mbgl)		50.7
uration	2880	CD discharge rate	4.01	CD drawdown		12.34
able drawdown (m)	40.71	% Recovery after CD	98	% after	90	min

CALIBRATION TEST AND RECOVERY

OREHOLE NO. :	EC/T11/007	PROJECT:	ENCGOBO FEASIBILITY STUDY
LTERNATIVE NO. :		SITE NAME:	ENCGOBO
TERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

OREHOLE DEPTH (mbdl):	75.02	CASING DEPTH (mbdl):	40.46	PUMP TYPE USED:	P 150
EPTH OF PUMP (mbdl):	62.80	CASING HEIGHT (magl):	0.32	OPERATOR:	JOHANNES
UMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	165.00	CONTRACTOR:	AB PUMPS
TATIC WATER LEVEL (mbdl):	13.16	DATUM LEVEL (magl):	0.15	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 10/05/2003 TIME: 10H10

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
	0.35		1	
	0.49	1.34	2	
	0.52		3	
5	0.66	1.3	5	
	0.71		7	
0	0.80	1.32	10	
15	0.92		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

YPE OF RESERVOIR:

RESERVOIR SIZE:

ESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 10/05/2003 TIME: 10H25

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.10	2.06	1	
2	1.12	2.12	2	
3	1.17		3	
5	1.25	2.11	5	
7	1.30		7	
10	1.36	2.12	10	
15	1.44		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 10/05/2003 TIME: 10H40

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.85	1.85	1	
2	2.02	2.02	2	
3	2.37	2.37	3	
5	2.50	2.5	5	
7	2.56	2.56	7	
10	2.75	2.75	10	
15	3.06	3.06	15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 10/05/2003 TIME: 10H55

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	4.51		1	
2	5.15	8.38	2	
3	5.47		3	
5	5.95	8.4	5	
7	6.27		7	
10	6.61	8.39	10	
15	6.99		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:

NONE

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 10/05/2003 TIME: 11H10

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	8.54	13.94	1	
2	9.89		2	
3	10.40	14.71	3	
5	11.98		5	
7	13.03	14.7	7	
10	13.76		10	
15	15.73		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	8.99
2			2	6.63
3			3	5.42
5			5	4.85
7			7	4.81
10			10	3.90
15			15	3.42
			20	2.83
			30	2.30
			40	1.87
			50	1.54
			60	1.33
			70	1.18
			80	1.04
			90	0.92
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/007	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	ENCGOBO
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	75.02	CASING DEPTH (mbdl):	40.46	PUMP TYPE USED:	P 150
DEPTH OF PUMP (mbdl):	62.80	CASING HEIGHT (magl):	0.32	OPERATOR:	JOHANNES
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	165.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	14.08	DATUM LEVEL (magl):	0.15		

DISCHARGE RATE 1

DATE: 10/05/2003
TIME: 13H00

Time (min)	Drawdown (m)	Yield (l/s)
1	1.53	
	1.87	4.380
	2.45	
5	2.89	
	3.07	4.110
0	3.29	
15	3.58	4.100
20	3.79	
0	4.13	
40	4.38	4.120
50	4.61	
0	4.83	
0	5.01	4.100
80	5.16	
0	5.28	4.120
00	5.40	
110		
120		

Average yield: 4.155

Recovery 1

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
(l/s)	

DISCHARGE RATE 2

DATE: 10/05/2003
TIME: 14H40

Time (min)	Drawdown (m)	Yield (l/s)
1	6.12	
2	6.85	8.600
3	7.12	
5	7.45	7.130
7	7.67	
10	7.69	7.120
15	7.72	
20	7.76	7.130
30	7.83	
40	7.87	7.130
50	7.94	7.120
60	8.02	
70	8.05	
80	8.14	7.140
90	8.23	7.130
100	8.39	
110		
120		

Average yield: 7.3125

Recovery 2

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 10/05/2003
TIME: 16H20

Time (min)	Drawdown (m)	Yield (l/s)
1	8.95	
2	9.10	10.940
3	9.54	
4	10.76	
7	11.42	11.250
10	12.12	
15	12.93	
20	13.94	11.270
30	15.00	
40	17.07	11.260
50	19.24	
60	22.45	
70	24.40	11.280
80	27.18	
90	29.21	11.270
100	32.04	
110		
120		

Average yield: 11.2116667

Recovery 3

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 10/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
3		
5		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

Recovery 4

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 10/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Recovery 5

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

DISCHARGE RATE 6

DATE: 10/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Recovery

Time (min)	Recovery (m)
1	19.20
2	13.59
3	11.00
5	10.28
7	9.44
10	9.12
15	8.91
20	8.59
30	8.05
40	7.36
50	6.88
60	6.49
70	6.08
80	5.72
90	5.33
100	5.04
110	4.47
120	4.03
150	3.15
180	2.59
210	2.01
240	1.41
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/007	PROJECT:	ENCGOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY
ALTERNATIVE NO. :	0	SITE NAME:	ENCGOBO		
DEPTH OF PUMP (mbdl):	62.80	PUMP TYPE USED:	P 150	OPERATOR:	JOHANNES
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	NONE	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	11/05/2003	TEST COMPLETED	DATE:	13/05/2003	TOTAL TIME - PUMPED (min):	1440	TOTAL TEST TIME (min):	1440
	TIME:	07H00		TIME:	07H00	TOTAL TIME RECOVERY(min):	1440	AVERAGE YIELD (l/s):	6.11

DISCHARGE BOREHOLE		OBSERVATION BOREHOLE 1		OBSERVATION BOREHOLE 2		OBSERVATION BOREHOLE 3	
CASING HEIGHT (magl):	0.32	No.:		No.:		No.:	
CASING DEPTH (mbdl):	40.46	DATUM LEVEL (magl):		DATUM LEVEL (magl):		DATUM LEVEL (magl):	
CASING ID (mm):	165.00	CASING DEPTH (mbdl):		CASING DEPTH (mbdl):		CASING DEPTH (mbdl):	
BOREHOLE DEPTH (mbdl):	75.02	BOREHOLE DEPTH:		BOREHOLE DEPTH:		BOREHOLE DEPTH:	
WATER LEVEL (mbdl):	13.16	WATER LEVEL:		WATER LEVEL:		WATER LEVEL:	
DATUM LEVEL (magl):	0.15	DISTANCE (m):		DISTANCE (m):		DISTANCE (m):	

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1	1.02		20.14	1			1			1		
2	1.54		17.32	2			2			2		
3	2.21	5.84	13.13	3			3			3		
5	2.94		11.95	5			5			5		
7	3.20	5.13	10.01	7			7			7		
10	4.11		9.79	10			10			10		
15	4.48		9.45	15			15			15		
20	4.93	6.11	9.26	20			20			20		
30	5.30		9.14	30			30			30		
40	5.68	6.14	9.01	40			40			40		
60	6.41		8.89	60			60			60		
90	7.07		8.63	90			90			90		
120	7.58	6.15	8.25	120			120			120		
150	8.01		7.83	150			150			150		
180	8.57		7.55	180			180			180		
210	8.86		7.32	210			210			210		
240	9.15	5.13	7.13	240			240			240		
300	10.40	5.15	6.89	300			300			300		
360	11.69		6.74	360			360			360		
420	12.90		6.52	420			420			420		
480	13.89		6.30	480			480			480		
540	15.10	6.14	6.11	540			540			540		
600	16.71		6.04	600			600			600		
660	17.76		6.00	720			720			720		
720	18.89	6.15	5.89	840			840			840		
780	19.77		5.80	960			960			960		
840	20.81		5.71	1080			1080			1080		
900	21.62		5.62	1200			1200			1200		
960	22.95	6.13	5.40	1320			1320			1320		
1020	24.33	6.14	5.22	1440			1440			1440		
1080	25.00		5.10	1800			1800			1800		
1140	25.57		4.97	2280			2280			2280		
1200	25.99		4.73	2880			2880			2880		
1260	26.47	6.13	4.54									
1320	26.94		4.31									
1380	27.41		4.23									
1440	28.30		4.10									

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500				1500			1500			1500		
1560				1560			1560			1560		
1620				1620			1620			1620		
1680				1680			1680			1680		
1740				1740			1740			1740		
1800				1800			1800			1800		
1860				1860			1860			1860		
1920				1920			1920			1920		
1980				1980			1980			1980		
2040				2040			2040			2040		
2100				2100			2100			2100		
2160				2160			2160			2160		
2220				2220			2220			2220		
2280				2280			2280			2280		
2340				2340			2340			2340		
2400				2400			2400			2400		
2460				2460			2460			2460		
2520				2520			2520			2520		
2580				2580			2580			2580		
2640				2640			2640			2640		
2700				2700			2700			2700		
2760				2760			2760			2760		
2820				2820			2820			2820		
2880				2880			2880			2880		

DESCRIPTION:		QUANTITY:	UNIT:
ESTABLISHMENT			Sum
INTER HOLE MOVE > 10 km			Km.
FROM: SITE NAME:			
BOREHOLE No:			
INTER HOLE MOVE < 10 km:		1	No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:		0	No.
REMOVAL OF EXISTING EQUIPMENT:		0	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:		0	No.
WORK TIME RATE (REPAIRS):		0	Hour
STANDING TIME:		0	Hour
LATITUDE:	LONGITUDE:		

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	1	No.
VERTICALITY TEST:	0	No.
CASING DETECTION:	1	No.
STEEL BOREHOLE COVER:	1	No.
BOREHOLE MARKING:	1	No.
SITE CLEANING / FINISHING:	1	No.
REPORTING & DATA RECORDING:	1	No.
SLUG TEST:	0	No.
LAYFLAT (m):	50	m
BOREHOLE DEPTH AFTER TEST:	75.02	m
BOREHOLE WATERLEVEL AFTER TEST:	19.84	m

TEST DESCRIPTION: STEP:	1	2	3	4	5	6	TOTAL: (min)	TOTAL: (hrs)	RECOVERY: (m)	RECOVERY: (min)
CALIBRATION TEST:										
TEST DURATION (Minutes)	15	15	15	15	15		75	1.25	0.92	90
TEST YIELD (l/s)	1.32	2.10	2.44	8.39	14.45		MAXIMUM (l/s)	14.5		
DRAWDOWN (m)	0.92	1.44	3.06	6.99	15.73		MAXIMUM (m)	15.7		
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	100				300	5.00	0.00	240
TEST YIELD (l/s)	4.16	7.31	11.21				MAXIMUM (l/s)	11.2		
DRAWDOWN (m)	5.4	8.39	32.04				MAXIMUM (m)	32.0		

RECOVERY TEST			
TIME TOTAL (hrs):			29.50
Cal	Steps	CD	Total
90	240	1440	1770
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
49.6	28.30		57.01

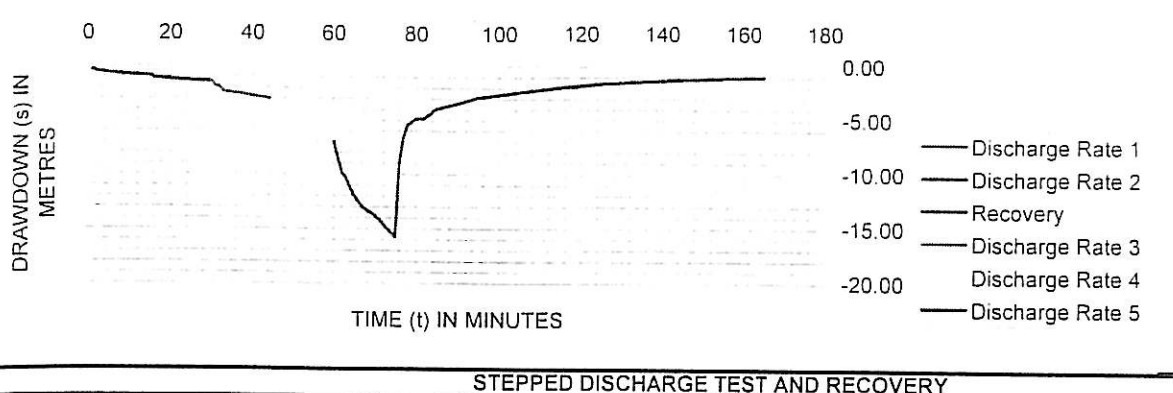
CONSTANT DISCHARGE TEST	TEST DURATION (min)	TEST DURATION (hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	RECOVERY: %	RECOVERY: (min)	RECOVERY: (hrs)
	1440	24.00	5.11	28.30	4.10	85.51	1440	24.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	>2880 (min) Time	TOTAL: (min)	TOTAL: (hrs)
							0	0.00

BOREHOLE NUMBER: EC/T11/007

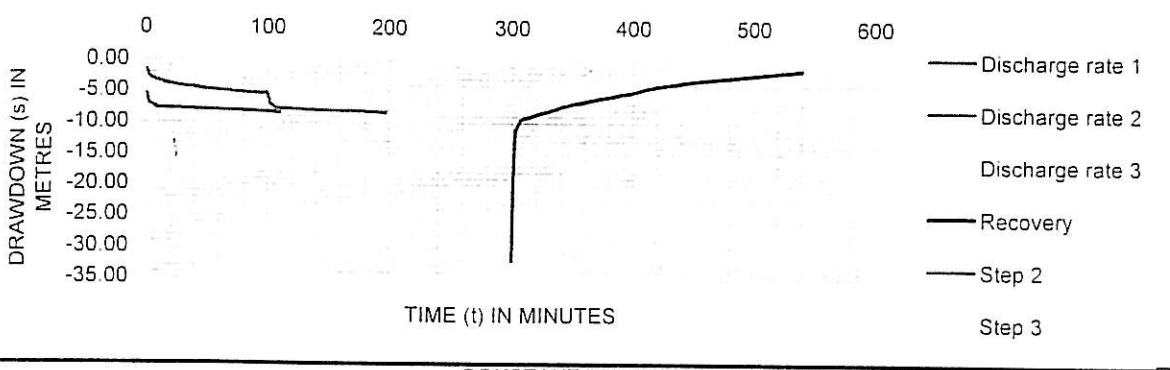
CALIBRATION TEST AND RECOVERY

Discharge 1:	1.32	Discharge 2:	2.10	Discharge 3:	2.44	Discharge 4:	8.39	Discharge 5:	14.45	Discharge 6:	
										Drawdown 1:	0.92
										Drawdown 2:	1.44
										Drawdown 3:	3.06
										Drawdown 4:	6.99
										Drawdown 5:	15.73
										Drawdown 6:	0.00
										Duration 1:	15
										Duration 2:	15
										Duration 3:	15
										Duration 4:	15
										Duration 5:	15
										Duration 6:	
										Recovery (m):	0.92
										Recovery (min):	90

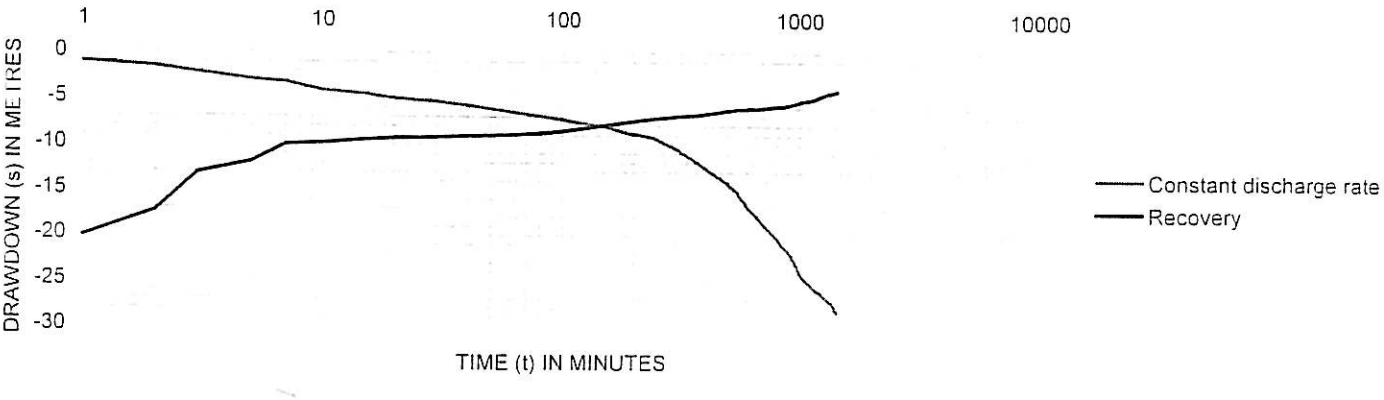


STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	4.155	Discharge 2:	7.3125	Discharge 3:	11.2117	Discharge 4:		Discharge 5:		Discharge 6:	
										Drawdown 1:	5.40
										Drawdown 2:	8.39
										Drawdown 3:	32.04
										Drawdown 4:	0.00
										Drawdown 5:	0.00
										Drawdown 6:	
										Duration 1:	100
										Duration 2:	100
										Duration 3:	100
										Duration 4:	
										Duration 5:	
										Duration 6:	
										Recovery (m):	0.00
										Recovery (min):	240



CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	11/05/2003	Water level (mbgl)	13.16	Depth of pump (mbgl)		62.8
CD duration	1440	CD discharge rate	6.11	CD drawdown		28.3
Available drawdown (m)	49.64	% Recovery after CD	86	% after	1440	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/008			PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO. :				SITE NAME:	KWA-SANDILE
ALTERNATIVE NO. :				CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY
BOREHOLE DEPTH (mbdl):	60.66	CASING DEPTH (mbdl):	18.15	PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	56.50	CASING HEIGHT (magl):	0.35	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	165.00	CASING ID (mm):	170.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	17.50	DATUM LEVEL (magl):	0.19	SUPERVISOR:	CJ VAN DER WALT

DISCHARGE RATE 1

DATE: 17/05/2003 TIME: 09H35

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.16		1	
2	0.18		2	
3	0.27	0.66	3	
5	0.41		5	
7	0.45		7	
10	0.47	0.65	10	
15	0.54		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 17/05/2003 TIME: 09H50

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.62	0.68	1	
2	0.67		2	
3	0.72	0.8	3	
5	0.80		5	
7	0.88		7	
10	0.95	0.81	10	
15	1.00		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 17/05/2003 TIME: 10H05

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.03		1	
2	1.05	0.94	2	
3	1.08	1.12	3	
5	1.20		5	
7	1.35	1.15	7	
10	1.57		10	
15	1.68		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 17/05/2003 TIME: 10H20

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.76		1	
2	1.80	1.7	2	
3	1.92	1.68	3	
5	2.05	2.03	5	
7	2.19		7	
10	2.39	2.05	10	
15	2.73		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 17/05/2003 TIME: 10H35

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	2.80		1	
2	3.01		2	
3	3.40	3.58	3	
5	3.68		5	
7	4.01	3.6	7	
10	4.35		10	
15	4.85		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: 17/05/2003 TIME: 10H50

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	5.02		1	7.40
2	5.27	5.07	2	6.86
3	5.51		3	6.49
5	5.80		5	5.96
7	6.56	7.03	7	5.42
10	7.15	7.05	10	4.86
15	8.00		15	4.04
			20	3.47
			30	2.65
			40	2.06
			50	1.75
			60	1.50
			70	1.30
			80	1.17
			90	1.05
			100	0.95
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/008	PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	KWA-SANDILE
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	60.66	CASING DEPTH (mbdl):	18.15	PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	56.50	CASING HEIGHT (magl):	0.35	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	165.000	CASING ID (mm):	170.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	18.25	DATUM LEVEL (magl):	0.19		

DISCHARGE RATE 1

DATE: 17/05/2003
TIME: 13H00

Time (min)	Drawdown (m)	Yield (l/s)
1	0.15	
	0.26	
	0.30	0.860
5	0.53	
	0.68	1.090
0	0.82	
15	1.06	1.100
20	1.11	
30	1.22	1.100
40	1.34	
50	1.43	
60	1.56	1.090
70	1.73	
80	1.86	1.070
90	1.94	
100	2.03	
110		
120		

Average yield: 1.05166667 (l/s)

Time (min)	Recovery 1 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 2

DATE: 17/05/2003
TIME: 14H40

Time (min)	Drawdown (m)	Yield (l/s)
1	2.18	
2	2.30	1.990
3	2.39	
5	2.50	2.040
7	2.63	
10	2.80	
15	3.10	2.050
20	3.29	
30	3.62	
40	3.85	2.030
50	4.03	
60	4.20	
70	4.34	2.050
80	4.44	
90	4.53	2.040
100	4.62	
110		
120		

Average yield: 2.03333333

Time (min)	Recovery 2 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 17/05/2003
TIME: 16H20

Time (min)	Drawdown (m)	Yield (l/s)
1	4.68	
2	4.80	3.640
3	4.94	
4	5.19	4.080
7	5.57	
10	6.02	
15	6.46	4.070
20	6.95	
30	7.54	
40	8.04	4.060
50	8.45	
60	8.83	
70	9.14	4.070
80	9.37	
90	9.63	4.060
100	9.85	
110		
120		

Average yield: 3.99666667

Time (min)	Recovery 3 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 17/05/2003
TIME: 18H00

Time (min)	Drawdown (m)	Yield (l/s)
1	10.02	
2	10.11	6.85
3	10.29	
5	10.55	7.09
7	10.70	
10	11.10	
15	11.54	7.08
20	12.01	
30	12.59	
40	13.09	7.09
50	13.57	
60	13.90	
70	14.22	7.08
80	14.49	
90	14.74	7.06
100	14.97	
110		
120		

Average yield: 7.04166667

Time (min)	Recovery 4 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 17/05/2003
TIME:

Time (min)	Drawdown (m)	(l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Time (min)	Recovery 5 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

DISCHARGE RATE 6

DATE: 17/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Time (min)	Recovery (m)
1	14.53
2	14.06
3	13.72
5	13.01
7	12.50
10	11.87
15	10.69
20	9.73
30	7.92
40	7.36
50	6.81
60	6.24
70	5.67
80	5.12
90	4.50
100	3.96
110	3.44
120	2.80
150	2.46
180	2.1
210	1.39
240	1
300	0.64
360	0.39
420	0.25
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/008	PROJECT:	ENGCOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIP
ALTERNATIVE NO. :	0	SITE NAME:	KWA-SANDILE		
DEPTH OF PUMP (mbdl):	56.50	PUMP TYPE USED:	P 100	OPERATOR:	PIETER MUNYAI
INLET DIAMETER (mm):	165	EXISTING EQUIPMENT:	0	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	18/05/2003	TEST COMPLETED	DATE:	21/05/2003	TOTAL TIME - PUMPED (min):	2880	TOTAL TEST TIME (min):	4140
	TIME:	10H00		TIME:	07H00	TOTAL TIME-RECOVERY(min):	1260	AVERAGE YIELD (l/s):	7.64

DISCHARGE BOREHOLE

CASING HEIGHT (magl):	0.35
CASING DEPTH (mbdl):	18.15
CASING ID (mm):	170.00
BOREHOLE DEPTH (mbdl):	60.66
WATER LEVEL (mbdl):	18.25
DATUM LEVEL (magl):	0.19

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)
1	0.49		26.35
2	1.10		26.25
3	2.15	3.01	26.18
5	2.60	6.75	26.05
7	3.45		25.96
10	4.77	8.05	25.79
15	5.51		25.60
20	6.25		25.47
30	7.01	8.03	25.23
40	8.35		24.85
60	10.53		24.04
90	12.71	8.05	22.40
120	14.91		20.38
150	16.49	8.05	18.01
180	17.63		15.27
210	18.63	8.02	13.45
240	19.40		11.63
300	20.67	8.05	8.67
360	21.53		6.37
420	22.11		4.96
480	22.85	8.03	3.99
540	23.43		3.28
600	24.01	8.05	2.75
660	24.30		2.56
720	24.42	8.00	2.37
780	24.68	8.02	2.17
840	24.82		1.98
900	24.95		1.86
960	25.09	8.04	1.60
1020	25.25		1.41
1080	25.34		1.22
1140	25.47	8.03	1.04
1200	25.59		0.85
1260	25.69	8.05	0.75
1320	25.90		
1380	26.24	8.03	
1440	26.43		

OBSERVATION BOREHOLE 1

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

OBSERVATION BOREHOLE 2

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

OBSERVATION BOREHOLE 3

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500	26.49	8.06		1500			1500			1500		
1560	26.51			1560			1560			1560		
1620	26.52	8.03		1620			1620			1620		
1680	26.53			1680			1680			1680		
1740	26.55	8.04		1740			1740			1740		
1800	26.57			1800			1800			1800		
1860	26.60	8.05		1860			1860			1860		
1920	26.66			1920			1920			1920		
1980	26.69	8.04		1980			1980			1980		
2040	26.71			2040			2040			2040		
2100	26.74	8.03		2100			2100			2100		
2160	26.77			2160			2160			2160		
2220	26.78	8.04		2220			2220			2220		
2280	26.80			2280			2280			2280		
2340	26.82	8.05		2340			2340			2340		
2400	26.84			2400			2400			2400		
2460	26.87	8.05		2460			2460			2460		
2520	26.90			2520			2520			2520		
2580	26.90			2580			2580			2580		
2640	26.91	8.03		2640			2640			2640		
2700	26.92			2700			2700			2700		
2760	26.92			2760			2760			2760		
2820	26.93	8.05		2820			2820			2820		
2880	26.94			2880			2880			2880		

DESCRIPTION:		QUANTITY:	UNIT:
ESTABLISHMENT			Sum
INTER HOLE MOVE > 10 km		1	Km.
FROM: SITE NAME:	NKONDLO		
BOREHOLE No:	T 32396		
INTER HOLE MOVE < 10 km:		38	No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:		0	No.
REMOVAL OF EXISTING EQUIPMENT:		0	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:		0	No.
WORK TIME RATE (REPAIRS):		0	Hour
STANDING TIME:		0	Hour
LATITUDE:	LONGITUDE:		

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	0	No.
VERTICALITY TEST:	0	No.
CASING DETECTION:	1	No.
STEEL BOREHOLE COVER:	1	No.
BOREHOLE MARKING:	1	No.
SITE CLEANING / FINISHING:	1	No.
REPORTING & DATA RECORDING:	1	No.
SLUG TEST:	0	No.
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	60.66	m
BOREHOLE WATERLEVEL AFTER TEST:	18.66	m

TEST DESCRIPTION	STEP	1	2	3	4	5	6	TOTAL: (min)	TOTAL: (hrs)	RECOVERY: (m)	RECOVERY: (min)
CALIBRATION TEST:											
TEST DURATION (Minutes)		15	15	15	15	15	15	90	1.50	0.95	100
TEST YIELD (l/s)		0.66	0.76	1.07	1.87	3.59	6.38	MAXIMUM (l/s)	6.4		
DRAWDOWN (m)		0.54	1.00	1.68	2.73	4.85	8.00	MAXIMUM (m)	8.0		
MULTI-RATE / STEP DRAWDOWN:											
TEST DURATION (Minutes)		100	100	100	100			400	6.67	0.25	420
TEST YIELD (l/s)		1.05	2.03	4.00	7.04			MAXIMUM (l/s)	7.0		
DRAWDOWN (m)		2.0	4.62	9.86	14.97			MAXIMUM (m)	15.0		

RECOVERY TEST			
TIME TOTAL (hrs):			29.67
Cal	Steps	CD	Total
100	420	1260	1780
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
39.0	26.94		69.08

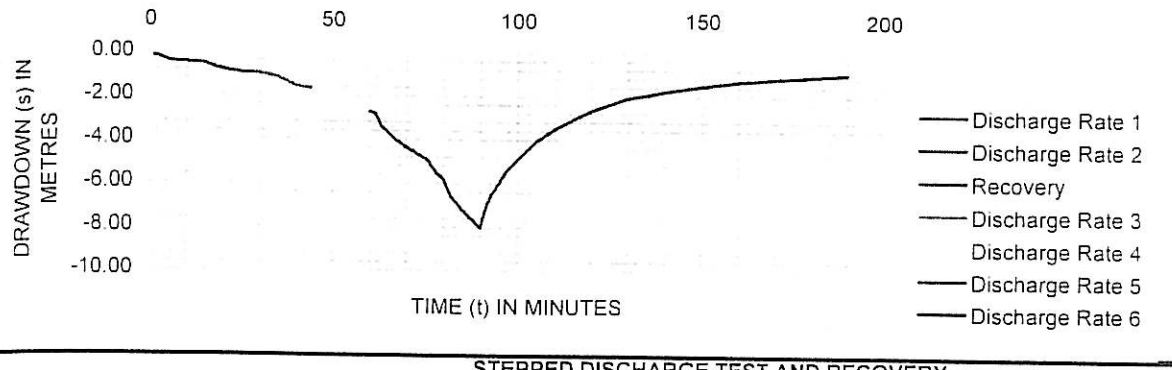
CONSTANT DISCHARGE TEST	TEST DURATION (min)	TEST DURATION (hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	RECOVERY: %	RECOVERY: (min)	RECOVERY: (hrs)
	2880	48.00	7.84	26.94	0.75	97.22	1260	21.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	>2880 (min) Time	TOTAL: (min)	TOTAL: (hrs)
							0	0.00

BOREHOLE NUMBER: EC/T11/008

CALIBRATION TEST AND RECOVERY

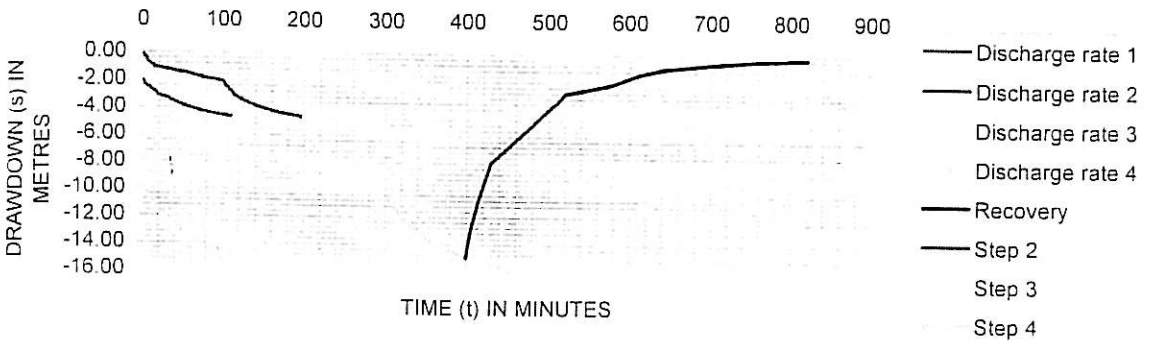
Discharge 1:	0.66	Discharge 2:	0.76	Discharge 3:	1.07	Discharge 4:	1.87	Discharge 5:	3.59



Discharge 6:	6.3833
Drawdown 1:	0.54
Drawdown 2:	1.90
Drawdown 3:	1.68
Drawdown 4:	2.73
Drawdown 5:	4.85
Drawdown 6:	8.00
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	15
Duration 6:	15
Recovery (m):	0.95
Recovery (min):	100

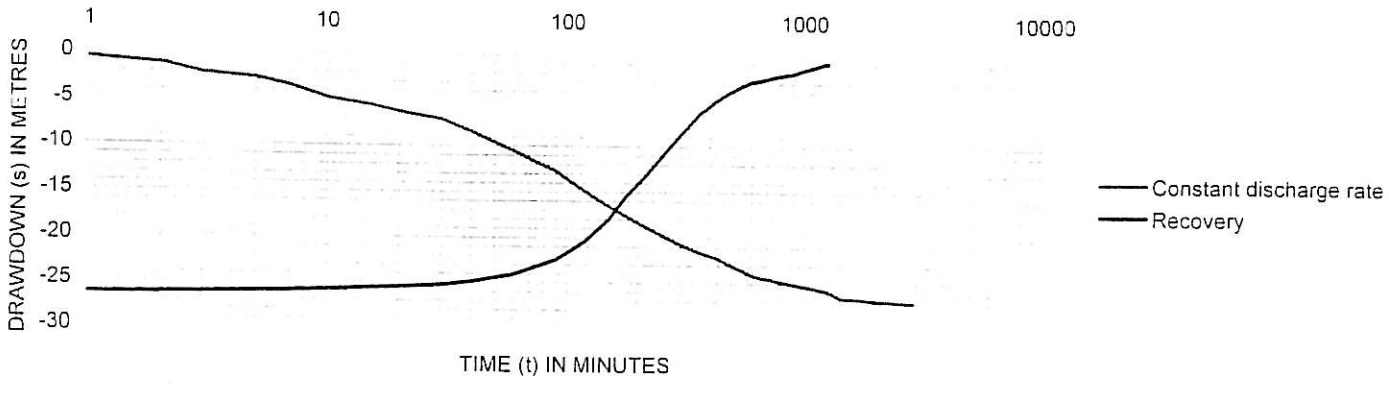
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	1.05167	Discharge 2:	2.03333	Discharge 3:	3.99667	Discharge 4:	7.04167	Discharge 5:	



Discharge 6:	
Drawdown 1:	2.03
Drawdown 2:	4.62
Drawdown 3:	9.85
Drawdown 4:	14.97
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	100
Duration 3:	100
Duration 4:	100
Duration 5:	
Duration 6:	
Recovery (m):	0.25
Recovery (min):	420

CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	18/05/2003	Water level (mbgl)	17.50	Depth of pump (mbgl)		56.5
CD duration	2880	CD discharge rate	7.64	CD drawdown		26.94
Available drawdown (m)	39	% Recovery after CD	97	% after	1260	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/004	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :		SITE NAME:	NKWENKWEZI
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	81.15	CASING DEPTH (mbdl):	13.20	PUMP TYPE USED:	BP 65
DEPTH OF PUMP (mbdl):	42.15	CASING HEIGHT (magl):	0.36	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	165.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	6.25	DATUM LEVEL (magl):	0.18	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
			1	
2			2	
			3	
			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

OREHOLE NO. :	EC/T12/004	PROJECT:	ENCGOBO FEASIBILITY STUDY
LTERNATIVE NO. :	0	SITE NAME:	NKWENKWEZI
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

OREHOLE DEPTH (mbdl):	81.15	CASING DEPTH (mbdl):	13.20	PUMP TYPE USED:	BP 65
EPTH OF PUMP (mbdl):	42.15	CASING HEIGHT (magl):	0.36	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	165.000	CONTRACTOR:	AB PUMPS
TATIC WATER LEVEL (mbdl):	6.25	DATUM LEVEL (magl):	0.18		

DISCHARGE RATE 1

DATE: 31/05/2003
TIME: 12H45

Time (min)	Drawdown (m)	Yield (l/s)
1	0.35	
	0.51	3.680
	0.65	4.890
5	1.41	
7	1.65	5.280
0	1.95	
15	2.35	5.290
20	2.66	
0	3.19	
40	3.57	5.270
50	3.96	
0	4.28	
0	4.57	5.290
80	4.80	
90	5.15	5.270
00	5.31	
110		
120		

Average yield: 4.99571429 (l/s)

Recovery 1

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 2

DATE: 31/05/2003
TIME: 14H25

Time (min)	Drawdown (m)	Yield (l/s)
1	6.52	8.890
2	6.78	
3	6.82	9.800
5	7.03	
7	7.27	10.200
10	8.03	
15	8.44	
20	9.00	10.190
30	9.70	
40	10.62	
50	11.13	10.210
60	11.62	
70	12.18	
80	12.61	10.200
90	13.04	
100	13.52	
110		
120		

Average yield: 9.915

Recovery 2

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 31/05/2003
TIME: 16H05

Time (min)	Drawdown (m)	Yield (l/s)
1	14.48	15.900
2	15.73	
3	16.19	16.320
4	17.08	
7	17.83	17.200
10	18.33	
15	19.21	
20	20.02	17.210
30	21.08	
40	22.10	
50	22.83	17.200
60	23.62	
70	24.32	
80	24.94	17.220
90	25.62	
100	26.19	
110		
120		

Average yield: 16.8416667

Recovery 3

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 31/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
3		
5		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

Recovery 4

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 31/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Recovery 5

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	
780	

DISCHARGE RATE 6

DATE: 31/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Recovery

Time (min)	Recovery (m)
1	20.46
2	19.32
3	18.64
5	18.02
7	17.15
10	16.76
15	15.47
20	14.73
30	13.49
40	12.53
50	11.47
60	10.85
70	10.34
80	9.99
90	9.48
100	8.99
110	8.71
120	8.44
150	8.16
180	7.97
210	7.79
240	7.5
300	7.03
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/004	PROJECT:	ENCGOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIP
ALTERNATIVE NO. :	0	SITE NAME:	NKWENKWEZI		
DEPTH OF PUMP (mbdl):	42.15	PUMP TYPE USED:	BP 65	OPERATOR:	PIETER MUNYAI
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT	0	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	01/06/2003	TEST COMPLETED	DATE:	05/06/2003	TOTAL TIME - PUMPED (min):	2880	TOTAL TEST TIME (min):	2880
	TIME:	18H10		TIME	18H10	TOTAL TIME-RECOVERY(min):	2880	AVERAGE YIELD (l/s):	8 90

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
CASING HEIGHT (magl)			0.36	No. :			No :			No :		
CASING DEPTH (mbdl):			13.20	DATUM LEVEL (magl):			DATUM LEVEL (magl)			DATUM LEVEL (magl)		
CASING ID (mm):			165.00	CASING DEPTH (mbdl):			CASING DEPTH (mbdl):			CASING DEPTH (mbdl):		
BOREHOLE DEPTH (mbdl):			81.15	BOREHOLE DEPTH :			BOREHOLE DEPTH :			BOREHOLE DEPTH :		
WATER LEVEL (mbdl):			8.25	WATER LEVEL:			WATER LEVEL:			WATER LEVEL:		
DATUM LEVEL (magl):			0.18	DISTANCE (m):			DISTANCE (m):			DISTANCE (m):		
Time	Drawdown	Yield	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery
(min)	(m)	(l/s)	(m)	(min)	(m)	(m)	(min)	(m)	(m)	(min)	(m)	(m)
1	4.76		19.73	1			1			1		
2	5.47	12.14	19.52	2			2			2		
3	6.61		19.32	3			3			3		
5	7.37	11.02	18.99	5			5			5		
7	7.59		18.52	7			7			7		
10	5.09	8.43	18.14	10			10			10		
15	5.47		17.64	15			15			15		
20	5.68		17.13	20			20			20		
30	6.20	8.40	16.38	30			30			30		
40	7.01		15.69	40			40			40		
60	7.67		14.84	60			60			60		
90	8.93	8.43	14.26	90			90			90		
120	9.96		13.99	120			120			120		
150	10.81		13.50	150			150			150		
180	11.50	8.41	13.03	180			180			180		
210	12.20		12.77	210			210			210		
240	12.87		12.41	240			240			240		
300	13.41		12.01	300			300			300		
360	14.26	8.36	11.60	360			360			360		
420	15.38		11.15	420			420			420		
480	16.69		10.52	480			480			480		
540	16.89		10.03	540			540			540		
600	17.46	8.40	9.38	600			600			600		
660	17.94		8.29	720			720			720		
720	18.19	8.42	7.72	840			840			840		
780	18.72		7.46	960			960			960		
840	18.91		7.21	1080			1080			1080		
900	19.14	8.39	6.98	1200			1200			1200		
960	19.26	8.41	6.76	1320			1320			1320		
1020	19.35		6.54	1440			1440			1440		
1080	19.49		6.32	1800			1800			1800		
1140	19.51	8.43	6.13	2280			2280			2280		
1200	19.59		5.91	2880			2880			2880		
1260	19.62		5.73									
1320	19.70	8.44	5.55									
1380	19.79		5.37									
1440	19.82		5.21									

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500	19.85	8.40	5.02	1500			1500			1500		
1560	20.10		4.89	1560			1560			1560		
1620	20.13		4.68	1620			1620			1620		
1680	20.17	8.42	4.49	1680			1680			1680		
1740	20.21		4.30	1740			1740			1740		
1800	20.25		4.16	1800			1800			1800		
1860	20.29		4.03	1860			1860			1860		
1920	20.32	8.43	3.92	1920			1920			1920		
1980	20.35	8.42	3.84	1980			1980			1980		
2040	20.39		3.76	2040			2040			2040		
2100	20.42		3.68	2100			2100			2100		
2160	20.45		3.59	2160			2160			2160		
2220	20.48	8.44	3.46	2220			2220			2220		
2280	20.79		3.35	2280			2280			2280		
2340	20.86		3.24	2340			2340			2340		
2400	20.89	8.41	3.14	2400			2400			2400		
2460	21.06		3.04	2460			2460			2460		
2520	21.20		2.95	2520			2520			2520		
2580	21.37	8.43	2.86	2580			2580			2580		
2640	21.39		2.75	2640			2640			2640		
2700	21.46		2.61	2700			2700			2700		
2760	21.51	8.40	2.53	2760			2760			2760		
2820	21.53		2.44	2820			2820			2820		
2880	21.76		2.32	2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT	0	Sum
INTER HOLE MOVE > 10 km	0	Km.
FROM: SITE NAME:		
BOREHOLE No:		
INTER HOLE MOVE < 10 km:	1	No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:	0	No.
REMOVAL OF EXISTING EQUIPMENT:	0	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	0	No.
WORK TIME RATE (REPAIRS):	0	Hour
STANDING TIME:	0	Hour
LATITUDE: LONGITUDE:		

S U M M A R Y

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	1	No.
VERTICALITY TEST:	0	No.
CASING DETECTION:	1	No.
STEEL BOREHOLE COVER:	1	No.
BOREHOLE MARKING:	1	No.
SITE CLEANING / FINISHING:	1	No.
REPORTING & DATA RECORDING:	1	No.
SLUG TEST:	0	No.
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	81.15	m
BOREHOLE WATERLEVEL AFTER TEST:	10.32	m

TEST DESCRIPTION	STEP: 1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:										
TEST DURATION (Minutes)							0	0.00	0.00	
TEST YIELD (l/s)							MAXIMUM (l/s)	0.0		
DRAWDOWN (m)							MAXIMUM (m)			
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	100				300	5.00	7.03	300
TEST YIELD (l/s)	5.00	9.92	16.84				MAXIMUM (l/s)	16.8		
DRAWDOWN (m)	5.3	13.52	26.19				MAXIMUM (m)	26.2		

RECOVERY TEST			
TIME TOTAL (hrs):			53.00
Cal	Steps	CD	Total
0	300	2880	3180
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
35.9	21.76		60.61

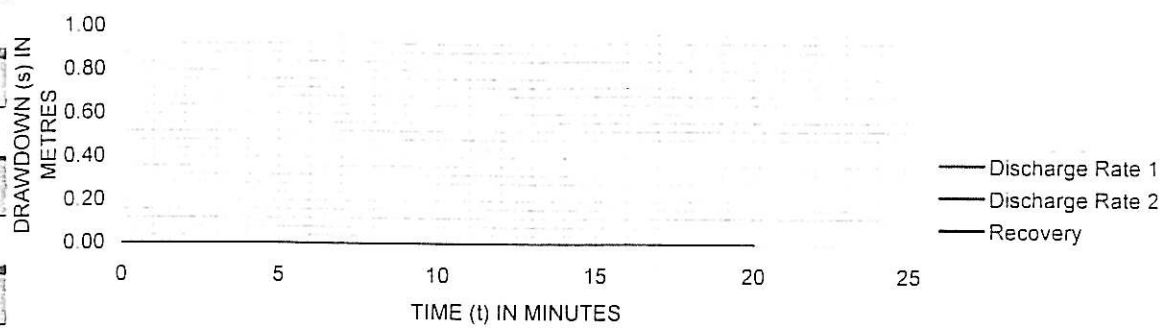
CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	2880	48.00	8.90	21.76	2.32	89.34	2880	48.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: EC/T12/004

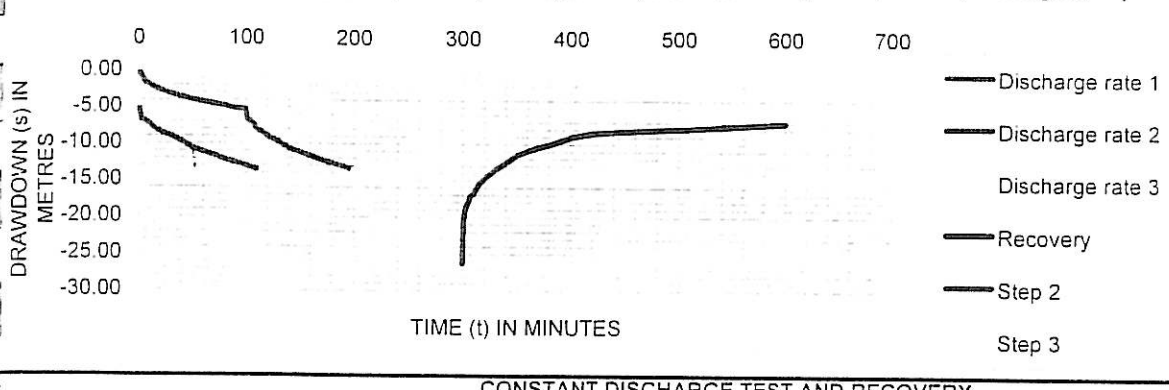
CALIBRATION TEST AND RECOVERY

Discharge 1:	0.00	Discharge 2:		Discharge 3:		Discharge 4:		Discharge 5:		Discharge 6:	
										Drawdown 1:	0.00
										Drawdown 2:	0.00
										Drawdown 3:	0.00
										Drawdown 4:	0.00
										Drawdown 5:	0.00
										Drawdown 6:	0.00
										Duration 1:	0
										Duration 2:	
										Duration 3:	
										Duration 4:	
										Duration 5:	
										Duration 6:	
										Recovery (m):	0.00
										Recovery (min):	0

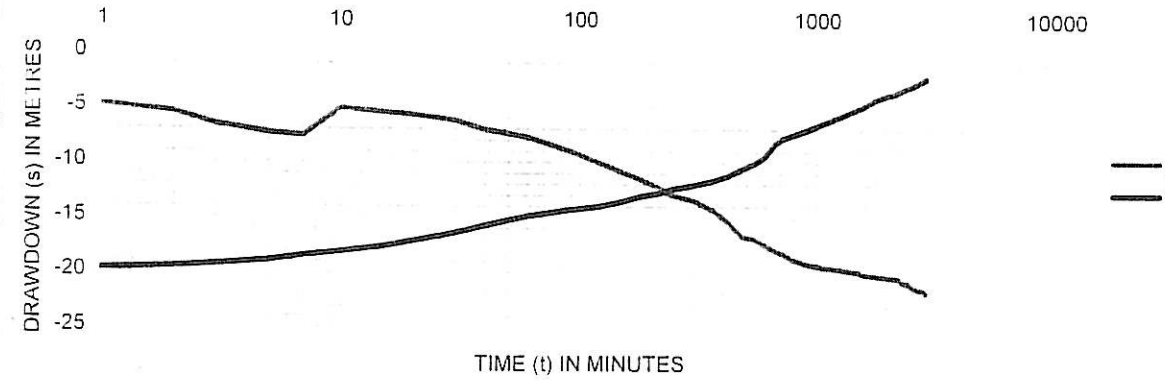


STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	4.99571	Discharge 2:	9.915	Discharge 3:	16.8417	Discharge 4:		Discharge 5:		Discharge 6:	
										Drawdown 1:	5.31
										Drawdown 2:	13.52
										Drawdown 3:	26.19
										Drawdown 4:	0.00
										Drawdown 5:	0.00
										Drawdown 6:	
										Duration 1:	100
										Duration 2:	100
										Duration 3:	100
										Duration 4:	
										Duration 5:	
										Duration 6:	
										Recovery (m):	7.03
										Recovery (min):	300



CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	01/06/2003	Water level (mbgl)	6.25	Depth of pump (mbgl)		42.15
CD duration	2880	CD discharge rate	8.90	CD drawdown		21.76
Available drawdown (m)	35.9	% Recovery after CD	89	% after	2880	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/005	PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO. :		SITE NAME:	GOBOTI
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	190.02	CASING DEPTH (mbdl):	26.50	PUMP TYPE USED:	P 150
DEPTH OF PUMP (mbdl):	122.70	CASING HEIGHT (magl):	0.55	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	170.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	36.01	DATUM LEVEL (magl):	0.29	SUPERVISOR:	CJ VAN DER WALT

DISCHARGE RATE 1

DATE: 21/05/2003 TIME: 19H25

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.40		1	
2	3.23		2	
3	5.11	0.52	3	
5	8.84	0.53	5	
7	10.21		7	
10	15.51	0.52	10	
15	19.14		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 21/05/2003 TIME: 19H40

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	19.16		1	
2	20.04	0.69	2	
3	20.92		3	
5	21.94	0.81	5	
7	22.56		7	
10	23.77	0.83	10	
15	24.59		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 21/05/2003 TIME: 19H55

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	26.13		1	
2	28.70	1.02	2	
3	31.09		3	
5	33.54	1.05	5	
7	35.70		7	
10	38.39	1.04	10	
15	40.91		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 21/05/2003 TIME: 20H10

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	41.84	1.21	1	
2	42.39		2	
3	44.25		3	
5	45.98	1.3	5	
7	50.16		7	
10	52.00	1.31	10	
15	56.16		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 21/05/2003 TIME: 20H25

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	57.97		1	
2	59.15	1.52	2	
3	62.38		3	
5	65.03	1.72	5	
7	69.42		7	
10	73.67	1.73	10	
15	78.50		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: 21/05/2003 TIME: 20H40

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	81.14	1.88	1	75.35
2	82.13		2	69.19
3	83.52	1.9	3	66.01
5	85.13		5	56.83
7	85.13	PI 1.34	7	50.56
10	85.13	PI 1.29	10	40.64
15	85.13	PI 1.09	15	29.54
			20	21.78
			30	11.53
			40	6.56
			50	4.79
			60	3.89
			70	3.36
			80	3.05
			90	2.70
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/005	PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	GOBOTI
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	190.02	CASING DEPTH (mbdl):	26.50	PUMP TYPE USED:	P 150
DEPTH OF PUMP (mbdl):	122.70	CASING HEIGHT (magl):	0.55	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	170.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	36.01	DATUM LEVEL (magl):	0.29		

DISCHARGE RATE 1

DATE: 22/05/2003
TIME: 08H20

Time (min)	Drawdown (m)	Yield (l/s)
1	0.99	
	2.03	0.650
	3.00	
5	3.39	0.510
7	4.67	0.400
0	5.23	
15	6.81	0.420
20	7.53	
30	7.83	
40	8.30	0.410
50	9.73	
60	10.45	0.420
70	11.95	
80	12.29	0.400
90	12.70	
00	13.45	
110		
120		

Average yield: 0.45857143 (l/s)

Recovery 1

Time (min)	(m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 2

DATE: 22/05/2003
TIME: 10H00

Time (min)	Drawdown (m)	Yield (l/s)
1	13.48	
2	13.94	0.770
3	14.96	
5	16.70	0.790
7	18.02	
10	21.29	0.800
15	23.28	
20	26.59	0.810
30	29.70	
40	31.83	
50	33.13	0.800
60	33.71	
70	34.13	
80	34.56	0.810
90	35.04	
100	35.64	
110		
120		

Average yield: 0.79666667

Recovery 2

Time (min)	(m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 22/05/2003
TIME: 11H40

Time (min)	Drawdown (m)	Yield (l/s)
1	36.12	
2	36.67	1.240
3	38.68	
4	42.16	1.560
7	45.46	
10	53.00	1.630
15	63.46	
20	69.74	1.610
30	76.12	
40	78.75	1.620
50	79.65	
60	79.87	1.600
70	84.79	
80	85.08	
90	85.08	PI 1.34
100	85.08	PI 1.15
110	85.08	PI 1.09
120		

Average yield: 1.54333333

Recovery 3

Time (min)	(m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 22/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
3		
5		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

Recovery 4

Time (min)	(m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 22/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Recovery 5

Time (min)	(m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
780	

DISCHARGE RATE 6

DATE: 22/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Recovery

Time (min)	(m)
1	76.35
2	70.16
3	64.84
5	56.33
7	47.35
10	41.02
15	29.93
20	21.89
30	13.66
40	8.59
50	6.78
60	6.06
70	5.54
80	5.12
90	4.67
100	4.41
110	4.15
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

OREHOLE NO. :	EC/T12/005	PROJECT:	ENGCOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIP
ALTERNATIVE NO. :	0	SITE NAME:	GOBOTI		

DEPTH OF PUMP (mbdl):	122.70	PUMP TYPE USED:	P 150	OPERATOR:	PIETER MUNYAI
LET DIAMETER (mm):	100	EXISTING EQUIPMENT:	0	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	22/05/2003	TEST COMPLETED	DATE:	23/05/2003	TOTAL TIME - PUMPED (min):	1440	TOTAL TEST TIME (min):	1650
	TIME:	15H00		TIME:	18H30	TOTAL TIME-RECOVERY(min):	210	AVERAGE YIELD (l/s):	0.53

DISCHARGE BOREHOLE		OBSERVATION BOREHOLE 1		OBSERVATION BOREHOLE 2		OBSERVATION BOREHOLE 3	
CASING HEIGHT (magl):	0.55	No. :		No. :		No. :	
CASING DEPTH (mbdl):	26.50	DATUM LEVEL (magl):		DATUM LEVEL (magl):		DATUM LEVEL (magl):	
ASING ID (mm):	170.00	CASING DEPTH (mbdl):		CASING DEPTH (mbdl):		CASING DEPTH (mbdl):	
BOREHOLE DEPTH (mbdl):	190.02	BOREHOLE DEPTH :		BOREHOLE DEPTH :		BOREHOLE DEPTH :	
WATER LEVEL (mbdl):	40.12	WATER LEVEL:		WATER LEVEL:		WATER LEVEL:	
ATUM LEVEL (magl):	0.29	DISTANCE (m):		DISTANCE (m):		DISTANCE (m):	

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
	2.35	0.65	19.08	1			1			1		
2	4.14		15.71	2			2			2		
3	6.48	0.57	13.24	3			3			3		
	8.90		9.28	5			5			5		
7	12.13	0.52	6.55	7			7			7		
10	14.82		4.67	10			10			10		
5	15.60	0.50	4.06	15			15			15		
20	16.38		3.38	20			20			20		
30	17.16	0.51	2.75	30			30			30		
0	17.98		2.44	40			40			40		
60	18.70	0.53	1.92	60			60			60		
90	19.07		1.32	90			90			90		
20	19.12	0.53	0.98	120			120			120		
150	19.13	0.52	0.52	150			150			150		
80	19.13	0.53	0.24	180			180			180		
10	19.14		0.00	210			210			210		
240	19.22			240			240			240		
00	19.30	0.51		300			300			300		
60	19.39			360			360			360		
420	19.47			420			420			420		
80	19.56	0.52		480			480			480		
40	19.64			540			540			540		
600	19.72			600			600			600		
60	19.81			720			720			720		
20	19.89	0.53		840			840			840		
780	19.97			960			960			960		
40	20.05	0.53		1080			1080			1080		
00	20.15			1200			1200			1200		
960	20.24	0.51		1320			1320			1320		
020	20.37			1440			1440			1440		
080	20.56	0.52		1800			1800			1800		
1140	20.69			2280			2280			2280		
200	20.80	0.53		2880			2880			2880		
260	20.91											
1320	21.02	0.54										
380	21.15	0.53										
440	21.29											

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500				1500			1500			1500		
1560				1560			1560			1560		
1620				1620			1620			1620		
1680				1680			1680			1680		
1740				1740			1740			1740		
1800				1800			1800			1800		
1860				1860			1860			1860		
1920				1920			1920			1920		
1980				1980			1980			1980		
2040				2040			2040			2040		
2100				2100			2100			2100		
2160				2160			2160			2160		
2220				2220			2220			2220		
2280				2280			2280			2280		
2340				2340			2340			2340		
2400				2400			2400			2400		
2460				2460			2460			2460		
2520				2520			2520			2520		
2580				2580			2580			2580		
2640				2640			2640			2640		
2700				2700			2700			2700		
2760				2760			2760			2760		
2820				2820			2820			2820		
2880				2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT	0	Sum
NTER HOLE MOVE > 10 km	65	Km.
FROM: SITE NAME:	KWASANDILE	
BOREHOLE No:	EC/T11/008	
NTER HOLE MOVE < 10 km:	0	No.
EMOVAL AND RE-ERECTION OF PUMP HOUSE:	0	No.
REMOVAL OF EXISTING EQUIPMENT:	0	No.
E-INSTALLATION OF EXISTING EQUIPMENT:	0	No.
VORK TIME RATE (REPAIRS):	0	Hour
STANDING TIME:	0	Hour
ATITUDE: S 31° 43' 30.4"	LONGITUDE: E 28° 04' 25.7"	

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	1	No.
VERTICALITY TEST:	0	No.
CASING DETECTION:	1	No.
STEEL BOREHOLE COVER:	1	No.
BOREHOLE MARKING:	1	No.
SITE CLEANING / FINISHING:	1	No.
REPORTING & DATA RECORDING:	1	No.
SLUG TEST:	0	No.
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	190.02	m
BOREHOLE WATERLEVEL AFTER TEST:	37.41	m

TEST DESCRIPTION	STEP: 1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:										
TEST DURATION (Minutes)	15	15	15	15	15	15	90	1.50	2.70	90
TEST YIELD (l/s)	0.52	0.78	1.04	1.27	1.66	1.89	MAXIMUM (l/s)	1.9		
DRAWDOWN (m)	19.14	24.59	40.91	56.16	78.50	85.13	MAXIMUM (m)	85.1		
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	110				310	5.17	4.15	110
TEST YIELD (l/s)	0.46	0.80	1.54				MAXIMUM (l/s)	1.5		
DRAWDOWN (m)	13.5	35.64	85.08				MAXIMUM (m)	85.1		

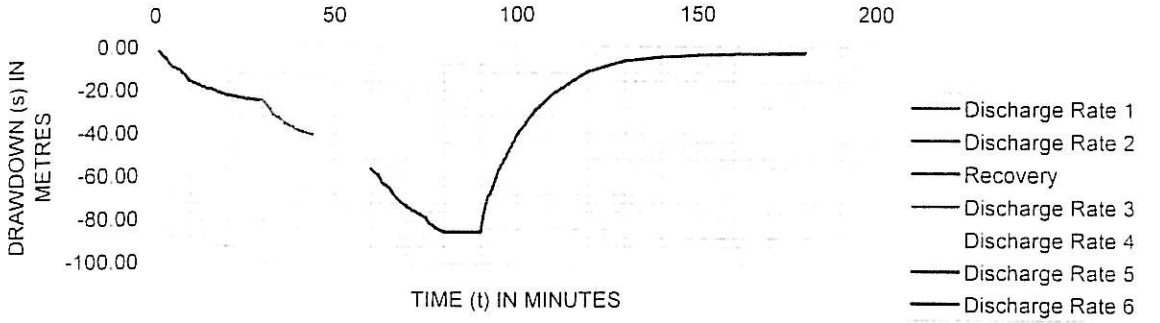
RECOVERY TEST			
TIME TOTAL (hrs):			6.83
Cal	Steps	CD	Total
90	110	210	410
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTILISED		%
86.7	21.29		24.56

CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	1440	24.00	0.53	21.29	0.00	100.00	210	3.50
OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: EC/T12/005

CALIBRATION TEST AND RECOVERY

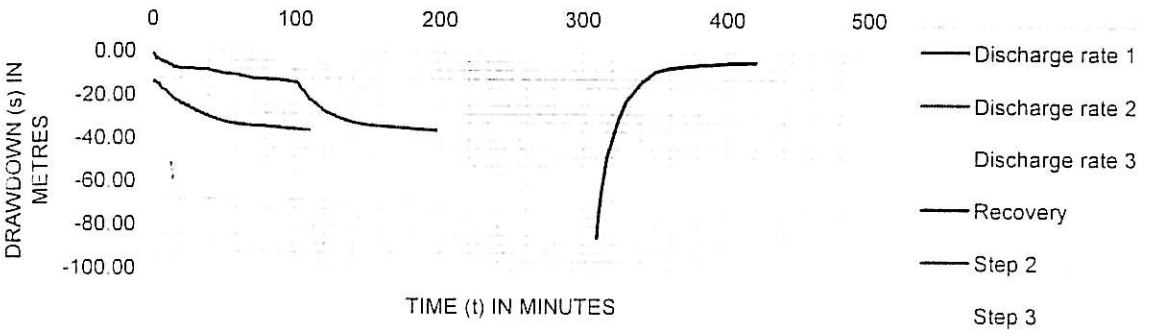
Discharge 1:	0.52	Discharge 2:	0.78	Discharge 3:	1.04	Discharge 4:	1.27	Discharge 5:	1.66



Discharge 6:	1.89
Drawdown 1:	19.14
Drawdown 2:	24.59
Drawdown 3:	40.91
Drawdown 4:	56.16
Drawdown 5:	78.50
Drawdown 6:	85.13
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	15
Duration 6:	15
Recovery (m):	2.70
Recovery (min):	90

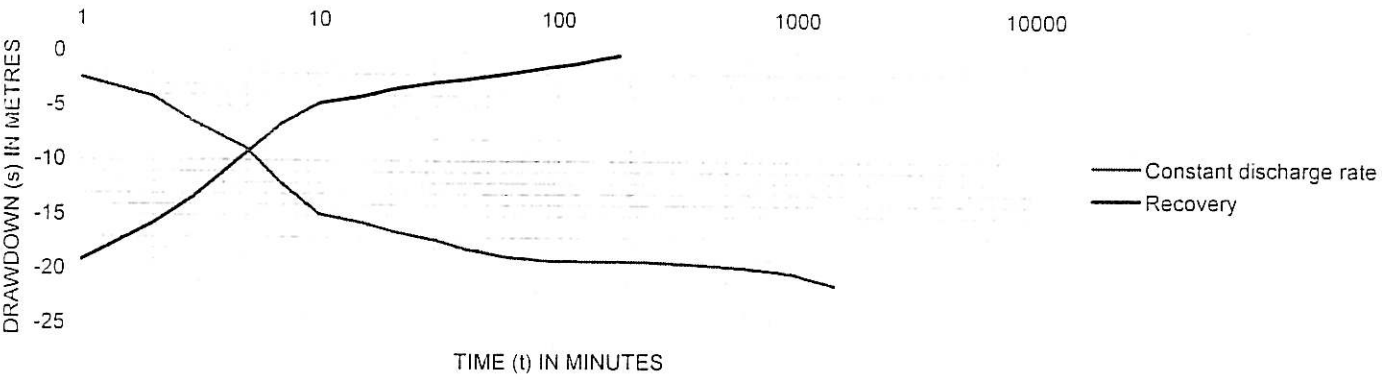
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	0.45857	Discharge 2:	0.79667	Discharge 3:	1.54333	Discharge 4:		Discharge 5:	



Discharge 6:	
Drawdown 1:	13.45
Drawdown 2:	35.64
Drawdown 3:	85.08
Drawdown 4:	
Drawdown 5:	
Drawdown 6:	
Duration 1:	100
Duration 2:	100
Duration 3:	110
Duration 4:	
Duration 5:	
Duration 6:	
Recovery (m):	4.15
Recovery (min):	110

CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	22/05/2003	Water level (mbgl)	36.01	Depth of pump (mbgl)		122.7
CD duration	1440	CD discharge rate	0.53	CD drawdown		21.29
Available drawdown (m)	86.69	% Recovery after CD	100	% after	210	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/008			PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :				SITE NAME:	CLARKBURY
ALTERNATIVE NO. :				CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY
BOREHOLE DEPTH (mbdl):	50.28	CASING DEPTH (mbdl):	26.15	PUMP TYPE USED:	BP 40
DEPTH OF PUMP (mbdl):	44.80	CASING HEIGHT (magl):	0.45	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	170.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	7.53	DATUM LEVEL (magl):	0.17	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 30/04/2003 TIME: 09H20

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.16		1	
2	0.16		2	
3	0.21		3	
5	0.23	1.5	5	
7	0.25		7	
10	0.31	1.51	10	
15	0.33		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 30/04/2003 TIME: 09H35

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.35		1	
2	0.37	2.05	2	
3	0.39		3	
5	0.42	2.04	5	
7	0.44		7	
10	0.44	2.05	10	
15	0.45		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 30/04/2003 TIME: 09H50

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.58	3.78	1	
2	0.62	4.09	2	
3	0.66		3	
5	0.74	4.1	5	
7	0.81		7	
10	0.84	4.11	10	
15	0.90		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 30/04/2003 TIME: 10H05

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.96	5.88	1	
2	1.02	6.28	2	
3	1.03		3	
5	1.06	6.29	5	
7	1.08		7	
10	1.10	6.27	10	
15	1.16		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:
HANDPUMP

PUMP MANUFACTURER:

PUMP SERIAL No:
242 HP37

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):
39 68

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 30/04/2003 TIME: 10H20

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.36	7.29	1	
2	1.42	8.19	2	
3	1.43		3	
5	1.44	8.21	5	
7	1.45		7	
10	1.46	8.2	10	
15	1.52		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.54		1	
2	1.56	9.28	2	
3	1.59	10.39	3	
5	1.61	10.41	5	
7	1.64		7	
10	1.68	10.4	10	
15	1.77		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/008	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	CLARKBURY
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	50.28	CASING DEPTH (mbdl):	26.15	PUMP TYPE USED:	BP 40
DEPTH OF PUMP (mbdl):	44.80	CASING HEIGHT (magl):	0.45	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	170.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	7.53	DATUM LEVEL (magl):	0.17		

DISCHARGE RATE 1

DATE: 30/04/2003
TIME: 11H50

Time (min)	Drawdown (m)	Yield (l/s)
1	0.17	
[illegible]	0.19	
[illegible]	0.23	
5	0.28	3.590
7	0.35	
10	0.41	3.600
15	0.45	
20	0.47	
30	0.50	3.580
40	0.53	
50	0.56	
60	0.57	3.560
70	0.58	
80	0.60	
90	0.62	3.570
100	0.65	
110		
120		

Average yield: 3.58 (l/s)

DISCHARGE RATE 2

DATE: 30/04/2003
TIME: 13H30

Time (min)	Drawdown (m)	Yield (l/s)
1	0.74	5.740
2	0.77	7.160
3	0.83	
5	0.94	7.150
7	1.02	
10	1.09	7.170
15	1.16	
20	1.24	
30	1.28	7.160
40	1.32	
50	1.38	
60	1.41	7.150
70	1.45	
80	1.50	
90	1.53	
100		
110		
120		

Average yield: 6.92166667

DISCHARGE RATE 3

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
4		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

DISCHARGE RATE 4

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
[illegible]		
[illegible]		
3		
5		
[illegible]		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

DISCHARGE RATE 5

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

DISCHARGE RATE 6

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average [illegible]

Recovery 1

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

Recovery 2

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

Recovery 3

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

Recovery 4

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

Recovery 5

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	
780	

Recovery

Time (min)	Recovery (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/008	PROJECT:	ENCGOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIP
ALTERNATIVE NO. :	0	SITE NAME:	CLARKBURY		
DEPTH OF PUMP (mbdl):	38.31	PUMP TYPE USED:	BP 100	OPERATOR:	PIETER MUNYAI
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	HANDPUMP	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	03/05/2003	TEST COMPLETED	DATE:	07/05/2003	TOTAL TIME - PUMPED (min):	2880	TOTAL TEST TIME (min):	5760
	TIME:	14H50		TIME:	14H50	TOTAL TIME-RECOVERY(min):	2880	AVERAGE YIELD (l/s):	10.39

DISCHARGE BOREHOLE		OBSERVATION BOREHOLE 1		OBSERVATION BOREHOLE 2		OBSERVATION BOREHOLE 3	
CASING HEIGHT (magl):	0.45	No. :		No. :		No. :	
CASING DEPTH (mbdl):	26.15	DATUM LEVEL (magl):		DATUM LEVEL (magl):		DATUM LEVEL (magl):	
CASING ID (mm):	170.00	CASING DEPTH (mbdl):		CASING DEPTH (mbdl):		CASING DEPTH (mbdl):	
BOREHOLE DEPTH (mbdl):	50.28	BOREHOLE DEPTH :		BOREHOLE DEPTH :		BOREHOLE DEPTH :	
WATER LEVEL (mbdl):	7.53	WATER LEVEL:		WATER LEVEL:		WATER LEVEL:	
DATUM LEVEL (magl):	0.17	DISTANCE (m):		DISTANCE (m):		DISTANCE (m):	

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1	0.47		6.56	1			1			1		
2	0.81		6.44	2			2			2		
3	0.89	8.42	6.37	3			3			3		
5	0.97		6.27	5			5			5		
7	1.21		6.13	7			7			7		
10	1.51	10.51	6.07	10			10			10		
15	1.94		5.94	15			15			15		
20	2.14		5.83	20			20			20		
30	2.38	10.50	5.72	30			30			30		
40	2.51		5.60	40			40			40		
60	2.70	10.52	5.40	60			60			60		
90	2.88		5.17	90			90			90		
120	3.06	10.51	4.97	120			120			120		
150	3.20		4.82	150			150			150		
180	3.36	10.50	4.72	180			180			180		
210	3.52		4.64	210			210			210		
240	3.60	10.51	4.56	240			240			240		
300	3.90	10.52	4.43	300			300			300		
360	4.01		4.36	360			360			360		
420	4.12	10.50	4.25	420			420			420		
480	4.34		4.18	480			480			480		
540	4.45	10.51	4.11	540			540			540		
600	4.56		4.04	600			600			600		
660	4.67	10.52	3.97	720			720			720		
720	4.78		3.91	840			840			840		
780	4.89	10.51	3.84	960			960			960		
840	5.00		3.77	1080			1080			1080		
900	5.11	10.50	3.71	1200			1200			1200		
960	5.22		3.66	1320			1320			1320		
1020	5.30	10.51	3.62	1440			1440			1440		
1080	5.42		3.58	1800			1800			1800		
1140	5.51	10.50	3.54	2280			2280			2280		
1200	5.62		3.50	2880			2880			2880		
1260	5.76	10.51	3.46									
1320	5.83		3.41									
1380	5.91	10.50	3.36									
1440	6.02		3.34									

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500	6.12	10.50	3.29	1500			1500			1500		
1560	6.29		3.25	1560			1560			1560		
1620	6.38	10.51	3.18	1620			1620			1620		
1680	6.45		3.14	1680			1680			1680		
1740	6.53	10.50	3.10	1740			1740			1740		
1800	6.62		3.07	1800			1800			1800		
1860	6.68	10.51	3.04	1860			1860			1860		
1920	6.74		3.02	1920			1920			1920		
1980	6.81	10.52	3.00	1980			1980			1980		
2040	6.88		2.97	2040			2040			2040		
2100	6.99	10.50	2.94	2100			2100			2100		
2160	7.06		2.91	2160			2160			2160		
2220	7.14	10.51	2.88	2220			2220			2220		
2280	7.28		2.86	2280			2280			2280		
2340	7.36	10.50	2.83	2340			2340			2340		
2400	7.45		2.80	2400			2400			2400		
2460	7.56	10.51	2.78	2460			2460			2460		
2520	7.60		2.75	2520			2520			2520		
2580	7.64	10.50	2.73	2580			2580			2580		
2640	7.70		2.71	2640			2640			2640		
2700	7.76	10.51	2.69	2700			2700			2700		
2760	7.80		2.65	2760			2760			2760		
2820	7.86	10.50	2.62	2820			2820			2820		
2880	7.91		2.59	2880			2880			2880		

DESCRIPTION:		QUANTITY:	UNIT:
ESTABLISHMENT		0	Sum
INTER HOLE MOVE > 10 km		20	Km.
FROM: SITE NAME:	BASE		
BOREHOLE No:			
INTER HOLE MOVE < 10 km:			No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:		1	No.
REMOVAL OF EXISTING EQUIPMENT:		1	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:		1	No.
WORK TIME RATE (REPAIRS):		0	Hour
STANDING TIME:		0	Hour
LATITUDE: S 31 47' 01.8"	LONGITUDE: E 028 16' 26.1"		

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	0	No.
VERTICALITY TEST:	0	No.
CASING DETECTION:	1	No.
STEEL BOREHOLE COVER:	1	No.
BOREHOLE MARKING:	1	No.
SITE CLEANING / FINISHING:	1	No.
REPORTING & DATA RECORDING:	1	No.
SLUG TEST:	0	No.
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	50.28	m
BOREHOLE WATERLEVEL AFTER TEST:	10.12	m

TEST DESCRIPTION	STEP	1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:											
TEST DURATION (Minutes)		15	15	15	15	15	15	90	1.50	0.00	
TEST YIELD (l/s)		1.51	2.05	4.02	6.18	7.97	10.12	MAXIMUM (l/s)	10.1		
DRAWDOWN (m)		0.33	0.45	0.90	1.16	1.52	1.77	MAXIMUM (m)	1.8		
MULTI-RATE / STEP DRAWDOWN:											
TEST DURATION (Minutes)		100	90					190	3.17	0.00	
TEST YIELD (l/s)		3.58	6.92					MAXIMUM (l/s)	6.9		
DRAWDOWN (m)		0.7	1.53					MAXIMUM (m)	1.5		

RECOVERY TEST			
TIME TOTAL (hrs):			48.00
Cal	Steps	CD	Total
0	0	2880	2880
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
37.3	7.91		21.22

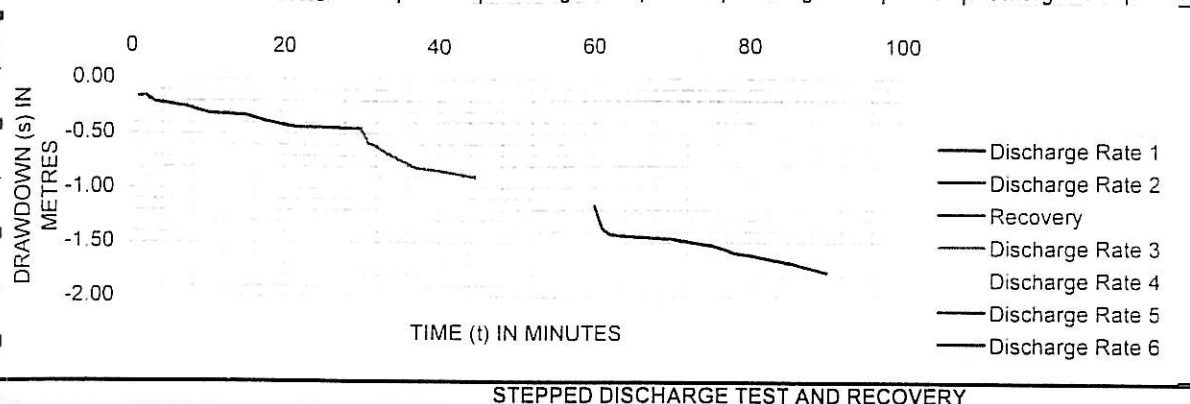
CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	2880	48.00	10.39	7.91	2.59	67.26	2880	48.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: EC/T12/008

CALIBRATION TEST AND RECOVERY

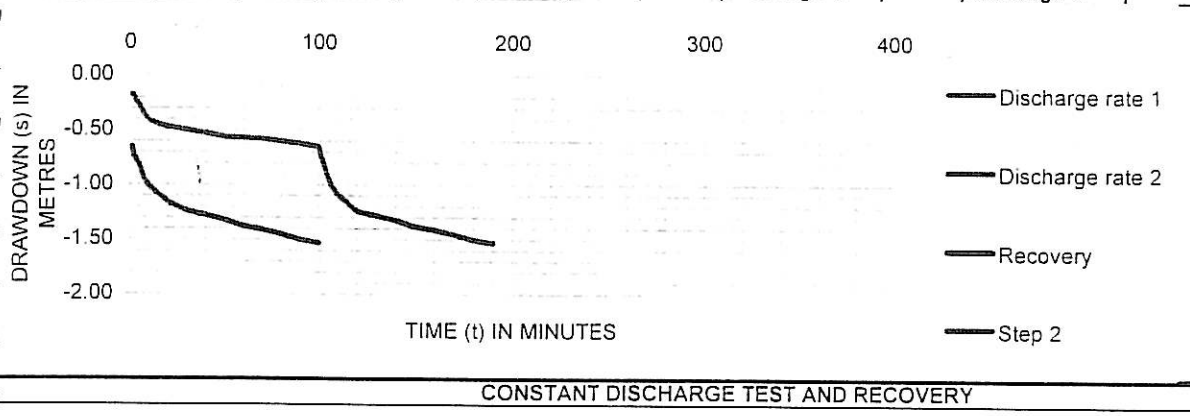
Discharge 1:	1.51	Discharge 2:	2.05	Discharge 3:	4.02	Discharge 4:	6.18	Discharge 5:	7.97



Discharge 6:	10.12
Drawdown 1:	0.33
Drawdown 2:	0.45
Drawdown 3:	0.90
Drawdown 4:	1.16
Drawdown 5:	1.52
Drawdown 6:	1.77
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	15
Duration 6:	15
Recovery (m):	0.00
Recovery (min):	0

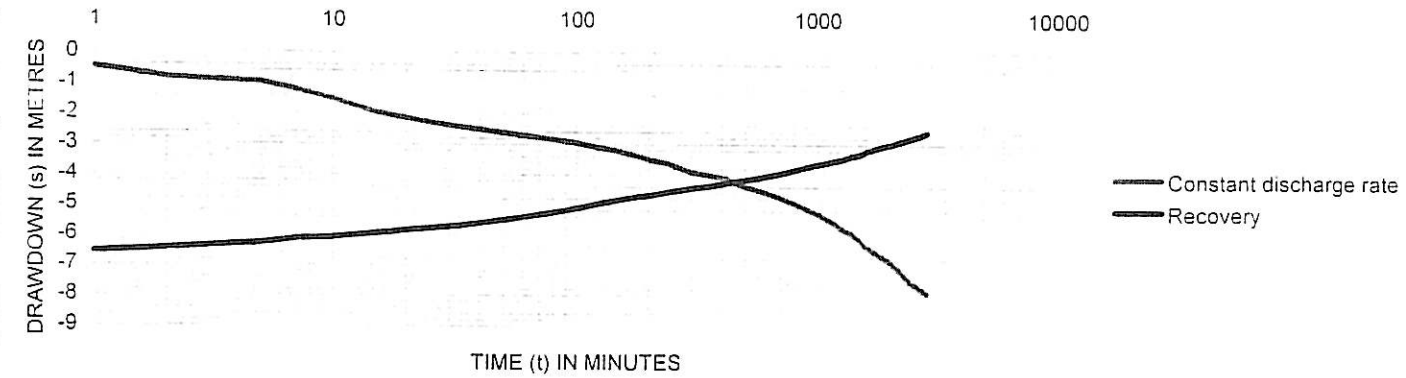
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	3.58	Discharge 2:	6.92167	Discharge 3:		Discharge 4:		Discharge 5:	



Discharge 6:	
Drawdown 1:	0.65
Drawdown 2:	1.53
Drawdown 3:	0.00
Drawdown 4:	0.00
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	90
Duration 3:	
Duration 4:	
Duration 5:	
Duration 6:	
Recovery (m):	0.00
Recovery (min):	0

CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	03/05/2003	Water level (mbgl)	7.53	Depth of pump (mbgl)		44.8
CD duration	2880	CD discharge rate	10.39	CD drawdown		7.91
Available drawdown (m)	37.27	% Recovery after CD	67	% after	2880	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/008	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :		SITE NAME:	CLARKBURY
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	50.28	CASING DEPTH (mbdl):	26.15	PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	44.50	CASING HEIGHT (magl):	0.45	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	170.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	7.53	DATUM LEVEL (magl):	0.17	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 29/04/03 TIME: 14H50

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.06		1	
2	0.06		2	
3	0.07	0.45	3	
5	0.07		5	
7	0.08	0.46	7	
10	0.09	0.45	10	
15	0.09		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 29/04/03 TIME: 15H05

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.10	0.65	1	
2	0.11		2	
3	0.12	0.72	3	
5	0.14		5	
7	0.14	0.73	7	
10	0.16		10	
15	0.17		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 29/04/03 TIME: 15H20

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.19		1	
2	0.22	1.6	2	
3	0.26		3	
5	0.29	1.63	5	
7	0.32		7	
10	0.34	1.62	10	
15	0.36		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 29/04/03 TIME: 15H35

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.38		1	
2	0.45		2	
3	0.48	3	3	
5	0.52		5	
7	0.59	3.01	7	
10	0.64		10	
15	0.69		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:
HANDPUMP

PUMP MANUFACTURER:

PUMP SERIAL No:
242 HP37

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):
39.68

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 29/04/03 TIME: 15H50

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.72		1	
2	0.79	5.5	2	
3	0.84		3	
5	0.93	5.52	5	
7	1.15		7	
10	1.18	5.51	10	
15	1.18		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: 29/04/03 TIME: 16H05

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.22		1	0.84
2	1.26		2	0.70
3	1.27	7.47	3	0.64
5	1.29		5	0.52
7	1.31	7.49	7	0.46
10	1.38		10	0.41
15	1.43		15	0.33
			20	0.31
			30	0.26
			40	0.25
			50	0.24
			60	0.23
			70	0.22
			80	0.21
			90	0.20
			100	0.19
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/008	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	CLARKBURY
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	50.28	CASING DEPTH (mbdl):	26.15	PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	44.50	CASING HEIGHT (magl):	0.45	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	170.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	7.53	DATUM LEVEL (magl):	0.17		

DISCHARGE RATE 1

DATE: 30/04/2003
TIME: 11H50

Time (min)	Drawdown (m)	Yield (l/s)
1	0.17	
2	0.19	
3	0.23	
5	0.28	3.590
7	0.35	
10	0.41	3.600
15	0.45	
20	0.47	
30	0.50	3.580
40	0.53	
50	0.56	
60	0.57	3.560
70	0.58	
80	0.60	
90	0.62	3.570
100	0.65	
110		
120		

Average yield: 3.58

Time (min)	Recovery 1 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
(l/s)	

DISCHARGE RATE 2

DATE: 30/04/2003
TIME: 13H30

Time (min)	Drawdown (m)	Yield (l/s)
1	0.74	5.740
2	0.77	7.160
3	0.83	
5	0.94	7.150
7	1.02	
10	1.09	7.170
15	1.16	
20	1.24	
30	1.28	7.160
40	1.32	
50	1.38	
60	1.41	7.150
70	1.45	
80	1.50	
90	1.53	
100		
110		
120		

Average yield: 6.92166667

Time (min)	Recovery 2 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
4		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

Time (min)	Recov (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Average yield: #DIV/0!

Time (min)	Recovery 4 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	(l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Time (min)	Recovery 5 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
780	

DISCHARGE RATE 6

DATE: 30/04/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Time (min)	Reco (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/008	PROJECT:	ENCGOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIP
ALTERNATIVE NO. :	0	SITE NAME:	CLARKBURY		
DEPTH OF PUMP (mbdl):	38.31	PUMP TYPE USED:	BP 100	OPERATOR:	PIETER MUNYAI
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	HANDPUMP	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	03/05/2003	TEST COMPLETED	DATE:	07/05/2003	TOTAL TIME - PUMPED (min):	2880	TOTAL TEST TIME (min):	5760
	TIME:	14H50		TIME:	14H50	TOTAL TIME-RECOVERY(min):	2880	AVERAGE YIELD (l/s):	10.39

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
CASING HEIGHT (magl):			0.45	No. :			No. :			No. :		
CASING DEPTH (mbdl):			26.15	DATUM LEVEL (magl):			DATUM LEVEL (magl):			DATUM LEVEL (magl):		
CASING ID (mm):			170.00	CASING DEPTH (mbdl):			CASING DEPTH (mbdl):			CASING DEPTH (mbdl):		
BOREHOLE DEPTH (mbdl):			50.28	BOREHOLE DEPTH :			BOREHOLE DEPTH :			BOREHOLE DEPTH :		
WATER LEVEL (mbdl):			7.53	WATER LEVEL:			WATER LEVEL:			WATER LEVEL:		
DATUM LEVEL (magl):			0.17	DISTANCE (m):			DISTANCE (m):			DISTANCE (m):		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1	0.47		6.56	1			1			1		
2	0.81		6.44	2			2			2		
3	0.89	8.42	6.37	3			3			3		
5	0.97		6.27	5			5			5		
7	1.21		6.13	7			7			7		
10	1.51	10.51	6.07	10			10			10		
15	1.94		5.94	15			15			15		
20	2.14		5.83	20			20			20		
30	2.38	10.50	5.72	30			30			30		
40	2.51		5.60	40			40			40		
60	2.70	10.52	5.40	60			60			60		
90	2.88		5.17	90			90			90		
120	3.06	10.51	4.97	120			120			120		
150	3.20		4.82	150			150			150		
180	3.36	10.50	4.72	180			180			180		
210	3.52		4.64	210			210			210		
240	3.60	10.51	4.56	240			240			240		
300	3.90	10.52	4.43	300			300			300		
360	4.01		4.36	360			360			360		
420	4.12	10.50	4.25	420			420			420		
480	4.34		4.18	480			480			480		
540	4.45	10.51	4.11	540			540			540		
600	4.56		4.04	600			600			600		
660	4.67	10.52	3.97	720			720			720		
720	4.78		3.91	840			840			840		
780	4.89	10.51	3.84	960			960			960		
840	5.00		3.77	1080			1080			1080		
900	5.11	10.50	3.71	1200			1200			1200		
960	5.22		3.66	1320			1320			1320		
1020	5.30	10.51	3.62	1440			1440			1440		
1080	5.42		3.58	1800			1800			1800		
1140	5.51	10.50	3.54	2280			2280			2280		
1200	5.62		3.50	2880			2880			2880		
1260	5.76	10.51	3.46									
1320	5.83		3.41									
1380	5.91	10.50	3.36									
1440	6.02		3.34									

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500	6.12	10.50	3.29	1500			1500			1500		
1560	6.29		3.25	1560			1560			1560		
1620	6.38	10.51	3.18	1620			1620			1620		
1680	6.45		3.14	1680			1680			1680		
1740	6.53	10.50	3.10	1740			1740			1740		
1800	6.62		3.07	1800			1800			1800		
1860	6.68	10.51	3.04	1860			1860			1860		
1920	6.74		3.02	1920			1920			1920		
1980	6.81	10.52	3.00	1980			1980			1980		
2040	6.88		2.97	2040			2040			2040		
2100	6.99	10.50	2.94	2100			2100			2100		
2160	7.06		2.91	2160			2160			2160		
2220	7.14	10.51	2.88	2220			2220			2220		
2280	7.28		2.86	2280			2280			2280		
2340	7.36	10.50	2.83	2340			2340			2340		
2400	7.45		2.80	2400			2400			2400		
2460	7.56	10.51	2.78	2460			2460			2460		
2520	7.60		2.75	2520			2520			2520		
2580	7.64	10.50	2.73	2580			2580			2580		
2640	7.70		2.71	2640			2640			2640		
2700	7.76	10.51	2.69	2700			2700			2700		
2760	7.80		2.65	2760			2760			2760		
2820	7.86	10.50	2.62	2820			2820			2820		
2880	7.91		2.59	2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT	0	Sum
INTER HOLE MOVE > 10 km	20	Km.
FROM: SITE NAME:	BASE	
BOREHOLE No:		
INTER HOLE MOVE < 10 km:		No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:	1	No.
REMOVAL OF EXISTING EQUIPMENT:	1	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	1	No.
WORK TIME RATE (REPAIRS):	0	Hour
STANDING TIME:	0	Hour
LATITUDE: S 31 47' 01.8"	LONGITUDE: E 028 16' 26.1"	

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	0	No.
VERTICALITY TEST:	0	No.
CASING DETECTION:	1	No.
STEEL BOREHOLE COVER:	1	No.
BOREHOLE MARKING:	1	No.
SITE CLEANING / FINISHING:	1	No.
REPORTING & DATA RECORDING:	1	No.
SLUG TEST:	0	No.
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	50.28	m
BOREHOLE WATERLEVEL AFTER TEST:	10.12	m

TEST DESCRIPTION	STEP	1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:											
TEST DURATION (Minutes)		15	15	15	15	15	15	90	1.50	0.19	100
TEST YIELD (l/s)		0.45	0.70	1.62	3.01	5.51	7.48	MAXIMUM (l/s)	7.5		
DRAWDOWN (m)		0.09	0.17	0.36	0.69	1.18	1.43	MAXIMUM (m)	1.4		
MULTI-RATE / STEP DRAWDOWN:											
TEST DURATION (Minutes)		100	90					190	3.17	0.00	
TEST YIELD (l/s)		3.58	6.92					MAXIMUM (l/s)	6.9		
DRAWDOWN (m)		0.7	1.53					MAXIMUM (m)	1.5		

RECOVERY TEST			
TIME TOTAL (hrs):			49.67
Cal	Steps	CD	Total
100	0	2880	2980
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
37.0	7.91		21.40

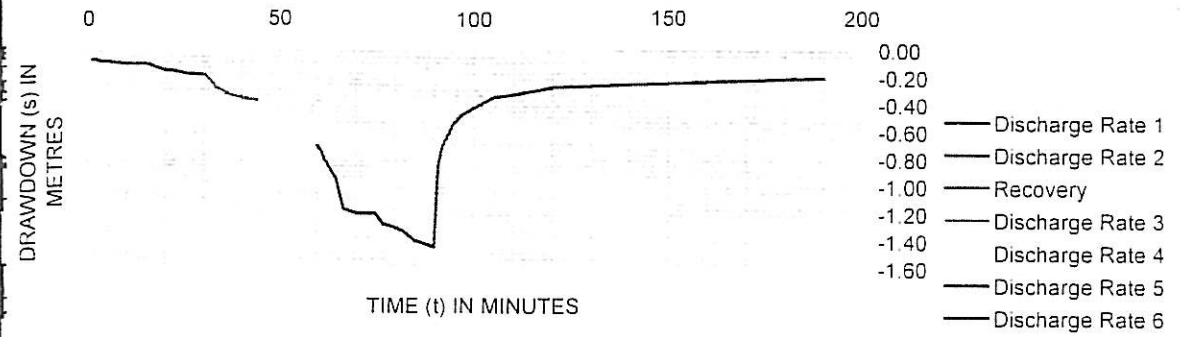
CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	2880	48.00	10.39	7.91	2.59	67.26	2880	48.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: EC/T12/008

CALIBRATION TEST AND RECOVERY

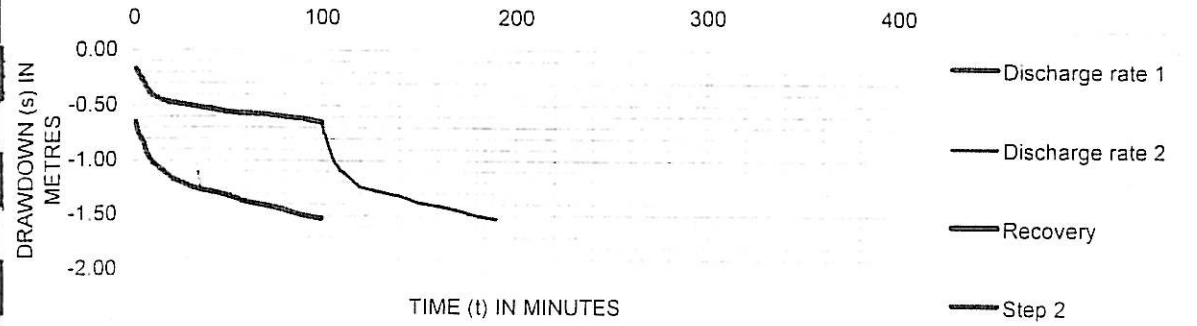
Discharge 1:	0.45	Discharge 2:	0.70	Discharge 3:	1.62	Discharge 4:	3.01	Discharge 5:	5.51



Discharge 6:	7.48
Drawdown 1:	0.09
Drawdown 2:	0.17
Drawdown 3:	0.36
Drawdown 4:	0.69
Drawdown 5:	1.18
Drawdown 6:	1.43
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	15
Duration 6:	15
Recovery (m):	0.19
Recovery (min):	100

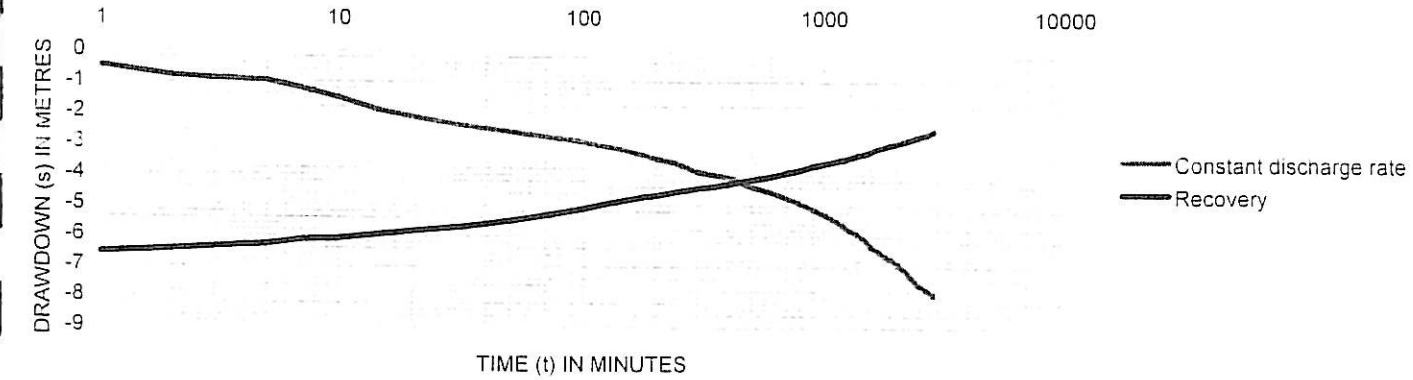
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	3.58	Discharge 2:	6.92167	Discharge 3:		Discharge 4:		Discharge 5:	



Discharge 6:	
Drawdown 1:	0.65
Drawdown 2:	1.53
Drawdown 3:	0.00
Drawdown 4:	0.00
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	90
Duration 3:	
Duration 4:	
Duration 5:	
Duration 6:	
Recovery (m):	0.00
Recovery (min):	0

CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	03/05/2003	Water level (mbgl)	7.53	Depth of pump (mbgl)		44.5
CD duration	2880	CD discharge rate	10.39	CD drawdown		7.91
Available drawdown (m)	36.97	% Recovery after CD	67	% after	2880	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/009	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :		SITE NAME:	TYENI
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	69.88	CASING DEPTH (mbdl):	11.07	PUMP TYPE USED:	P 75 H
DEPTH OF PUMP (mbdl):	38.50	CASING HEIGHT (magl):	0.32	OPERATOR:	JAN MUDAU
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	180.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	9.54	DATUM LEVEL (magl):	0.30	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 0 | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: | TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/009	PROJECT:	ENCGOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	TYENI
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	69.88	CASING DEPTH (mbdl):	11.07	PUMP TYPE USED:	P 75 H
DEPTH OF PUMP (mbdl):	38.50	CASING HEIGHT (magl):	0.32	OPERATOR:	JAN MUDAU
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	180.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	9.54	DATUM LEVEL (magl):	0.30		

DISCHARGE RATE 1			Time	Recovery 1
DATE:	03/06/2003		(min)	(m)
TIME:	11H40		1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
1	0.57		5	
2	0.81	0.220	7	
3	0.97		10	
5	1.16	0.320	15	
7	1.33		20	
10	1.53	0.340	30	
15	1.70		40	
20	1.80	0.310	50	
30	1.92		60	
40	2.01	0.330	70	
50	2.09		80	
60	2.13	0.330	90	
70	2.16		100	
80	2.19	0.320	110	
90	2.23		120	
100	2.29	0.340	150	
110			180	
120			210	
Average yield:	0.31375	l/s		

DISCHARGE RATE 2			Time	Recovery 2
DATE:	03/06/2003		(min)	(m)
TIME:	13H20		1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
1	2.61		5	
2	2.94		7	
3	3.30	0.620	10	
5	3.52		15	
7	3.68	0.600	20	
10	4.14		30	
15	4.40	0.640	40	
20	4.60		50	
30	4.74	0.630	60	
40	4.83		70	
50	4.92	0.610	80	
60	4.96	0.590	90	
70	5.10	0.630	100	
80	5.16		110	
90	5.22	0.630	120	
100	5.33		150	
110			180	
120			210	
Average yield:	0.61875			

DISCHARGE RATE 3			Time	Recovery 3
DATE:	03/06/2003		(min)	(m)
TIME:	15H00		1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
1	5.67		5	
2	6.18		7	
3	7.14	1.530	10	
4	8.89	1.450	15	
7	9.94	1.310	20	
10	10.66		30	
15	11.24	1.330	40	
20	11.85		50	
30	12.68	1.360	60	
40	13.45		70	
50	13.94	1.340	80	
60	14.24		90	
70	14.41	1.350	100	
80	14.60		110	
90	14.79	1.320	120	
100	15.02		150	
110			180	
120			210	
Average yield:	1.37375			

DISCHARGE RATE 4			Time	Recovery 4
DATE:	03/06/2003		(min)	(m)
TIME:	16H40		1	
Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3	
1	16.05		5	
2	17.08		7	
3	19.44	2.70	10	
5	23.36	2.65	15	
7	25.74		20	
10	28.89	2.63	30	
15	28.89	PI 2.24	40	
20	28.89	PI 2.10	50	
30	28.89	PI 2.03	60	
40			70	
50			80	
60			90	
70			100	
80			110	
90			120	
100			150	
110			180	
120			210	
Average yield:	2.66			

DISCHARGE RATE 5			Time	Recovery 5
DATE:	03/06/2003		(min)	(m)
TIME:			1	
Time	Drawdown		2	
(min)	(m)	(l/s)	3	
1			5	
2			7	
3			10	
5			15	
7			20	
10			30	
15			40	
20			50	
30			60	
40			70	
50			80	
60			90	
70			100	
80			110	
90			120	
100			150	
110			180	
120			210	
			240	
			300	
			360	
			420	
			480	
			540	
			600	
			660	
			720	

DISCHARGE RATE 6			Time	Recovery
DATE:	03/06/2003		(min)	(m)
TIME:			1	24.69
Time	Drawdown	Yield	2	21.25
(min)	(m)	(l/s)	3	18.56
1			5	14.66
2			7	11.29
3			10	6.47
5			15	3.50
7			20	2.68
10			30	2.08
15			40	1.70
20			50	1.45
30			60	1.32
40			70	1.15
50			80	1.02
60			90	0.94
70			100	0.87
80			110	0.81
90			120	0.75
100			150	0.62
110			180	0.53
120			210	0.47
150			240	0.42
180			300	0.34
210			360	0.26
240			420	
300			480	
360			540	
420			600	
480			660	
			720	
Average yield				

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T12/009	PROJECT:	ENCGOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIP
ALTERNATIVE NO. :	0	SITE NAME:	TYENI		
DEPTH OF PUMP (mbdl):	38.50	PUMP TYPE USED:	P 75 H	OPERATOR:	JAN MUDAU
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	0	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	04/06/2003	TEST COMPLETED	DATE:	06/06/2003	TOTAL TIME - PUMPED (min):	1440	TOTAL TEST TIME (min):	2880
	TIME:	07H10		TIME:	07H10	TOTAL TIME-RECOVERY(min):	1440	AVERAGE YIELD (l/s):	0.64

DISCHARGE BOREHOLE

CASING HEIGHT (magl):	0.32
CASING DEPTH (mbdl):	11.07
CASING ID (mm):	180.00
BOREHOLE DEPTH (mbdl):	69.88
WATER LEVEL (mbdl):	9.48
DATUM LEVEL (magl):	0.30

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)
1	0.44		4.64
2	0.79	0.54	3.72
3	1.08		3.13
5	1.55	0.66	2.42
7	2.00		2.05
10	2.49	0.68	1.80
15	3.13		1.56
20	3.70	0.68	1.40
30	4.53		1.24
40	5.09	0.66	1.13
60	5.33		0.96
90	5.44	0.65	0.81
120	5.53		0.72
150	5.64	0.67	0.64
180	5.70		0.58
210	5.75	0.64	0.52
240	5.80		0.48
300	5.86	0.64	0.42
360	5.92		0.36
420	5.94	0.63	0.33
480	5.95		0.31
540	6.00	0.64	0.29
600	6.05		0.27
660	6.08	0.62	0.25
720	6.12		0.24
780	6.16	0.62	0.23
840	6.19		0.22
900	6.23	0.63	0.21
960	6.25		0.20
1020	6.28	0.61	0.19
1080	6.30		0.18
1140	6.32	0.63	0.17
1200	6.35		0.16
1260	6.37	0.63	0.15
1320	6.39		0.14
1380	6.42	0.62	0.13
1440	6.46		0.12

OBSERVATION BOREHOLE 1

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

OBSERVATION BOREHOLE 2

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

OBSERVATION BOREHOLE 3

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500				1500			1500			1500		
1560				1560			1560			1560		
1620				1620			1620			1620		
1680				1680			1680			1680		
1740				1740			1740			1740		
1800				1800			1800			1800		
1860				1860			1860			1860		
1920				1920			1920			1920		
1980				1980			1980			1980		
2040				2040			2040			2040		
2100				2100			2100			2100		
2160				2160			2160			2160		
2220				2220			2220			2220		
2280				2280			2280			2280		
2340				2340			2340			2340		
2400				2400			2400			2400		
2460				2460			2460			2460		
2520				2520			2520			2520		
2580				2580			2580			2580		
2640				2640			2640			2640		
2700				2700			2700			2700		
2760				2760			2760			2760		
2820				2820			2820			2820		
2880				2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT	0	Sum
INTER HOLE MOVE > 10 km	0	Km.
FROM: SITE NAME:		
BOREHOLE No:		
INTER HOLE MOVE < 10 km:	1	No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:	0	No.
REMOVAL OF EXISTING EQUIPMENT:	0	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	0	No.
WORK TIME RATE (REPAIRS):	0	Hour
STANDING TIME:	0	Hour
LATITUDE: LONGITUDE:		

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	0	No.
VERTICALITY TEST:	0	No
CASING DETECTION:	1	No
STEEL BOREHOLE COVER:	1	No
BOREHOLE MARKING:	1	No
SITE CLEANING / FINISHING:	1	No
REPORTING & DATA RECORDING:	1	No
SLUG TEST:	0	No.
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	69.86	m
BOREHOLE WATERLEVEL AFTER TEST:	9.02	m

TEST DESCRIPTION STEP	1	2	3	4	5	6	TOTAL: (min)	TOTAL: (hrs)	RECOVERY: (m)	RECOVERY: (min)
CALIBRATION TEST:										
TEST DURATION (Minutes)							0	0.00	0.00	
TEST YIELD (l/s)							MAXIMUM (l/s)	0.0		
DRAWDOWN (m)							MAXIMUM (m)			
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	100	10			310	5.17	0.26	360
TEST YIELD (l/s)	0.31	0.62	1.37	2.66			MAXIMUM (l/s)	2.7		
DRAWDOWN (m)	2.3	5.33	15.02	28.89	0.00		MAXIMUM (m)	28.9		

RECOVERY TEST			
TIME TOTAL (hrs):			30.00
Cal	Steps	CD	Total
0	360	1440	1800
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED	%	
29.0	6.46	22.31	

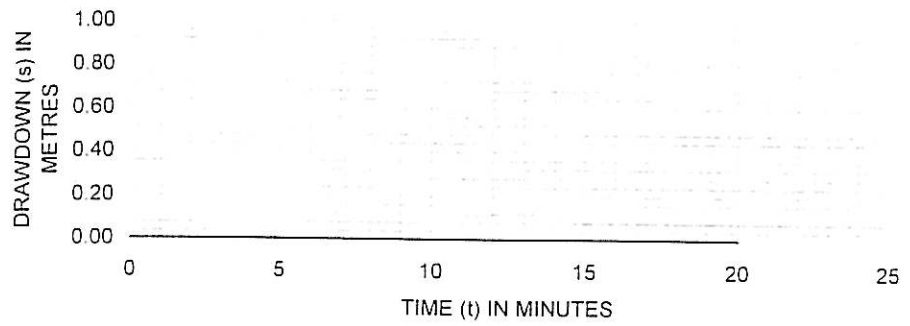
CONSTANT DISCHARGE TEST	TEST DURATION (min)	TEST DURATION (hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	RECOVERY: %	RECOVERY: (min)	RECOVERY: (hrs)
	1440	24.00	0.64	6.46	0.12	98.14	1440	24.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	>2880 (min) Time	TOTAL: (min)	TOTAL: (hrs)
							0	0.00

BOREHOLE NUMBER: EC/T12/009

CALIBRATION TEST AND RECOVERY

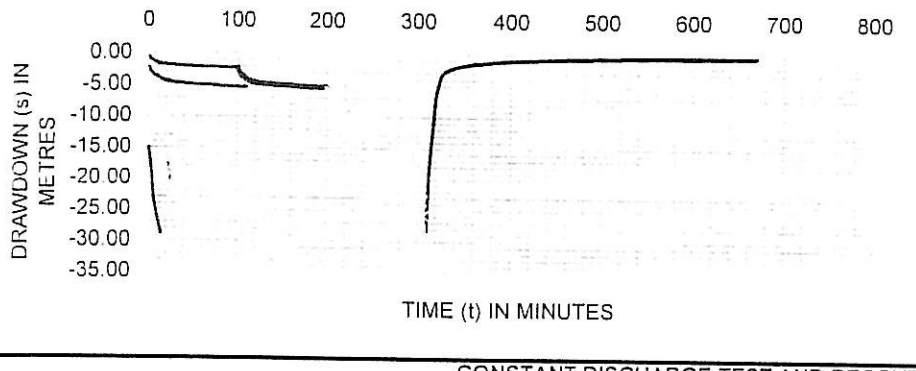
Discharge 1:	0.00	Discharge 2:		Discharge 3:		Discharge 4:		Discharge 5:	



Discharge 6:	
Drawdown 1:	0.00
Drawdown 2:	0.00
Drawdown 3:	0.00
Drawdown 4:	0.00
Drawdown 5:	0.00
Drawdown 6:	0.00
Duration 1:	0
Duration 2:	
Duration 3:	
Duration 4:	
Duration 5:	
Duration 6:	
Recovery (m):	0.00
Recovery (min):	0

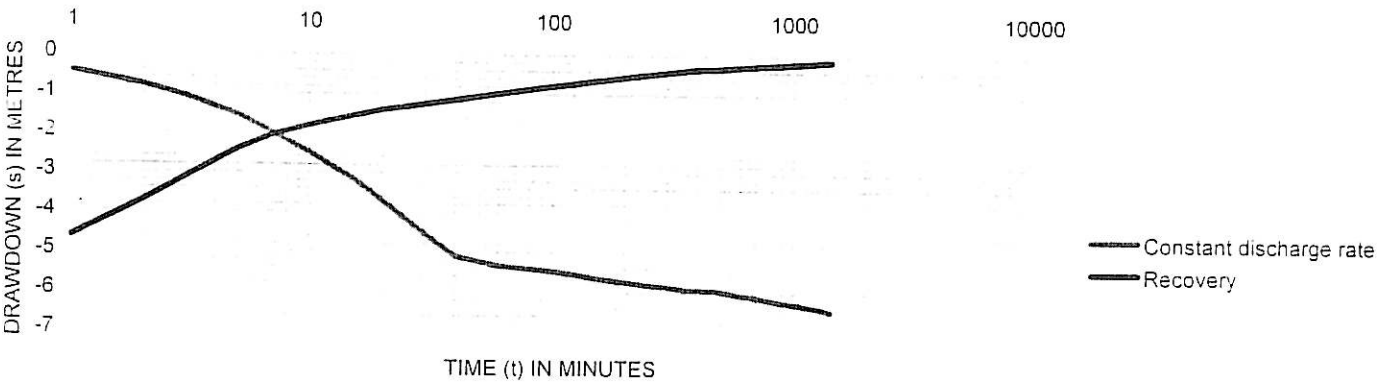
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	0.31375	Discharge 2:	0.61875	Discharge 3:	1.37375	Discharge 4:	2.66	Discharge 5:	



Discharge 6:	
Drawdown 1:	2.29
Drawdown 2:	5.33
Drawdown 3:	15.02
Drawdown 4:	28.89
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	100
Duration 3:	100
Duration 4:	10
Duration 5:	
Duration 6:	
Recovery (m):	0.26
Recovery (min):	360

CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	04/06/2003	Water level (mbgl)	9.54	Depth of pump (mbgl)		38.5
CD duration	1440	CD discharge rate	0.64	CD drawdown		6.46
Available drawdown (m)	28.96	% Recovery after CD	98	% after	1440	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	T 32314	PROJECT:	ENCGOBO FEASIBILTY STUDY
ALTERNATIVE NO. :		SITE NAME:	NGQOBONCO
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	34.19	CASING DEPTH (mbdl):	3.85	PUMP TYPE USED:	BP 22
DEPTH OF PUMP (mbdl):	27.00	CASING HEIGHT (magl):	0.30	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	165.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	3.74	DATUM LEVEL (magl):	0.28	SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 02/05/2003 TIME: 16H05

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.88		1	
2	0.91		2	
3	1.17		3	
5	1.33	0.27	5	
7	1.36		7	
10	1.38	0.25	10	
15	1.40		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 02/05/2003 TIME: 16H20

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.58		1	
2	1.67	0.4	2	
3	1.83		3	
5	2.00	0.41	5	
7	2.04		7	
10	2.10	0.42	10	
15	2.22		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 02/05/2003 TIME: 16H35

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	2.42	0.65	1	
2	2.66		2	
3	2.93	0.84	3	
5	3.24		5	
7	4.55	0.85	7	
10	4.98		10	
15	5.40		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 02/05/2003 TIME: 16H50

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	5.65		1	
2	5.82	0.93	2	
3	5.97		3	
5	6.09	1.61	5	
7	6.50		7	
10	7.61	1.64	10	
15	11.26		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:
WINDMILL

PUMP MANUFACTURER:

PUMP SERIAL No:
MW 200 12T014KT198

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):
24 65

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 02/05/2003 TIME: 17H05

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	11.69		1	
2	12.24	2.09	2	
3	13.56	2.71	3	
5	16.25		5	
7	21.47		7	
10	24.13	2.12	10	
15	24.13	PI 2.19	15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: TIME:

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1			1	16.95
2			2	11.47
3			3	6.64
5			5	4.34
7			7	2.97
10			10	1.33
15			15	1.15
			20	0.98
			30	0.78
			40	0.63
			50	0.47
			60	0.36
			70	0.33
			80	
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:
CYLINDER

CLASS OF RISER:

DIAMETER OF RISER (mm):
3 08

CONDITION OF RISER:
BAD

SHAFT DIAMETER (mm):
90

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	T 32314	PROJECT:	ENCGOBO FEASIBILTY STUDY
ALTERNATIVE NO. :	0	SITE NAME:	NGQOBONCO
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	34.19	CASING DEPTH (mbdl):	3.85	PUMP TYPE USED:	BP 22
DEPTH OF PUMP (mbdl):	27.00	CASING HEIGHT (magl):	0.30	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	165.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	3.74	DATUM LEVEL (magl):	0.28		

DISCHARGE RATE 1

DATE: 03/05/2003
TIME: 06H30

Time (min)	Drawdown (m)	Yield (l/s)
1	1.18	
[illegible]	1.77	0.450
[illegible]	1.98	
5	2.00	0.350
7	2.01	
10	2.02	0.340
15	2.09	
20	2.15	0.340
30	2.32	
40	2.52	0.350
50	2.61	
60	2.65	0.330
70	2.73	
80	2.75	
90	2.77	0.360
100	2.78	
110		
120		

Average yield: 0.36

Time (min)	Recovery 1 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
(l/s)	

DISCHARGE RATE 2

DATE: 03/05/2003
TIME: 08H10

Time (min)	Drawdown (m)	Yield (l/s)
1	3.11	
2	3.28	
3	3.33	0.610
5	3.43	
7	3.52	
10	3.55	
15	3.60	0.600
20	3.63	
30	3.67	0.600
40	3.75	
50	3.80	
60	3.84	0.610
70	3.87	
80	3.88	
90	3.90	0.620
100	3.93	
110		
120		

Average yield: 0.608

Time (min)	Recovery 2 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 03/05/2003
TIME: 09H50

Time (min)	Drawdown (m)	Yield (l/s)
1	5.61	
2	6.69	1.160
3	7.40	
4	7.87	1.250
7	8.24	
10	8.58	
15	8.93	1.240
20	9.11	
30	9.33	1.260
40	9.45	
50	9.60	1.250
60	9.80	
70	9.87	
80	9.90	1.260
90	9.95	
100	9.97	
110		
120		

Average yield: 1.23666667

Time (min)	Recovery 3 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 03/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
[illegible]		
[illegible]		
3		
5		
[illegible]		
10		
15		
20		
30		
40		
50		
60		
70		
80		
100		
110		
120		

Average yield: #DIV/0!

Time (min)	Recovery 4 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 03/05/2003
TIME:

Time (min)	Drawdown (m)	
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Time (min)	Recovery 5 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	
780	

DISCHARGE RATE 6

DATE: 03/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Time (min)	Recovery (m)
1	6.44
2	4.65
3	3.50
5	2.46
7	2.04
10	1.54
15	1.30
20	1.13
30	0.87
40	0.74
50	0.60
60	0.54
70	0.45
80	0.40
90	0.36
100	0.34
110	0.33
120	0.29
150	0.22
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	T 32314	PROJECT:	ENCGOBO FEASIBILTY STUDY	CLIENT	CHRIS HANI DISTRICT MUNICIPALITY
ALTERNATIVE NO. :	0	SITE NAME:	NGQOBONCO		
DEPTH OF PUMP (mbdl):	27.00	PUMP TYPE USED:	BP 22	OPERATOR:	PIETER MUNYAI
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT	WINDMILL	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE: 03/05/2003	TEST COMPLETED	DATE: 05/05/2003	TOTAL TIME - PUMPED (min):	1440	TOTAL TEST TIME (min):	2760
	TIME: 14H30		TIME: 12H30	TOTAL TIME-RECOVERY(min):	1320	AVERAGE YIELD (l/s):	0.94

DISCHARGE BOREHOLE		OBSERVATION BOREHOLE 1		OBSERVATION BOREHOLE 2		OBSERVATION BOREHOLE 3	
CASING HEIGHT (magl)	0.30	No. :		No. :		No. :	
CASING DEPTH (mbdl):	3.85	DATUM LEVEL (magl):		DATUM LEVEL (magl):		DATUM LEVEL (magl):	
CASING ID (mm)	165.00	CASING DEPTH (mbdl):		CASING DEPTH (mbdl)		CASING DEPTH (mbdl)	
BOREHOLE DEPTH (mbdl):	34.19	BOREHOLE DEPTH :		BOREHOLE DEPTH		BOREHOLE DEPTH	
WATER LEVEL (mbdl):	3.74	WATER LEVEL :		WATER LEVEL:		WATER LEVEL	
DATUM LEVEL (magl):	0.28	DISTANCE (m):		DISTANCE (m):		DISTANCE (m):	

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1	1.06		5.55	1			1			1		
2	1.87		4.21	2			2			2		
3	2.70		3.30	3			3			3		
5	3.70	0.93	2.44	5			5			5		
7	4.21		2.07	7			7			7		
10	4.99	0.94	1.79	10			10			10		
15	6.22		1.55	15			15			15		
20	6.58		1.36	20			20			20		
30	6.88		1.19	30			30			30		
40	7.10	0.92	1.06	40			40			40		
60	7.26		0.88	60			60			60		
90	7.30	0.94	0.73	90			90			90		
120	7.50		0.63	120			120			120		
150	7.51	0.93	0.54	150			150			150		
180	7.62		0.53	180			180			180		
210	7.63	0.92	0.47	210			210			210		
240	7.67		0.41	240			240			240		
300	7.70	0.91	0.39	300			300			300		
360	7.77		0.35	360			360			360		
420	7.81		0.32	420			420			420		
480	7.95	0.94	0.29	480			480			480		
540	8.09		0.26	540			540			540		
600	8.16		0.23	600			600			600		
660	8.19	0.95	0.20	720			720			720		
720	8.25		0.17	840			840			840		
780	8.27	0.93	0.16	960			960			960		
840	8.30		0.14	1080			1080			1080		
900	8.34		0.12	1200			1200			1200		
960	8.37	0.95	0.11	1320			1320			1320		
1020	8.36	0.94	0.10	1440			1440			1440		
1080	8.36	0.96	0.09	1800			1800			1800		
1140	8.36	0.95	0.08	2280			2280			2280		
1200	8.37		0.07	2880			2880			2880		
1260	8.37	0.95	0.06									
1320	8.38		0.04									
1380	8.38	0.94										
1440	8.39											

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500				1500			1500			1500		
1560				1560			1560			1560		
1620				1620			1620			1620		
1680				1680			1680			1680		
1740				1740			1740			1740		
1800				1800			1800			1800		
1860				1860			1860			1860		
1920				1920			1920			1920		
1980				1980			1980			1980		
2040				2040			2040			2040		
2100				2100			2100			2100		
2160				2160			2160			2160		
2220				2220			2220			2220		
2280				2280			2280			2280		
2340				2340			2340			2340		
2400				2400			2400			2400		
2460				2460			2460			2460		
2520				2520			2520			2520		
2580				2580			2580			2580		
2640				2640			2640			2640		
2700				2700			2700			2700		
2760				2760			2760			2760		
2820				2820			2820			2820		
2880				2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT		Sum
INTER HOLE MOVE > 10 km	21	Km.
FROM: SITE NAME: CLARKBURY		
BOREHOLE No:		
INTER HOLE MOVE < 10 km:		No.
REMOVAL AND RE-ERECTION OF PUMP HOUSE:	1	No.
REMOVAL OF EXISTING EQUIPMENT:	1	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	1	No.
WORK TIME RATE (REPAIRS):	0	Hour
STANDING TIME:	0	Hour
LATITUDE: S31 32' 40.9" LONGITUDE: E 028 15' 50.9"		

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	0	No.
VERTICALITY TEST:	0	No.
CASING DETECTION:	1	No.
STEEL BOREHOLE COVER:	0	No.
BOREHOLE MARKING:	1	No.
SITE CLEANING / FINISHING:	1	No.
REPORTING & DATA RECORDING:	1	No.
SLUG TEST:	0	No.
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	34.17	m
BOREHOLE WATERLEVEL AFTER TEST:	3.76	m

TEST DESCRIPTION	STEP: 1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:										
TEST DURATION (Minutes)	15	15	15	15	10		70	1.17	0.33	70
TEST YIELD (l/s)	0.26	0.41	0.78	1.39	2.31		MAXIMUM (l/s)	2.3		
DRAWDOWN (m)	1.40	2.22	5.40	11.26	24.13		MAXIMUM (m)	24.1		
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	100				300	5.00	0.22	150
TEST YIELD (l/s)	0.36	0.61	1.24				MAXIMUM (l/s)	1.2		
DRAWDOWN (m)	2.8	3.93	9.97				MAXIMUM (m)	10.0		

RECOVERY TEST			
TIME TOTAL (hrs):			25.67
Cal	Steps	CD	Total
70	150	1320	1540
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
23.3	8.39		36.07

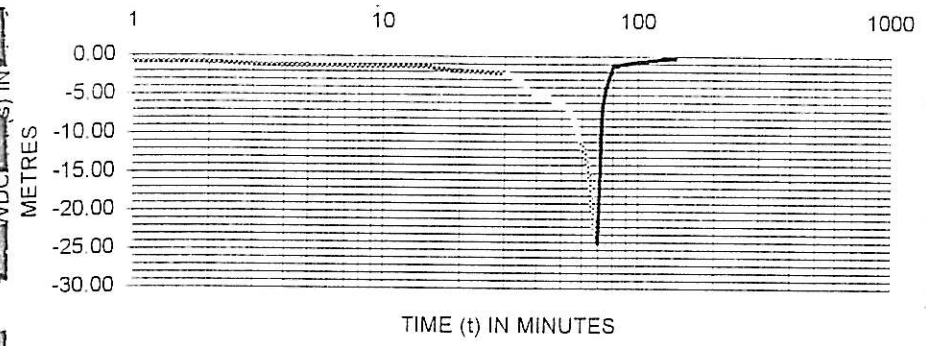
CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	1440	24.00	0.94	8.39	0.04	99.52	1320	22.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: T 32314

CALIBRATION TEST AND RECOVERY

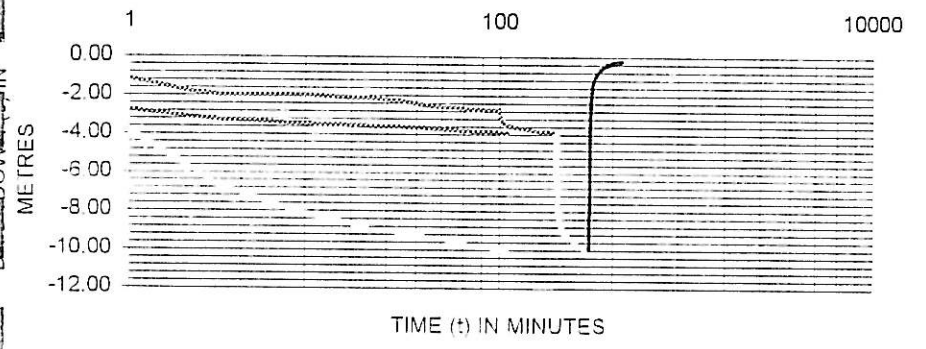
Discharge 1:	0.26	Discharge 2:	0.41	Discharge 3:	0.78	Discharge 4:	1.39	Discharge 5:	2.31	Discharge 6:	



Drawdown 1:	1.40
Drawdown 2:	2.22
Drawdown 3:	5.40
Drawdown 4:	11.26
Drawdown 5:	24.13
Drawdown 6:	0.00
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	10
Duration 6:	
Recovery (m):	0.33
Recovery (min):	70

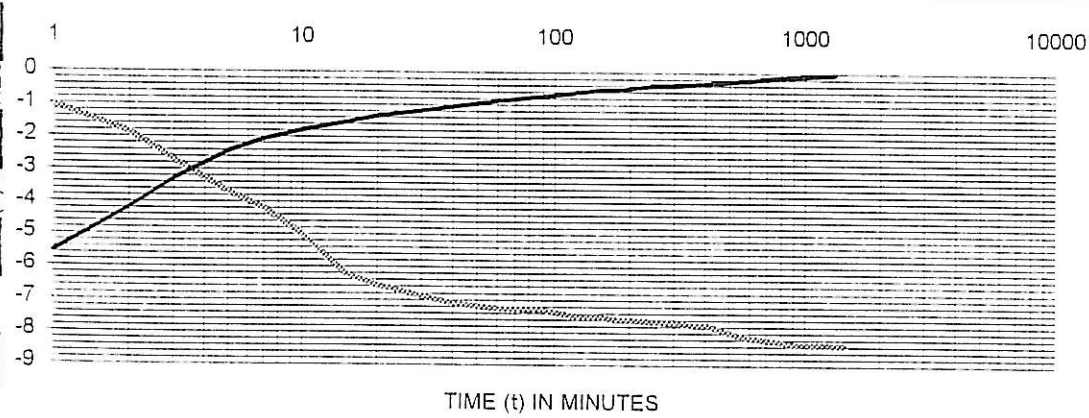
STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	0.36	Discharge 2:	0.608	Discharge 3:	1.23667	Discharge 4:		Discharge 5:		Discharge 6:	



Drawdown 1:	2.78
Drawdown 2:	3.93
Drawdown 3:	9.97
Drawdown 4:	0.00
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	100
Duration 3:	100
Duration 4:	
Duration 5:	
Duration 6:	
Recovery (m):	1.55
Recovery (min):	150

CONSTANT DISCHARGE TEST AND RECOVERY



INFORMATION

Date tested	03/05/2003	Water level (mbgl)	3.74	Depth of pump (mbgl)		27
CD duration	1440	CD discharge rate	0.94	CD drawdown		8.39
Available drawdown (m)	23.26	% Recovery after CD	100	% after	1320	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	T32333	PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO. :		SITE NAME:	QOBA JUNIOR PRIMARY SCHOOL
ALTERNATIVE NO. :		CLIENT:	CHRIS HANI DISTRICT MUN

BOREHOLE DEPTH (mbdl):	34.22	CASING DEPTH (mbdl):		PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	32.70	CASING HEIGHT (magl):		OPERATOR:	SELAKI
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):		CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	1.85	DATUM LEVEL (magl):		SUPERVISOR:	H VORSTER

DISCHARGE RATE 1

DATE: 22/05/2003 TIME: 17H30

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
	0.45		1	
2	0.83	0.46	2	
	1.03		3	
	1.53		5	
7	1.92	0.45	7	
10	2.45		10	
15	2.54		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 22/05/2003 TIME: 17H45

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	3.24		1	
2	3.59	0.86	2	
3	3.85		3	
5	4.09	1.08	5	
7	4.15		7	
10	4.30	1.07	10	
15	4.43		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 22/05/2003 TIME: 18H00

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	5.09		1	
2	5.72	1.49	2	
3	6.15		3	
5	6.98	1.55	5	
7	7.48		7	
10	7.73	1.53	10	
15	7.95		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 22/05/2003 TIME: 18H15

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
	8.74		1	
2	9.72	2.04	2	
	10.38	2.02	3	
	10.47		5	
7	10.67	2.04	7	
10	10.87		10	
15	10.91		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:
WINDMILL

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):
30

PUMP RPM:

PUMP CONDITION:
BROKEN

DISCHARGE RATE 5

DATE: 22/05/2003 TIME: 18H30

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	11.59		1	
2	12.12	2.38	2	
3	12.49		3	
5	13.22	2.4	5	
7	13.65	2.42	7	
10	14.09		10	
15	14.35		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: 22/05/2003 TIME: 18H45

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	14.76	3.18	1	20.76
2	15.33		2	13.60
3	19.72	5.1	3	8.21
5	20.93		5	3.87
7	26.04	5.09	7	2.20
10	29.45		10	1.57
15	29.45	PI 3.51	15	1.23
			20	1.04
			30	0.88
			40	0.77
			50	0.68
			60	0.63
			70	0.58
			80	0.54
			90	0.50
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO.:	T32333	PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO.:	0	SITE NAME:	QOBA JUNIOR PRIMARY SCHOOL
ALTERNATIVE NO.:	0	CLIENT:	CHRIS HANI DISTRICT MUN

BOREHOLE DEPTH (mbdl):	34.22	CASING DEPTH (mbdl):	0.00	PUMP TYPE USED:	P 100
DEPTH OF PUMP (mbdl):	32.70	CASING HEIGHT (magl):	0.00	OPERATOR:	SELAKI
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	0.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	1.85	DATUM LEVEL (magl):	0.00		

DISCHARGE RATE 1

DATE: 23/05/2003
TIME: 07H15

Time (min)	Drawdown (m)	Yield (l/s)
1	1.62	
2	1.74	1.040
3	1.89	1.030
5	2.27	
7	2.86	
10	3.58	
15	4.19	1.050
20	4.66	1.040
30	4.74	
40	4.86	
50	4.96	
60	5.01	1.030
70	5.06	1.050
80	5.09	
90	5.12	1.040
100	5.15	
110		
120		

Average yield: 1.04

Recovery 1

Time (min)	Recovery 1 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
(l/s)	

DISCHARGE RATE 2

DATE: 23/05/2003
TIME: 08H55

Time (min)	Drawdown (m)	Yield (l/s)
1	5.74	
2	5.98	
3	6.09	1.510
5	6.81	
7	7.36	1.520
10	7.69	1.500
15	7.90	
20	7.97	
30	8.00	1.470
40	8.12	
50	8.19	
60	8.31	1.500
70	8.34	
80	8.38	
90	8.41	1.510
100	8.43	
110		
120		

Average yield: 1.50166667

Recovery 2

Time (min)	Recovery 2 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 3

DATE: 23/05/2003
TIME: 10H35

Time (min)	Drawdown (m)	Yield (l/s)
1	7.64	
2	10.54	2.090
3	10.77	
4	10.91	
7	11.34	2.070
10	11.79	
15	12.09	
20	12.13	2.050
30	12.29	
40	12.40	
50	12.45	2.080
60	12.52	
70	12.63	
80	12.70	
90	12.80	2.090
100	12.84	
110		
120		

Average yield: 2.076

Recovery 3

Time (min)	Recovery 3 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 4

DATE: 23/05/2003
TIME: 12H15

Time (min)	Drawdown (m)	Yield (l/s)
1	13.64	
2	14.45	2.39
3	14.78	
5	15.94	2.58
7	16.77	
10	16.92	
15	17.27	2.56
20	17.58	
30	19.06	
40	20.06	2.56
50	20.58	
60	21.39	2.57
70	22.05	
80	22.57	
90	23.38	2.58
100	23.91	2.54
110		
120		

Average yield: 2.54

Recovery 4

Time (min)	Recovery 4 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	

DISCHARGE RATE 5

DATE: 23/05/2003
TIME:

Time (min)	Drawdown (m)	(l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		

Recovery 5

Time (min)	Recovery 5 (m)
1	
2	
3	
5	
7	
10	
15	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
150	
180	
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	
780	

DISCHARGE RATE 6

DATE: 23/05/2003
TIME:

Time (min)	Drawdown (m)	Yield (l/s)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		
150		
180		
210		
240		
300		
360		
420		
480		

Average yield:

Recovery

Time (min)	Recovery (m)
1	18.45
2	13.50
3	9.11
5	4.76
7	3.62
10	3.08
15	2.76
20	2.58
30	2.36
40	1.97
50	1.84
60	1.73
70	1.66
80	1.58
90	1.52
100	1.46
110	1.40
120	1.35
150	1.23
180	1.14
210	
240	
300	
360	
420	
480	
540	
600	
660	
720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	T32333	PROJECT:	ENGCOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUN
ALTERNATIVE NO. :	0	SITE NAME:	QOBA JUNIOR PRIMARY SCHOOL		
DEPTH OF PUMP (mbdl):	32.70	PUMP TYPE USED:	P 100	OPERATOR:	SELAKI
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	WINDMILL	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	23/05/2003	TEST COMPLETED	DATE:	27/05/2003	TOTAL TIME - PUMPED (min):	2880	TOTAL TEST TIME (min):	2880
	TIME:	19H00		TIME:	19H00	TOTAL TIME-RECOVERY (min):	2880	AVERAGE YIELD (l/s):	2.09

DISCHARGE BOREHOLE

CASING HEIGHT (magl):	0.00
CASING DEPTH (mbdl):	0.00
CASING ID (mm):	0.00
BOREHOLE DEPTH (mbdl):	34.22
WATER LEVEL (mbdl):	1.85
DATUM LEVEL (magl):	0.00

Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)
	5.00		25.87
	6.92	2.10	24.26
3	8.16		17.39
	9.01	2.08	9.19
	10.11		6.54
10	10.71	2.11	5.48
15	10.96	2.06	5.10
20	11.72		4.91
30	12.29		4.68
40	12.51	2.09	4.51
60	12.92		4.26
90	13.30	2.03	3.98
120	13.54		3.78
150	13.90	2.11	3.56
180	14.20	2.08	3.46
210	14.32		3.33
240	14.44		3.23
300	14.53	2.10	3.11
360	14.62		2.86
420	14.81	2.07	2.74
480	15.00		2.55
540	15.05	2.04	2.46
600	15.19		2.38
660	15.38	2.09	2.26
720	15.65		1.98
780	15.78	2.14	1.91
840	16.14		1.84
900	16.24	2.11	1.78
960	16.34		1.71
1020	16.48	2.09	1.66
1080	17.14		1.59
1140	17.24	2.11	1.54
1200	17.46		1.49
1260	17.57	2.07	1.44
1320	17.72		1.40
1380	18.25	2.05	1.38
1440	19.16	2.10	1.33

OBSERVATION BOREHOLE 1

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

OBSERVATION BOREHOLE 2

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

OBSERVATION BOREHOLE 3

No. :	
DATUM LEVEL (magl):	
CASING DEPTH (mbdl):	
BOREHOLE DEPTH :	
WATER LEVEL:	
DISTANCE (m):	

Time (min)	Drawdown (m)	Recovery (m)
1		
2		
3		
5		
7		
10		
15		
20		
30		
40		
60		
90		
120		
150		
180		
210		
240		
300		
360		
420		
480		
540		
600		
720		
840		
960		
1080		
1200		
1320		
1440		
1800		
2280		
2880		

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time	Drawdown	Yield	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery
(min)	(m)	(l/s)	(m)	(min)	(m)	(m)	(min)	(m)	(m)	(min)	(m)	(m)
1500	19.37	2.08	1.30	1500			1500			1500		
1560	19.68		1.27	1560			1560			1560		
1620	19.79	2.04	1.24	1620			1620			1620		
1680	20.21		1.21	1680			1680			1680		
1740	20.42	2.12	1.18	1740			1740			1740		
1800	20.63		1.14	1800			1800			1800		
1860	20.84	2.06	1.11	1860			1860			1860		
1920	20.92		1.08	1920			1920			1920		
1980	21.53	2.08	1.05	1980			1980			1980		
2040	21.92		1.03	2040			2040			2040		
2100	22.09	2.14	1.01	2100			2100			2100		
2160	22.18		0.99	2160			2160			2160		
2220	22.30	2.07	0.97	2220			2220			2220		
2280	22.46		0.95	2280			2280			2280		
2340	22.59	2.11	0.93	2340			2340			2340		
2400	23.45		0.91	2400			2400			2400		
2460	23.73	2.09	0.89	2460			2460			2460		
2520	24.06		0.87	2520			2520			2520		
2580	24.41	2.10	0.85	2580			2580			2580		
2640	24.99		0.83	2640			2640			2640		
2700	25.28	2.07	0.81	2700			2700			2700		
2760	25.84		0.79	2760			2760			2760		
2820	26.72		0.77	2820			2820			2820		
2880	27.52	2.13	0.75	2880			2880			2880		

DESCRIPTION:	QUANTITY:	UNIT:
ESTABLISHMENT	0	Sum
INTER HOLE MOVE > 10 km	35	Km.
FROM: SITE NAME:		
BOREHOLE No:		
INTER HOLE MOVE < 10 km:	35	No.
EMOVAL AND RE-ERECTION OF PUMP HOUSE:	1	No.
EMOVAL OF EXISTING EQUIPMENT:	1	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:	1	No.
/ORK TIME RATE (REPAIRS):	0	Hour
TANDING TIME:	0	Hour
LATITUDE: S 31° 44' 44.3"	LONGITUDE: E 027° 54' 13.6"	

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	0	No.
VERTICALITY TEST:	0	No
CASING DETECTION:	1	No
STEEL BOREHOLE COVER:	0	No
BOREHOLE MARKING:	1	No
SITE CLEANING / FINISHING:	1	No
REPORTING & DATA RECORDING:	1	No
SLUG TEST:	0	No
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	34.2	m
BOREHOLE WATERLEVEL AFTER TEST:	1.84	m

EST DESCRIPTION	STEP 1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:										
EST DURATION (Minutes)	15	15	15	15	15	10	85	1.42	0.50	90
EST YIELD (l/s)	0.46	1.00	1.52	2.03	2.40	4.46	MAXIMUM (l/s)	4.5		
DRAWDOWN (m)	2.54	4.43	7.95	10.91	14.35	29.45	MAXIMUM (m)	29.5		
ULTI-RATE / STEP DRAWDOWN:										
EST DURATION (Minutes)	100	100	100	100			400	6.67	1.14	180
TEST YIELD (l/s)	1.24	1.50	2.08	2.54			MAXIMUM (l/s)	2.5		
RAWDOWN (m)	5.2	8.43	12.84	23.91			MAXIMUM (m)	23.9		

RECOVERY TEST			
TIME TOTAL (hrs):			52.50
Cal	Steps	CD	Total
90	180	2880	3150
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTIL-ISED		%
30.9	27.52		89.1

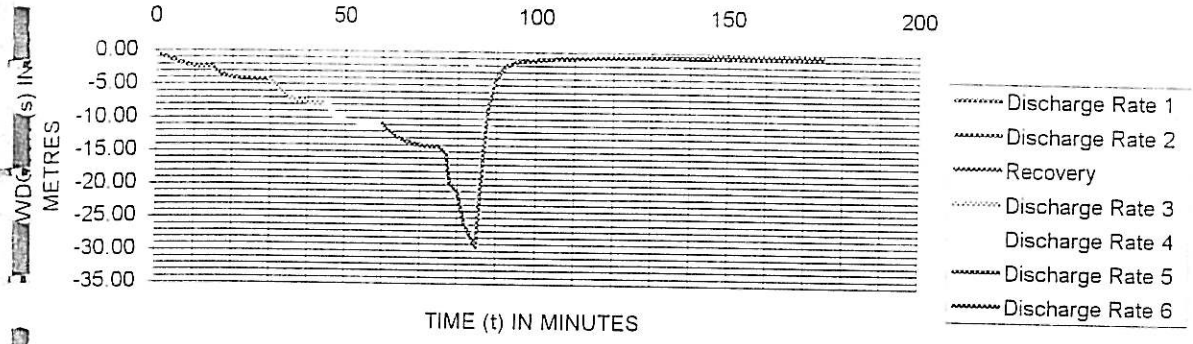
ONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	2880	48.00	2.09	27.52	0.75	97.37	2880	48.00

BSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: T32333

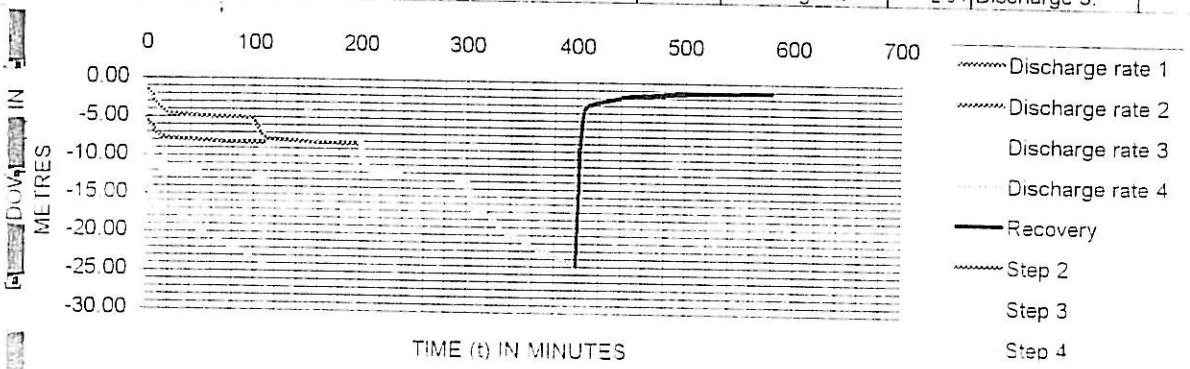
CALIBRATION TEST AND RECOVERY

Discharge 1:	0.46	Discharge 2:	1.00	Discharge 3:	1.52	Discharge 4:	2.03	Discharge 5:	2.40	Discharge 6:	4.4567
										Drawdown 1:	2.54
										Drawdown 2:	4.43
										Drawdown 3:	7.95
										Drawdown 4:	10.91
										Drawdown 5:	14.35
										Drawdown 6:	29.45
										Duration 1:	15
										Duration 2:	15
										Duration 3:	15
										Duration 4:	15
										Duration 5:	15
										Duration 6:	10
										Recovery (m):	0.50
										Recovery (min):	90

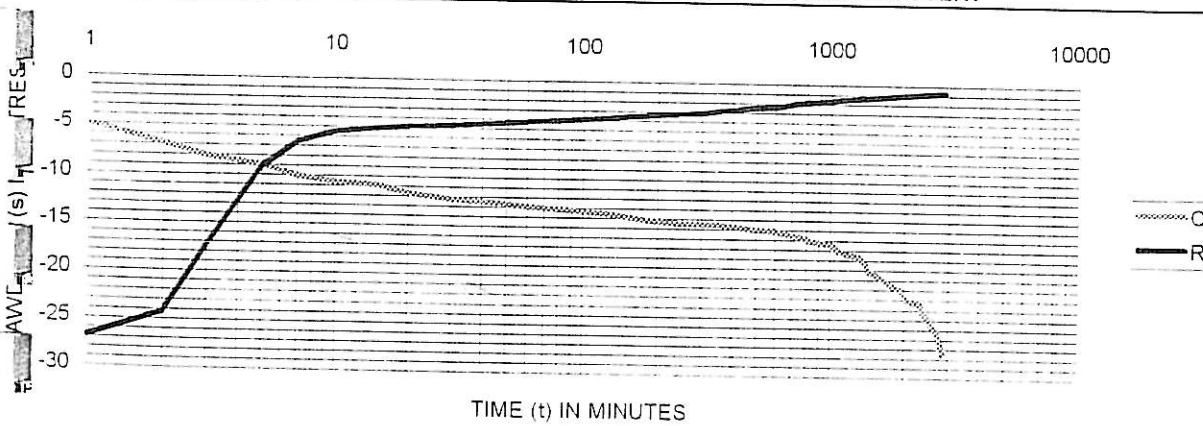


STEPPED DISCHARGE TEST AND RECOVERY

Discharge 1:	1.04	Discharge 2:	1.50167	Discharge 3:	2.076	Discharge 4:	2.54	Discharge 5:		Discharge 6:	
										Drawdown 1:	5.15
										Drawdown 2:	8.43
										Drawdown 3:	12.64
										Drawdown 4:	23.91
										Drawdown 5:	0.00
										Drawdown 6:	
										Duration 1:	100
										Duration 2:	100
										Duration 3:	100
										Duration 4:	100
										Duration 5:	
										Duration 6:	
										Recovery (m):	
										Recovery (min):	180



CONSTANT DISCHARGE TEST AND RECOVERY



INFORMATION

ate tested	23/05/2003	Water level (mbgl)	1.85	Depth of pump (mbgl)		32.7
D duration	2880	CD discharge rate	2.09	CD drawdown		27.52
ble drawdown (m)	30.85	% Recovery after CD	97	% after	2880	min

CALIBRATION TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/007			PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	T32396			SITE NAME:	NKONDLO
ALTERNATIVE NO. :				CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY
BOREHOLE DEPTH (mbdl):	65.90	CASING DEPTH (mbdl):	5.84	PUMP TYPE USED:	BP 40
DEPTH OF PUMP (mbdl):	57.30	CASING HEIGHT (magl):	0.24	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.00	CASING ID (mm):	180.00	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	0.54	DATUM LEVEL (magl):	0.48	SUPERVISOR:	CJ VAN DER WALT

DISCHARGE RATE 1

DATE: 09/05/2003 TIME: 12H30

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	0.63		1	
2	0.68		2	
3	0.70	1.07	3	
5	0.75		5	
7	0.79	1.06	7	
10	0.82		10	
15	0.85		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF RESERVOIR:

RESERVOIR SIZE:

RESERVOIR CONITION:

STAND HEIGHT (m):

DISCHARGE RATE 2

DATE: 09/05/2003 TIME: 12H45

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	1.33		1	
2	1.49		2	
3	1.60	1.82	3	
5	1.74		5	
7	1.75	1.8	7	
10	1.80		10	
15	1.85		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF ENCLOSURE:

MATERIAL OF ENCLOSURE:

CONDITION OF ENCLOSURE:

WATER METER MANUFACTURER:

WATER METER READING:

DISCHARGE RATE 3

DATE: 09/05/2003 TIME: 13H00

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	3.06		1	
2	3.48		2	
3	3.95		3	
5	4.54	3.45	5	
7	4.70		7	
10	4.78	3.46	10	
15	4.94		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PRESSURE GAUGE MANUFACTURER:

GAUGE READING (KpA):

MONITORING FACILITY:

MAINTAINED:

DISCHARGE RATE 4

DATE: 09/05/2003 TIME: 13H15

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	5.12		1	
2	5.43	3.89	2	
3	8.38	4.4	3	
5	9.92	4.42	5	
7	11.72		7	
10	12.57	4.43	10	
15	14.30		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

PUMP TYPE:
AND PUMP

PUMP MANUFACTURER:

PUMP SERIAL No:

PUMP PULLEY DIAMETER (mm):

PUMP INTAKE DEPTH (m):
3.12

PUMP RPM:

PUMP CONDITION:

DISCHARGE RATE 5

DATE: 09/05/2003 TIME: 13H30

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	16.18		1	
2	17.68	5.87	2	
3	19.35		3	
5	21.20	5.85	5	
7	23.75		7	
10	25.47		10	
15	30.28		15	
			20	
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	

EXISTING EQUIPMENT DETAIL:

TYPE OF POWER:

ENGINE MANUACTURER:

ENGINE MODEL:

ENGINE SERIAL No:

ENGINE PULLEY DIAMETER (mm):

POWER RATING (kW):

ENGINE CONDITION:

DISCHARGE RATE 6

DATE: 09/05/2003 TIME: 13H45

Time (min)	Drawdown (m)	Yield (l/s)	Time (min)	Recovery (m)
1	32.90		1	48.80
2	35.40	6.46	2	30.90
3	41.70		3	16.54
5	47.82	6.47	5	3.87
7	55.74		7	1.99
10	56.84		10	1.65
15	56.84	PI 4.85	15	1.38
			20	0.95
			30	
			40	
			50	
			60	
			70	
			80	
			90	
			100	
			110	
			120	
			150	
			180	
			210	
			240	
			300	
			420	
			480	
			540	
			600	
			660	

EXISTING EQUIPMENT DETAIL:

TYPE OF RISER:

CLASS OF RISER:

DIAMETER OF RISER (mm):

CONDITION OF RISER:

SHAFT DIAMETER (mm):

ELEMENT DIAMETER (mm):

ELEMENT STROKE (mm):

COMMENTS:

DID THE BOREHOLE PRODUCE ANY SILT / SAND / GRAVEL ?

STEPPED DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/007	PROJECT:	ENGCOBO FEASIBILITY STUDY
ALTERNATIVE NO. :	T32396	SITE NAME:	NKONDLO
ALTERNATIVE NO. :	0	CLIENT:	CHRIS HANI DISTRICT MUNICIPALITY

BOREHOLE DEPTH (mbdl):	65.90	CASING DEPTH (mbdl):	5.84	PUMP TYPE USED:	BP 40
DEPTH OF PUMP (mbdl):	57.30	CASING HEIGHT (magl):	0.24	OPERATOR:	PIETER MUNYAI
PUMP INLET DIAMETER (mm):	100.000	CASING ID (mm):	180.000	CONTRACTOR:	AB PUMPS
STATIC WATER LEVEL (mbdl):	1.49	DATUM LEVEL (magl):	0.48		

DISCHARGE RATE 1			Time	Recovery 1	DISCHARGE RATE 2			Time	Recovery 2	DISCHARGE RATE 3			Time	Recovery 3
DATE:	09/05/2003		(min)	(m)	DATE:	09/05/2003		(min)	(m)	DATE:	09/05/2003		(min)	(m)
TIME:	14H30		1		TIME:	16H10		1		TIME:	17H50		1	
Time	Drawdown	Yield	2		Time	Drawdown	Yield	2		Time	Drawdown	Yield	2	
(min)	(m)	(l/s)	3		(min)	(m)	(l/s)	3		(min)	(m)	(l/s)	3	
1	1.54		5		1	5.15	2.910	5		1	13.60	3.890	5	
	1.76	1.270	7		2	5.77		7		2	14.20		7	
	1.97		10		3	6.47		10		3	14.68	4.450	10	
5	2.15	1.550	15		5	7.08	3.170	15		4	16.82	4.510	15	
	2.20		20		7	7.57		20		7	18.80		20	
	2.45	1.570	30		10	7.91		30		10	22.00	4.530	30	
15	3.00		40		15	8.27	3.150	40		15	24.01		40	
20	3.10		50		20	8.41		50		20	27.25		50	
	3.16	1.570	60		30	8.92		60		30	30.90	4.520	60	
40	3.21		70		40	9.38	3.160	70		40	34.56		70	
50	3.24		80		50	9.70		80		50	38.10		80	
	3.31	1.550	90		60	10.70		90		60	46.00	4.500	90	
	3.36		100		70	10.80	3.150	100		70	49.60		100	
80	3.40		110		80	11.12		110		80	53.41		110	
	3.44	1.560	120		90	11.50	3.170	120		90	55.80		120	
00	3.49		150		100	11.75		150		100	55.80	PI 4.31	150	
110			180		110			180		110	55.80	PI 3.79	180	
120			210		120			210		120	55.80	PI 3.50	210	
Average yield:	1.51166667 l/s				Average yield:	3.11833333				Average yield:	4.4			

DISCHARGE RATE 4			Time	Recovery 4	DISCHARGE RATE 5			Time	Recovery 5	DISCHARGE RATE 6			Time	Recovery
DATE:	09/05/2003		(min)	(m)	DATE:	09/05/2003		(min)	(m)	DATE:	09/05/2003		(min)	(m)
TIME:			1		TIME:			1		TIME:			1	36.91
Time	Drawdown	Yield	2		Time	Drawdown		2		Time	Drawdown	Yield	2	20.33
(min)	(m)	(l/s)	3		(min)	(m)	(l/s)	3		(min)	(m)	(l/s)	3	10.12
			5		1			5		1			5	6.15
			7		2			7		2			7	4.00
3			10		3			10		3			10	3.68
			15		5			15		5			15	3.65
			20		7			20		7			20	3.61
10			30		10			30		10			30	3.47
15			40		15			40		15			40	3.20
			50		20			50		20			50	3.10
0			60		30			60		30			60	2.99
40			70		40			70		40			70	2.90
			80		50			80		50			80	2.83
			90		60			90		60			90	2.74
70			100		70			100		70			100	2.68
			110		80			110		80			110	2.63
			120		90			120		90			120	2.57
100			150		100			150		100			150	2.49
110			180		110			180		110			180	2.4
20			210		120			210		120			210	2.31
Average yield:	#DIV/0!							240		150			240	2.2
								300		180			300	2.09
								360		210			360	
								420		240			420	
								480		300			480	
								540		360			540	
								600		420			600	
								660		480			660	
								720						
								780		Average yield:			720	

COMMENTS:

CONSTANT DISCHARGE TEST AND RECOVERY

BOREHOLE NO. :	EC/T11/007	PROJECT:	ENGCOBO FEASIBILITY STUDY	CLIENT:	CHRIS HANI DISTRICT MUNICIP
ALTERNATIVE NO. :	T32396	SITE NAME:	NKONDLO		
DEPTH OF PUMP (mbdl):	57.30	PUMP TYPE USED:	BP 40	OPERATOR:	PIETER MUNYAI
INLET DIAMETER (mm):	100	EXISTING EQUIPMENT:	HAND PUMP	CONTRACTOR:	AB PUMPS

TEST STARTED	DATE:	10/05/2003	TEST COMPLETED	DATE:	14/05/2003	TOTAL TIME - PUMPED (min):	2880	TOTAL TEST TIME (min):	5760
	TIME:	06H30		TIME:	06H30	TOTAL TIME-RECOVERY(min):	2880	AVERAGE YIELD (l/s):	2.00

DISCHARGE BOREHOLE		OBSERVATION BOREHOLE 1		OBSERVATION BOREHOLE 2		OBSERVATION BOREHOLE 3	
CASING HEIGHT (magl):	0.24	No.:		No.:		No.:	
CASING DEPTH (mbdl):	5.84	DATUM LEVEL (magl):		DATUM LEVEL (magl):		DATUM LEVEL (magl):	
CASING ID (mm):	180.00	CASING DEPTH (mbdl):		CASING DEPTH (mbdl):		CASING DEPTH (mbdl):	
BOREHOLE DEPTH (mbdl):	65.90	BOREHOLE DEPTH :		BOREHOLE DEPTH :		BOREHOLE DEPTH :	
WATER LEVEL (mbdl):	1.85	WATER LEVEL:		WATER LEVEL:		WATER LEVEL:	
DATUM LEVEL (magl):	0.48	DISTANCE (m):		DISTANCE (m):		DISTANCE (m):	

Time	Drawdown	Yield	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery	Time	Drawdown	Recovery
(min)	(m)	(l/s)	(m)	(min)	(m)	(m)	(min)	(m)	(m)	(min)	(m)	(m)
	1.01		18.95	1			1			1		
2	1.53		16.85	2			2			2		
3	1.94	1.92	12.21	3			3			3		
	2.49	2.02	6.82	5			5			5		
7	2.96		6.39	7			7			7		
10	3.23		6.32	10			10			10		
15	3.60	2.01	6.30	15			15			15		
20	3.78		6.24	20			20			20		
30	3.90		6.16	30			30			30		
40	4.17		6.08	40			40			40		
60	4.33	2.00	5.24	60			60			60		
90	4.74		5.76	90			90			90		
120	4.87	2.01	5.60	120			120			120		
150	5.12		5.48	150			150			150		
180	5.39	2.00	5.35	180			180			180		
210	5.56		5.25	210			210			210		
240	5.79	2.01	5.15	240			240			240		
300	6.23		4.96	300			300			300		
360	6.77		4.76	360			360			360		
420	7.07	2.02	4.59	420			420			420		
480	7.35		4.43	480			480			480		
540	7.73		4.30	540			540			540		
600	8.00	2.00	4.16	600			600			600		
660	8.37		4.04	720			720			720		
720	8.66	2.03	3.92	840			840			840		
780	9.18		3.82	960			960			960		
840	9.53	2.00	3.73	1080			1080			1080		
900	9.92		3.64	1200			1200			1200		
960	10.12		3.54	1320			1320			1320		
1020	10.36	2.01	3.45	1440			1440			1440		
1080	10.54		3.36	1800			1800			1800		
1140	10.73	1.99	3.26	2280			2280			2280		
1200	10.92		3.17	2880			2880			2880		
1260	11.11	1.99	3.08									
1320	11.30		2.99									
1380	11.49		2.90									
1440	11.68	2.03	2.83									

DISCHARGE BOREHOLE				OBSERVATION BOREHOLE 1			OBSERVATION BOREHOLE 2			OBSERVATION BOREHOLE 3		
Time (min)	Drawdown (m)	Yield (l/s)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)	Time (min)	Drawdown (m)	Recovery (m)
1500	11.82	2.04	2.76	1500			1500			1500		
1560	12.01		2.70	1560			1560			1560		
1620	12.56	2.02	2.64	1620			1620			1620		
1680	13.12		2.56	1680			1680			1680		
1740	13.66	2.00	2.50	1740			1740			1740		
1800	13.99		2.42	1800			1800			1800		
1860	14.33	2.00	2.35	1860			1860			1860		
1920	14.75	2.01	2.28	1920			1920			1920		
1980	15.66	2.00	2.22	1980			1980			1980		
2040	16.57		2.15	2040			2040			2040		
2100	17.48	2.01	2.09	2100			2100			2100		
2160	17.98		2.04	2160			2160			2160		
2220	18.64	2.00	1.98	2220			2220			2220		
2280	19.22		1.93	2280			2280			2280		
2340	19.80	2.01	1.87	2340			2340			2340		
2400	20.38		1.81	2400			2400			2400		
2460	20.97		1.76	2460			2460			2460		
2520	21.55	2.00	1.70	2520			2520			2520		
2580	22.14		1.65	2580			2580			2580		
2640	22.73		1.59	2640			2640			2640		
2700	23.31	2.02	1.53	2700			2700			2700		
2760	23.90		1.48	2760			2760			2760		
2820	24.50	2.01	1.42	2820			2820			2820		
2880	25.12		1.37	2880			2880			2880		

DESCRIPTION:		QUANTITY:	UNIT:
ESTABLISHMENT		0	Sum
INTER HOLE MOVE > 10 km		45	Km.
FROM:	SITE NAME:	CLARKBURY	
	BOREHOLE No:	EC/T12/008	
INTER HOLE MOVE < 10 km:		0	No.
EMOVAL AND RE-ERECTION OF PUMP HOUSE:		1	No.
EMOVAL OF EXISTING EQUIPMENT:		1	No.
RE-INSTALLATION OF EXISTING EQUIPMENT:		1	No.
/ORK TIME RATE (REPAIRS):		0	Hour
TANDING TIME:		0	Hour
LATITUDE: S 31° 39' 45.7"	LONGITUDE: E 028° 14' 09.2"		

SUMMARY

DESCRIPTION:	QUANTITY:	UNIT
STRAIGHTNESS TEST:	0	No
VERTICALITY TEST:	0	No
CASING DETECTION:	1	No
STEEL BOREHOLE COVER:	1	No
BOREHOLE MARKING:	1	No
SITE CLEANING / FINISHING:	0	No
REPORTING & DATA RECORDING:	1	No
SLUG TEST:	0	No
LAYFLAT (m):	100	m
BOREHOLE DEPTH AFTER TEST:	65.84	m
BOREHOLE WATERLEVEL AFTER TEST:	2.6	m

TEST DESCRIPTION	STEP 1	2	3	4	5	6	TOTAL: (min)	(hrs)	RECOVERY: (m)	(min)
CALIBRATION TEST:										
TEST DURATION (Minutes)	15	15	15	15	15	10	85	1.42	0.95	20
TEST YIELD (l/s)	1.07	1.81	3.46	4.29	5.86	6.47	MAXIMUM (l/s)	6.5		
DRAWDOWN (m)	0.85	1.85	4.94	14.30	30.28	56.84	MAXIMUM (m)	56.8		
MULTI-RATE / STEP DRAWDOWN:										
TEST DURATION (Minutes)	100	100	120				320	5.33	2.09	300
TEST YIELD (l/s)	1.51	3.12	4.40				MAXIMUM (l/s)	4.4		
DRAWDOWN (m)	3.5	11.75	55.80				MAXIMUM (m)	55.8		

RECOVERY TEST			
TIME TOTAL (hrs):			48.00
Cal	Steps	CD	Total
20	300	2880	2880
DRAWDOWN TOTALS (CD):			
AVAILABLE	UTILISED		%
56.8	25.12		44.26

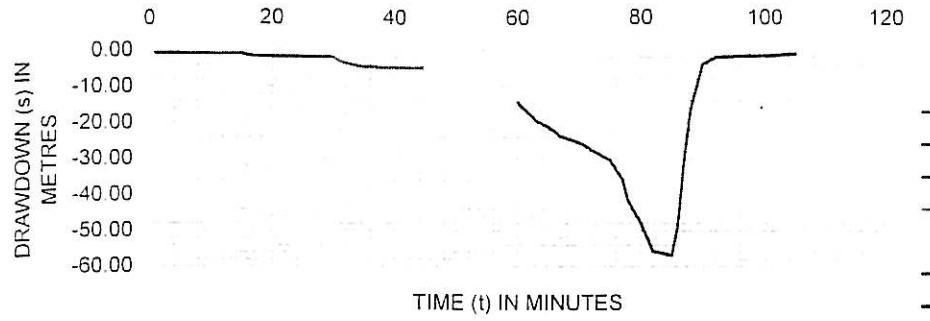
CONSTANT DISCHARGE TEST	TEST DURATION (min)	(hrs)	TEST YIELD (l/s)	DRAWDOWN (m)	RECOVERY: (m)	%	(min)	(hrs)
	2880	48.00	2.00	25.12	1.37	94.55	2880	48.00

OBSERVATION BOREHOLES:	No. of boreholes	720 (min)	1440 (min)	2880 (min)	>2880 (min) nr.	Time	TOTAL: (min)	(hrs)
							0	0.00

BOREHOLE NUMBER: EC/T11/007

CALIBRATION TEST AND RECOVERY

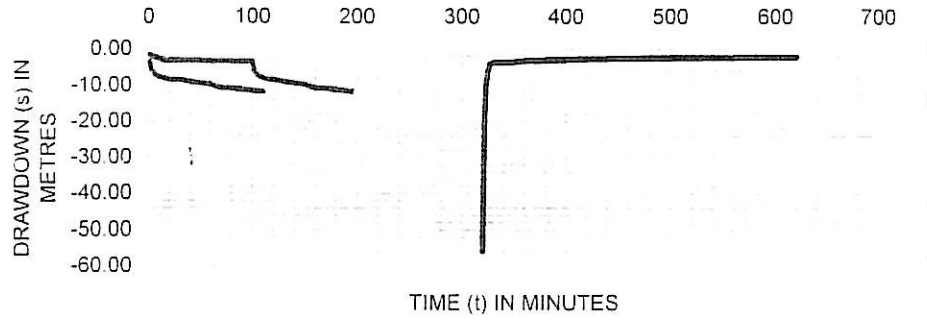
ischarge 1:	1.07	Discharge 2:	1.81	Discharge 3:	3.46	Discharge 4:	4.29	Discharge 5:	5.86



Discharge 6:	6.465
Drawdown 1:	0.85
Drawdown 2:	1.85
Drawdown 3:	4.94
Drawdown 4:	14.30
Drawdown 5:	30.28
Drawdown 6:	56.84
Duration 1:	15
Duration 2:	15
Duration 3:	15
Duration 4:	15
Duration 5:	15
Duration 6:	10
Recovery (m):	0.95
Recovery (min):	20

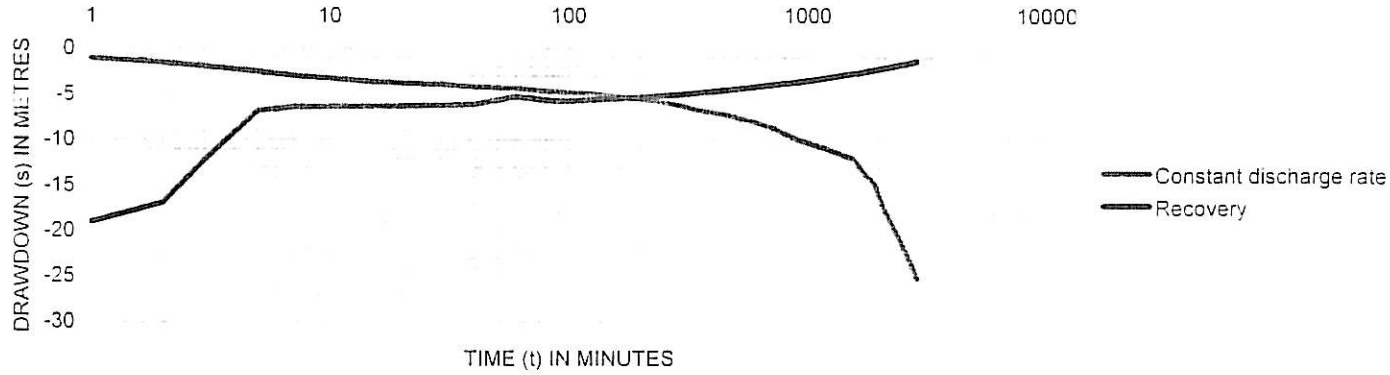
STEPPED DISCHARGE TEST AND RECOVERY

ischarge 1:	1.51167	Discharge 2:	3.11833	Discharge 3:	4.4	Discharge 4:		Discharge 5:	



Discharge 6:	
Drawdown 1:	3.49
Drawdown 2:	11.75
Drawdown 3:	55.80
Drawdown 4:	0.00
Drawdown 5:	0.00
Drawdown 6:	
Duration 1:	100
Duration 2:	100
Duration 3:	120
Duration 4:	
Duration 5:	
Duration 6:	
Recovery (m):	2.09
Recovery (min):	300

CONSTANT DISCHARGE TEST AND RECOVERY



TEST INFORMATION

Date tested	10/05/2003	Water level (mbgl)	0.54	Depth of pump (mbgl)		57.3
CD duration	2880	CD discharge rate	2.00	CD drawdown		25.12
Available drawdown (m)	56.76	% Recovery after CD	95	% after	2880	min

APPENDIX B

CHEMICAL WATER ANALYSES DATA

Chris Hani Groundwater Study - Phase 2

Borehole Id	T32314 3128CB
Date Sampled	7-May-03 00046
Drinking water class	2
Sample Number	15363

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			1.00	2
	Total coliforms			1.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m	60.00	0
	Total Dissolved Salts	*TDS*	mg / l	303.00	0
	pH Value	*pH*		7.29	0
	Turbidity		NTU	0.31	1
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	37.00	0
	Chloride	*Cl*	mg / l	55.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.24	0
	Iron	*Fe*	mg / l	0.10	1
	Total Hardness	$CaCO_3$	mg / l	170.00	0
	Magnesium	*Mg*	mg / l	19.00	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	0.65	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.95	0
	Sodium	*Na*	mg / l	50.00	0
	Sulphate	SO_4	mg / l	2.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l	0.01	
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l	229.00	
	Calcium Hardness	*CaCO3*	mg / l	92.00	
	Magnesium Hardness	*CaCO3*	mg / l	78.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Chris Hani Groundwater Study - Phase 2

Borehole Id	EC-T12-008
Date Sampled	7-May-03
Drinking water class	1
Sample Number	15364

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			0.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m	93.00	1
	Total Dissolved Salts	*TDS*	mg / l	467.00	1
	pH Value	*pH*		7.06	0
	Turbidity		NTU	0.66	1
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	63.00	0
	Chloride	*Cl*	mg / l	112.00	1
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.47	0
	Iron	*Fe*	mg / l	0.10	1
	Total Hardness	$CaCO_3$	mg / l	281.00	1
	Magnesium	*Mg*	mg / l	30.00	1
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	1.80	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.87	0
	Sodium	*Na*	mg / l	65.00	0
	Sulphate	SO_4	mg / l	16.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l	0.01	
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l	275.00	
	Calcium Hardness	*CaCO3*	mg / l	157.00	
	Magnesium Hardness	*CaCO3*	mg / l	124.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Chris Hani Groundwater Study - Phase 2

Borehole Id	EC/T11/003
Date Sampled	11-Apr-03
Drinking water class	4
Sample Number	15026

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			14000.00	4
	Total coliforms			25000.00	4
Physical Properties	Electrical Conductivity	*EC*	mS / m	194.00	2
	Total Dissolved Salts	*TDS*	mg / l	971.00	1
	pH Value	*pH*		7.38	0
	Turbidity		NTU	0.32	1
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	61.00	0
	Chloride	*Cl*	mg / l	403.00	2
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.73	1
	Iron	*Fe*	mg / l	0.14	1
	Total Hardness	$CaCO_3$	mg / l	346.00	2
	Magnesium	*Mg*	mg / l	47.00	1
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	7.60	1
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	9.40	0
	Sodium	*Na*	mg / l	196.00	1
	Sulphate	SO_4	mg / l	35.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l	0.10	
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l	297.00	
	Calcium Hardness	*CaCO3*	mg / l	152.00	
	Magnesium Hardness	*CaCO3*	mg / l	194.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Chris Hani Groundwater Study - Phase 2

3127DB00031

Borehole Id	T32333 Qoba J.P. School
Date Sampled	30-May-03
Drinking water class	2
Sample Number	15748

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			3.00	2
	Total coliforms			9.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m	26.00	0
	Total Dissolved Salts	*TDS*	mg / l	129.00	0
	pH Value	*pH*		7.15	0
	Turbidity		NTU	0.68	1
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	13.00	0
	Chloride	*Cl*	mg / l	54.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.25	0
	Iron	*Fe*	mg / l	0.26	2
	Total Hardness	$CaCO_3$	mg / l	69.00	0
	Magnesium	*Mg*	mg / l	8.90	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	0.22	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.80	0
	Sodium	*Na*	mg / l	22.00	0
	Sulphate	SO_4	mg / l	17.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l	102.00	
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l	32.00	
	Magnesium Hardness	*CaCO3*	mg / l	37.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Dalasile Police Station

Borehole Id	EC/T11/001
Date Sampled	9-Apr-03
Drinking water class	4
Sample Number	14983

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			2.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m	50.00	0
	Total Dissolved Salts	*TDS*	mg / l	251.00	0
	pH Value	*pH*		8.40	0
	Turbidity		NTU	1.40	2
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	6.00	0
	Chloride	*Cl*	mg / l	56.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	3.70	4
	Iron	*Fe*	mg / l	0.21	2
	Total Hardness	$CaCO_3$	mg / l	21.00	0
	Magnesium	*Mg*	mg / l	1.40	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	0.10	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.21	0
	Sodium	*Na*	mg / l	91.00	0
	Sulphate	SO_4	mg / l	3.20	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l	0.08	
	P - Alkalinity	$CaCO_3$	mg / l	162.00	
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l	15.00	
	Magnesium Hardness	*CaCO3*	mg / l	5.80	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 as *P*	mg / l		

Mhlopekezi

Borehole Id	EC/T11/002
Date Sampled	09/04/03
Drinking water class	2
Sample Number	14984

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			7.00	2
	Total coliforms			19.00	2
Physical Properties	Electrical Conductivity	*EC*	mS / m	73.00	1
	Total Dissolved Salts	*TDS*	mg / l	366.00	0
	pH Value	*pH*		7.49	0
	Turbidity		NTU	0.25	1
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	69.00	0
	Chloride	*Cl*	mg / l	56.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.35	0
	Iron	*Fe*	mg / l	0.10	1
	Total Hardness	$CaCO_3$	mg / l	304.00	2
	Magnesium	*Mg*	mg / l	32.00	1
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	3.10	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.76	0
	Sodium	*Na*	mg / l	32.00	0
	Sulphate	SO_4	mg / l	14.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l	0.08	
	P - Alkalinity	$CaCO_3$	mg / l	228.00	
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l	172.00	
	Magnesium Hardness	*CaCO3*	mg / l	122.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Borehole Id	EC-T12-004
Date Sampled	10-Jun-03
Drinking water class	2
Sample Number	15926

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			7.00	2
	Total coliforms			13.00	2

Physical Properties	Electrical Conductivity	*EC*	mS / m	29.00	0
	Total Dissolved Salts	*TDS*	mg / l	145.00	0
	pH Value	*pH*		7.44	0
	Turbidity		NTU	0.59	1

Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	22.00	0
	Chloride	*Cl*	mg / l	45.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.63	0
	Iron	*Fe*	mg / l	0.15	1
	Total Hardness	$CaCO_3$	mg / l	99.00	0
	Magnesium	*Mg*	mg / l	8.30	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	0.24	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.58	0
	Sodium	*Na*	mg / l	23.00	0
	Sulphate	SO_4	mg / l	2.00	0
	Zinc	*Zn*	mg / l		0

Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l	0.04	
	P - Alkalinity	$CaCO_3$	mg / l	96.00	
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l	55.00	
	Magnesium Hardness	*CaCO3*	mg / l	34.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Borehole Id	EC-T12-009
Date Sampled	10-Jun-03
Drinking water class	1
Sample Number	15927

				Class
Micro-biological properties	Viable organisms			0
	Faecal coliforms		0.00	1
	Total coliforms		0.00	1

Physical Properties	Electrical Conductivity	EC	mS / m	83.00	1
	Total Dissolved Salts	TDS	mg / l	414.00	0
	pH Value	pH		7.23	0
	Turbidity		NTU	0.37	1

Chemical properties	Arsenic	As	mg / l		0
	Cadmium	Cd	mg / l		0
	Calcium	Ca	mg / l	58.00	0
	Chloride	Cl	mg / l	115.00	1
	Copper	Cu	mg / l		0
	Fluoride	F	mg / l	0.56	0
	Iron	Fe	mg / l	0.18	1
	Total Hardness	$CaCO_3$	mg / l	248.00	1
	Magnesium	Mg	mg / l	25.00	0
	Manganese	Mn	mg / l		0
	Nitrate	N	mg / l	0.73	0
	Nitrate	NO_3	mg / l		0
	Potassium	K	mg / l	1.10	0
	Sodium	Na	mg / l	79.00	0
	Sulphate	SO_4	mg / l	15.00	0
	Zinc	Zn	mg / l		0

Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l	0.12	
	P - Alkalinity	$CaCO_3$	mg / l	302.00	
	M - Alkalinity	CaCO3	mg / l		
	Calcium Hardness	CaCO3	mg / l	145.00	
	Magnesium Hardness	CaCO3	mg / l	103.00	
	Carbonate	CaCO3	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	Si	mg / l		
	Phosphor	PO_4 as P	mg / l		

Nkondlo

3128CA 060041

Borehole Id	T32396
Date Sampled	15/05/2003
Drinking water class	2
Sample Number	15534

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			0.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m	66.00	0
	Total Dissolved Salts	*TDS*	mg / l	329.00	0
	pH Value	*pH*		8.29	0
	Turbidity		NTU	1.50	2
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	9.70	0
	Chloride	*Cl*	mg / l	92.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	1.20	2
	Iron	*Fe*	mg / l	0.09	1
	Total Hardness	$CaCO_3$	mg / l	34.00	0
	Magnesium	*Mg*	mg / l	2.50	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	0.10	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.35	0
	Sodium	*Na*	mg / l	123.00	1
	Sulphate	SO_4	mg / l	2.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l	235.00	
	Calcium Hardness	*CaCO3*	mg / l	24.00	
	Magnesium Hardness	*CaCO3*	mg / l	10.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

KwaSandile

Borehole Id	EC-T11-007
Date Sampled	15/05/2003
Drinking water class	2
Sample Number	15535

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			6.00	2
	Total coliforms			11.00	2
Physical Properties	Electrical Conductivity	*EC*	mS / m	39.00	0
	Total Dissolved Salts	*TDS*	mg / l	195.00	0
	pH Value	*pH*		7.34	0
	Turbidity		NTU	5.30	2
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	31.00	0
	Chloride	*Cl*	mg / l	14.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.66	0
	Iron	*Fe*	mg / l	0.43	2
	Total Hardness	$CaCO_3$	mg / l	135.00	0
	Magnesium	*Mg*	mg / l	14.00	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	2.00	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.80	0
	Sodium	*Na*	mg / l	24.00	0
	Sulphate	SO_4	mg / l	2.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l	197.00	
	Calcium Hardness	*CaCO3*	mg / l	77.00	
	Magnesium Hardness	*CaCO3*	mg / l	58.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

#REF!

Borehole Id	EC-T11-008
Date Sampled	22/05/2003
Drinking water class	2
Sample Number	15638

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			2.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m	35.00	0
	Total Dissolved Salts	*TDS*	mg / l	173.00	0
	pH Value	*pH*		7.57	0
	Turbidity		NTU	0.55	1
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	27.00	0
	Chloride	*Cl*	mg / l	67.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	0.08	0
	Iron	*Fe*	mg / l	0.48	2
	Total Hardness	$CaCO_3$	mg / l	121.00	0
	Magnesium	*Mg*	mg / l	13.00	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	2.40	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.77	0
	Sodium	*Na*	mg / l	23.00	0
	Sulphate	SO_4	mg / l	4.70	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l	173.00	
	Calcium Hardness	*CaCO3*	mg / l	67.00	
	Magnesium Hardness	*CaCO3*	mg / l	54.00	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Gobhoti

Borehole Id	EC-T12-005
Date Sampled	27/05/2003
Drinking water class	3
Sample Number	15724

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			0.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m	16.00	0
	Total Dissolved Salts	*TDS*	mg / l	79.00	0
	pH Value	*pH*		9.98	2
	Turbidity		NTU	0.55	1
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l	2.50	0
	Chloride	*Cl*	mg / l	17.00	0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l	1.70	3
	Iron	*Fe*	mg / l	0.09	1
	Total Hardness	$CaCO_3$	mg / l	6.30	0
	Magnesium	*Mg*	mg / l	0.04	0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l	0.01	0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l	0.14	0
	Sodium	*Na*	mg / l	31.00	0
	Sulphate	SO_4	mg / l	2.00	0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l	34.00	
	Calcium Hardness	*CaCO3*	mg / l	6.20	
	Magnesium Hardness	*CaCO3*	mg / l	0.10	
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Chris Hani

Borehole Id	EC-T12-004
Date Sampled	23-Jul-03
Drinking water class	2
Sample Number	16698

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			1.00	2
	Total coliforms			1.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 as P	mg / l		

Class 0	**Ideal water quality**	Suitable for lifetime use
Class 1	**Good water quality**	Suitable for use, rare instances of negative effects
Class 2	**Marginal water quality**	Conditionally acceptable. Negative effects may occur in some sensitive groups.
Class 3	**Poor water quality**	Unsuitable for use without treatment. Chronic effects may occur
Class 4	**Dangerous water quality**	Totally unsuitable for use. Acute effects may occur

Chris Hani

Borehole Id — EC-T11-007

Date Sampled — 23-Jul-03

Drinking water class — 1

Sample Number — 16699

				Class
Micro-biological properties	Viable organisms			0
	Faecal coliforms		0.00	1
	Total coliforms		0.00	1
Physical Properties	Electrical Conductivity	EC mS / m		0
	Total Dissolved Salts	TDS mg / l		0
	pH Value	pH		0
	Turbidity	NTU		0
Chemical properties	Arsenic	As mg / l		0
	Cadmium	Cd mg / l		0
	Calcium	Ca mg / l		0
	Chloride	Cl mg / l		0
	Copper	Cu mg / l		0
	Fluoride	F mg / l		0
	Iron	Fe mg / l		0
	Total Hardness	$CaCO_3$ mg / l		0
	Magnesium	Mg mg / l		0
	Manganese	Mn mg / l		0
	Nitrate	N mg / l		0
	Nitrate	NO_3 mg / l		0
	Potassium	K mg / l		0
	Sodium	Na mg / l		0
	Sulphate	SO_4 mg / l		0
	Zinc	Zn mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4 mg / l		
	P - Alkalinity	$CaCO_3$ mg / l		
	M - Alkalinity	CaCO3 mg / l		
	Calcium Hardness	CaCO3 mg / l		
	Magnesium Hardness	CaCO3 mg / l		
	Carbonate	CaCO3 mg / l		
	Bicarbonate	HCO_3 mg / l		
	Silica	Si mg / l		
	Phosphor	PO_4 as P mg / l		

Class 0	Ideal water quality	Suitable for lifetime use
Class 1	Good water quality	Suitable for use, rare instances of negative effects
Class 2	Marginal water quality	Conditionally acceptable. Negative effects may occur in some sensitive groups
Class 3	Poor water quality	Unsuitable for use without treatment. Chronic effects may occur
Class 4	Dangerous water quality	Totally unsuitable for use. Acute effects may occur

Chris Hani

Borehole Id	EC-035-CH
Date Sampled	23-Jul-03
Drinking water class	2
Sample Number	16700

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			3.00	2
	Total coliforms			4.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Class 0	Ideal water quality	Suitable for lifetime use
Class 1	Good water quality	Suitable for use, rare instances of negative effec
Class 2	Marginal water quality	Conditionally acceptable. Negative effects may o in some sensitive groups
Class 3	Poor water quality	Unsuitable for use without treatment. Chronic ef may occur
Class 4	Dangerous water quality	Totally unsuitable for use. Acute effects may occ

Chris Hani

Borehole Id	EC-035-CH
Date Sampled	23-Jul-03
Drinking water class	2
Sample Number	16700

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			3.00	2
	Total coliforms			4.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	$P0_4$ as *P*	mg / l		

Class 0	Ideal water quality	Suitable for lifetime use
Class 1	Good water quality	Suitable for use, rare instances of negative effec
Class 2	Marginal water quality	Conditionally acceptable. Negative effects may o in some sensitive groups.
Class 3	Poor water quality	Unsuitable for use without treatment. Chronic ef may occur
Class 4	Dangerous water quality	Totally unsuitable for use. Acute effects may occ

Chris Hani

Borehole Id	EC-T11-007
Date Sampled	23-Jul-03
Drinking water class	1
Sample Number	16699

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			0.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 as *P*	mg / l		

Class 0	Ideal water quality	Suitable for lifetime use
Class 1	Good water quality	Suitable for use, rare instances of negative effects
Class 2	Marginal water quality	Conditionally acceptable. Negative effects may occur in some sensitive groups
Class 3	Poor water quality	Unsuitable for use without treatment. Chronic effects may occur
Class 4	Dangerous water quality	Totally unsuitable for use. Acute effects may occur

Chris Hani

Borehole Id	EC-T12-003
Date Sampled	23-Jul-03
Drinking water class	1
Sample Number	16701

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			2.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Chris Hani

Borehole Id	River EL303
Date Sampled	23-Jul-03
Drinking water class	3
Sample Number	16702

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			18.00	3
	Total coliforms			43.00	2
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

Chris Hani

Borehole Id	River EL303
Date Sampled	23-Jul-03
Drinking water class	3
Sample Number	16702

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			18.00	3
	Total coliforms			43.00	2
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	$P0_4$ *as P*	mg / l		

Chris Hani

Borehole Id	EC-T12-003
Date Sampled	23-Jul-03
Drinking water class	1
Sample Number	16701

					Class
Micro-biological properties	Viable organisms				0
	Faecal coliforms			0.00	1
	Total coliforms			2.00	1
Physical Properties	Electrical Conductivity	*EC*	mS / m		0
	Total Dissolved Salts	*TDS*	mg / l		0
	pH Value	*pH*			0
	Turbidity		NTU		0
Chemical properties	Arsenic	*As*	mg / l		0
	Cadmium	*Cd*	mg / l		0
	Calcium	*Ca*	mg / l		0
	Chloride	*Cl*	mg / l		0
	Copper	*Cu*	mg / l		0
	Fluoride	*F*	mg / l		0
	Iron	*Fe*	mg / l		0
	Total Hardness	$CaCO_3$	mg / l		0
	Magnesium	*Mg*	mg / l		0
	Manganese	*Mn*	mg / l		0
	Nitrate	*N*	mg / l		0
	Nitrate	NO_3	mg / l		0
	Potassium	*K*	mg / l		0
	Sodium	*Na*	mg / l		0
	Sulphate	SO_4	mg / l		0
	Zinc	*Zn*	mg / l		0
Chemical properties (not required for the clasification of domestic drinking water supply)	Ammonia	NH_4	mg / l		
	P - Alkalinity	$CaCO_3$	mg / l		
	M - Alkalinity	*CaCO3*	mg / l		
	Calcium Hardness	*CaCO3*	mg / l		
	Magnesium Hardness	*CaCO3*	mg / l		
	Carbonate	*CaCO3*	mg / l		
	Bicarbonate	HCO_3	mg / l		
	Silica	*Si*	mg / l		
	Phosphor	PO_4 *as P*	mg / l		

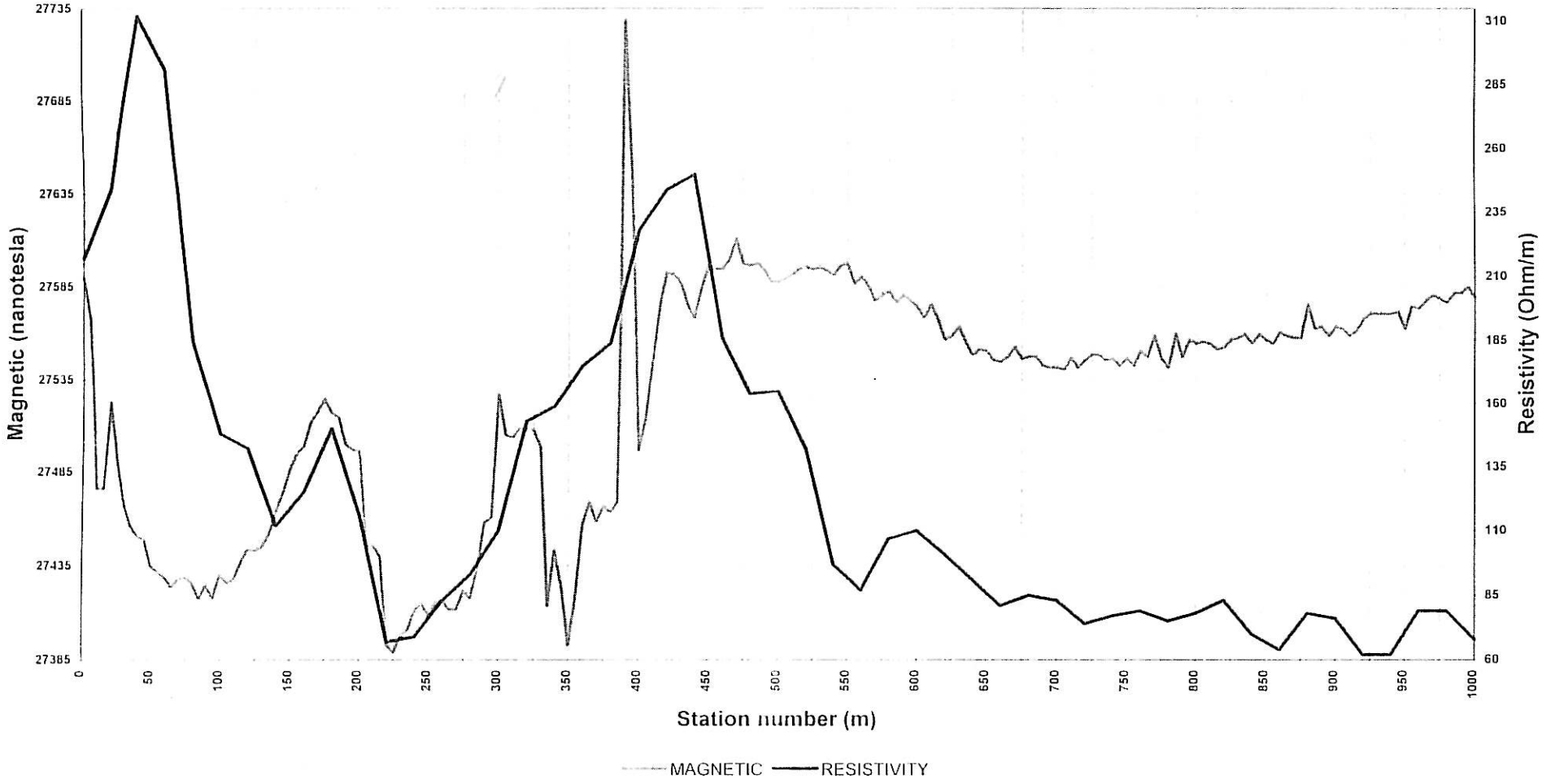
APPENDIX C

GEOPHYSICAL PROFILING DATA

CHRIS HANI GROUNDWATER STUDY - PHASE 2

Profile 1 - Cefani

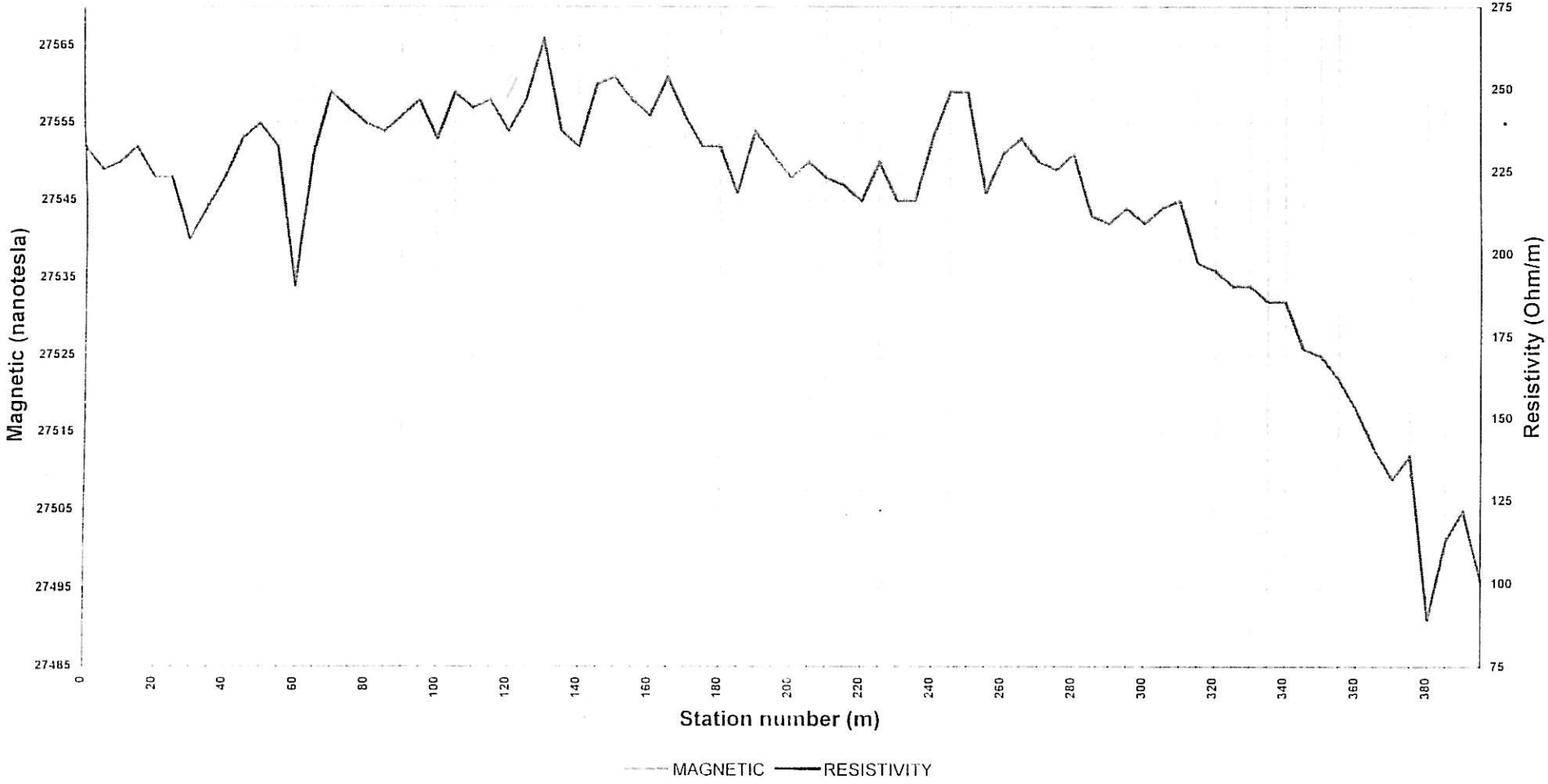
Magnetic & Resistivity Profiling (Wenner Configuration) 20/40m Spacing



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Etyeni - Profile 1

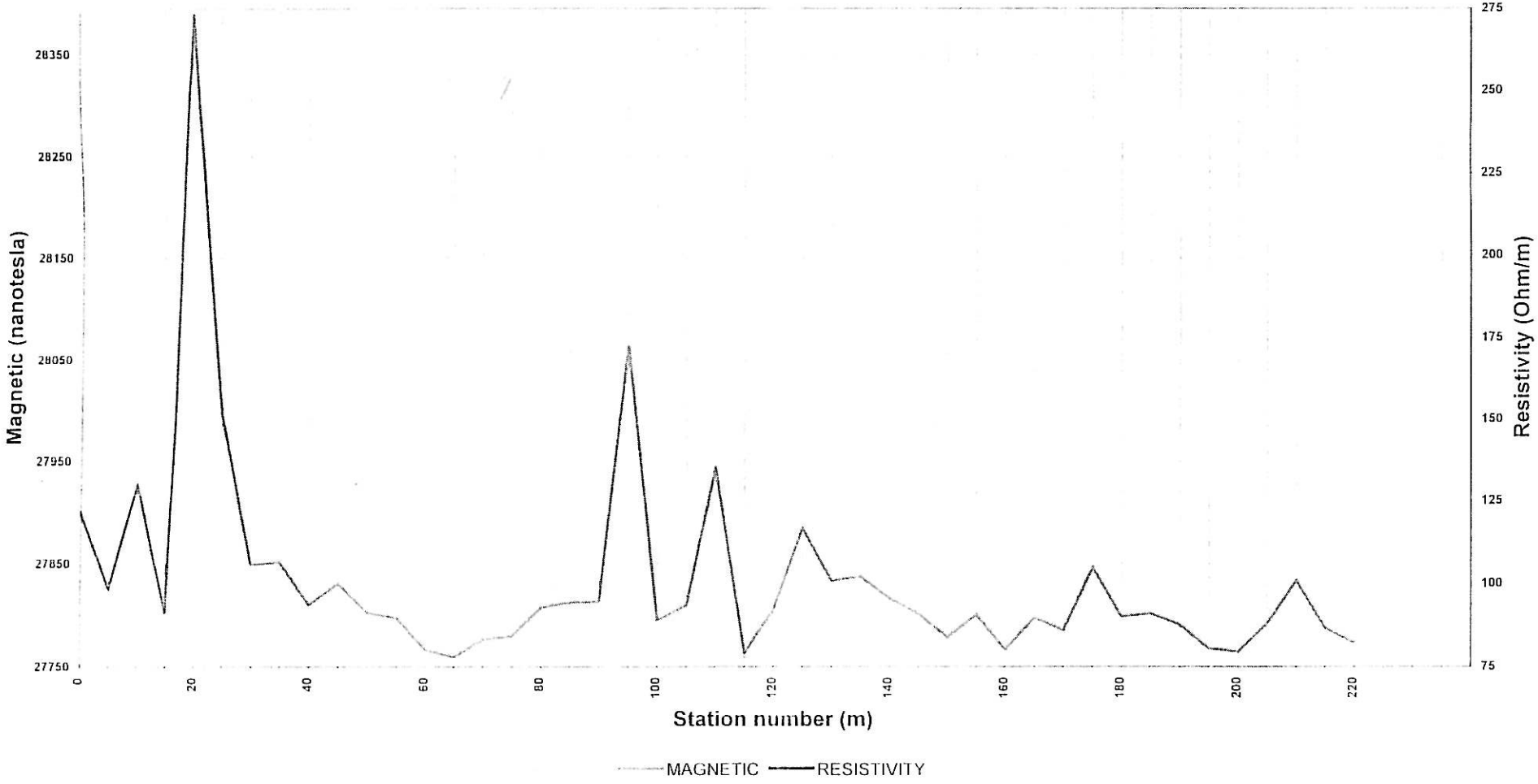
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Kwa Sandile Profile 1

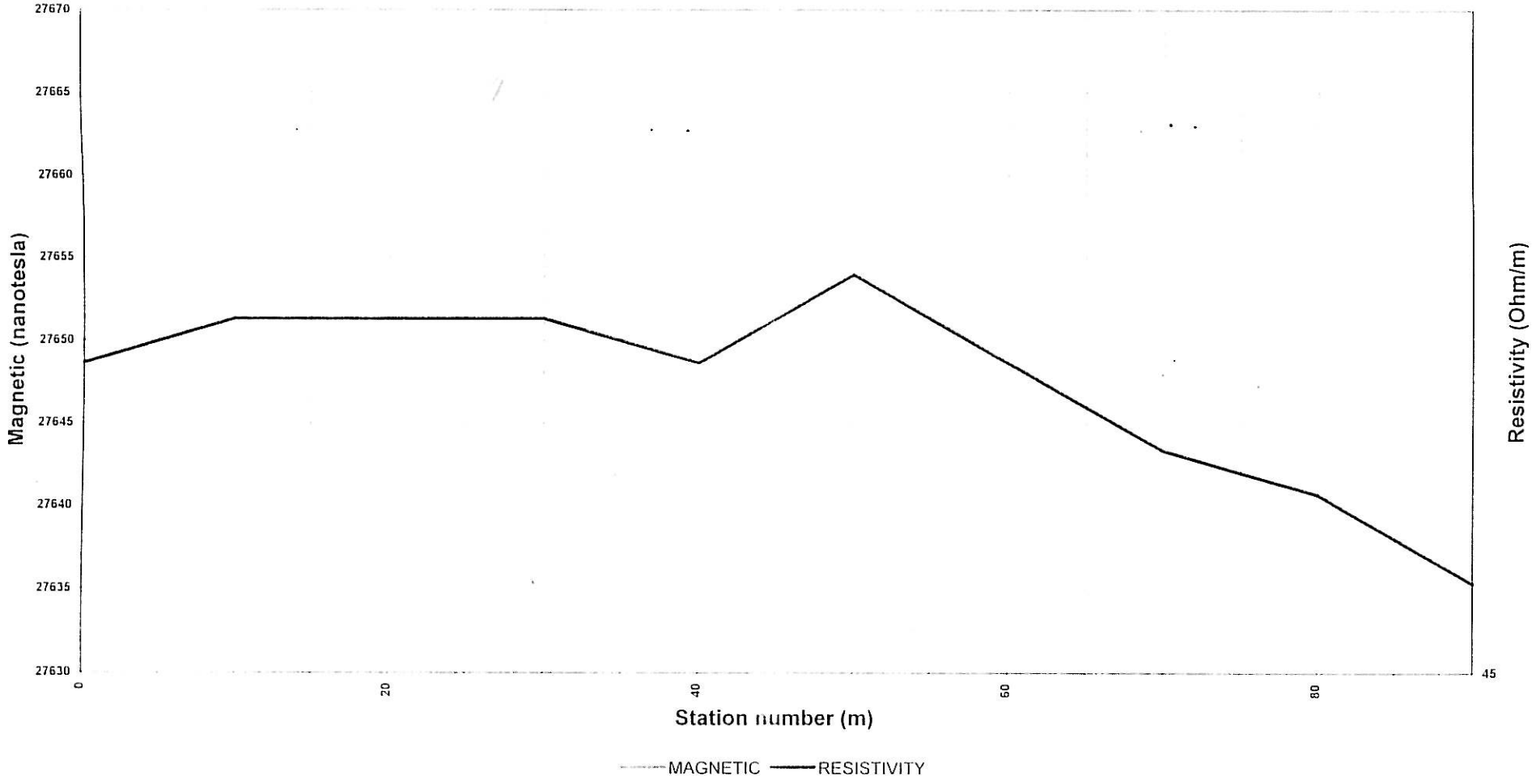
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Kwasandile - Profile 3

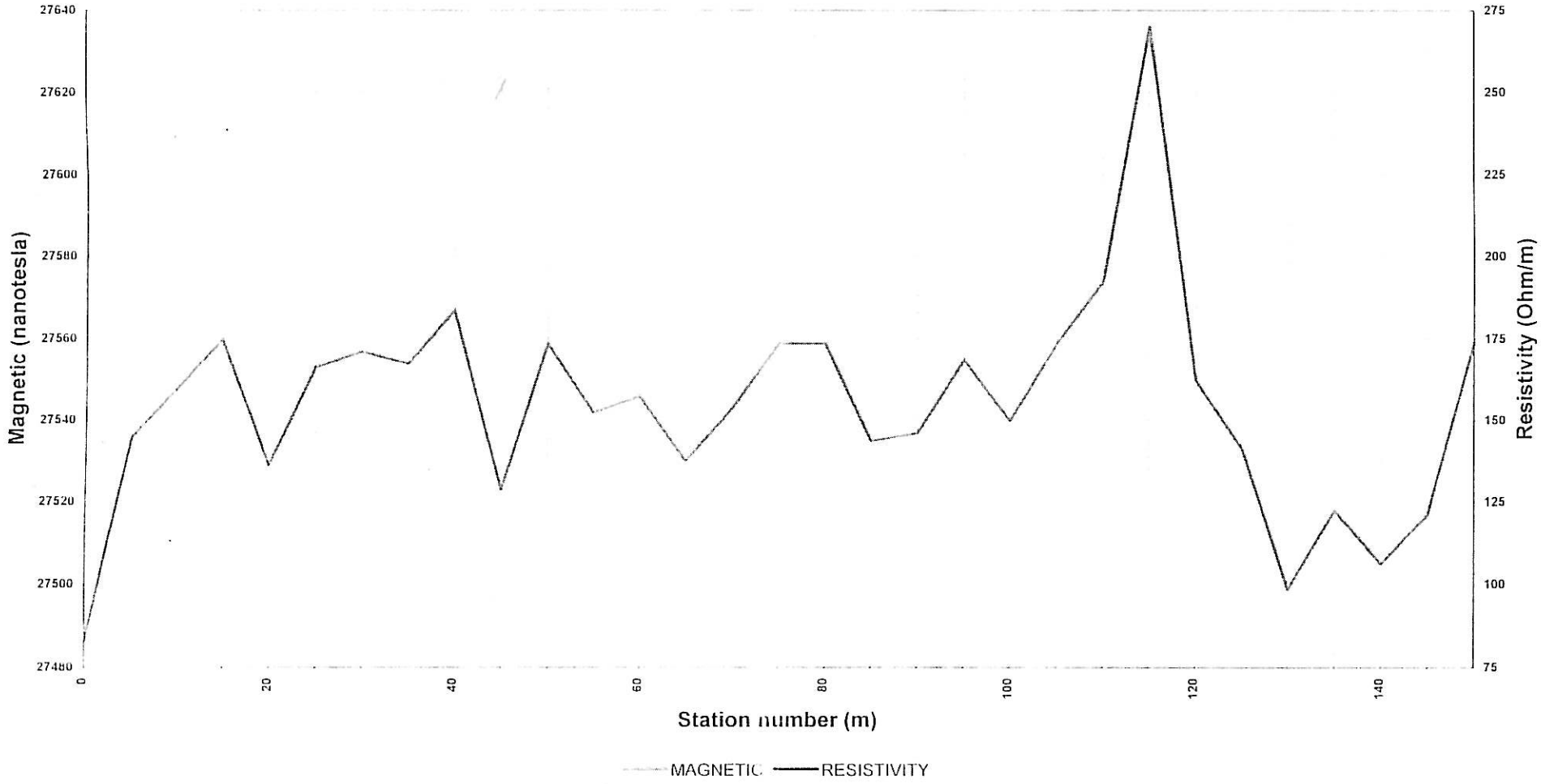
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Nkwenkwezi- Profile 1

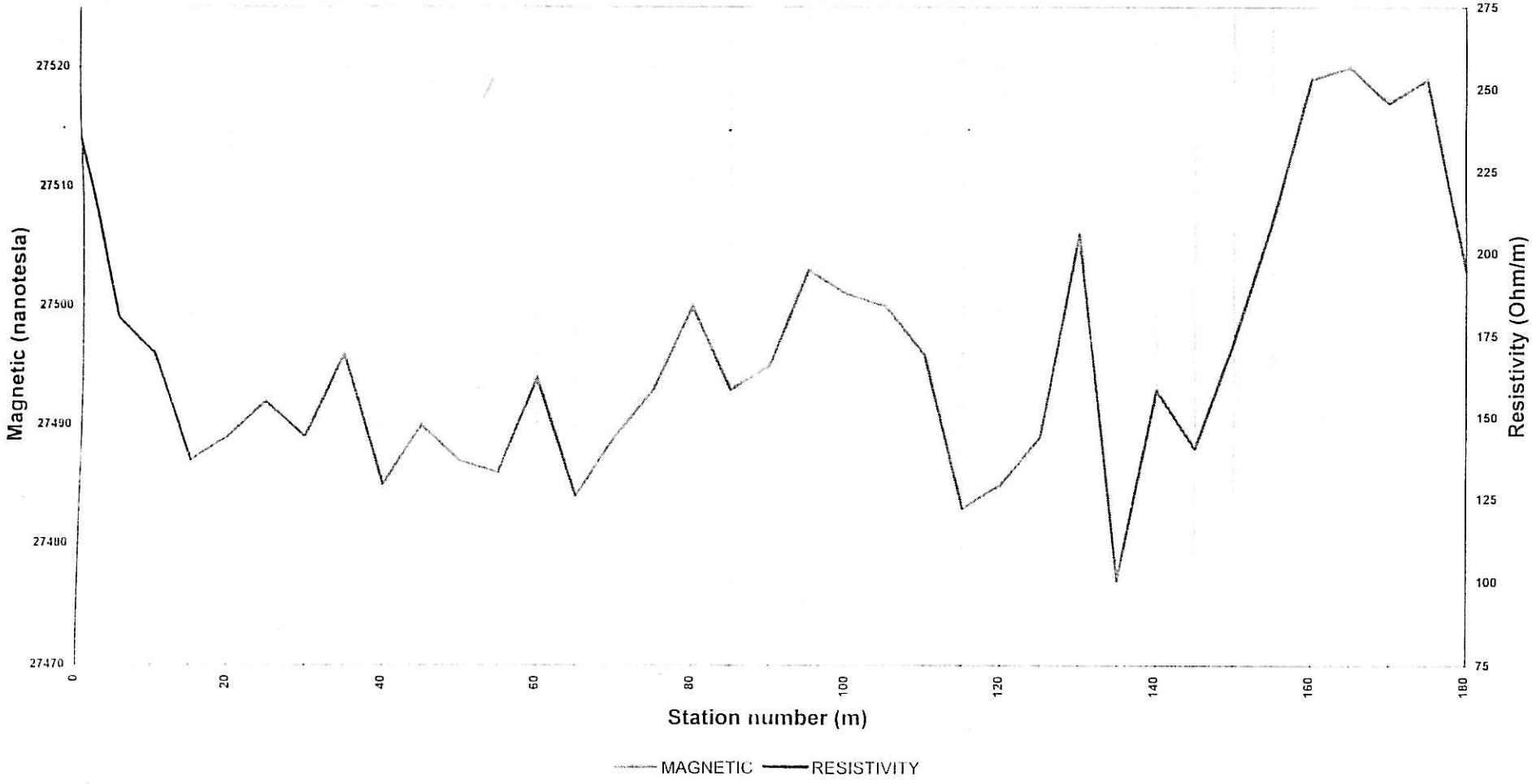
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Nkwenkwezi Profile 3

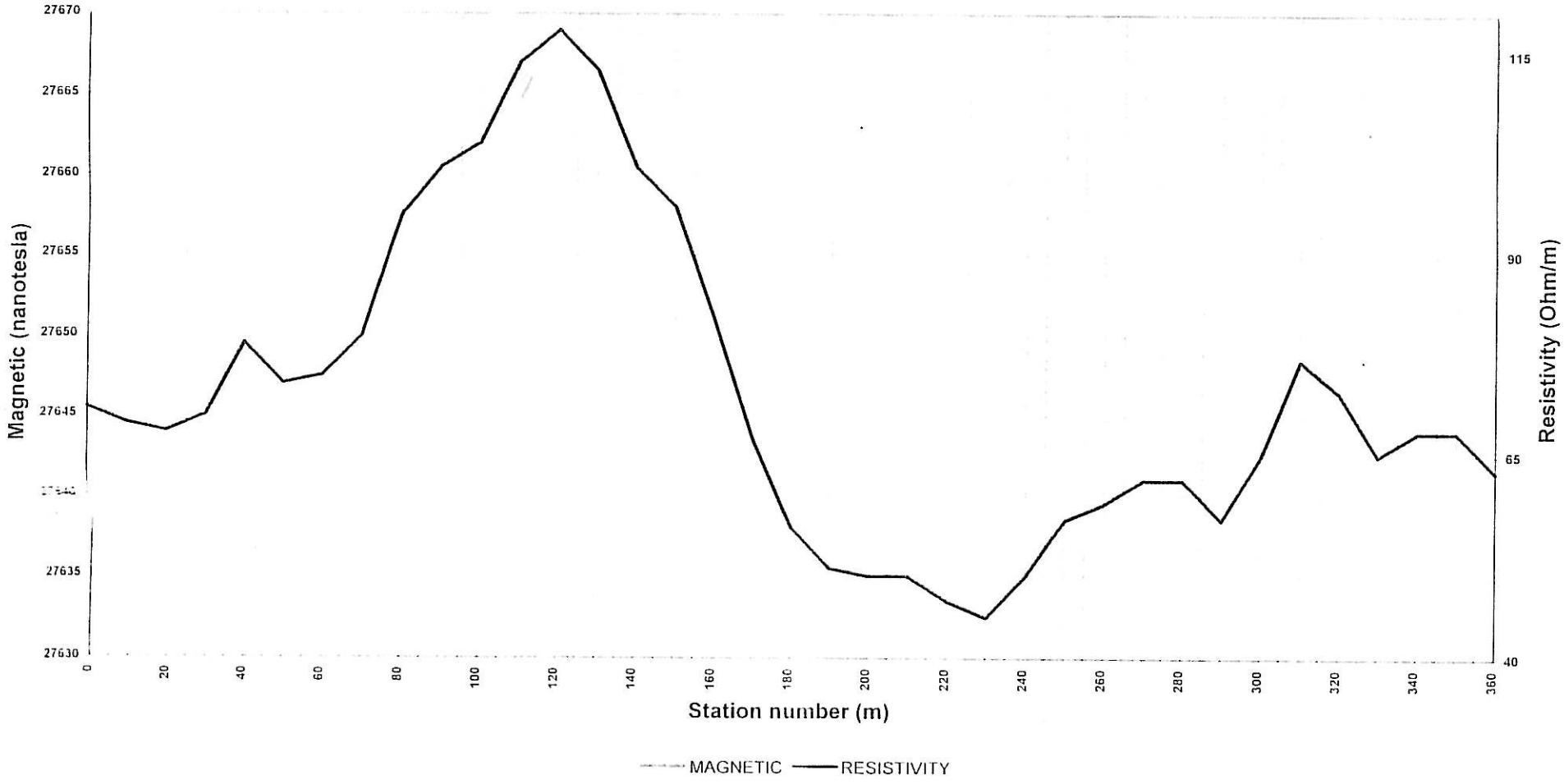
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Sentube - Profile1 (10/20m Spacing)

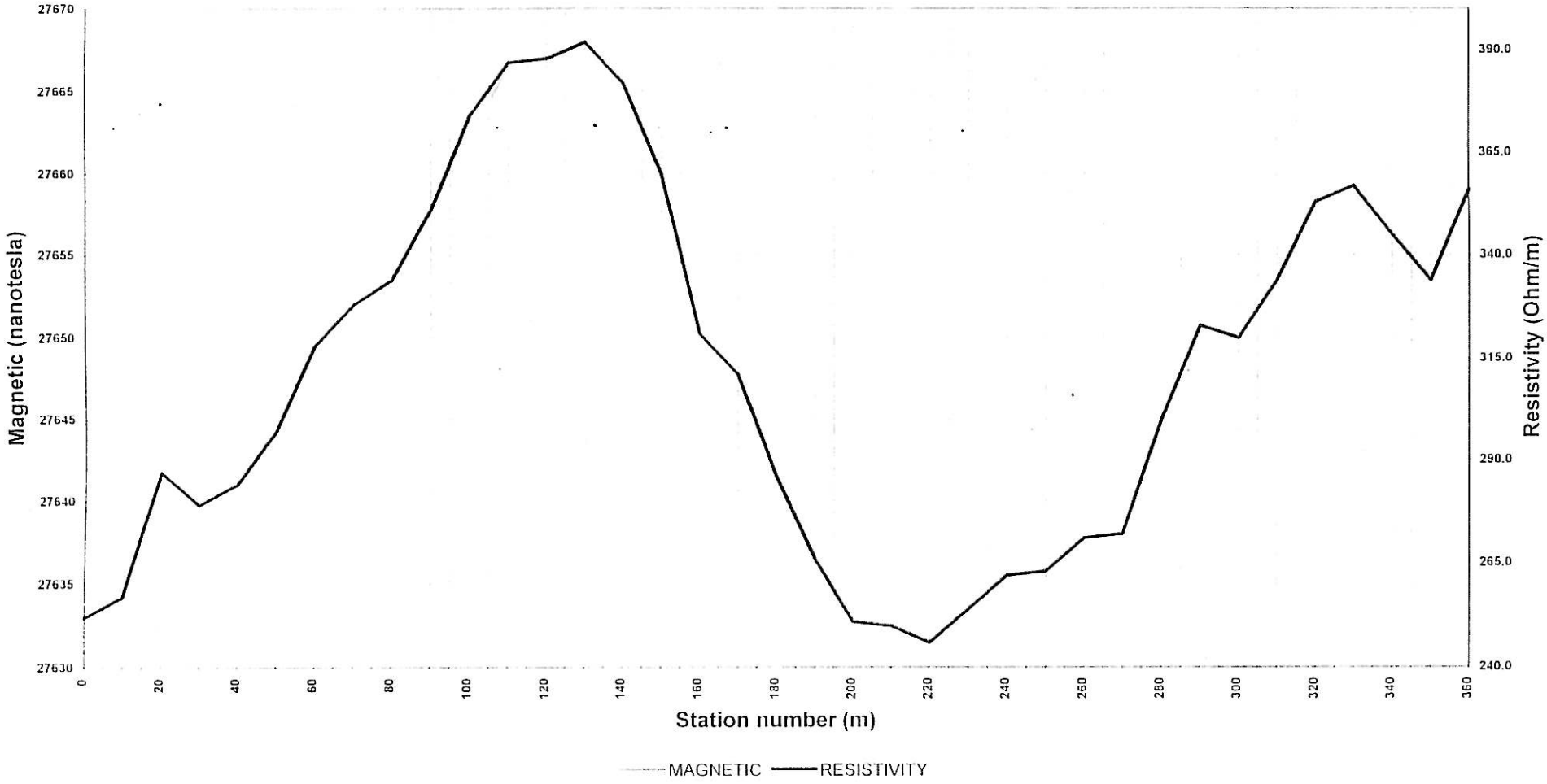
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Sentube- Profile 1 (30/60m spacing)

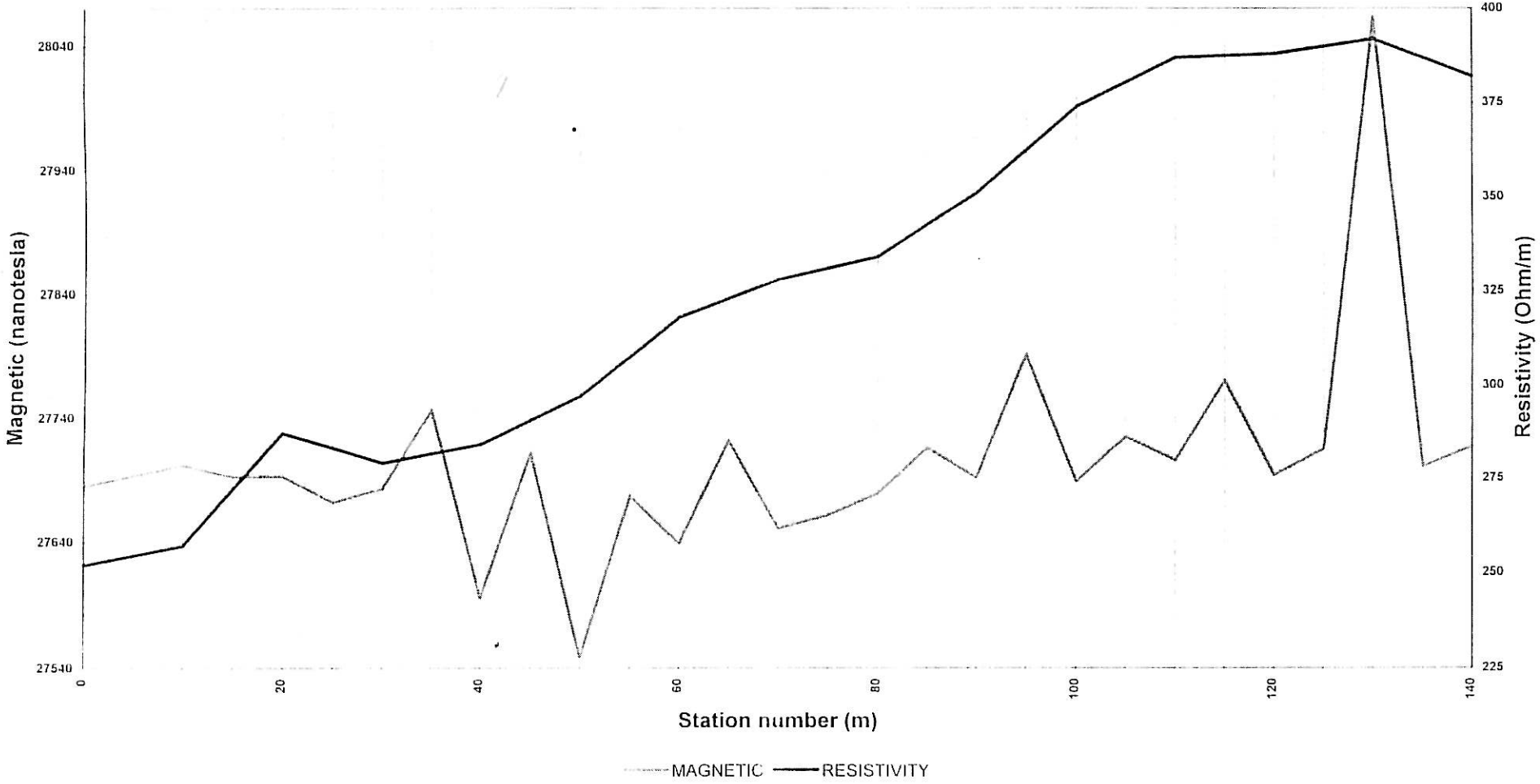
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Sentube - Profile 3

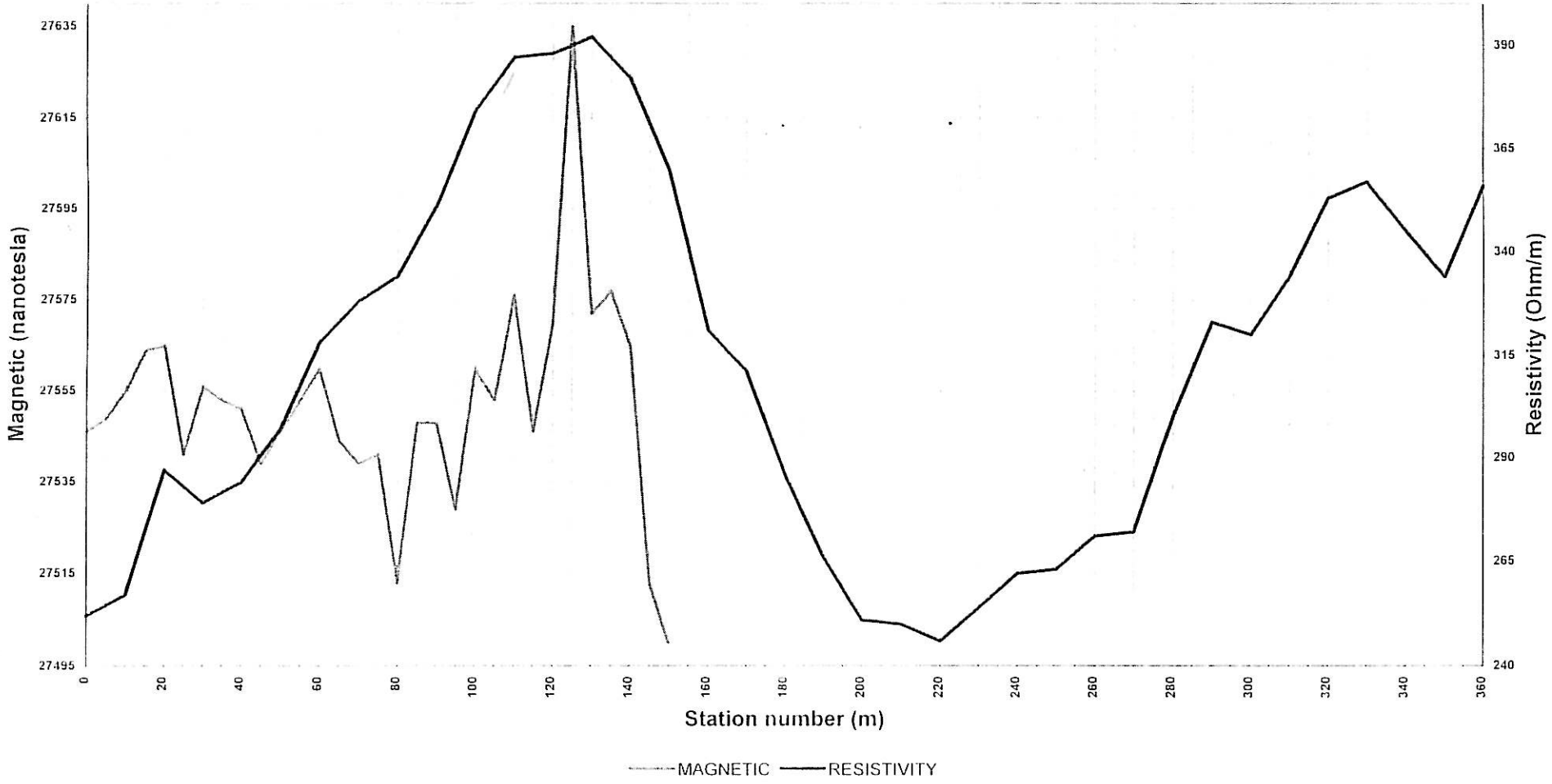
Magnetic & Resistivity Profiling (Wenner Configuration)



CHRIS HANI GROUNDWATER STUDY - PHASE 2

Profile 1

Magnetic & Resistivity Profiling (Wenner Configuration)



APPENDIX D

LITHOLOGICAL & CONSTRUCTION DRILLING LOGS

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
8 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nr 202-0019	PROJECT :	Chris Hani Groundwater Study - Phase 2	
WATER LEVEL:	DRILLER :	BJ Cilliers	LATITUDE :
BLOW YIELD:	DATE STARTED :	4/9/03	LONGITUDE :

Apparent Water Quality:
Casing thickness: mm
Casing depth: m

BOREHOLE CONSTRUCTION

165mm
165mm
165mm
EOH
168m

WATER STRIKE (l/s)

STRIKE DEPTH (m)

S.W.L (m)

PENETRATION RATE (min) 0 — 10

DEPTH (m)

PROFILE

MATERIAL DESCRIPTION

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
8 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NO:	EC-T11-003	PROJECT:	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER:	BJ Cilliers
BLOW YIELD:	0.5l/s	DATE STARTED:	4/14/03
LATITUDE:	28°12'15.6"E	LONGITUDE:	31°42'38.9"S

Apparent Water Quality:
Casing thickness: mm
Casing depth: m

BOREHOLE CONSTRUCTION
WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)
PENETRATION RATE (min) 0 10
DEPTH (m)
PROFILE
MATERIAL DESCRIPTION

Concrete collar
254mm
Solid 4mm steel casing
Backfill
165mm
165mm
Open hole
165mm
EOH 150m

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
8 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NO:	EC-T11-003 Cont.	PROJECT :	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER :	BJ Cilliers
BLOW YIELD:	0.5l/s	DATE STARTED :	4/14/03

LATITUDE : 28°12'16.6"E
LONGITUDE : 31°42'38.9"S

BOREHOLE CONSTRUCTION
Apparent Water Quality:
Casing thickness: mm
Casing depth: m
155mm
165mm
155mm
EOH 150m

WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)

PENETRATION RATE (min) 0 10

DEPTH (m)
PROFILE
MATERIAL DESCRIPTION

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
9 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NO:	EC-T11-004	PROJECT :	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER :	BJ Cilliers
BLOW YIELD:	0.5l/s	DATE STARTED :	4/11/03
		LATITUDE :	28°09'45.0"
		LONGITUDE :	31°34'50.3"

Apparent Water Quality:
Casing thickness: mm
Casing depth: m

BOREHOLE CONSTRUCTION

Concrete collar

254mm

Solid 4mm steel casing

Backfill

165mm

165mm

Open hole

165mm

WATER STRIKE (l/s)

STRIKE DEPTH (m)

S.W.L (m)

PENETRATION RATE (min)

0 10

DEPTH (m)

PROFILE

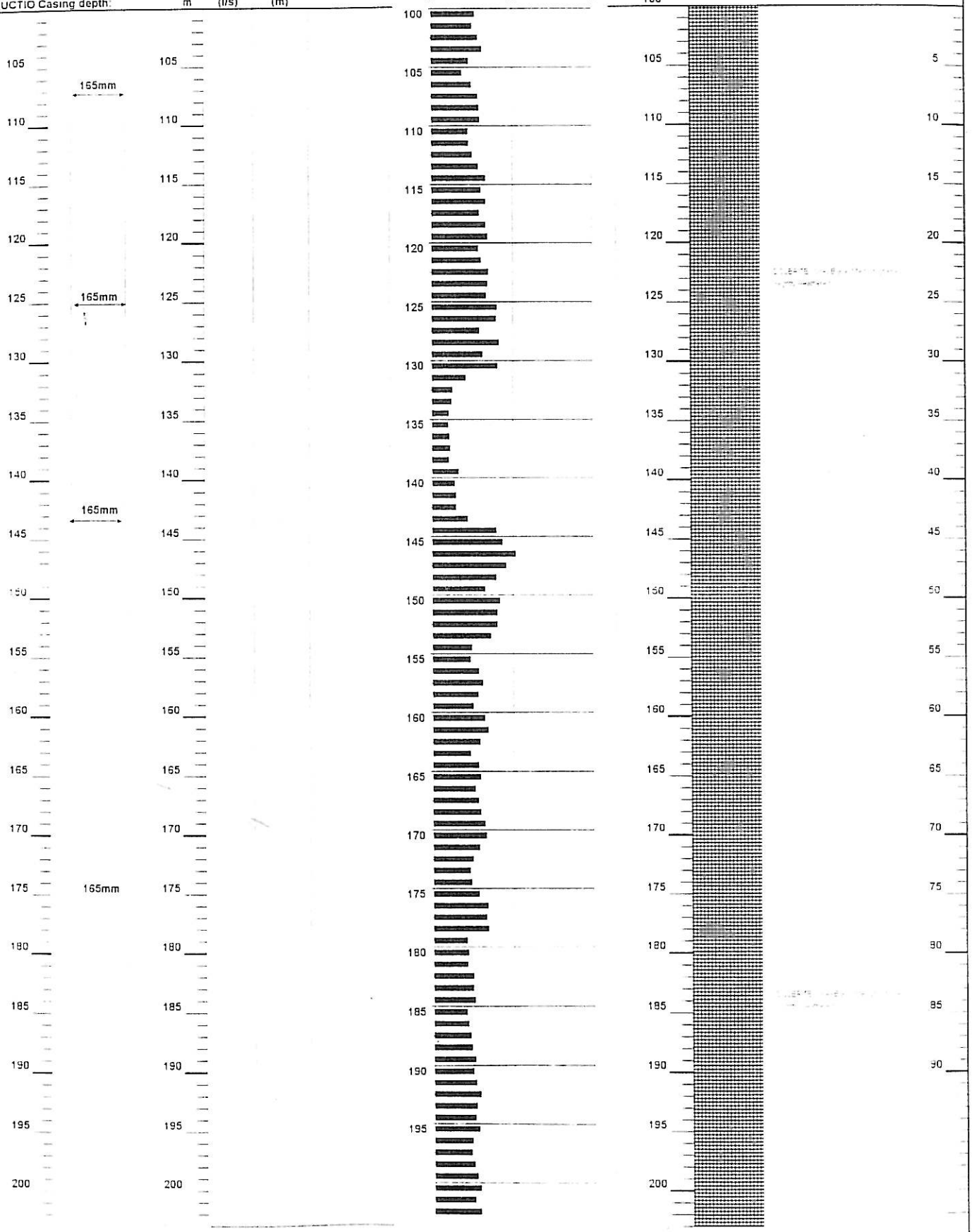
MATERIAL DESCRIPTION

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
8 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nr	EC-T11-004 Cont.1	PROJECT :	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER :	BJ Cilliers
BLOW YIELD:	0.5l/s	DATE STARTED :	4/11/03
		LATITUDE :	28°09'45.0"
		LONGITUDE :	31°34'50.3"

BOREHOLE CONSTRUCTIO
Apparent Water Quality:
Casing thickness: mm
Casing depth: m
WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)
PENETRATION RATE (min) 0 10 20
DEPTH (m) 100
PROFILE
MATERIAL DESCRIPTION



SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
9 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NO:	EC-T11-004 Cont.2	PROJECT :	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER :	BJ Cilliers
BLOW YIELD:	0.5l/s	DATE STARTED :	4/11/03

LATITUDE : 28°09'45.0"
LONGITUDE : 31°34'50.3"

BOREHOLE CONSTRUCTION
Apparent Water Quality:
Casing thickness: mm
Casing depth: m
WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)
PENETRATION RATE (min) 0 10
DEPTH (m)
PROFILE
MATERIAL DESCRIPTION

165mm
165mm
165mm
165mm

200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
8 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nr	EC-T11-004 Cont.3	PROJECT :	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER :	BJ Cilliers
BLOW YIELD:	0.5l/s	DATE STARTED :	4/11/03
			LATITUDE : 28°09'45.0"
			LONGITUDE : 31°34'50.3"

BOREHOLE CONSTRUCTION
Apparent Water Quality:
Casing thickness: mm
Casing depth: m
WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)
PENETRATION RATE (min) 0 10 20
DEPTH (m)
PROFILE
MATERIAL DESCRIPTION

165mm

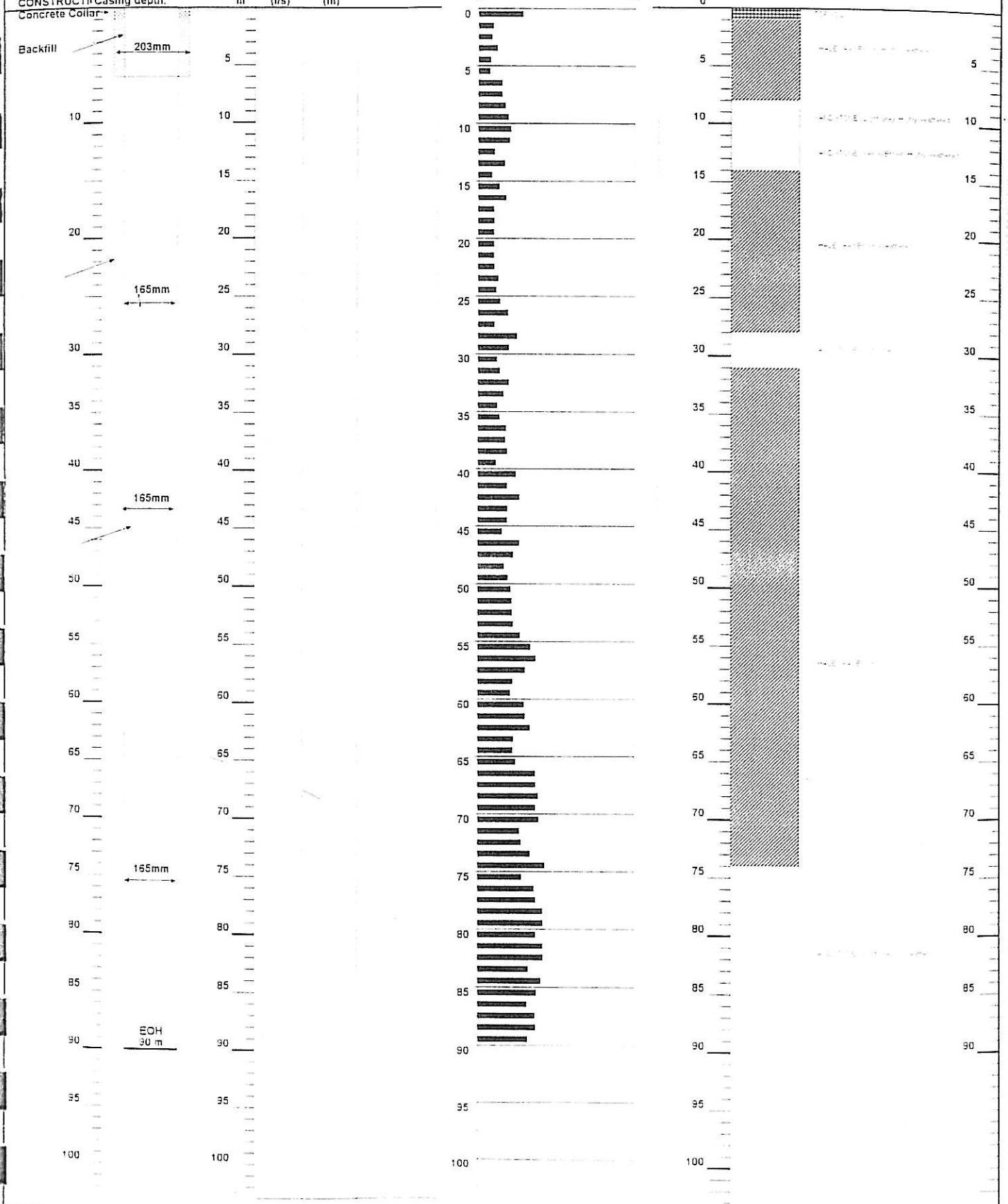
EOH 311m

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
8 SANSOM STREET
VINCENT
EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nr EC-T11-005	PROJECT :	Chris Hani Groundwater Study Phase 2	
WATER LEVEL:	DRILLER :	BJ Cilliers	LATITUDE : 28°12'24.0"E
BLOW YIELD: 0.5l/s	DATE STARTED :	4/17/03	LONGITUDE : 31°42'34.4"

Apparent Water Quality:
BOREHOLE CONSTRUCTI Casing thickness: mm
Casing depth: m
WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)
PENETRATION RATE (min)
DEPTH (m)
PROFILE
MATERIAL DESCRIPTION



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BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NR	EC-T11-007	PROJECT :	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER :	BJ Cilliers
BLOW YIELD:	6 l/s	DATE STARTED :	07/05/2003
LATITUDE :	28°17'45.6"	LONGITUDE :	31°34'36.9"S

Apparent Water Quality:
Casing thickness: mm
Casing depth: m

BOREHOLE CONSTRUCTIC

Concrete collar
Sanitary Seal
216mm
Solid 4mm steel casing
Backfill
165mm
Perforated 4mm steel casing
165mm
Open hole
165 mm
EOH 75 m

WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)
PENETRATION RATE (min)
DEPTH (m)
PROFILE
MATERIAL DESCRIPTION

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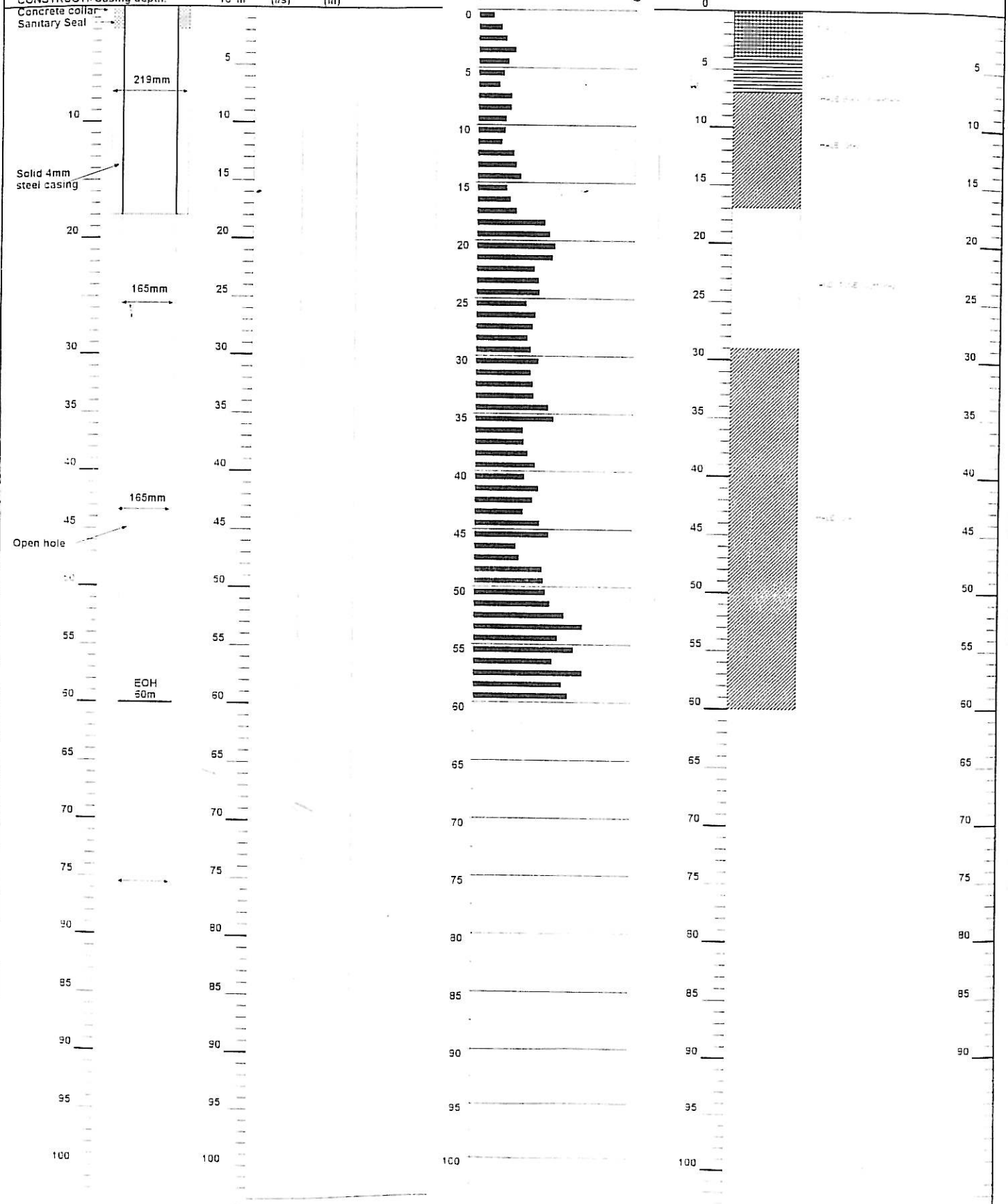
BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nr EC-T11-008	PROJECT :	Chris Hani Groundwater Study - Phase 2	
WATER LEVEL:	DRILLER :	BJ Cilliers	LATITUDE : 28°16'57.2"E
BLOW YIELD: 10 l/s	DATE STARTED :	9/5/03	LONGITUDE : 31°36'04.5"S

Apparent Water Quality:
BOREHOLE Casing thickness: 4 mm
CONSTRUCTI Casing depth: 18 m

WATER STRIKE (l/s) | STRIKE DEPTH (m) | S.W.L (m) | PENETRATION RATE (min) 0 10 | DEPTH (m) | PROFILE | MATERIAL DESCRIPTION



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BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NR EC-T12-004	PROJECT :	Chris Hani Groundwater Study - Phase 2	
WATER LEVEL:	DRILLER :	BJ Cilliers	LATITUDE : 27°46'50.1"E
BLOW YIELD: 15l/s	DATE STARTED :	25/04/2003	LONGITUDE : 31°37'11.9"S

Apparent Water Quality: Good

BOREHOLE CONSTRUCTIC Casing thickness: Casing depth:

Concrete collar

254mm

Solid 4mm steel casing

Backfill

165mm

165mm

Open hole

EOH 71m

WATER STRIKE (l/s)	STRIKE DEPTH (m)
	39m
	42m

S.W.L (m)

PENETRATION RATE (min) 0 — 10

DEPTH (m)

PROFILE

MATERIAL DESCRIPTION

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BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nr EC-T12-005	PROJECT :	Chris Hani Groundwater Study - Phase 2	
WATER LEVEL:	DRILLER :	BJ Cilliers	LATITUDE : 28°44'25.5"E
BLOW YIELD: 2l/s	DATE STARTED :	4/22/03	LONGITUDE : 31°43'30.3"S

Apparent Water Quality:
Casing thickness: 4 mm
Casing depth: 6 m

BOREHOLE CONSTRUCTION

Concrete collar
Solid 4mm steel casing
Backfill
Open hole
203mm
165mm
165mm
155mm

WATER STRIKE (l/s)

STRIKE DEPTH (m)

S.W.L (m)

PENETRATION RATE (min)

DEPTH (m)

PROFILE

MATERIAL DESCRIPTION

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EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nº EC-T12-005 Cont.	PROJECT :	Chris Hani Groundwater Study - Phase 2	
WATER LEVEL:	DRILLER :	BJ Cilliers	LATITUDE : 28°44'25.5"E
BLOW YIELD: 2l/s	DATE STARTED :	4/22/03	LONGITUDE : 31°43'30.3"S

Apparent Water Quality:
BOREHOLE CONSTRUCTI Casing thickness: 4 mm
Casing depth: 6 m

WATER STRIKE (l/s)	STRIKE DEPTH (m)
0.1l/s	126m
0.2l/s	135m
0.8l/s	137m

S.W.L (m)

PENETRATION RATE (min) 0 — 10

DEPTH (m) 100

PROFILE

MATERIAL DESCRIPTION

165mm
165mm
165mm
EOH 190m

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FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NO: EC-T12-006 (a)	PROJECT : Chris Hani Groundwater Study Phase 2	
WATER LEVEL Dry	DRILLER : BJ Cilliers	LATITUDE : 31°46'9.6"S
BLOW YIELD: Dry	DATE STARTED : 4/25/03	LONGITUDE : 28°04'18.6"E

BOREHOLE CONSTRUCTION
Apparent Water Quality:
Casing thickness: mm
Casing depth: m
Concrete plug

WATER STRIKE (l/s)

STRIKE DEPTH (m)

S.W.L (m)

PENETRATION RATE (min) 0 10

DEPTH (m)

PROFILE

MATERIAL DESCRIPTION

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
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BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NO:	EC-T12-006 (b)	PROJECT :	Chris Hani Groundwater Study Phase 2
WATER LEVEL:	Dry	DRILLER :	BJ Cilliers
BLOW YIELD:	Dry	DATE STARTED :	4/25/03
			LATITUDE : 31°46'9.6"S
			LONGITUDE : 28°04'18.6"E

BOREHOLE CONSTRUCTION
Apparent Water Quality:
Casing thickness: mm
Casing depth: m
Concrete plug

WATER STRIKE (l/s)

STRIKE DEPTH (m)

S.W.L (m)

PENETRATION RATE (min) 0 — 10

DEPTH (m)

PROFILE

MATERIAL DESCRIPTION

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

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BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE NO: EC-T12-006 (c)	PROJECT :	Chris Hani Groundwater Study Phase 2	
WATER LEVEL Dry	DRILLER :	BJ Cilliers	LATITUDE : 31°46'9.6"S
BLOW YIELD: Dry	DATE STARTED : 4/25/03		LONGITUDE : 28°04'18.6"E

BOREHOLE CONSTRUCTION
Apparent Water Quality:
Casing thickness: mm
Casing depth: m
Concrete plug

WATER STRIKE (l/s)

STRIKE DEPTH (m)

S.W.L (m)

PENETRATION RATE (min) 0 — 10

DEPTH (m)

PROFILE

MATERIAL DESCRIPTION

SOUTHERN AFRICA GEOCONSULTANTS (PTY) LTD
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EAST LONDON
TEL NO: 043 726 2070
FAX NO: 043 726 9232

BOREHOLE CONSTRUCTION & LITHOLOGY

BOREHOLE Nr	EC-T12-009	PROJECT :	Chris Hani Groundwater Study - Phase 2
WATER LEVEL:		DRILLER :	BJ Cilliers
BLOW YIELD:	1.2 l/s	DATE STARTED :	5/12/03
			LATITUDE : 28°17'51.9"E
			LONGITUDE : 31°49'14.2"S

Apparent Water Quality:
Casing thickness: 4 mm
Casing depth: 11.5 m

BOREHOLE CONSTRUCTION

Concrete collar
216mm
Solid 4mm steel casing
Backfill
165mm
165mm
Open hole
EOH 70m

WATER STRIKE (l/s)
STRIKE DEPTH (m)
S.W.L (m)
PENETRATION RATE (min)
DEPTH (m)
PROFILE
MATERIAL DESCRIPTION