GROUNDWATER RESOURCE INFORMATION PROJECT
EASTERN CAPE PROVINCE

GROUNDWATER INFORMATION SOURCE REFERENCE SHEET

SOURCE REF NR:	SR 023	Own Archive	✓	Copy attached	✓
		Sourced		Copy at source	

A: SOURCE DESCRIPTION

District Municipality:	Amatole		Chris Hani	✓	O.R Tambo	
	Ukhahlamba		Cacadu		Alfred Nzo	
Local Municipality:	SAKHISIZWE					
Institution where Information is held:	SRK CONSULTING					
Branch of Institution:	EAST LONDON					
Contact details: Contact person:	JU du Plooy					
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B: TYPE OF INFORMATION

Information format:	Hard copy	✓	Data Summary		Electronic Report	
	Specify Other:					
Report / Info Title:	GROUNDWATER SOURCE DEFINITION & INVESTIGATION					
Report Nr:	306199		Date:	Apr-02		
Author Details:	JU DU PLOOY					
Author's Qualification:	Hydrogeologist	✓	Govt Dept		Project Manager	
	Engineer		Technician		Other	
	Specify Other:					
Captured by:	RHEE	Date:	13 SEP'07	Signed:		

C: GEOHYDROLOGICAL CATEGORIZATION

Project Type	Source development		Feasibility Study		Sanitation Study:	
	Specify Other: GROUNDWATER SOURCE DEFINITION & INVESTIGATION					

Reference Co-ordinate:	Latitude	Longitude
	S 31.5361944	E 27.6449722

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

Comments: No info

Reviewed by: JU du Plooy Date: Signed:

SR 023

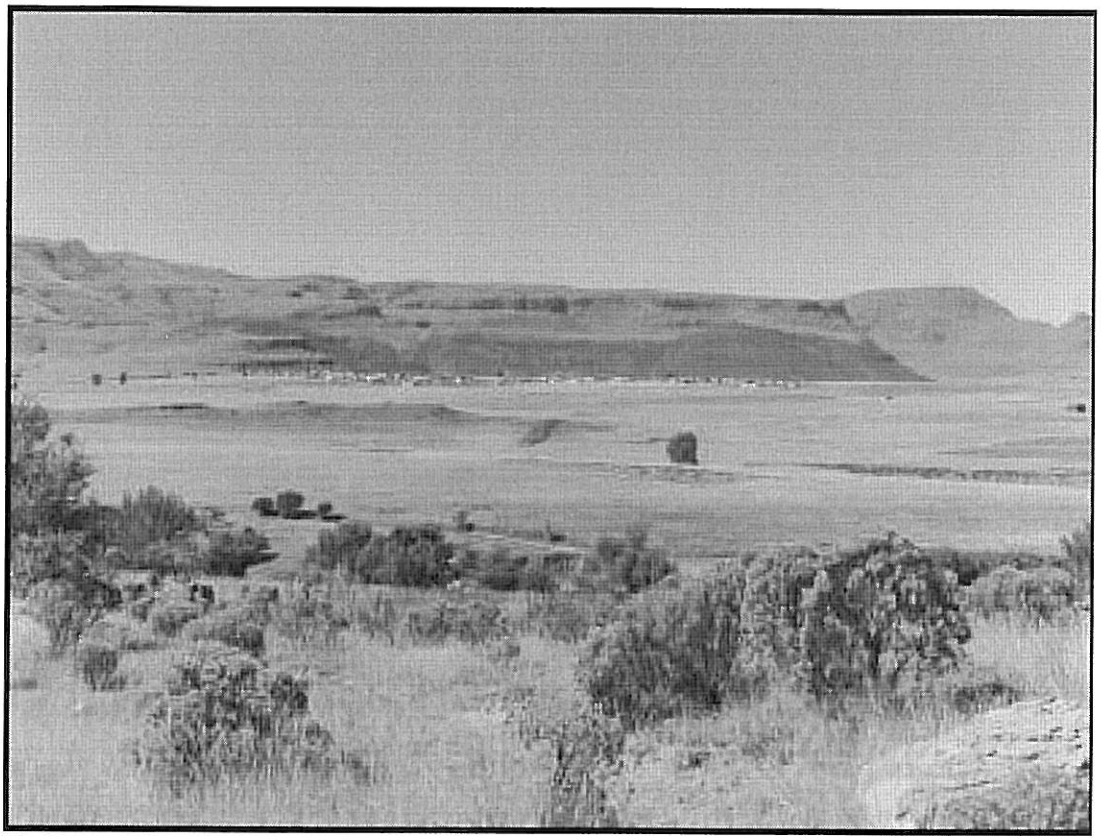
SRK Consulting

Engineers and Scientists

AFRICON ENGINEERING

Groundwater Source Definition and Investigation

SAKHISIZWE LOCAL MUNICIPAL AREA



Report No. 306199/1

May 2002

AFRICON ENGINEERING

Groundwater Source Definition and Investigation

SAKHISIZWE LOCAL MUNICIPAL AREA

By:

J.U du Plooy

Reviewed by:

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Report No. 306199/1

April 2002

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Appendices

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GROUNDWATER SOURCE DEFINITION AND INVESTIGATION

1. INTRODUCTION

SRK Consulting (SRK) was appointed by Africon Engineering (Africon) to conduct a preliminary groundwater feasibility assessment on the Sakhisizwe Local Municipal Area. Africon wishes to obtain sufficient information on the potential of the groundwater resources of the study area to determine the most suitable and cost effective measures for water supply.

This report evaluates previous groundwater studies that were done in and around the area and uses this information, as well as various scientific techniques e.g. Landsat Lineament Mapping, to determine the groundwater potential.

1.1 Project Objectives

This study has therefore been commissioned to examine the findings of previous studies and to apply structural mapping techniques to verify the groundwater potential.

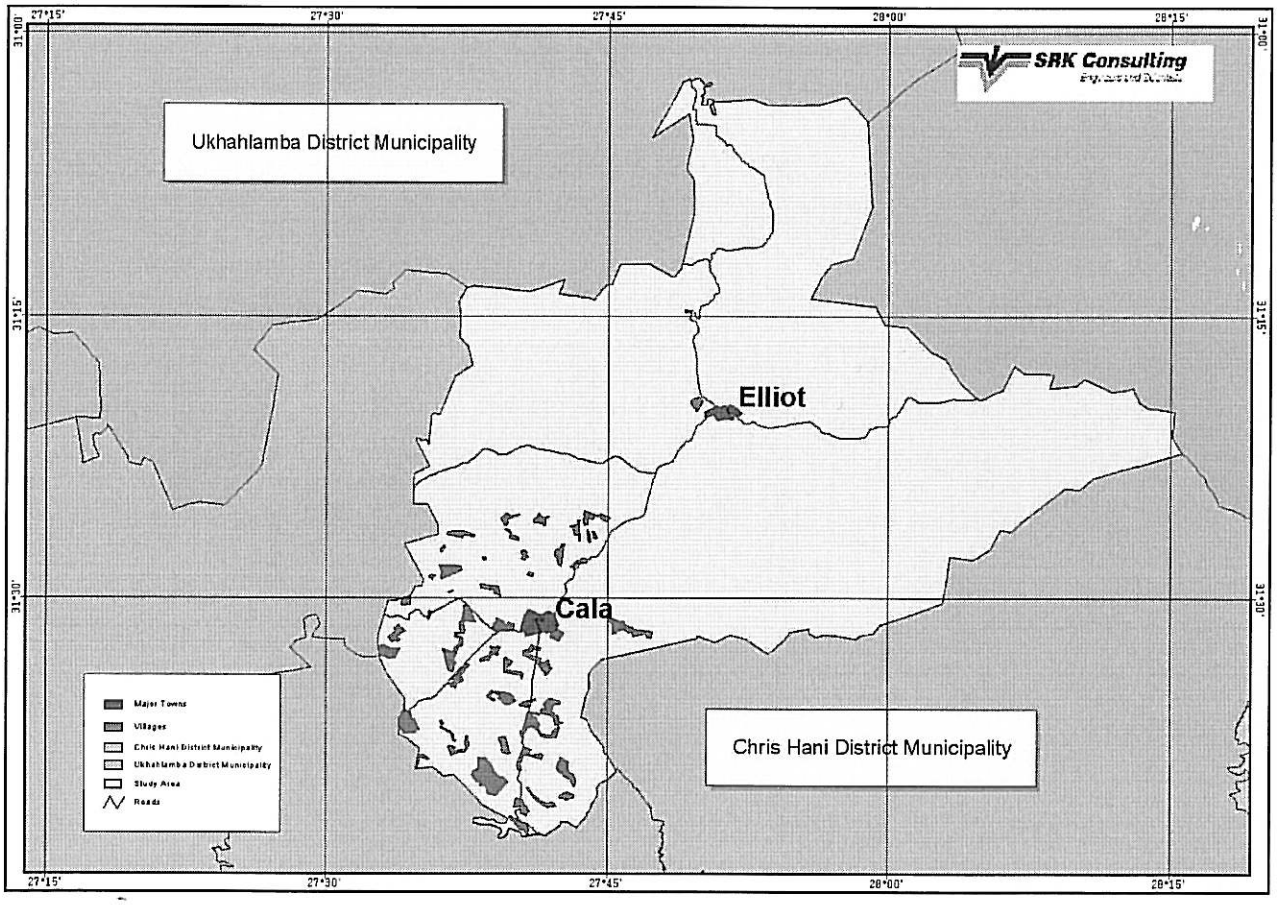
The main objectives of this hydrogeological investigation are as follows:

- Collate and evaluate available groundwater information of the study and surrounding areas;
- Consult with role players that have been involved in projects in the study area;
- Prepare the relevant maps, Landsat images for the structural analysis and groundwater potential determination;
- Compile a technical report, with accompanying GIS-based maps, outlining areas of low, moderate and high groundwater potential.

1.2 Location of the Study Area

The Sakhisizwe study area is situated in north eastern part of the Chris Hani District Munipal area ,(see Figure 1) and includes the majot towns of Elliot an Cala. The main river in the study area is the Tsomo river, which intersect the study area.

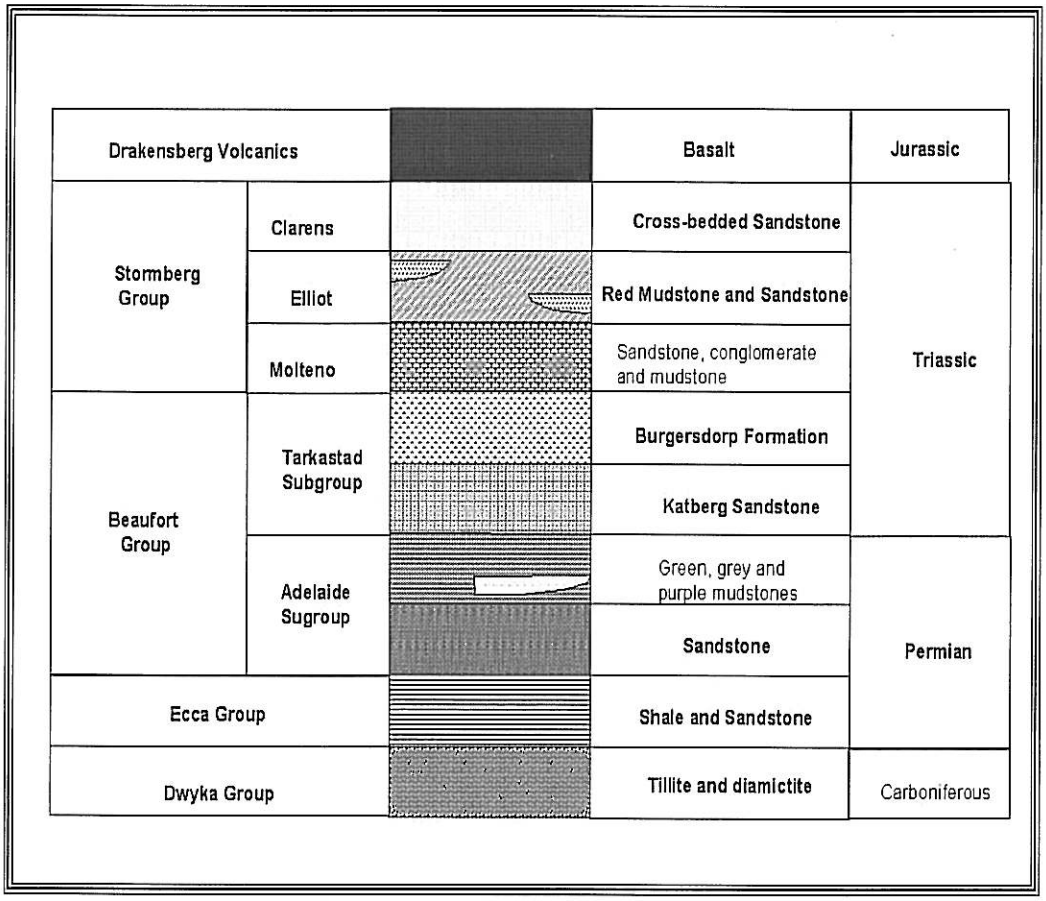
Figure 1: Sakhisizwe Local Municipal Area



1.4 Geology and Hydrogeology

The relation (interaction) between geology and hydrogeology of the Karoo aquifers (i.e. occurrence of groundwater) have been researched extensively in the past and one of the conclusions that was made was that the major storage units of water in Karoo aquifers must be the formations themselves, while bedding-parallel fractures provide the main conduits of water to boreholes" (Botha, *et al* ,WRC report - Karoo Aquifers). Sedimentary strata belonging to the Karoo Sequence underlie the study area and comprise the Beaufort groups (Tarkastad subgroup),Drakensberg-,Clarens-,Elliot-, Molteno- and Burgersdorp formations . Dolerite dykes, sills and inclined sheets from the Jurassic period intrude these sedimentary strata. The sequence is shown in Figure 2 below.

Figure 2: Karoo Sequence



Beaufort Group

The Beaufort Group achieves a maximum thickness of approximately 3 000 m in the Eastern Cape Province and underlies an area of approximately 200 000 km^2. The Group is stratigraphically divided into two major units, the upper Tarkastad Subgroup and the Lower Adelaide Subgroup.

In terms of hydrogeological properties, research has shown that aquifers in the Beaufort Group are multi-layered and also multi-porous with variable thicknesses. The implication with regard to groundwater development and sustainability is that the **life span of a high-yielding borehole in the Beaufort Group may be limited**, if the aquifer is not recharged frequently (Botha *et al*, Karoo Aquifers 1997). Aquifer storage is therefore limited and the sustainability of the borehole is dependent on **frequent** recharge.

Molteno Formation

The Molteno Formation is characterized by the occurrence of medium to coarse-grained, often pebbly, light grey to yellowish-grey, 'glittering' sandstones alternating with massive, soft, pale-olive mudstones and subordinate grey shale. Impersistent, thin coal seams occur at four horizons within the succession. Total

thickness of the sequence is 500m (Karpeta & Johnson, 1979), decreasing to 250m northwards (Bruce et al., 1983).

Johnson (1984) reports 30-50% sandstone content in the so-called 'Boesmanhoek' Member to the west of Molteno. Johnson states that the average thickness of the sandstones are 2 to 3m, up to a maximum of 60 metres. The sandstone lithosomes are laterally persistent, tending to form distinct edges that can in many cases be followed for a few tens of kilometers. Mudrock lithosomes vary from a few metres to a few tens of metres in thickness.

The presence of numerous upward-fining cycles of sediments, coupled with the characteristic primary structures in the sandstone and plant remains in the shale points to deposition in a fluviatile environment. The absence of red discolouration in the mudrocks and the presence of plant fossils rather than reptile remains would suggest that wetter, reducing conditions characterized the flood plains.

Elliot Formation

The Elliot Formation, conformably overlies the Molteno Formation, and consists of purplish-grey to greyish-red or, less commonly, greenish-grey mudstone and subordinate sandstone (Karpeta & Johnson,1979). The Formation shows marked local thickness variations of up to 100m (Johnson, 1984), and is expected to vary between 250m and 500m in the study area.

Upward-fining sedimentary cycles are common in the Elliot Formation. Each cycle commences with a metre or so of poorly bedded fine to medium grained sandstone with mud clasts, followed by up to 20m of yellowish, fine-grained, trough or tabular cross-bedded sandstone. The sandstones pass upward into siltstone and mudstone units of up to 40m thick. Coarse grained sandstone with quartzite clasts may occur in the lower 60m of the Formation (Karpeta & Johnson,1979). Johnson (1984) states that the Elliot Formation contains 30% sandstone. Individual sandstone lithosomes are generally between 5 and 8m thick, with a maximum thickness of about 30m. Individual lithosomes have limited lateral extent and can seldom be traced for more than a few kilometers.

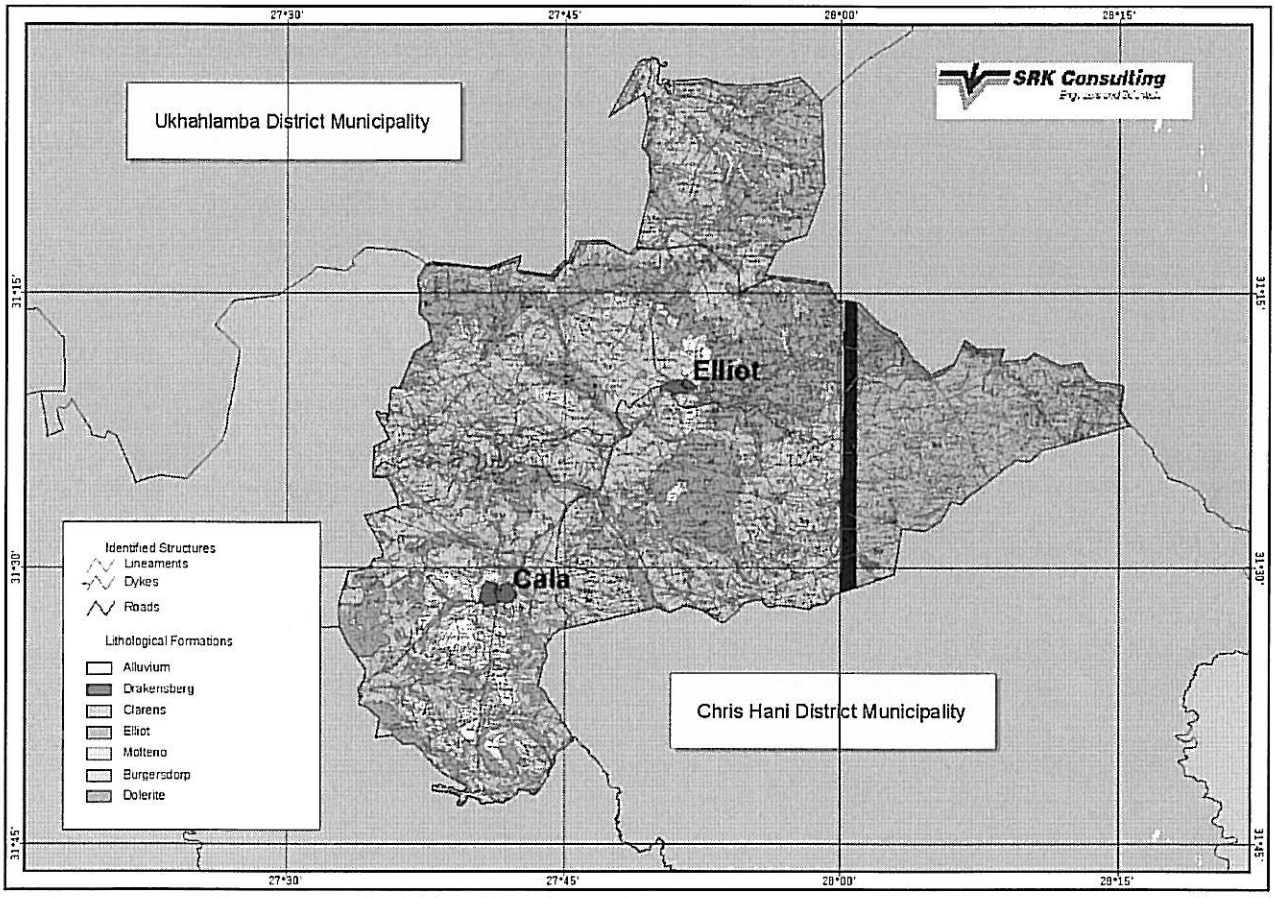
The Elliot Formation comprises a lower arenaceous unit with fining-upward cycles, interpreted as a playa deposit. It is likely that the Elliot sediments were deposited under much drier climate than that of the Molteno Formation.

Ring dykes form prominent, ring-shaped features and comprise positively weathered dolerite structures with the form of a cup. **Sills** are sheet like forms of dolerite intrusion that tend to follow the bedding planes of the sedimentary formations concordantly. **Linear dykes** are considered younger than ring-dykes and sills (they are often seen cutting through the sills and ring-dykes). They are also usually thinner than the other two and seem to be confined to the Ecca and Beaufort Groups.

Linear dolerite dykes have always been regarded as the major sources of groundwater in the Karoo Supergroup, partly because they are fairly easy to detect using geophysical techniques. The density of fractures is also usually higher near linear dykes than in the undisturbed sedimentary rocks.

Figure 3 indicates the Lithology of the study area.

Figure 3: Lithology of the Sakhisizwe Local Municipal Area



2.0 CONCLUSIONS FROM PREVIOUS STUDIES THAT WERE DONE IN AND AROUND THE STUDY AREA

2.1 Upgrading of the Water Supply in Xalanga Phases 1 and 2 (Noslen May & October 2000)

From the results obtained in the report by Noslen, the following statistics was obtained:

- A total of 50 boreholes were drilled with a 70% success rate. Twelve (12) of the boreholes drilled were dry.
- The major targets during the drilling of these boreholes were dolerite dykes.
- A total of 19 boreholes were yield tested, with an average recommended abstraction rate of 0.65 l/s on a 8hr abstraction cycle.
- The water quality in the area investigated can be classified as good with occasional high Fluoride and Iron values.

2.1 Upgrading of the Water Supply in Xalanga Phase 3 (Khulani VSA 2001)

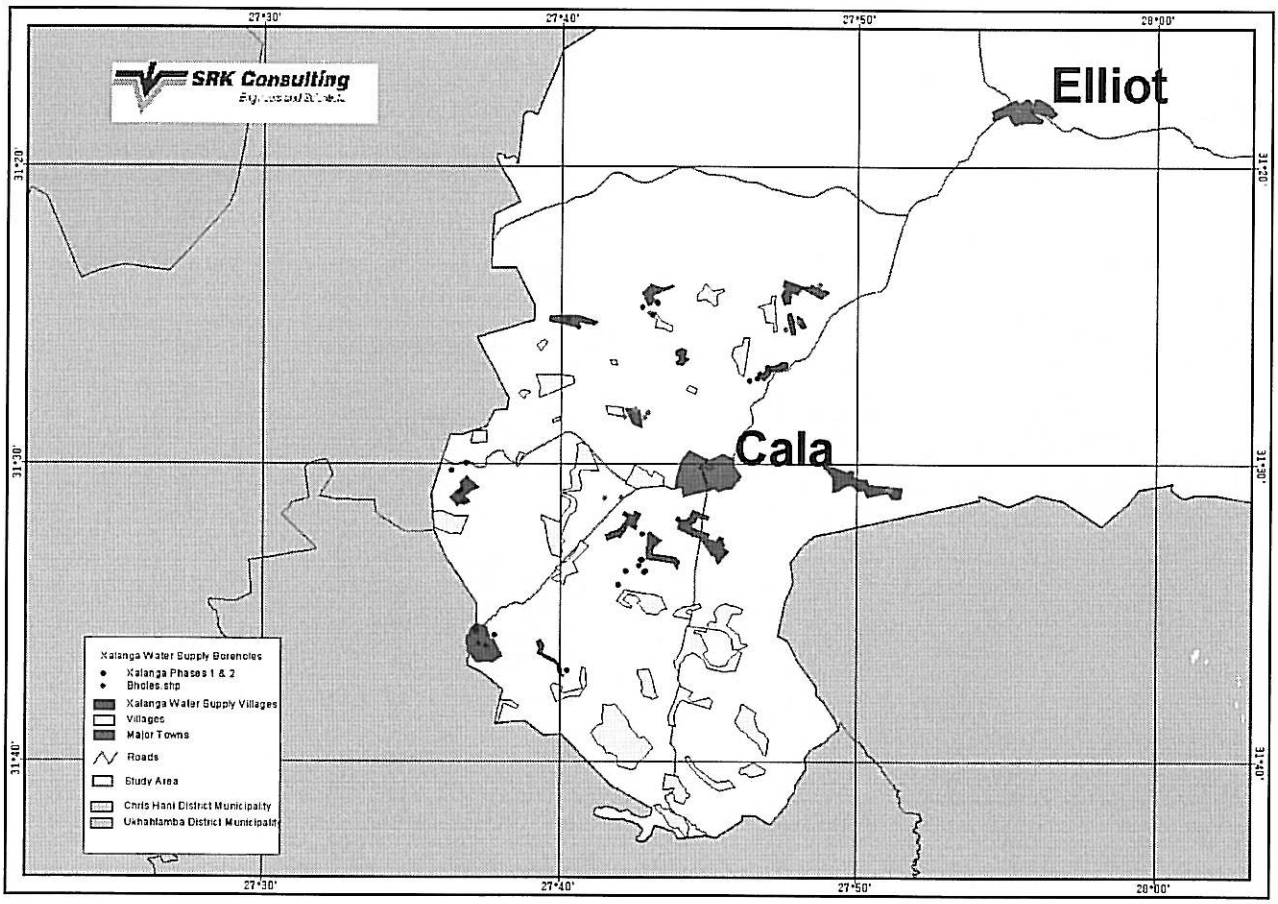
From the results obtained from the Khulani VSA report the following statistics was obtained:

- A total of 18 boreholes were drilled with a success rate of 84 %. Three (3) of the boreholes drilled were dry.
- The major targets during the drilling comprised of dolerite dykes, dolerite sheet contact zones and fracturing within the sedimentary rocks.
- Of the 18 boreholes drilled, 14 were yield tested. The average recommended abstraction rate over a 12 hour duty cycle were 0.56 l/s
- The water quality was classified as good, with occasional high values for iron and Turbidity.

From the studies done by both Noslen and Khulani VSA it can be concluded that a high drilling success rate can be expected with a moderate to high recommended abstraction rates. The water quality seems good with occasional high values for Fluoride, Iron and Turbidity.

Figure 4 indicates the villages completed on the upgrading of the Xalanga Water Supply.

Figure 4: Upgrading of Xalanga Water Supply



3.0 GROUNDWATER POTENTIAL ASSESSMENT

The development of a groundwater development potential model requires the following input:

1. Existing data, i.e. borehole and spring information (literature review);
2. Favourable groundwater targets i.e. geological information, structural information (Landsat, etc.);
3. Rainfall information to determine recharge and evaporation;
4. Digital Terrain Models (DTM) to generate groundwater catchment areas;

The information obtained from the literature review on the surrounding areas, together with the new information (e.g. Landsat), have been used to determine the groundwater character of the Sakhisizwe Local Municipal Area. The determination of recharge, evaporation and groundwater catchment areas can be done as a second phase of this project with the building of a DTM.

3.1 Geographical assessment

The processes followed during the geographical assessment included:

- Structural mapping, including Landsat (TM-7) and geological analysis;
- Classification of villages into low, moderate and high groundwater potential;
- Description of the groundwater development potential of each class.

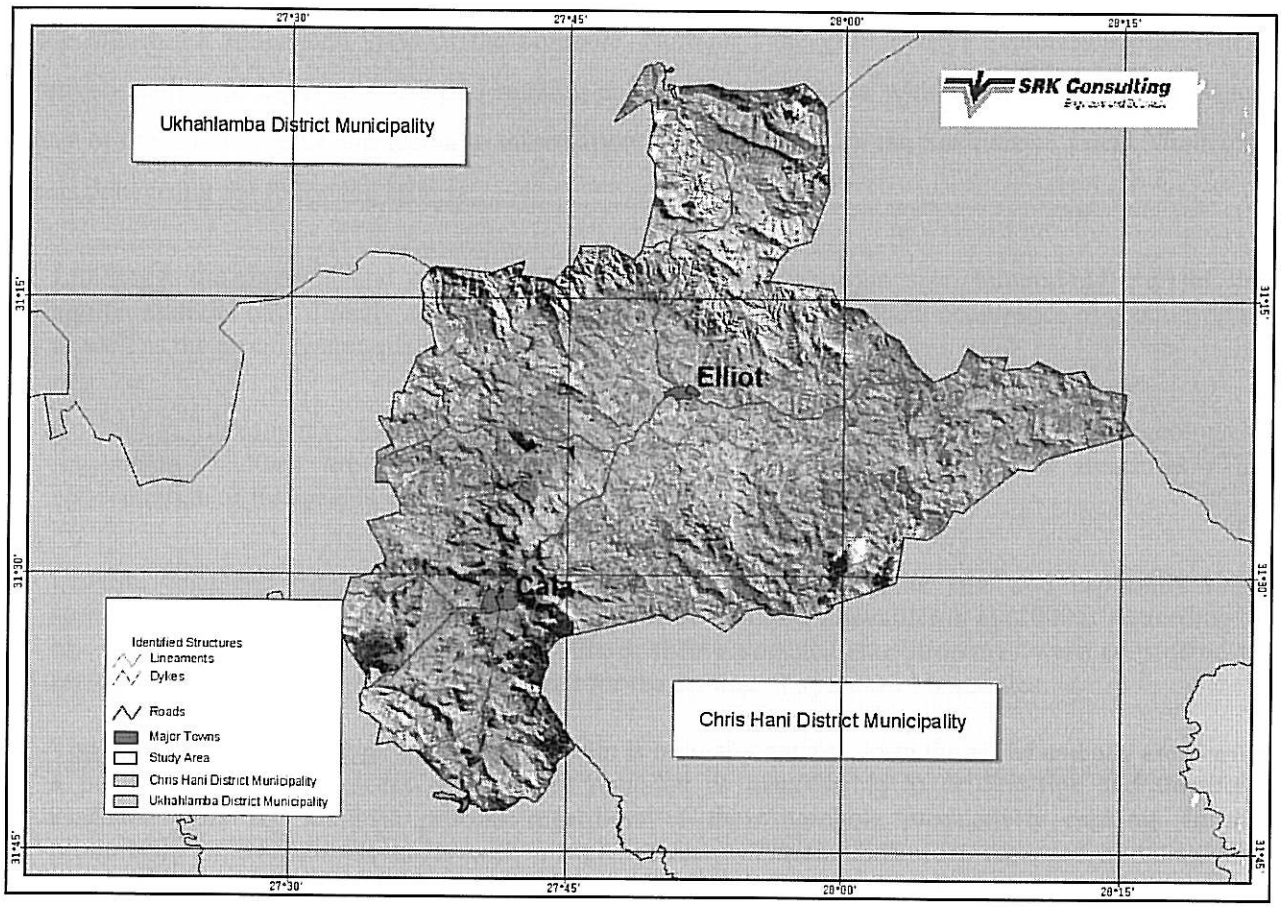
3.2 Remote sensing and lineament mapping

Remote sensing and lineament mapping are used to identify suitable targets for groundwater development. These targets could include:

- Dolerite dykes;
- Dolerite sheets (weathered basins);
- Dolerite Ring Structures;
- Faults;
- Geological contact zones;
- Other linear structures that cannot easily be identified from aerial photographs.

Once target areas have been identified, the sustainability of these targets in terms of groundwater development needs to be determined. This is done by evaluating topography, rainfall and recharge.

Figure 5: Landsat Image of the Sakhisizwe Local Municipal Area



SRK Consulting

Elliot

Cala

27°30'
27°40'
27°50'
28°00'
31°20'
31°30'
31°40'

Village GW Potential
- High
- Moderate
- Low
- Major Towns
- Chris Hani District Municipality
- Ukhahlamba District Municipality
- Roads
- Study Area

27°30'
27°45'
28°00'
28°15'
31°15'
31°30'
31°45'

Ukhahlamba District Municipality

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Elliot

Identified Structures
Lineaments
Dykes
Roads
Major Towns
Study Area
Chris Hani District Municipality
Ukhahlamba District Municipality

Chris Hani District Municipality

APPENDIX B

B1- Estimated Development Costs